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

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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.

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

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Environmental and Social Impact Assessment

Volume I – ESIA Report

Volume II – Environmental and Social Management Plans

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Cassinga Electrical Power Supply ESIA – Air Quality Desktop Assessment

Report Prepared for

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Cassinga Electrical Power Supply Project

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Abbreviations

Acronym	Description
AQ	Air Quality
CO	Carbon Monoxide
DEM	Digital elevation model
HMV	Heavy Motor Vehicles
km	Kilometres
m	Metres
NM	Parameter is not measured at the station
NO_2	Nitrogen dioxide
P99	99th percentile
PM	Particulate matter
SF6	Sulfur hexafluoride
SO_2	Sulfur dioxide
$\mu g/m^3$	Micrograms per cubic meter

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1 Introduction

The Republic of Angola, through its Ministry of Energy and Water (MINEA), is embarking on a significant enhancement of its electrical infrastructure with the implementation of the Cassinga Electrical Power Supply Project. This initiative is geared towards enhancing electric power provision across multiple communities within the Province of Huíla. The primary aim of the project is to facilitate power supply for both the Cassinga Project itself and the neighbouring communities. This will be achieved through the construction of three new substations and the establishment of a new 170 km 220 kV Overhead Line (OHL) network extending from Gove to Chipindo, Cuvango, and Jamba (

Figure 1-1). For electrification of the villages (i.e., Chipindo, Cuvango and Jamba), the Project will include a 30 kV Medium Voltage OHL network to the new substations and a Low Voltage network to supply electricity to 1 000 homes in each of the three villages.

SRK Consulting (South Africa) (Pty) Ltd. (SRK) has been appointed by PAK YATIRIM to undertake an Environmental and Social Impact Assessment (ESIA) for the Cassinga Project in Angola. The ESIA process is undertaken in terms of Angolan environmental laws, and in compliance with the World Bank Group Environment, Health and Safety (EHS) Guidelines and International Finance Corporation (IFC). This report is a specialist Air Quality Study in the form of a qualitative desktop assessment assessing the impacts related to the development of the Cassinga Electrical Power Supply Project in Angola.

1.1 Overview of the project

The Cassinga 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 overhead lines for distribution, along with the necessary low voltage 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 OHL 220 kV interconnection to Cuchi/Menongue.

An estimated power demand of 80 MW has been calculated for the Cassinga 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 Cassinga Electric Power Supply Initiative represents a significant leap forward in Angola's energy infrastructure development. This project is poised to significantly enhance the electric power distribution network in Huíla Province, catalysing economic development and improving the livelihoods of the Angolan people.

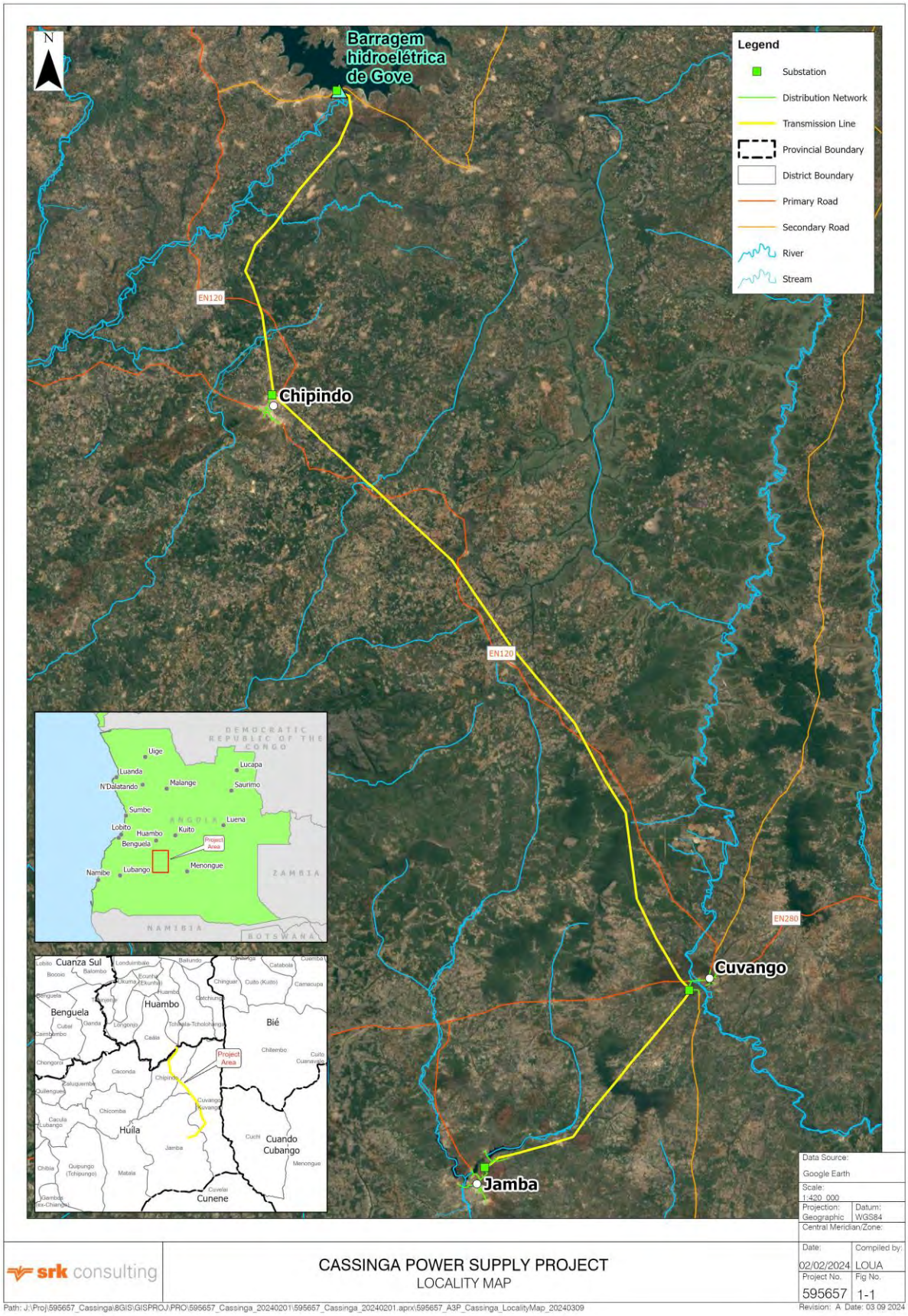


Figure 1-1: Locality map

1.2 Purpose of the study

The objective of the Cassinga Project has a primary focus on bolstering the region's energy infrastructure, particularly through the construction, operation, and eventual decommissioning of the powerline. This initiative underscores the critical importance of sustainable development and meeting the energy demands of the local populace. By conducting a thorough analysis of the potential air quality impacts on communities such as Chipindo, Cuvango, and Jamba, the project aims to ensure that progress in energy supply is achieved responsibly, prioritizing the environmental and public health concerns of the region.

This qualitative air quality assessment provides a comprehensive desktop analysis on the potential impacts arising from the construction, operation, and eventual decommissioning phases of the powerline on the local communities of Chipindo, Cuvango, and Jamba.

1.3 Terms of reference

The terms of reference is provided below:

- Review of applicable air quality legislation including the World Health Organisation (WHO), IFC Performance Standards and National Angolan legislation.
- Identification of all current emission sources at the project area in the vicinity of each substation and powerline for the construction and operation phase.
- Review of the potential health effects associated with atmospheric emissions the construction and operational and decommissioning phase.
- Identification of neighbouring sensitive receptors, including adjacent communities, farms and residential areas.
- Assessment of existing baseline conditions:
    - A review and analysis of existing air quality conditions through the analysis of existing available reports prepared to date, secondary data (e.g., existing published materials and documents, maps, reports, etc.). Should additionally air quality monitoring data be required to be collected, a discussion will be held with the client.
    - A meteorological review using online platform to aid in a discussion on prevailing wind speed and direction, precipitation, relative humidity and ambient temperatures.

1.4 Assumptions, exclusions and limitations

Several assumptions and limitations are acknowledged within the study; however, it is unlikely that these will have a substantial effect on the results and are considered suitable for the purpose of this air quality assessment. The assumptions and limitations include:

- No ambient monitoring data was available for assessment in this 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.

1.5 Information sources

The following information sources was referenced in this Air Quality Assessment.

- IFC EHS Guidelines for Electric Power Transmission and Distribution (2007).
- World Health Organisation (2021), Global Air quality guidelines for Particulate matter (PM_{10} and $PM_{2.5}$), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide.

2 Key legislative frameworks

2.1 Angola Legislative requirements

Presidential Decree No. 117/2020, issued on 22 April in Angola, establishes comprehensive regulations governing Environmental and Social Impact Assessment (ESIA) and Environmental Licensing Procedures for both public and private projects. These regulations are aimed at managing projects that may potentially lead to significant environmental and social impacts due to their inherent characteristics, location, or scale. Notably, this Decree nullifies the previous regulations outlined in Decree No. 51/04 of 23 July regarding Environmental Impact Assessment and Decree No. 59/07 of 13 July concerning Environmental Licensing.

Key provisions of this legislation include:

- Mandating the registration of projects within the integrated environmental system, a digital platform administered by the Ministry of Environment (Article 6).
- Categorizing projects into five categories (A to E) for licensing purposes (Article 7).
- Delegating evaluation responsibilities from the central authority (Ministry of Environment) to local administrative services and provincial governments, along with the pre-evaluation of projects for subsequent categorization (Article 8, 9).
- Introducing the requirement of an Environmental Pre-Feasibility Study and Scope Definition (Scoping Report) specifically for Category A projects (Article 12).
- Outlining the essential content for a Simplified Environmental Study (SES) in Article 15, with the necessity of submitting Terms of Reference for such studies to the provincial environmental authority.

2.2 International Finance Corporation (IFC) Standards

The IFC's EHS guidelines serve as technical reference materials that offer both general and industry-specific examples of recognised international best practices. 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, such as Angola, deviate from the standards set in the EHS Guidelines, projects are required to comply with the more stringent requirements. Should less strict standards be deemed appropriate due to unique project conditions, a comprehensive justification for any alternative approaches must be provided. The General EHS Guidelines offer insights into broad EHS issues that could be relevant to various projects.

Furthermore, sector specific EHS Guidelines have been established to address the unique challenges of different industries. For this project, the applicable sector-specific guidelines will be incorporated into the ESIA process. Particularly relevant to this project and its ESIA are the IFC EHS Guidelines for Electric Power Transmission and Distribution.

2.3 IFC Ambient Air Quality Guidelines and its Application

The WHO Air Quality Guidelines (AQG) discussed in the IFC Air Emissions and Ambient Air Quality section of the EHS guidelines, are designed to offer guidance in reducing the health impacts of air pollution. While the IFC provides scientific guidance to all countries on the levels of pollution that adversely affect human health, its work does not take into consideration the socio-economic conditions prevalent within any country. These guidelines are intended to inform policymakers and to provide appropriate targets for a broad range of policy options for air quality management in different parts of the world. To minimise the significance of the project related impacts, the IFC states that the pollutant

concentrations should not reach or exceed the nationally legislated standards or in their absence, the current WHO Air Quality Guidelines or other internationally recognised sources.

2.4 World Health Organisation Air Quality Guidelines

The WHO AQGs 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 2-1 (World Health Organization, 2021).

Table 2-1: WHO Air Quality Guidelines, 2021

Pollutant	Averaging Period	Concentration (µg/m^3)
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

[a] 99th 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.

3 Approach and methodology

3.1.1 Scope of work

This qualitative air quality assessment encompasses a comprehensive review of relevant air quality legislation, such as WHO AQGs, IFC Performance Standards, and Angolan National Regulations. It involves identifying current emission sources during both construction and operation and decommissioning phases of the project, along with an evaluation of potential health impacts associated with atmospheric emissions. Additionally, sensitive receptors like nearby communities, farms, and residential areas are identified for consideration. Baseline conditions are assessed through an analysis of existing air quality reports and secondary data, with the possibility of collecting additional monitoring data if necessary. A meteorological review is conducted using online platforms to understand prevailing wind patterns, precipitation, humidity, and ambient temperatures, providing a holistic understanding of the project's environmental impact.

3.1.2 Objectives

The objective of this study is to understand the potential air quality impacts of the Cassinga Powerline Project on communities such as Chipindo, Cuvango, and Jamba across the construction, operational and decommissioning phases. Additionally, the project aims to ensure that progress in energy supply is achieved responsibly, prioritizing the environmental and public health concerns of the region.

3.1.3 Methodology

The methodology used in this assessment is qualitative. The study focuses on understanding and describing the impacts associated with the construction, operational and decommissioning impacts associated with the Cassinga electrical power supply project. In air quality assessment, it involves examining pollution sources, health impacts, environmental conditions, and regulations through descriptive observations and qualitative indicators, rather than precise measurements. The qualitative air quality assessment begins with a comprehensive review of pertinent air quality legislation, encompassing WHO AQGs, IFC Performance Standards, and Angolan National Regulations. Current emission sources during construction, operation, and decommissioning phases are identified, alongside an evaluation of potential health impacts from atmospheric emissions, paying heed to sensitive receptors like nearby communities and residential areas.

Baseline conditions are established through an analysis of existing air quality data. A meteorological review, utilizing online platforms (MERRA), is conducted to understand prevailing wind patterns, precipitation and ambient temperatures. A thorough reporting and documentation phase highlights methodology, data sources, and recommendations for continual monitoring and improvement, ensuring compliance with regulations and standards while mitigating adverse air quality impacts.

4 Project activities posing potential impacts

4.1.1 Construction phase

The construction phase of the Project will include several steps for laying the foundation of the electrical infrastructure. This phase will include preparatory activities such as land clearing, access road construction and the establishment of temporary construction camps and laydown areas for materials and equipment. Following these preliminary activities, the main construction works will commence, including the erection of the three new substations at Chipindo, Cuvango, and Jamba, and the installation of the 220 kV OHL network stretching approximately 170 km across three municipalities. Construction activities will involve significant 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.

Heavy construction is a source of dust emissions that can have a substantial temporary impact on the local air quality situation. Emissions during construction are associated with land clearing, ground excavation and cut and fill operations. Dust emissions often vary substantially on a daily basis, depending on the level of activity, the specific operations and the prevailing meteorological conditions. A large portion of the emissions results from equipment traffic over temporary and unpaved roads at the construction site.

4.1.2 Operational

Once the construction phase is completed, the Project will transition into the operational 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 to meet the anticipated demand of 80 MW for the Cassinga Powerline Project and an additional 10 MW for local community needs.

Potential impacts arising from the operational phase includes; electrical equipment, such as transformers and switchgear, which can emit small quantities of Sulphur Hexafluoride (SF6) gas, a potent greenhouse gas, due to leakage. Although these emissions are low in volume, SF6 has a high global warming potential. In addition, vehicle entrainment on unpaved are also a source of dust emission.

4.1.3 Closure/rehabilitation

The closure or rehabilitation phase will be initiated upon the decommissioning of the project facilities at the end of their operational life or if there's 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 the 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.

The air quality impacts associated with the closure/rehabilitation are minimal and do not pose a threat to local ambient air quality.

5 Baseline conditions

5.1 Site description

The Cassinga Project is located South of the Centre of Angola, namely, in the province of Huila. The OHL extends for about 170 km, crossing three municipalities which include: Jamba, Cuvango and Chipindo. Industrial and agricultural practices play crucial roles in the local economy and livelihoods of the people. Agriculture is the backbone of the economy in the province, with fertile land and favourable climatic conditions supporting a variety of crops. The fertile plains and valleys are conducive to the cultivation of crops such as maize, beans, cassava, and coffee. Coffee production, in particular, is a significant economic activity, with Huila being one of the largest coffee-producing regions in Angola. While agriculture remains the primary economic activity, there are also emerging industrial sectors contributing to the provinces' development. Industries such as food processing, agri-industry, and manufacturing are gaining traction. Processing facilities for coffee and other agricultural products are being established, adding value to local produce and creating employment opportunities for residents. Additionally, there is growing investment in renewable energy projects, such as solar and hydroelectric power, to support industrial growth and infrastructure development.

Sensitive receptors, as defined by the United States Environmental Protection Agency (USEPA, include, but are not limited to hospitals, schools, day-care facilities, elderly housing, and convalescent facilities. These areas are characterized by occupants who are particularly vulnerable to the adverse effects of exposure to toxic chemicals, pesticides, and other pollutants. Given this definition, residential, educational, and recreational lands in the surrounding area are classified as sensitive receptors for this study.

For this assessment, sensitive receptors were sourced from 1:6300 digital raster graphic (DRG) maps and cross-verified during site visits to the region. Receptors were selected based on proximity to the study site and are places where sensitive individuals may be impacted, such as residences, retirement homes, schools, or medical facilities. Educational, agricultural, recreational, and residential communities within a 10km radius of Chipindo, Cuvango and Jamba were identified and displayed in Table 5-1 to Table 5-3 and illustrated in Figure 5-1 to Figure 5-3.

Table 5-1: 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 5-2: 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 5-3: 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

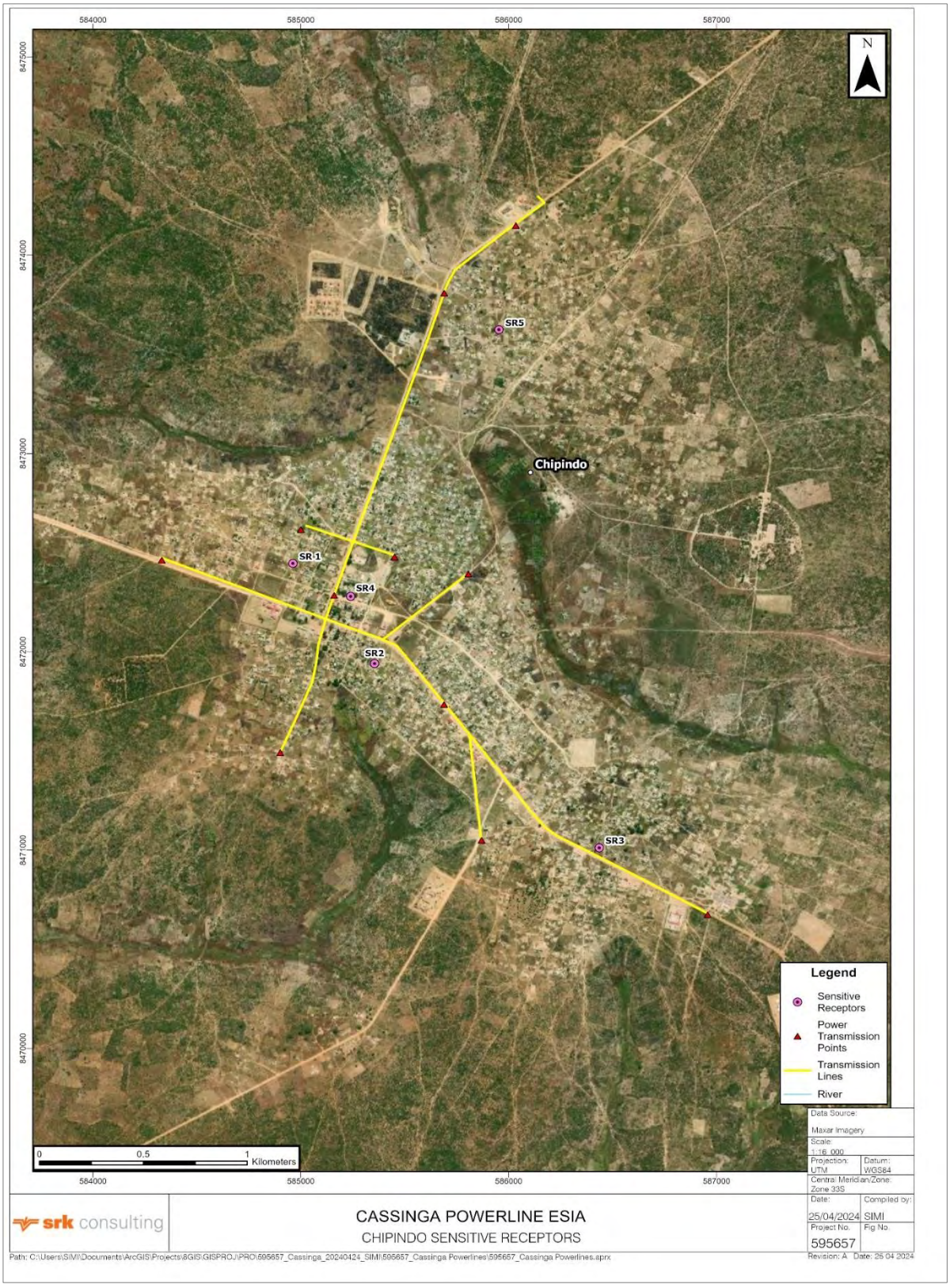


Figure 5-1: Sensitive receptors- Chipindo

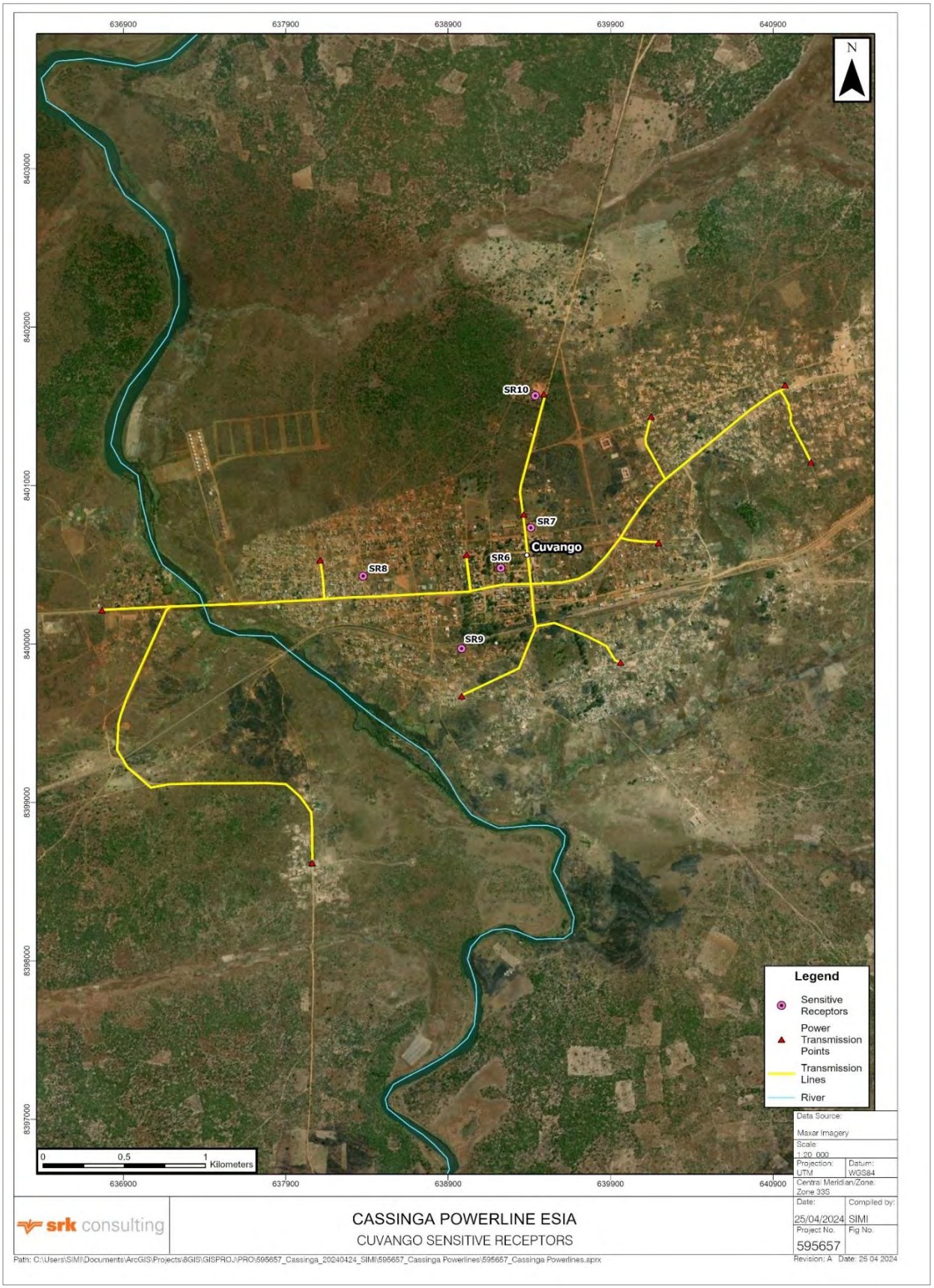


Figure 5-2: Sensitive receptors – Cuvango

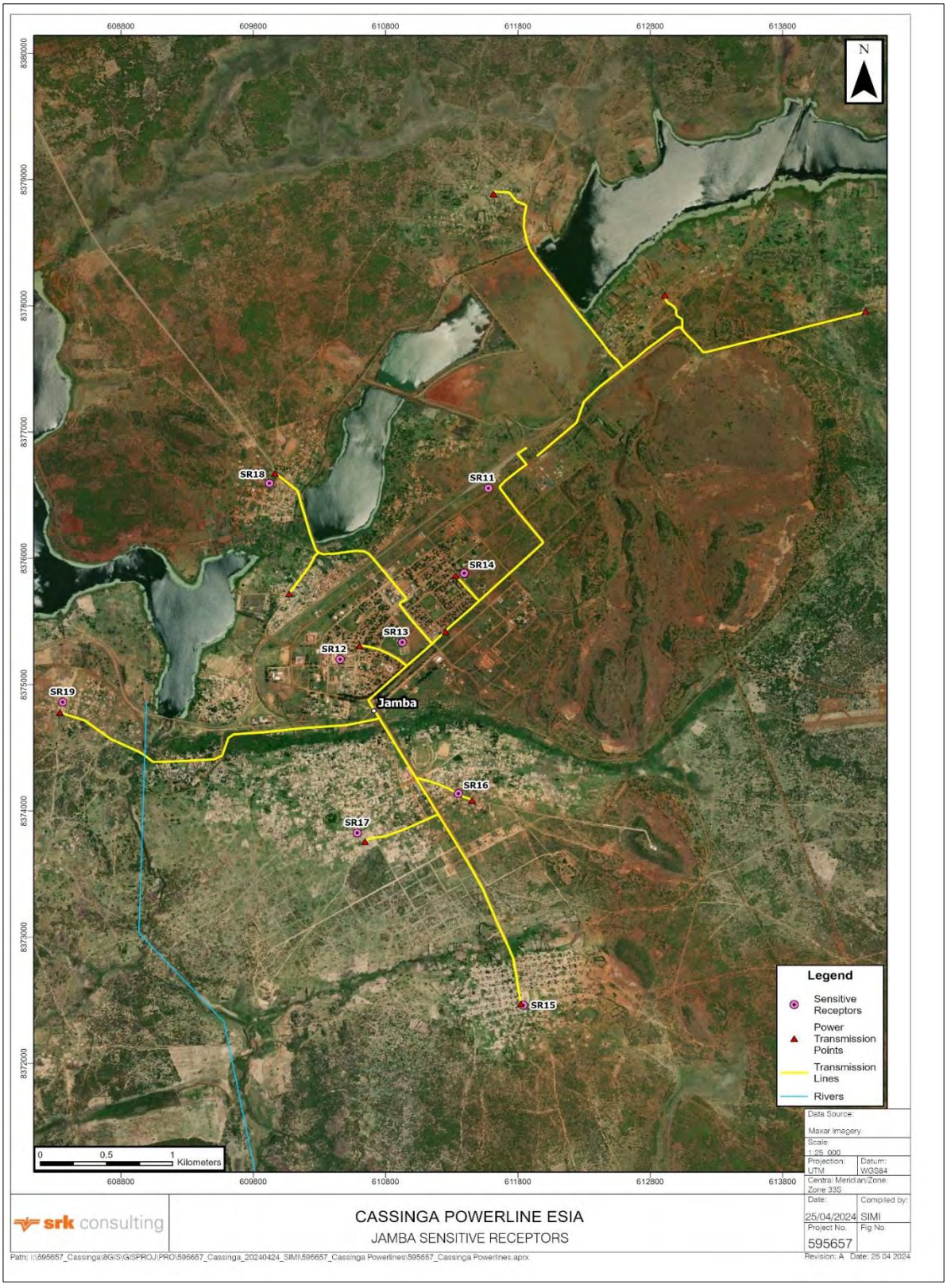


Figure 5-3: Sensitive receptors – Jamba

5.2 Local and regional context

The meteorological conditions described in the study area are divided into regional (Section 5.2.1) and local conditions (Section 5.2.2). Meteorological data was sourced and analysed from MERRA (Modern-Era Retrospective analysis for Research and Applications) from the Cuanja (Jamba), Chipindo and Cuvango station for the January 2019 to December 2023 monitoring period. MERRA is an online dataset developed by NASA that provides retrospective atmospheric analyses, which can be used to characterise the atmospheric dispersion potential of the proposed project site and surrounding environment. Key meteorological parameters considered include wind speed, wind direction, ambient air temperature, and precipitation.

5.2.1 Regional climate context

Cuvango, Chipindo and Jamba localities, are located in southern Angola, which experiences a subtropical climate characterized by distinct wet and dry seasons. The arid lowlands, extending from the Namibian border to Luanda, transition into plateau and escarpment zones as they move inland. These areas are categorized as temperate mesothermal. Towards the east and southeast lies the Planalto region, characterized by dry savanna. In the north, Angola features a lush tropical rainforest climate.

The southern region (Project locality) generally has warm to hot temperatures throughout the year, with relatively mild variations between seasons. The hottest months typically occur from October to March, with average daytime temperatures ranging from 25°C to 30°C. The coolest months are from May to August, with temperatures dropping to around 15°C to 20°C during the day. The wet season typically spans from November to April, with peak rainfall occurring from December to February period. During this period, heavy rains are common, contributing to lush vegetation and agricultural productivity. Annual rainfall can range from 800mm to 1200mm, with higher amounts in the eastern regions and lower amounts in the west.

The dry season extends from May to October. During this time, rainfall significantly decreases, and the weather becomes drier and more arid. The months of June, July, and August are generally the driest, with little to no precipitation. However, occasional showers or thunderstorms may occur, particularly towards the beginning and end of the dry season. The humidity levels vary depending on the season. During the wet season, humidity tends to be higher due to increased moisture in the air from rainfall and evaporation. In contrast, the dry season is characterized by lower humidity levels, especially during the peak of the dry months when moisture is scarce. The wind profile for the region experiences relatively mild wind patterns throughout the year, however during the dry season, particularly in the afternoons, gusty winds known as "Harmattan winds" may blow from the east or northeast. These winds can carry dust and sand particles, leading to reduced visibility and creating a dusty haze in the atmosphere.

In addition, the regional area is subject to climate variability and occasional extreme weather events such as droughts or floods. These events can impact local communities, agriculture, and infrastructure, highlighting the importance of climate resilience and adaptation strategies.

5.2.2 Local climate context

Seasonal and diurnal air pollutant concentration levels fluctuate in response to the changing state of atmospheric stability, concurrent variations in mixing depth, and the influence of mesoscale and macroscale wind systems. To accurately represent meteorological conditions occurring in the project area, data was downloaded from MERRA for the Cuanja Station (Jamba), Chipindo and Cuvango stations for the January 2019 to December 2023 monitoring period. The sections below provides as assessment on the prevailing wind profile, average temperatures and total precipitation recorded for the study area.

Wind Field

The degree to which winds can influence dispersion depends on the wind speed and wind direction. Higher wind speeds result in increased dispersion and dilution of the air pollution while lower, more stable wind conditions result in shorter travel distance and build-up of pollutant levels (especially gases) over a smaller area. Furthermore, windspeed is a primary factor in dust generation, with vegetation cover and soil structure also playing significant roles (Csavina et al., 2013).

The wind roses were analysed using Lakes Environmental WRPlot freeware (Version 8.0.2) for all for the period January 2019 to December 2023.

Figure 5-4 illustrates the annual wind rose from the Cuanja Station (Jamba). Winds predominantly occurred from the east and east-northeast directions. The average wind speed for the monitoring period was 3.34 m/s. Calms conditions were observed for 0.67% for the period under review.

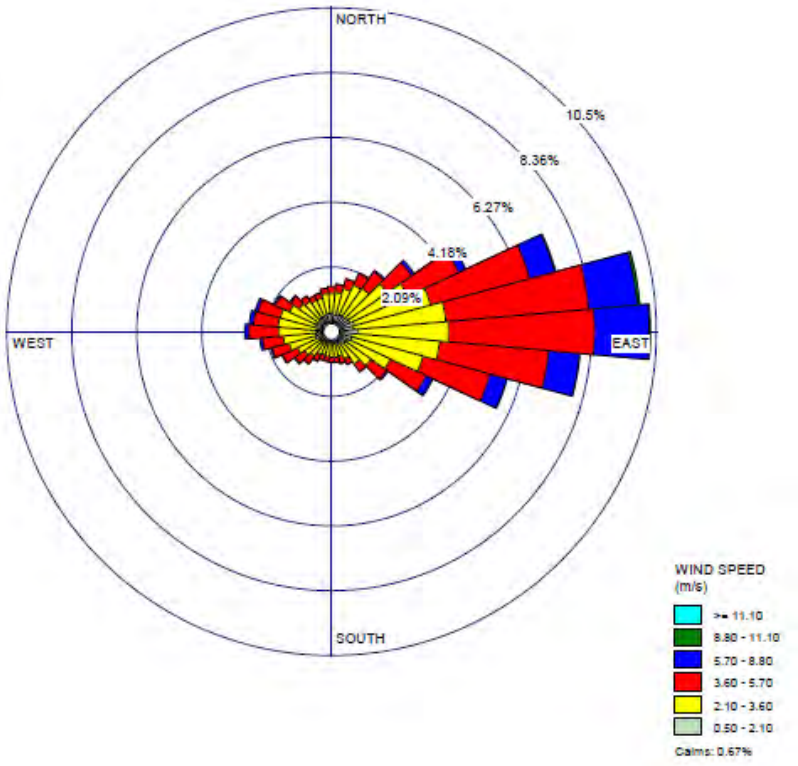


Figure 5-4: Local wind conditions period January 2019 to December 2023, using MERRA data from the Cuanja Station

Figure 5-5 illustrates the annual wind rose from the Chipindo Station. Winds predominantly occurred from the east, east-northeast directions with lower occurrences from the west-northwest trajectory. The average wind speed for the monitoring period was 3.34 m/s. Calms conditions were observed for 1.02% for the period under review.

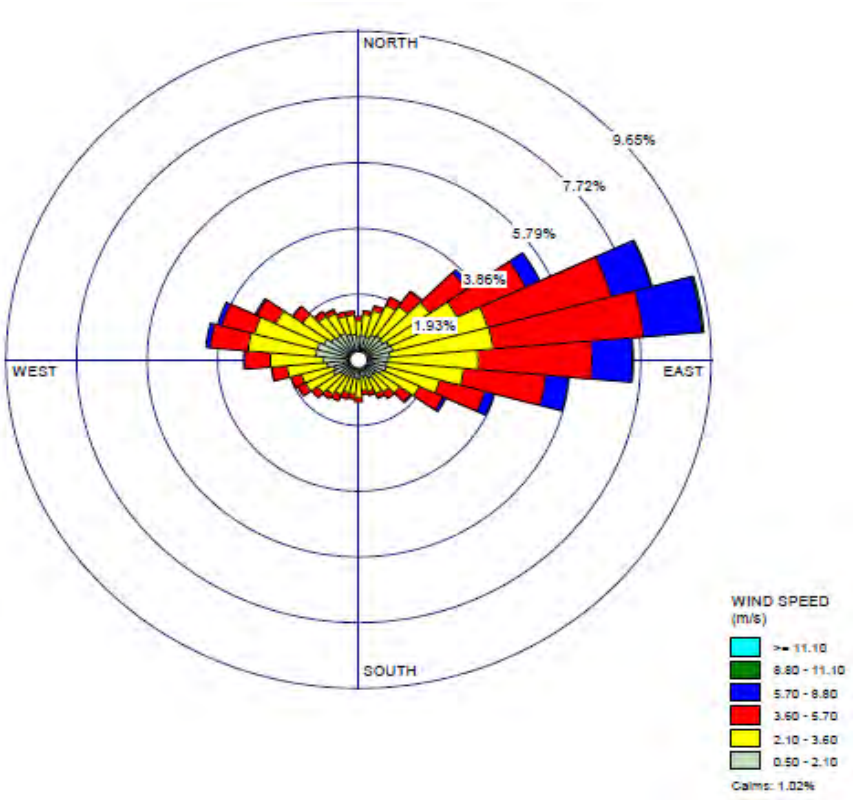


Figure 5-5: Local wind conditions period January 2019 to December 2023, using MERRA data from the Chipindo Station

Figure 5-6 illustrates the annual wind rose from the Cuvango Station. Winds predominantly occurred from the east and northeast directions with lower occurrences from the west-northwest trajectory. The average wind speed for the monitoring period was 3.34 m/s. Calms conditions were observed for 0.67% for the period under review.

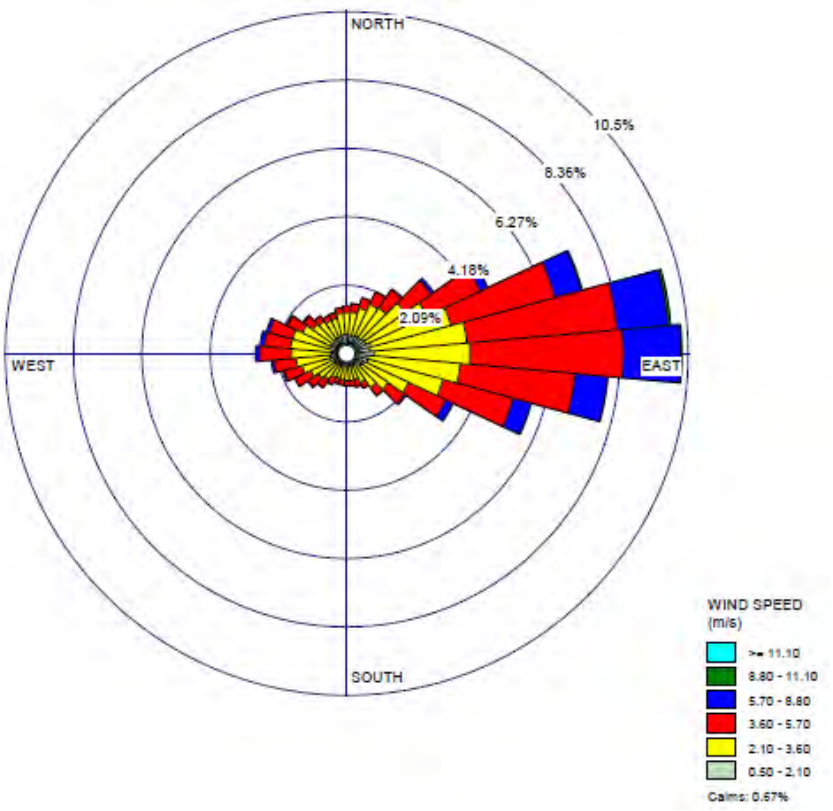


Figure 5-6: Local wind conditions period January 2019 to December 2023, using MERRA data from the Cuvango Station

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, Cuanja and Gove met station for the area under review. Figure 5-7 illustrates the average monthly and cumulative monthly rainfall experienced at each monitoring station for the January 2019 to December 2023 period. The highest rainfall average for the period was 216.5mm, measured in December, while the lowest average rainfall (0mm) was recorded between May to August. Trends indicates a distinct wet and dry season.

Temperature

Ambient air temperature is essential for determining the effect of plume buoyancy (as the larger the temperature difference between the emissions plume and the ambient air, the higher the plume can rise) and determining the development of the mixing depth and inversion layers.

The minimum, average and maximum daily temperatures are for Cuanjo, Chipindo and Cuvango are graphically shown in Figure 5-8, Figure 5-9 and Figure 5-10 respectively.

The Cuanjo Station (Figure 5-8) recorded an average temperature range from 12.39°C to 29.51°C. A minimum temperature of 4.14°C was recorded with the highest temperature peaking at 37.87°C for the period under review.

The Chipindo monitoring station (Figure 5-9) recorded an average temperature range from 12.15°C to 29.78°C. A minimum temperature of 4.44°C was recorded with the highest temperature peaking at 38.33°C for the period under review.

The Cuvango monitoring station (Figure 5-10) recorded an average temperature range from 12.39°C to 29.51°C. A minimum temperature of 4.14°C was recorded with the highest temperature peaking at 37.87°C for the period under review.

The datasets complement each other, revealing distinct seasonal trends in temperature ranges for the various residential areas.

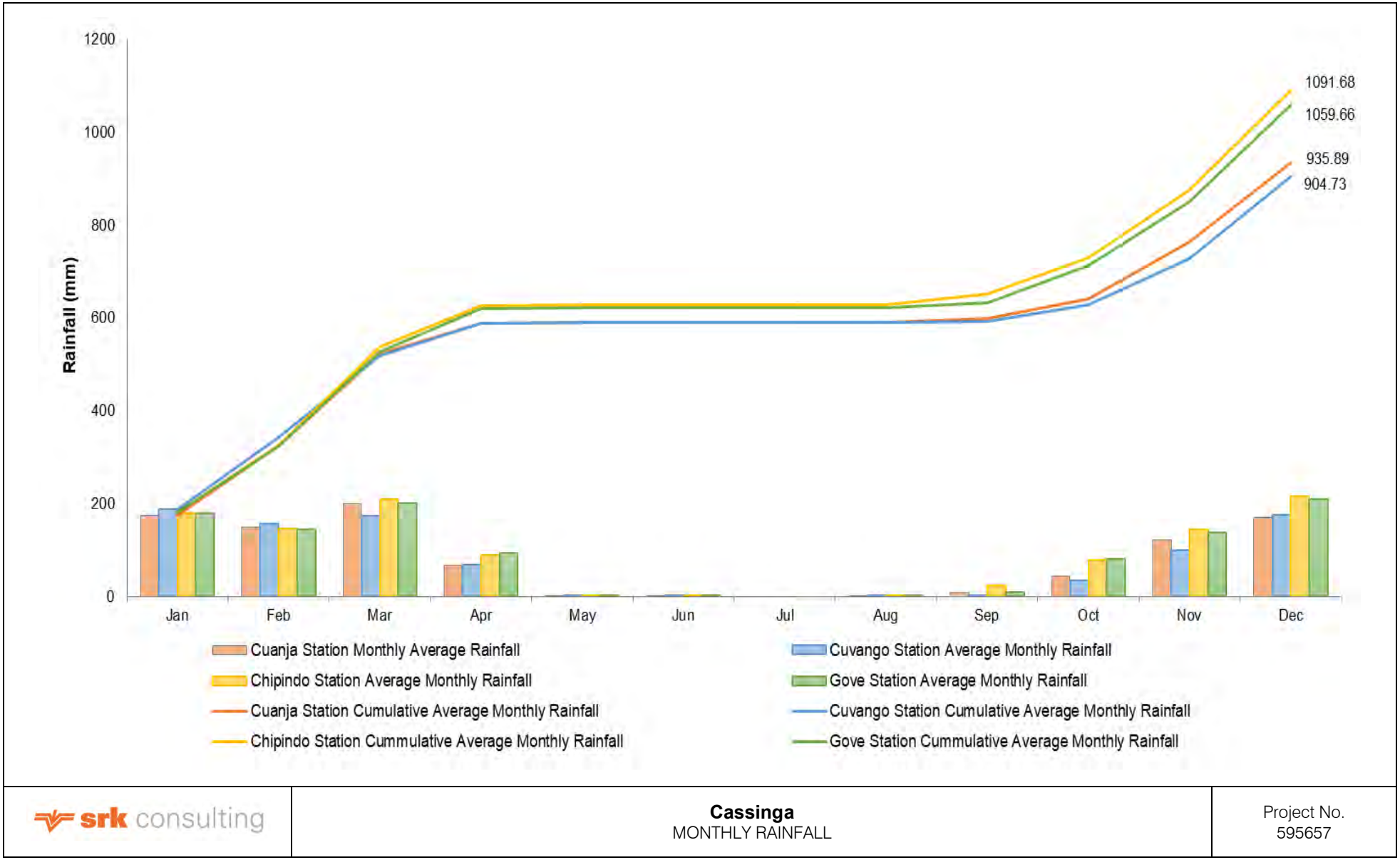


Figure 5-7: Average monthly and cumulative rainfall at each of the monitoring station

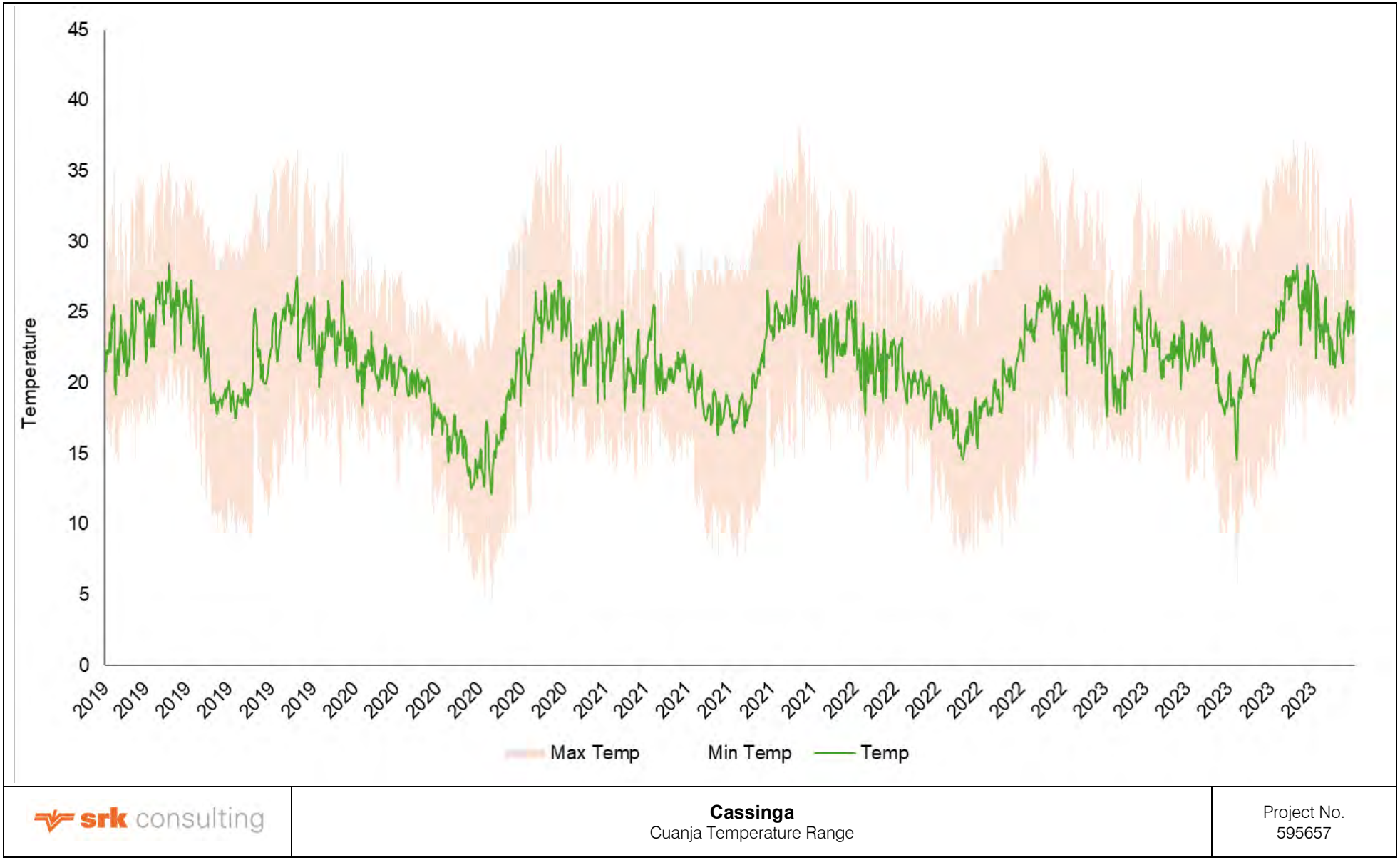


Figure 5-8: Maximum, minimum and average temperature recorded at the Cuanja Monitoring station for the 2019 to 2023 monitoring period

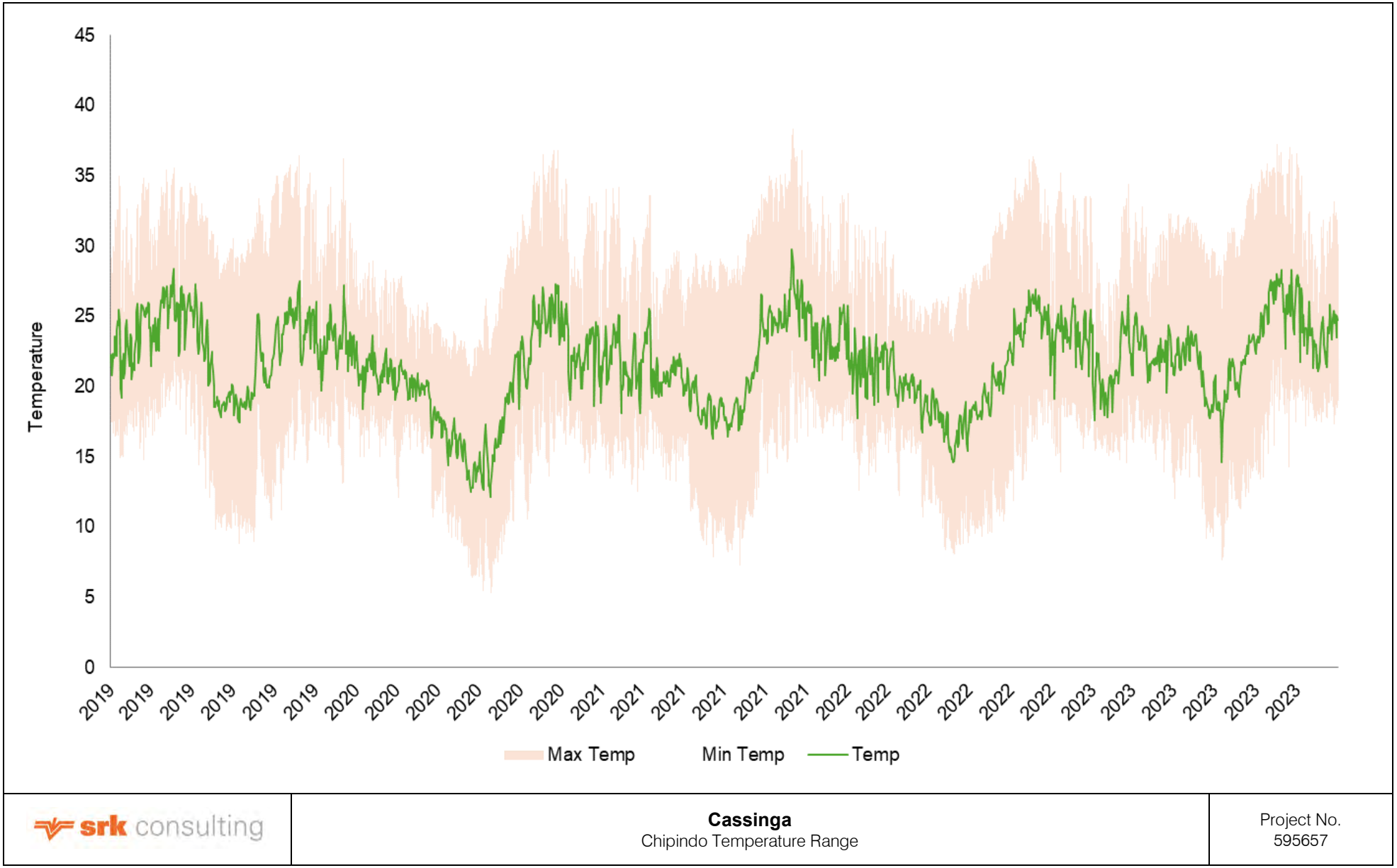


Figure 5-9: Maximum, minimum and average temperature recorded at the Chipindo Monitoring station for the 2019 to 2023 monitoring period

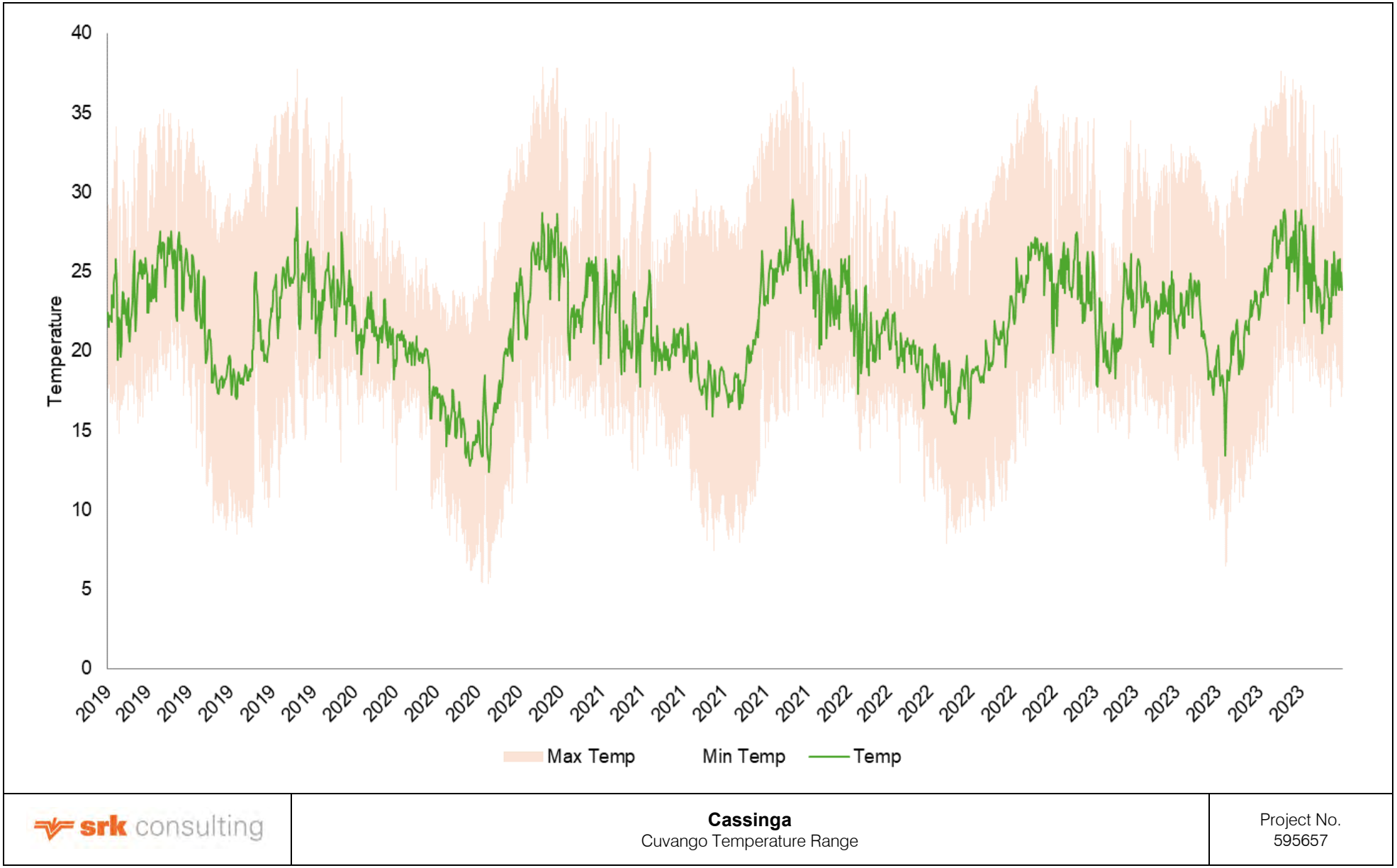


Figure 5-10: Maximum, minimum and average temperature recorded at the Cuvango Monitoring station for the 2019 to 2023 monitoring period

5.3 Ambient conditions

A qualitative discussion of identified emission sources in the vicinity of the study site is provided below. Key emission sources in the region are agricultural emissions, mining operations, domestic fuel burning, fugitive dust from paved and unpaved roads and industrial activity. These emission sources contribute towards the air quality status quo within the region, with PM and DFO being of particular concern in this regard.

5.3.1 Agriculture activities

Agriculture is also one of the dominant lands uses within the surrounding area, comprising mostly in the form of maize, beans, cassava, and coffee. Coffee production, in particular, is a significant economic activity, with Huila being one of the largest coffee-producing regions in Angola

Emissions from agricultural activities are difficult to control due to the seasonality of emissions and the large surface area producing emissions (USEPA, 1995). Expected emissions resulting from agricultural activities include particulates associated with wind erosion, ploughing and burning of crop residue, chemicals associated with crop spraying and odiferous emissions resulting from manure, fertilizer and crop residue.

Dust associated with agricultural practices may contain seeds, pollen and plant tissue, as well as agrochemicals, such as pesticides. The application of pesticides during temperature inversions increases the drift of the spray and the area of impact. Dust entrainment from vehicles travelling on gravel roads may also cause increased particulates in an area. Dust from traffic on gravel roads increases with higher vehicle speeds, more vehicles and lower moisture conditions.

These are the most likely contributors of fugitive emissions from agricultural activities. However, it is noted that fugitive emissions from agricultural activities generally have confined impacts near to the source and are short term in duration occurring when the land is being prepared for planting and during harvesting thus limiting the regional impacts.

5.3.2 Domestic fuel burning

Residential energy consumption is categorized into three primary types: traditional, transitional, and modern. As per a recent survey done by the International Energy Agency, the traditional energy sources include wood, dung, and bagasse, while transitional sources consist of coal, paraffin, and liquefied petroleum gas (LPG). Modern energy sources primarily encompass electricity, with an increasing integration of renewable energy sources. The prevailing trend in energy use typically progresses from traditional to transitional and finally to modern sources. Common pollutants associated with residential energy use include combustion by-products such as carbon monoxide (CO), nitrogen oxides (NOx), sulfur dioxide (SO_2), volatile organic compounds (VOCs), unburned hydrocarbons (HCs), and particulate matter.

5.3.3 Unpaved roads

Unpaved roads are a substantial source of atmospheric emissions. As vehicles traverse these roads, the friction between the wheels and the surface pulverizes the material, lifting particles into the air. Even after the vehicle has passed, turbulent air shear continues to agitate the road surface, releasing additional dust particles. The extent of dust emissions from unpaved roads depends on factors such as vehicle traffic and the amount of silt present on the road surface, which is often high due to these roads primarily serving as haul routes.

While emissions from paved roads are lower compared to unpaved roads, they still contribute to atmospheric particulate levels. When vehicles travel on paved surfaces, loose materials can become re-suspended in the air, adding to the particulate load.

5.3.4 Mining operations

Angola is known to have significant mineral resources, including diamonds, gold, iron ore, and copper, among others. Cassinga Mine is located within the vicinity of Jamba. The mine is currently under care and maintenance with a possibility of re-starting in the future. Should the mine restart its operations, the following activities will give rise to fugitive emissions. Fugitive emission sources from mining operations mainly comprise of land clearing operations (i.e., scraping, dozing and excavating), materials handling operations (i.e., tipping, off-loading and loading, conveyor transfer points), vehicle entrainment from haul roads and wind erosion from open areas.

5.3.5 Industrial activity

Coffee production can result in air emissions throughout its lifecycle, including agricultural activities such as fertilizer use and land clearing, processing stages like drying and milling, transportation of beans, and waste management processes. Emissions include greenhouse gases like CO_2, methane, and nitrous oxide, as well as particulate matter and volatile organic compounds. Sustainable practices such as organic farming, efficient processing techniques, renewable energy utilization, and improved waste management can help mitigate these emissions and reduce the environmental impact of coffee production.

6 Permits requirements

6.1 Consideration of best practicable environmental options (BPEOs), where applicable.

In various industries and projects, there may be multiple ways to achieve a desired outcome, each with different environmental implications. The aim is to select the option that provides the greatest overall environmental benefit, considering both short-term and long-term impacts. This process often involves consultation with stakeholders, experts, and regulatory bodies to ensure that all relevant factors are considered. Consideration should be given to the following guidelines:

- IFC EHS Guidelines for Construction and Decommissioning Activities.
- a IFC EHS Guidelines for Environmental Air Emissions and Ambient Air Quality for the Cassinga Project.
- WHO Global Air Quality Guidelines for Particulate matter (PM_{10} and $PM_{2.5}$), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide.

6.2 Identification of permits/licenses required under Angolan Legislation, as well as applicable guidelines or protocols under national or international legislation.

Given the absence of specific air quality standards in Angola, the International Finance Corporation (IFC) guideline on Ambient Air Quality will serve as the relevant tool for conducting this study For more information on the global standards, refer to Section 3.4.

7 Assessment of impacts and identification of management actions for the construction, operation and decommissioning phases

Air emissions associated with the Project will also vary across different phases of the project, notably during construction and operation. Understanding and mitigating these emissions is crucial for ensuring environmental compliance and minimising impacts on air quality and public health. An overview of the anticipated air emissions is provided below.

This section qualitatively assesses the three phases of the Cassinga Powerline Projects, and its air quality impacts on the Chipindo, Cuvango and Jamba localities.

7.1 Construction impacts

Emissions during construction are associated with land clearing, drilling, and potentially 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), PM_{10} and $PM_{2.5}$ with lesser contributions of CO, NO_2, SO_2 and C_6H_6 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, PM_{10} (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 infraction, 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, NOx 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 DPM, and consist of soot (unburnt organic material), sulfates 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.

In conclusion, construction activities will impact negatively on ambient air quality, however impacts can be mitigated with the application of appropriate dust control options. It is highlighted that construction related emissions are transient and will cease once construction is complete. Since activities aren't ongoing, the majority of dust emissions will settle within close proximity of the source with a short-term duration.

The qualitative assessment relies on studies from the US EPA's AP42 document, a widely recognized 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 though comprehensive documentation and community engagement.

7.2 Operational 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.
- 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.

7.3 Decommissioning impacts

Activities and emissions associated with the decommissioning phase are considered to be similar to those of the construction phase discussed in 7.1.1.

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.

7.4 Qualitative Impact rating

The assessment of impacts focuses on the resultant change in air quality because of a change in ambient particulate based on the Cassinga Powerline Project. The methodology used to assess identified impacts is detailed in **Appendix A.**

Table 7-1: Impact significance rating and mitigation measures for dust emissions during the construction phase

	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
Without mitigation	Minor	Short-term	Local	Low	Possible	Low	-	Low
	1	2	1					
Management and Mitigation Measures The following recommendations are provided: • Undertake fenceline dust fallout monitoring during construction phase. In the absence of local (in country) dust fallout monitoring regulations , the South African National Dust Control Regulations (insert year) can be used as a guide to undertake and assess compliance. • Reduce or stop work during very dry and windy conditions. • Regularly watering the construction site can help suppress dust and prevent it from becoming airborne. • Enclosing solid and material stockpiles at the construction site with temporary fencing and covering materials like tarps can help reduce dust and other pollutants from escaping the site. • Limiting the amount of earth-moving and excavation work and controlling the speed and movement of heavy equipment can help reduce the amount of dust generated during the construction process.								
With mitigation	Minor	Short-term	Site	Very low	Possible	Very low	-	Very low
	1	2	1					

While emissions from construction are probable, the potential for construction emissions to impact on human health is expected to be low given that the emissions are site specific and temporary and will reduce to very-low once management measures are implemented as presented in Table 7-1.

Table 7-2: Impact significance rating and mitigation measures for dust emissions during the operational phase

	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
Without mitigation	Minor	Short-term	Local	Low	Possible	Low	-	Low
	1	2	1					
Mitigation Measures The following recommendations are provided: • Ensure all vehicles are maintained according to the manufacturer's requirements. • Encourage driving practices that reduce fuel usage (e.g., measured acceleration and reduced driving speeds). • Replace older vehicles with newer vehicles that are more fuel-efficient. • Convert vehicles to cleaner fuels where feasible. • Install and maintain emission control devices (e.g., catalytic converters).								
With mitigation	Minor	Short-term	Site	Very low	Possible	Very low	-	Very low
	1	2	1					

Fugitive dust emissions to air associated with the operational phase of the Cassinga Powerline Project would only result from maintenance vehicles. Prior to mitigation measure, the impacts arising from the operational phase are anticipated to be low. With the implementation of management measures, the low impacts will be reduced to very low.

Table 7-3: Impact significance rating and mitigation measures for SF_6 during the operational phase

	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
Without mitigation	Minor	Short-term	Local	Low	Possible	Low	-	Low
	1	2	1					
Mitigation Measures The following recommendations are provided: • Carry out leak detection bi-annually, both visually and with suitable gas leak detection equipment/testing. • Scheduled maintenance and inspection routines ensure that equipment is in optimal condition, reducing the likelihood of leaks and emissions								
With mitigation	Minor	Short-term	Site	Very Low	Possible	Very Low	-	Very Low
	1	2	1					

While transformers and switchgears may emit small quantities of SF_6 during their operation, for projects at this scale, such emissions are typically minimal and do not pose significant environmental concerns. Through responsible containment, monitoring, and appropriate disposal methods, the impact of SF6 emissions can be effectively mitigated. Additionally, ongoing efforts to develop alternative insulating gases aim to further reduce the environmental footprint of such projects while maintaining operational excellence.

Table 7-4: Impact significance rating and mitigation measures for dust emissions during the decommissioning phase

	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
Without mitigation	Minor	Short-term	Local	Low	Possible	Low	-	Low
	1	2	1					
Management and Mitigation Measures The following recommendations are provided: • Reduce or stop work during very dry and windy conditions. • Vegetate areas that could be a source of windblown dust emissions. • Regularly watering the area of under closure can help suppress dust and prevent it from becoming airborne. • 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.								
With mitigation	Minor	Short-term	Site	Very low	Possible	Very low	-	Very low
	1	2	1					

8 Recommendations

Table 8-1 below provides a comprehensive outline for identifying potential impacts linked to each project phase, along with delineating action plans to mitigate these effects.

Table 8-1: Recommendations measure for each project phase

Project Phase	Potential Impact	Detailed Action	Responsible person/Entity	Monitoring mechanism	Indicator/performance criteria
Construction Phase	Fugitive emissions during construction are associated with land clearing, drilling, and blasting, ground excavation, cut and fill operations and the movement of heavy construction vehicles on temporary roads.	Potential requirements based on the IFC EHS Guidelines for Construction activities: • Reduce dust from material handling sources by using covers and/or suppression techniques (water and/or chemical dust suppression). • Use enclosures or covers on stockpiles. • Increase moisture content of stockpiles. • Avoid open burning of waste. • Avoid or minimize project transportation through community areas. • Reduce loose material on paved roads. • Reduce traffic volumes. • Reduce vehicle speed on unpaved roads. • All construction vehicles carrying material must be tarped. • Maintaining general housekeeping onsite, focusing on spilt material which can be re-entrained by vehicles and wind and potentially contribute to impacts on the receiving environment. Spilt material should be collected within acceptable time to ensure material does not contribute to overall emissions from the site.	Project Engineer	Keeping complaints register on dust levels. Dust fallout monitoring during construction period.	Dust emission levels as per regional standards.
Operational phase	Maintenance operations, including the use of vehicles and portable	• Ensure all vehicles are maintained according to the manufacturer's requirements.	Project Engineer	Regular maintenance of vehicles.	Emission levels as per WHO standards.

Project Phase	Potential Impact	Detailed Action	Responsible person/Entity	Monitoring mechanism	Indicator/performance criteria
	generators, can produce exhaust emissions similar to those during the construction phase but on a smaller scale.	• Encourage driving practices that reduce fuel usage (e.g., measured acceleration and reduced driving speeds). • Replace older vehicles with newer vehicles that are more fuel-efficient. • Convert vehicles to cleaner fuels where feasible. • Install and maintain emission control devices (e.g., catalytic converters). • Reduce vehicle speeds. • Reduce loose material on paved roads. • Reduce traffic volumes. • Regular cleaning of hard surfaces.		Passive sampling testing in the three major cities.	
	SF_6 emissions from transformers and switchgears.	• Carry out leak detection bi-annually • Scheduled maintenance and inspection routines ensure that equipment is in optimal condition, reducing the likelihood of leaks and emissions	Project Engineer	Leak detection testing bi-annually.	Emission levels as per WHO standards.
Decommissioning phase	Fugitive emissions during are associated with land clearing and the movement of heavy construction vehicles on roads.	• The site should revegetate relatively quickly limiting this wind-blown dust and creating no permanent air quality issues going forward. • Maintaining general housekeeping onsite, focusing on spilt material which can be re-entrained by vehicles and wind and potentially contribute to impacts on the receiving environment. Spilt material should be collected within acceptable time to ensure material does not contribute to overall emissions from the site.	Project Engineer	Keeping complaints register on dust levels.	Dust emission levels as per WHO standards.

Project Phase	Potential Impact	Detailed Action	Responsible person/Entity	Monitoring mechanism	Indicator/performance criteria
		• Reduce dust from material handling sources by using covers and/or suppression techniques (water and/or chemical dust suppression). • Use enclosures or covers on stockpile. • Reduce loose material on paved roads. • Reduce traffic volumes.			

9 Conclusion

The main findings from the qualitative assessment of the Cassinga Powerline Project are as follows:

- Construction operations: Whilst the construction activities are likely to contribute to an increase in localised air pollution, impacts are likely to be minimal on surrounding receptors as the impacts are transient and will cease once construction operations are complete. Existing sources of pollution in the surrounding environment such as vehicle tailpipe emissions are likely to remain the predominant source.
- Operational phase operations: Majority of emissions to air associated with the operational phase would only result from maintenance vehicles. These are regarded as insignificant. Although transformers and switchgears may release small amounts of SF_6 during operation, the emissions from projects of this magnitude are generally negligible and don't raise significant environmental worries.
- Based on the findings of this assessment, impacts on the surrounding sensitive receptors as a result of activities taking place are considered to be low. The Project is set within an area that has relatively good ambient air quality, with only periodic localized impacts from emissions caused by smoke from cooking fires in villages and from fires set to clear small patches of vegetation for gardens. This existing situation indicates that air quality is generally stable, with transient impacts that are limited in scope and duration.
- Once the Project becomes operational, there are no anticipated adverse impacts to regional or local air quality, as there will be no significant sources of air emissions. The nature of the project is such that it does not involve industrial processes or heavy machinery that would typically contribute to air pollution. Additionally, the project design includes the use of modern, energy-efficient technology, which further minimizes any potential for emissions. Any minor emissions that might occur during operations are expected to be well within acceptable limits, as determined by environmental regulations and standards. Furthermore, the project's location and design consider the prevailing wind patterns and topography, which naturally disperse any potential pollutants, preventing accumulation in populated areas that lead to chronic exposure to poor air quality. Given that the baseline air quality is already good and that the project does not introduce new significant sources of pollution, it is reasonable to conclude that the baseline will remain largely unchanged.
- Decommissioning phase: The decommissioning phase will mainly include materials handling activities, wind erosion and to a lesser extent vehicle and equipment movement on-site and on the access road. Planting vegetation in exposed areas prone to wind-blown dust emissions is an effective strategy for minimizing their impact.

In summary, the project is designed to be environmentally sustainable, with no significant contributions to air pollution. The existing high air quality and the absence of new pollution sources justify a qualitative rather than quantitative assessment, ensuring that the environmental integrity of the area is maintained.

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Appendices

Appendix A: Impact assessment methodology

Impact assessment methodology

Potential impacts (direct, indirect, cumulative) will be assessed using information gathered during the baseline assessment in combination with previously collected desktop data and compared with the detailed project description.

Impact significance rating

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 1 and involves the following 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.

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 1: Method for rating 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
	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

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**
SPATIAL SCALE OR POPULATION	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	Medium	High
		Short term	Low	Medium	Medium
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

After determining the significance rating, practicable management measures are suggested for each specific impact. The impact description should indicate the significance rating prior to and following mitigation/optimisation. As explained above:
"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 is then re-assessed with assumed management measures in place ("after management"). Specialists also recommend and describe 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 10-1.

Table 10-1: Impact significance rating and mitigation measures for the impact.

Activity: XXXX								
Project phase: XXXX								
Impact Summary: XXXXX								
	Magnitude	**Duration**		**Consequence**	**Probability**	**SIGNIFICANCE**		**Confidence**
	Moderate	*Long term*		***Medium***	*Possible*	***Medium***		*Medium*
Management Measures:								
After Management	*Minor*	*Short term*	*Site / local*	***Low***	*Unlikely*	***Low***	-	*Medium*

Appendix B: Climate change

Cassinga Power Supply ESIA - Climate Change Specialist Report

Report Prepared for

PAK YATIRIM

Report Number 595657-DCCIA

Report Prepared by

srk consulting

October 2024

Cassinga Powerline ESIA – Climate Change Specialist Report

PAK YATIRIM

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Executive Summary

Baseline

A comprehensive climate baseline assessment was conducted for the period 2002 to 2023 along the proposed transmission line in Angola, using data from four virtual stations: Jamba, Cuvango, Chipindo, and Gove. These stations are aligned south to north as depicted in Figure 3-1. The study utilized MERRA2 for temperature, relative humidity, and windspeed data, while rainfall patterns were analysed using the CHIRPS model dataset. Additionally, solar irradiance and potential evaporation rates were calculated using the Penman-Monteith method as per FAO 56 guidelines.

Throughout the baseline period, the recorded temperature extremes were 3.74 °C in Gove and 38.33°C in Chipindo, with an average temperature rise of at least 4% across all sites from 2002 to 2023. Jamba and Cuvango experienced the most days exceeding their monthly maximum temperatures, while Chipindo had the highest average monthly maximum temperature at 35.3 °C. The peak solar radiation was observed in September, with all sites experiencing higher than average solar irradiance from August to February.

The region is characterized by distinct wet (October to April) and dry (May to September) seasons, with over 98% of annual rainfall occurring during the wet season. Cuvango is notably the driest, and Chipindo and Gove have the highest average number of rain event days, with Chipindo also recording the highest average monthly rainfall. A significant decrease in rainfall from December to March, especially in the southern sites, suggests a potential for extended dry periods and droughts in the future.

Relative humidity levels never drop below 40%, with higher humidity observed towards the northern end of the transmission line. The lowest humidities were recorded between May and October, with August and March marking the minimum and maximum humidity levels, respectively. Evaporation rates were highest during the dry season, peaking in September, and consistently exceeded average monthly rates from July to October, aligning with the minimal rainfall and lower humidity levels.

Windspeeds across the proposed site are generally mild, with average speeds below 3 m/s year-round and high windspeed events (exceeding 5.7 m/s) being unlikely, as indicated by the wind class diagram (Figure 6-25). This comprehensive data provides a crucial understanding of the climatic conditions along the transmission line's route, which is essential for planning for future climatic changes.

Predicted Climatic Changes

Climate projections for the region suggest a shift in rainfall patterns, with an overall decrease in annual rainfall, yet an increase in the intensity of rain events. Rain is expected to occur in fewer but heavier bursts, leading to longer dry spells. Seasonal analysis indicates a reduction in rainfall towards the end of the dry season, particularly in October and November, and an uptick during the wet season from December to February, with Huambo showing a more pronounced trend.

For the site specifically average annual temperatures, temperature extremes, and windspeeds are all forecasted to rise. Near-term mean temperatures could climb by up to 1.8°C, and near-term maximum temperatures by up to 2.1°C, while the frequency of frost days is likely to stay relatively constant.

Despite some outliers, the annual average rainfall is projected to increase for the site which is different from the regional prediction. The noticeable rise in maximum 1-day and 5-day rainfall events is however consistent. The number of consecutive dry days is also expected to grow, suggesting a higher risk of flooding during heavy rainfall and increased drought occurrences, especially at the dry season's end.

Wind predictions for specific sites, as detailed in Table 7-5, show little change in average windspeeds. However, the predictive models used do not account for changes in maximum windspeeds or wind gusts, and their accuracy in forecasting extreme weather events is limited. Therefore, the possibility of short-term high-speed winds and gusts cannot be discounted.

Although landslides cannot be predicted by the models utilised in this assessment, NASA's Global Landslide Catalog indicates that Chipindo is susceptible to landslides with a moderate-high susceptibility rating. Gove, Cuvango and Jamba are classified as having very low to low susceptibility to landslides.

Risks, Opportunities and Recommendations

Risks and opportunities identified alongside their associated recommended management options are summarised in Table ES-1 alongside their significance pre-and-post-management. All risks identified have medium to low significance pre-management, which can be reduced to low post-management (apart from those associated with the use of SF_6 in the substations). SF_6 gas is used in the breakers of substations. While SF_6-containing equipment is designed to prevent gas emissions into the atmosphere, leaks can occur, particularly as equipment ages or is not appropriately maintained. Furthermore, equipment will be disassembled during the decommissioning phase of the project, ultimately allowing all the SF_6 to escape to the atmosphere. This is concerning, as the Global Warming Potential for SF_6 is 23 500 (This means that one tonne of SF_6 has the same impact on global warming as 23 500 tonnes of CO_2).

One significant opportunity has been identified. While wood and charcoal (renewable energy sources) are largely used in these areas for cooking, lighting is, in some instances, provided using fossil fuels (diesel generators or lamps, possibly paraffin or LPG lamps). Increasing the availability of electricity may therefore reduce the use of non-renewable fuels and ultimately reduce Angola's carbon footprint given that the electricity provided will be hydroelectric.

Table ES-1: Risks Identified and Associated Management Methods

Risk/ Opportunity	Pre-Management Significance	Management measure	Post Management Significance
Risks			
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.	**Low**	• Clearing for construction must ensure that cleared areas are kept to a minimum and are only cleared immediately prior to the start of construction and rehabilitated as soon as possible thereafter. • Land clearing should be avoided during December and January when heavy rainfall is most likely to occur.	**Low**
Increased possibility of landslides near Chipindo due to the geomorphic changes associated with land clearance and if large, cleared areas are left unvegetated.	**Medium**	• Clearing for construction must ensure that cleared areas are kept to a minimum and are only cleared immediately prior to the start of construction and rehabilitated as soon as possible thereafter. • Land clearing should be avoided during December and January when heavy rainfall is most likely to occur.	**Low**
Temperatures exceed the designed operational limits of the equipment.	**Medium**	• Ensure all equipment is similarly designed for temperatures up to 50°C. • Ensure Substations are fitted with a fire suppression system which is regularly maintained.	**Low**
Increased staff heat stress, demand for cooling and associated increase in GHG emissions.	**Medium**	• Create and roll out a toolbox talk to educate staff of heat stress and preventative measures. • Make allowance in staff schedules to limit outside work during the hottest parts of the day. • Make sufficient water and other PPE available to limit sun/ heat exposure.	**Low**
Uncontrolled release of hazardous materials or waste to surrounding environment could occur should the hazardous storage facilities flood.	**Medium**	• Implement appropriate stormwater management, taking predicted extreme rainfall into account to prevent any hazardous storage areas flooding. • Store all hazardous materials in enclosed buildings and containers as specified in the MSDS.	**Low**

Risk/ Opportunity	Pre-Management Significance	Management measure	Post Management Significance
Failure of wastewater treatment facilities to contain increased volumes of contaminated water may result in overflow of contaminated water to the environment.	**Medium**	• Oil traps and other wastewater containment and treatment facilities should be designed to accommodate additional annual and extreme rainfall predicted. • Oil traps and other wastewater containment and treatment facilities should be regularly inspected and drained as appropriate.	**Low**
Operational disruptions or damage to project infrastructure due to flooding.	**Low**	• Undertake a flood line assessment, taking predicted changes to 1-day extremes into account and ensure all substations are located outside of the 1:100 year flood line. • Implement appropriate stormwater management, taking predicted extreme rainfall into account to prevent flooding in the substations.	**Low**
Operational disruptions or damage to project infrastructure due to lightning.	**Medium**	• It is noted that the infrastructure is fitted with lightning protection to reduce risks. The disaster management plan however should include measures to address damages to infrastructure as a result of lightning.	**Low**
Operational disruptions or damage to project infrastructure due to high windspeeds.	**Low**	• Update baseline meteorological data sets every 5 years with available monitoring data and implement infrastructure upgrades/ reinforcement as applicable.	**Low**
Increased prevalence or intensity of fires caused by infrastructure amidst extended dry periods.	**Medium**	• It is noted that fire suppression has been included in the design of the substations. • Ensure the Emergency Response Plan details measures to reduce fire risk and manage the extent of damage to surrounding areas as a result of fires from the substations or the associated infrastructure.	**Low**
The increased prevalence or intensity of wildfires amidst the extended dry period affecting infrastructure.	**Low**	• Ensure the Emergency Response Plan addresses the risk of fires to the infrastructure and aims to reduce the extent of damage as a result of fires started offsite that might cause damage to the substations or any wooden poles used in distribution network.	**Low**

Risk/ Opportunity	Pre-Management Significance	Management measure	Post Management Significance
Increased possibility of landslides near Chipindo due to moderate-high landslide susceptibility.	**Medium**	• Ensure all areas have been revegetated as required in the environmental management plan. • Undertake monitoring of steep slope areas to identify areas that become denuded of vegetation.	**Low**
Increased prevalence of vector borne diseases due to higher temperatures and rainfall in certain months (with specific relevance to malaria).	**Low**	• Create and roll out a staff awareness campaign to educate staff of vector borne diseases and preventative measures. • Provide any equipment/ vaccines or other materials to support staff in preventing disease.	**Low**
Disruption of transportation routes due to offsite/ remote flooding related infrastructure damage.	**Medium**	• Identify and map all alternative access route. • Identify local community members to be upskilled to undertake emergency maintenance (e.g., Safely empty oil traps during heavy rainfall).	**Low**
Health and safety risks to staff associated with flooding.	**Medium**	• Disaster Management Plan to include emergency evacuation routes and protocols during flood events for staff that may be undertaking infrastructure maintenance. The emergency evacuation routes and protocols must form part of induction and be included annually in safety training.	**Low**
Use of SF_6 as quencher for the substations given its high global warming potential.	**High**	• Regular maintenance of the substations specifically the arc quenchers (breakers) must be undertaken to limit the potential for leaks. • Consider the use of alternative refrigerants with a lower global warming potential. • Investigate options to capture all SF_6 gas during decommissioning.	**Medium**
Opportunities			
Increasing the availability of electricity which in turn could reduce the use of non-renewable fuels.	**High**	• Promote the use of electrical appliance over non-renewable energy alternatives through subsidies.	**High**

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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

AR4	-	Fourth Assessment Report
AR5	-	Fifth Assessment Report
AR6	-	Sixth Assessment Report
CCRA	-	Climate Change Risk Assessment
CCKP	-	Climate Change Knowledge Portal
CCRA	-	Climate Change Risk Assessment
CIMP6	-	Sixth Phase of the Coupled Model Intercomparison Project
ENAC	-	Estratégia Nacional sobre as Alterações Climáticas
ESMs	-	Earth System Models
GHG	-	Greenhouse Gas
GLC	-	Global Landslide Catalog
GWLs	-	Global Warming Levels
INAMET	-	Instituto Nacional de Meteorologia e Geofísica
IPCC	-	Intergovernmental Panel on Climate Change
LHASA	-	Landslide Hazard Assessment Model
MINEA	-	The Ministry of Energy and Water of Angola
NDC	-	Nationally Determined Contributions
OHL	-	Overhead Line
OPGW	-	Optical Ground Wire
PET	-	Potential Evapotranspiration
PNAAC	-	National Plan for Adaptation to Climate Change
PNE	-	National Emissions Plan
SASSCAL	-	Southern African Science Service Centre for Climate Change and Adaptive Land Management
SCADA	-	Supervisory, Control and Data Acquisition
SDGs	-	Sustainable Development Goals
SRK	-	SRK Consulting (South Africa) (Pty) Ltd
SSP	-	Shared Socio-economic Pathway
TCFD	-	Task Force on Climate-Related Financial Disclosures
UNDRR	-	United Nations Office for Disaster Risk Reduction
WSAF	-	West Southern Africa

1 Introduction

SRK Consulting (South Africa) Pty Ltd (SRK), in collaboration with Angolan-registered consultancy Geolab, has been commissioned by PAK YATIRIM to oversee the Environmental and Social Impact Assessment (ESIA) for the construction and operation of a significant electrical infrastructure project.

As part of the ESIA a Climate Change Risk Assessment (CCRA) is required. This report details the CCRA and includes the following:

- Understanding of the project and aspects that may be affected by climate change.
- A review of applicable policy and legislation to inform the approach to the assessment.
- Detail of how the assessment was undertaken and the uncertainties, assumptions and limitations that form part of the assessment.
- Identification and assessment of climate change risks.
- Identification of measures required to address potential risks.

2 CCRA Project Team

Personnel as detailed in Table 2-1 were instrumental in the development of the CCRA.

Curricula vitae of team members are available on request.

Table 2-1: Project Team

Name	Designation	Role
Philippa Burmeister Pr.Sci.Nat/ Reg.EAP	Partner/ Principal Scientist	Project manager, quality review risk identification and assessment and development of adaptation strategies.
Joss Cahi	Hydrologist	Meteorological data sourcing and processing and baseline reporting.
Gareth van der Walt	Chemical Engineer	Baseline and risk reporting.

3 Project Description

The Ministry of Energy and Water of Angola (MINEA) awarded the design, construction, and commissioning of a 220 kV transmission line with an approximate length of 170 km in Cassinga, Huila, Angola. The project encompasses the construction of the transmission line (running from the Gove Hydro Dam to Cuvango and Jamba via Chipindo), three 220/30 kV substations, and the subsequent electrification of the Chipindo, Cuvango and Jamba villages. To facilitate electrification of the three villages, the project will include a 30 kV medium voltage overhead line (OHL) network to the new substations and a low voltage network to supply electricity to 1 000 homes in each of the three villages. A Google Earth image of the site, virtual stations and accompanying villages is

presented in



Figure 3-1.

The design criteria include the following environmental criteria for the electrical reticulation:

- Maximum Temperature: 50 °C;
- Minimum Temperature: 0 °C;
- Average Daily Temperature: <40 °C;
- Maximum Wind Speed: 33 m/s;
- Pollution Level: Strong; and
- Altitude: <1000 m.

Two guard wires will be installed; a conventional Guinea wire and an Optical Ground Wire (OPGW); for earthing and lightning protection of the OHL. 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 may occur due to lightning strikes and for lightning protection, respectively. Fire detection and suppression systems have yet to be designed for the project. Although water will be required during the construction and operational phases of the project, the source of the water has not yet been identified. Similarly, although wastewater treatment will be required during construction and operation, plans for these services have not been finalised.

The power required for construction will mainly be sourced from diesel (diesel vehicles and generators). Although each of the substations will include a diesel generator, it is assumed that these generators are only used to maintain power supply during outages. Both the construction and operational phases of the project are expected to generate waste; however, it is expected that waste generated during operations will be less than that generated during construction, considering that operational waste is only associated with maintenance.

The proposed Cassinga powerline spans roughly 170 km. It is approximately 300 km northeast of the city of Lubango and 285 km southwest of the city of Benguela. Approximately 335 km from the centre of Angola with elevations between 1470 and 1600 mamsl, the site lies within the inland plateaus and semi-desert lowlands discussed above.



Figure 3-1: Cassinga Powerline Locality Map

4 Legal and Policy Overview

4.1 The Paris Agreement

The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at COP 21 in Paris on December 12th, 2015, and entered into force on November 4th, 2016. Its goal is to limit global warming to well below 2 °C (preferably to 1.5 °C) compared to pre-industrial levels. To achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas (GHG) emissions as soon as possible to achieve a climate-neutral world by the mid-century. Angola signed the Paris Agreement on April 22nd, 2016, and ratified it on August 12th, 2020.

4.2 IFC Performance standards

The IFC's Performance Standard 3 on Resource Efficiency and Pollution Prevention requires quantification of GHG emissions as the first step towards managing and ultimately reducing GHG emissions in a cost-effective manner. These GHG emissions are to be quantified annually. Furthermore, the standard requires the consideration of alternatives and the implementation of technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of a project. Cost-effectiveness of a resource efficiency or GHG emissions reduction measure is determined according to the capital and operational cost and financial benefits of the measure relative to the life of the measure.

The IFC's policies only require projects with "significant emissions" to quantify their GHG emissions. Significant emissive projects are those that emit at least "25 000 tons CO_2 equivalent [emissions] per year ". Their Scope 3 Calculation Guidance provides:

- Detailed technical guidance on all relevant calculation methods, i.e., methods to calculate GHG emissions for each of the fifteen categories of Scope 3 emissions;
- Guidance on selecting the most appropriate calculation methods; and
- Demonstrative examples.

Since this project is not expected to emit 25 000 tons CO_2 equivalent emissions annually, quantification of the project's GHG emissions is not required.

Performance Standard 6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources) considers the implications of climate change on biodiversity conservation. The standard guides clients on how to manage and mitigate their environmental and social risks as part of IFC's sustainability framework.

No specific approach is dictated in terms of the IFC's performance standards with regards to developing climate change scenarios or assessing the risks posed by the different scenarios.

4.3 UN Sustainable Development Goals

In 2015 (the same year that the Paris Agreement was signed) the 2030 Agenda for Sustainable Development was adopted alongside a set of seventeen Sustainable Development Goals (SDGs) (Figure 4-1). These SDGs serve to guide policy and funding for the next decade. As a member state of the United Nations, Angola committed to the 2030 Agenda for Sustainable Development when it was adopted by all 193 United Nations member states in 2015.

The SDGs support the Paris Agreement; climate change specifically highlighted under SDG 13 (Climate Action). This SDG mentions targets relating to strengthening resilience and adaptive capacity. SDG 7 (for Affordable and Clean Energy), however, also links to sustainable energy, and therefore, low-carbon energy alternatives.



Figure 4-1: Sustainable Development Goals

The 2030 Agenda for Sustainable Development includes five targets. These targets are focused on:

- Interventions by member states to enhance global resilience to climate-related disasters;
- Embedding climate change measures into national frameworks;
- Improving climate change education and capacity building;
- Mobilizing $100 billion annually for developing countries' climate actions; and
- Bolstering climate change planning and management in the most vulnerable countries, with a focus on marginalized groups.

However, these stipulated targets and goals do not dictate an approach to climate change risk assessment for individual projects.

4.4 Task Force on Climate-Related Financial Disclosures (TCFD)

Standard Chartered has issued a climate change policy statement that acknowledges the risks of climate change. Their policy statement indicates the expectation that clients (beginning with those in high-carbon sectors) must have a public strategy to reduce their GHG emissions and should report their emissions to align with requirements of the TCFD. As such, the Standard Chartered statement focusses on climate change mitigation (reducing GHG emissions), and this specific development will contribute to mitigation and is not a high-carbon sector.

In contrast to the IFC, the TCFD does provide significant guidance on the reporting of climate change risks. In terms of the TCFD, this project falls in the category of Energy, specifically, Electric Utilities. Requirements for disclosure in terms of the TCFD as quoted above requires the following:

- **Strategy**:
  - Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning.

- Describe the resilience of the organisation's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.

- **Metrics and Targets**:
  - Disclose the metrics used by the organisation to assess climate-related risks and opportunities in line with its strategy and risk management process.

TCFD guidance then goes on to provide requirements for scenario analyses that have informed the development of the approach discussed below.

4.5 Local Legislation

To give effect to the requirements of the Paris Agreement, Angola has developed the National Climate Change Strategy (Estratégia Nacional sobre as Alterações Climáticas - ENAC). This strategy outlines the country's approach towards mitigating and adapting to climate change. As such, it acts as a strategic framework that is aimed at guiding the country towards becoming resilient to the impacts of climate change in tandem with pursuing low-carbon developments that help eradicate poverty. The strategy acknowledges Angola's vulnerability to climate change, noting the country's experience with floods, droughts, soil erosion and rising sea levels, as well the varying effects these have across different regions.

ENAC sets a vision for Angola's climate policy up to the year 2030, emphasising the need to integrate mitigation and adaptation efforts into national policy. The strategy will lead to the creation of two key plans: the National Emissions Plan (PNE) and the National Plan for Adaptation to Climate Change (PNAAC). It is anticipated that the PNE will regulate GHG emissions reporting and reduction strategies to achieve the planned 14% reduction in GHG emissions by 2025 as detailed in the Angolan Nationally Determined Contributions (NDC).

The PNAAC will outline requirements for building resilience and adapting to climatic changes. It is currently uncertain whether the plan will include requirements for private projects. Furthermore, no specific local requirements have been identified that would dictate or alter the approach to assessing the climate change risks of the project.

5 Approach

5.1 Objectives

The objective of this study is to determine the impact climate change will have on the proposed project and whether it will also exacerbate other impacts of the project.

5.2 Scope of Work

The scope of work for the Climate Change Risk Assessment (CCRA) was based on the TCFD guidelines; Section 5.5.1.3 of the Scope of Work supplied by the client and SRK's experience in the CCRA. The TCFD identifies two main categories of climate-related risks, namely Climate Physical Risk and Transitional Risk. As per section 4.2, projects that emit more than 25 000 tons CO_2e per year are required to quantify GHG emissions quantification. PAK YATIRIM have confirmed that the project emissions are estimated to be 20.811,28 CO_2e. The approach proposed by SRK has therefore focused on Climate Physical Risk and includes:

- Obtain climate baseline data (historical climate conditions) from onsite monitoring and available modelled datasets. It is assumed observed meteorological monitoring will be made available by the client and therefore costs to purchase observed meteorological data has not been included in the scope.
- Compile climate baseline information to include the following:
  - Average daily mean temperatures for the past 20 years and projected temperature changes.

- Records of extreme high temperatures/ heatwave events and projected changes.
- Records of extreme low temperatures/ frost day's events and projected changes.
- Average precipitation levels for the past 20 years and projected changes.
- Records of dry spells/ drought events.
- Wind speeds and projected changes in wind speeds.

- Obtain climate change projections for the area based on the Intergovernmental Panel on Climate Change (IPCC)'s Sixth Assessment Report (AR6) projections, downscaled for the region using the World Bank Climate Change Knowledge Portal (CCKP).
- Based on the climate baseline and climate risk projections develop a plausible climate change scenario as the basis for the risk assessment. Regional risks to be identified for 4 different climate change scenarios and the predicted changes to relevant climatic factors. The scenarios will be expanded over all the project's phases.
- Conduct an internal risk workshop to present the climatic changes predicted and discuss and capture the potential risks to the proposed project and any practical mitigation measures to be implemented.
- Based on the discussions during the workshop, complete the impact assessment to be provided by the EA team.

Sources of GHG emissions are limited to fugitive emissions from the substations. As such, a GHG emissions inventory has not been included in the scope of work. This aligns with the IFC's performance standard requirement that stipulates that only projects expected to emit 25 000 tons CO_2 equivalent emissions per year are required to quantify their annual GHG emissions.

5.3 Information Sources

Data for the climate baseline was initially sought from the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) and the Instituto Nacional de Meteorologia e Geofísica (INAMET). Virtual stations selected from SASSCAL included Matala and Gove that were 100 km and 1.5 km away from the proposed site, respectively. Virtual stations from INAMET included Dongo (70 km away) and Cuvelai (115 km away). SASSCAL did not respond to email queries, and INAMET provided a quote of 1 232 000 Kwanzas per station.

5.3.1 SASSCAL

Although the Gove SASSCAL station is the closest to site, there are discrepancies in the rainfall data records where 6.5 years' worth of rainfall was not recorded. Similarly, the temperature data record from this station is patchy; a substantial portion of data not recorded. The second station, Matala, is 150 m above the proposed site and does not have a complete dataset (roughly 50% of all the data requested is not available). As such, the use of SASSCAL data for the climate baseline would not provide a representative record for the site.

5.3.2 INAMET

Both stations from INAMET are far away from the proposed site. Additionally, there is a substantial elevation difference between both stations and the site. As such, although 21 years' worth of data is available from either station, the use of INAMET data for the climate baseline will result in uncertainties regarding its representation of the site's climatic conditions.

5.3.3 Virtual Stations

To reduce the uncertainties in the climate baseline that would arise from the missing data and extremes in both the general and altitudinal distances from site, additional, free virtual stations were used. Historical baseline conditions were then established for the period 2002 to 2023 using these free stations.

Meteorological (MET) data was downloaded from four virtual MET stations Jamba, Cuvango, Chipindo and Gove) that move south to north along the proposed transmission line's pathway. Meteorological parameters essential for the climate baseline included:

- Temperature;
- Rainfall;
- Relative humidity;
- Windspeed;
- Solar radiation; and
- Potential evaporation.

5.4 Climate Baseline

Modelled temperature, relative humidity and windspeed data were obtained from MERRA2; a global atmospheric reanalysis product developed by NASA. Although it uses a variety of data sources (satellites and observed data) to produce a historic record that extends to present, MERRA2 tends to overpredict during low rainfall periods and under predict during high rainfall periods. As such, rainfall data was obtained from the CHIRPS model dataset (produced by the Climate Hazards Centre at the university of California - Santa Barbara) to reduce uncertainty. Solar radiation and potential evaporation were calculated using the Penman-Monteith equation and the temperature, relative humidity and windspeed data downloaded from MERRA2.

5.5 Climate Change Predictions

The IPCC is the United Nations body for assessing the science related to climate change. It provides regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation. The IPCC recently released its Sixth Assessment Report (AR6). The AR6 consists of contributions by three Working Groups as follows:

- Working Group I - The Physical Science Basis, released 9 August 2021.
- The Working Group II - Impacts, Adaptation and Vulnerability, released 28 February 2022.
- The Working Group III - Mitigation of Climate Change, released 4 April 2022.

The IPCC assesses and communicates climate change, risks that may arise from potential impacts of climate change as well as human responses to climate change. These risks are assessed taking climatic impact-drivers and low-likelihood, high-impact outcomes into account.

The AR6 considers five new emission scenarios that illustrate climate response to a broader range of GHG, land-use and air pollutant futures. These scenarios start in 2015 and form the basis of climate model projections of changes in the climate system and include:

- Shared Socio-economic Pathway (SSP)1-1.9 and SSP1-2.6 – represents scenarios with very low and low GHG emissions and CO_2 emissions declining to net zero around or after 2050, followed by varying levels of net negative CO_2 emissions.
- SSP2-4.5 – represents CO_2 emissions remaining around current levels until the middle of the century.
- SSP3-7.0 and SSP5-8.5 – represents high and very high GHG emissions, roughly double from current levels by 2100 and 2050.

SSP's are associated with a contribution to global surface temperature. Table 5-1, from the IPCC, 2021: Summary for Policymakers illustrates the predicted changes in global surface temperature for varying timeframes.

Table 5-1: Predicted Global Surface Temperature Changes

Scenario	Near term, 2021–2040		Mid-term, 2041–2060		Long term, 2081–2100	
	Best estimate (°C)	Very likely range (°C)	Best estimate (°C)	Very likely range (°C)	Best estimate (°C)	Very likely range (°C)
SSP1-1.9	1.5	1.2-1.7	1.6	1.2-2	1.4	1-1.8
SSP1-2.6	1.5	1.2-1.8	1.7	1.3-2.2	1.8	1.3-2.4
SSP2-4.5	1.5	1.2-1.8	2	1.6-2.5	2.7	2.1-3.5
SSP3-7.0	1.5	1.2-1.8	2.1	1.7-2.6	3.6	2.8 – 4.6
SSP5-8.5	1.6	1.3-1.9	2.4	1.9-3	4.4	3.3 – 5.7

The IPCC AR6 translates scenario-based climate projections into Global Warming Levels (GWLs) by aggregating the Earth System Models (ESMs) response to GWLs for different scenarios. A key outcome of the assessment is the Working Group I Atlas that allows interrogation of the regional information and responses predicted by the models. The identification of climate change projections was undertaken using the Working Group I Atlas that is based on the sixth phase of the Coupled Model Intercomparison Project (CIMP6).

The World Bank CCKP further provides climate-related information, data, and tools at a country and watershed level to inform regional climatic changes. This information was included in the regional climate projections to inform changes to the country and the watershed that may affect the site.

Both the CIMP6 and the CCKP where used to identify regional predictions while the site-specific predictions where sourced directly from the results of the CIMP6 ESMs.

5.6 Risk Assessment Methodology

Climate change risks identified were assessed in terms of the impact assessment methodology supplied by the ESIA consulting firm, i.e., SRK Consulting. This methodology is detailed in Section 6.3.1 of the ESIA and involves the assessment of impact significance in terms of 3 parts as follows:

- 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.

5.7 Assumptions, Exclusions and Limitations

Monitored data was not used for the generation of the climate baseline due to:

- Missing data records for rainfall and temperature captured by the Gove SASSCAL station;
- Missing data records for all MET parameters from the Matala SASSCAL station; and
- The general and altitudinal distances between both INAMET stations (Dongo and Cuvelai) and the proposed site.

As such, modelled data from MERRA2 (temperature, relative humidity and windspeed) and CHIRPS (rainfall) was downloaded for the baseline. Solar radiation and potential evaporation were calculated using said data via the Penman-Monteith equation. However, since monitored data closer to the proposed site was unavailable, data from MERRA2 and CHIRPS could not be calibrated to specific stations. This, coupled with the fact that modelled data generally performs poorly when predicting extremes, results in a lower level of confidence in the generated baseline and ultimately the preparation of the risk assessment.

The site-specific climate change projections were based on the mean climate change GCM values for the site and are presented in the report without bias correction. As for the modelled data the GCM are climatic models and predicting extremes are a known limitation. Therefore, again confidence in the accuracy of the predictions, if not the trends, is not high.

6 Climate Baseline

6.1 Regional Climate

Angola is located on the southwest coast of sub-Saharan Africa. Bordered by the Democratic Republic of the Congo, Namibia, and Zambia, it is considered to have a tropical to sub-tropical climate. The region is characterised by warm, humid summers (October to mid-May) and mild, dry winters (mid-May to September); climatic conditions are heavily affected by the altitudinal, longitudinal, and oceanic influence (United Nations Development Programme, 2024).

The regional climate is divided into four major zones as follows with the southern and central regions of the country being the driest:

- Dry and semi-desert arid lowlands from the Namibian border to the capital city of Luanda;
- Inland plateaus that culminate into large escarpments (described as mesothermal);
- A dry savanna region to the east and southeast; and
- The northern rainforests (wet and tropical).

Generally, the rainy season runs from September to April in the north and inland plateaus and from November to March in the southern parts of the country. The highest temperatures are experienced during the austral summer (September to April). The lowest temperatures are experienced between July and August (Red Cross Climate Centre, 2021).

6.2 Local Climate

The proposed Cassinga powerline spans roughly 170 km in Cassinga, Huila, Angola with elevations between 1470 and 1600 mamsl. The site lies within the inland plateaus and semi-desert lowlands. The Benguela Current that moves northwest along the Namibian coastline may cause heavy fog in the winter and a precipitation gradient that increases from west to east and south to north along the proposed site (Red Cross Climate Centre, 2021). Modelled and calculated MET parameters mentioned in Section 5.3.3 above are discussed below. As per Section 5.4, the climate baseline has been characterised using four virtual stations along the length of the transmission line given the length of the proposed power line and the anticipated changes in climate from one site to the next.

6.2.1 Temperature and Solar Radiation

Daily minimum, average and maximum temperatures for Jamba and Cuvango are presented in Figure 6-1; those for Chipindo and Gove are presented in Figure 6-2. The average temperature between 2002 and 2023 is presented alongside the minimum, and maximum temperature noted in the period in Table 6-1. It should be noted that the average annual temperature in Jamba, Cuvango, Chipindo and Gove increased by 4.16%, 4.16%, 4.58% and 4.62%, respectively, when comparing 2023's records to 2002's records.

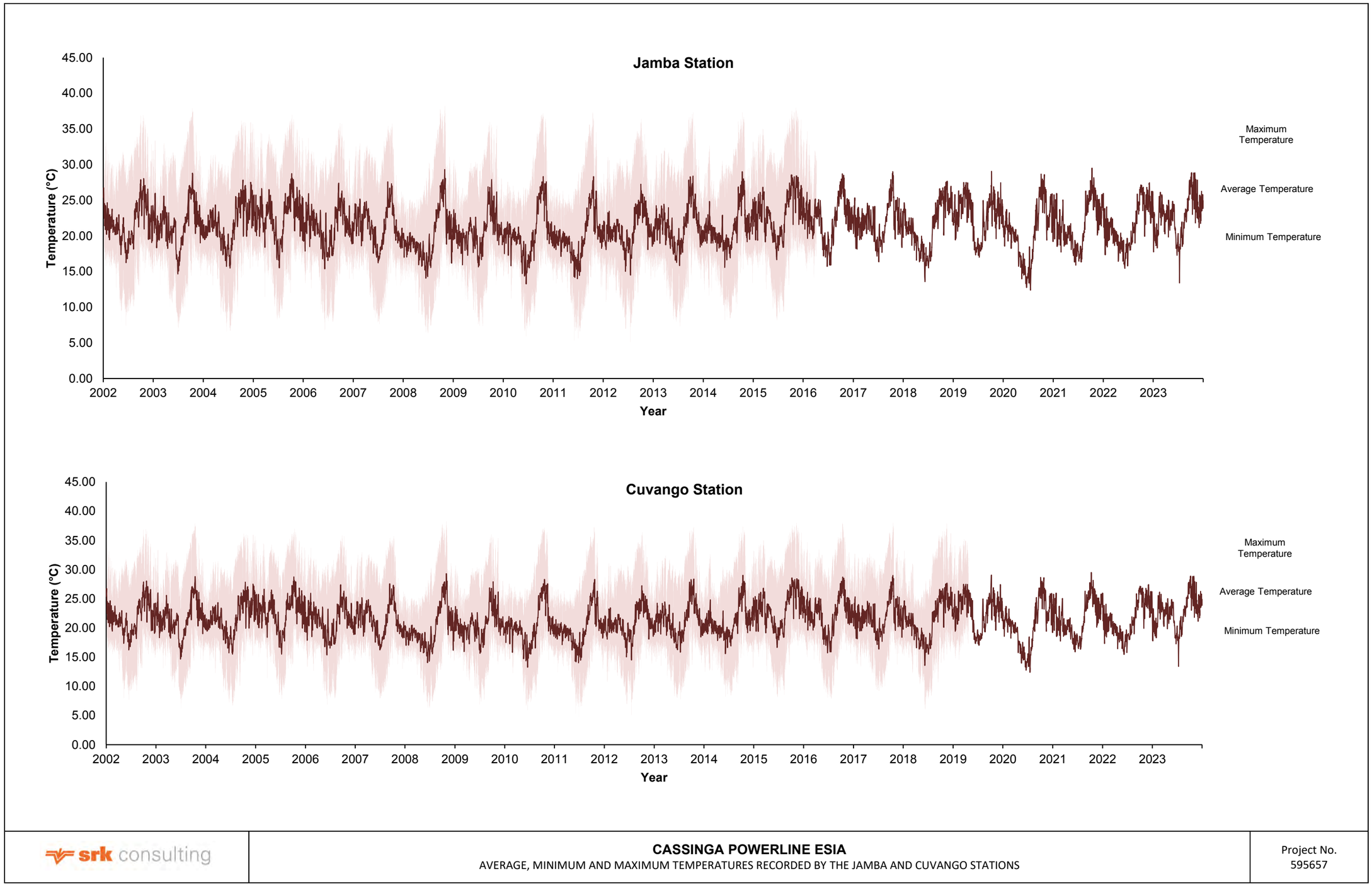


Figure 6-1: Average, Minimum and Maximum Temperatures for Jamba and Cuvango

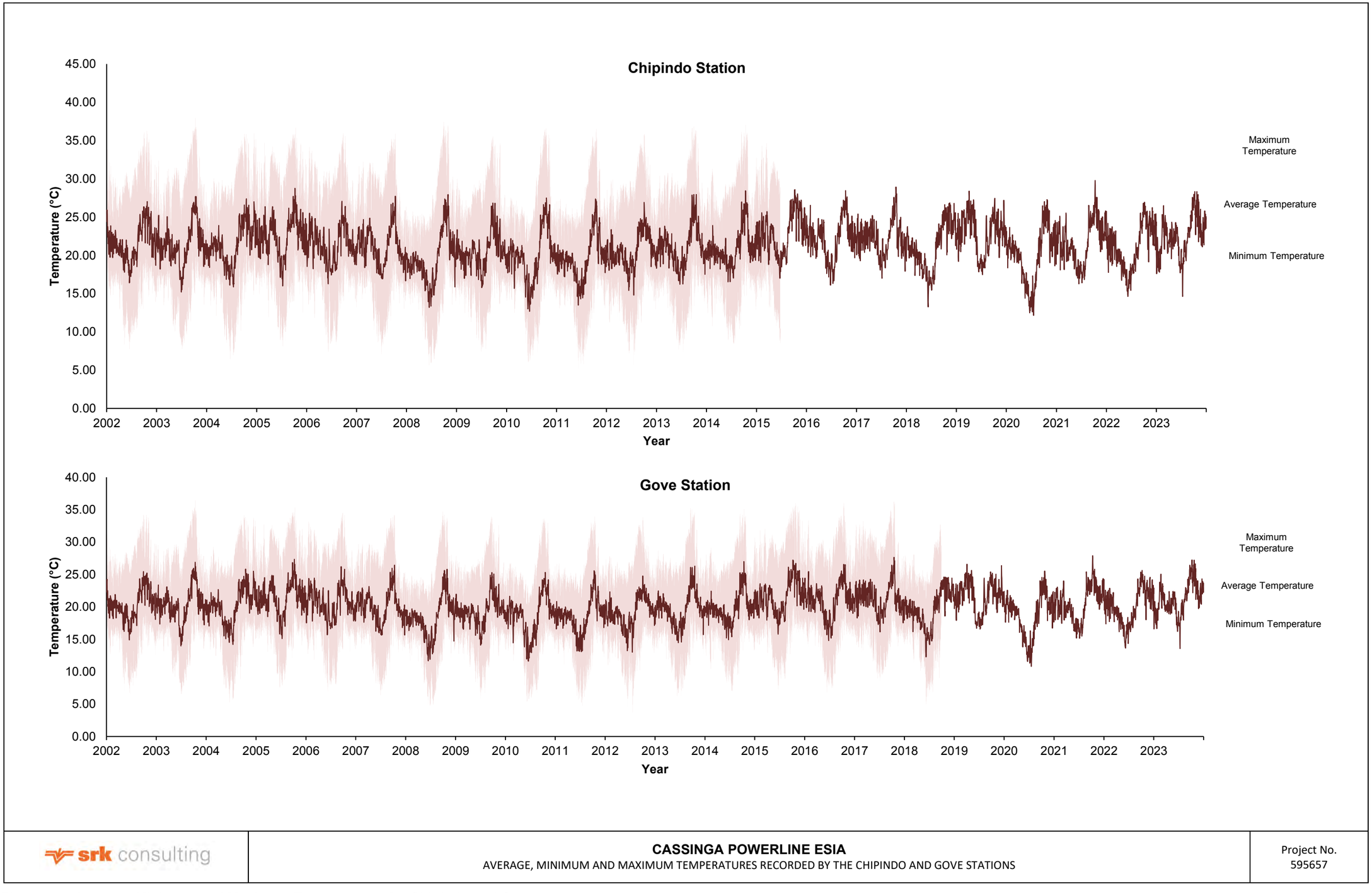


Figure 6-2: Average, Minimum and Maximum Temperatures for Chipindo and Gove

Table 6-1: Average, Minimum and Maximum Temperatures for the Virtual Stations

Station Name	Min. Temp. (°C)	Avg. Temp. (°C)	Max. Temp. (°C)
Jamba	4.14 (July 2023)	21.50	38.23 (October 2008)
Cuvango	4.14 (July 2023)	21.50	38.23 (October 2008)
Chipindo	4.44 (July 2020)	21.31	38.33 (October 2021)
Gove	3.74 (July 2012)	20.10	36.87 (October 2021)

The number of days per year where the maximum temperature exceeds the average monthly maximum temperature for each site is presented in Figure 6-3 and Figure 6-4.

These figures indicate that:

- The highest number of days above the average maximum were recorded in Jamba and Cuvango (43 days above 35.2 °C in 2015);
- The highest average monthly maximum temperature was recorded in Chipindo (35.3 °C);
- Both Jamba and Cuvango experience an average of 18 days above their maximum monthly temperature annually;
- Chipindo experiences an average of 12.1 days above its maximum monthly temperature annually; and
- Gove experiences an average of 11 days above its maximum monthly temperature annually.

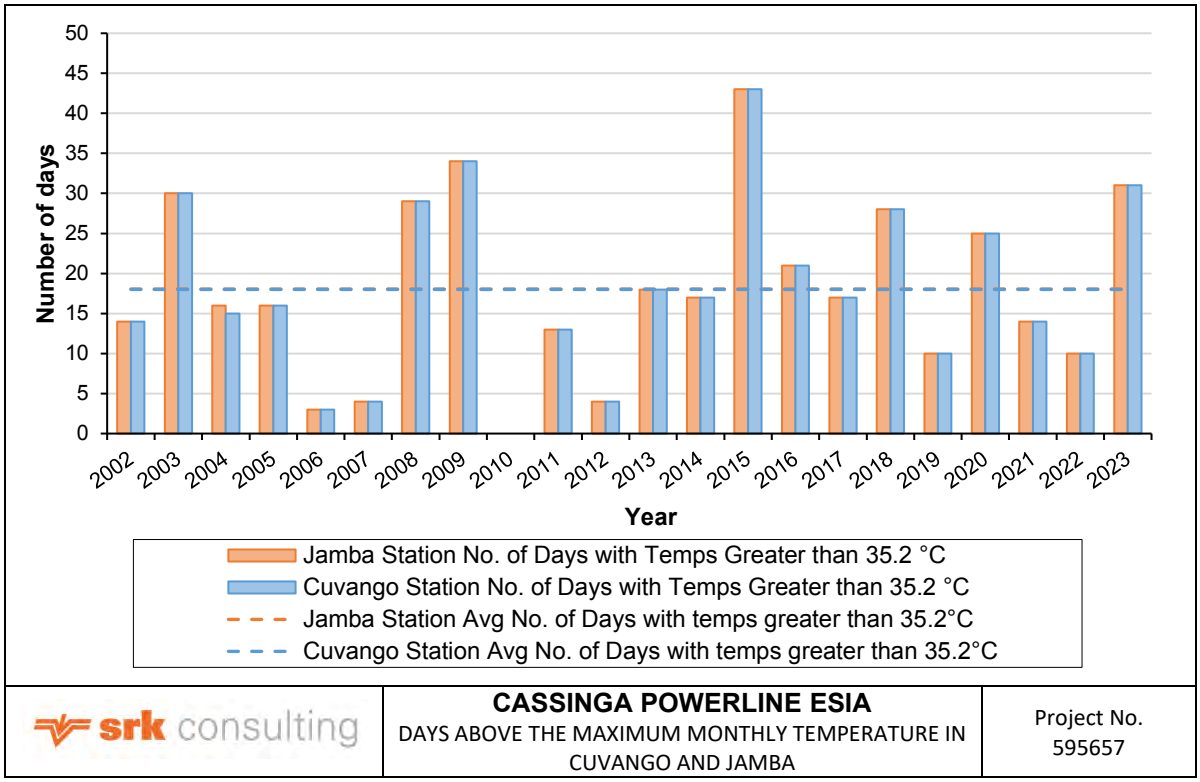


Figure 6-3: Days Above the Average Monthly Maximum Temperature in Jamba and Cuvango

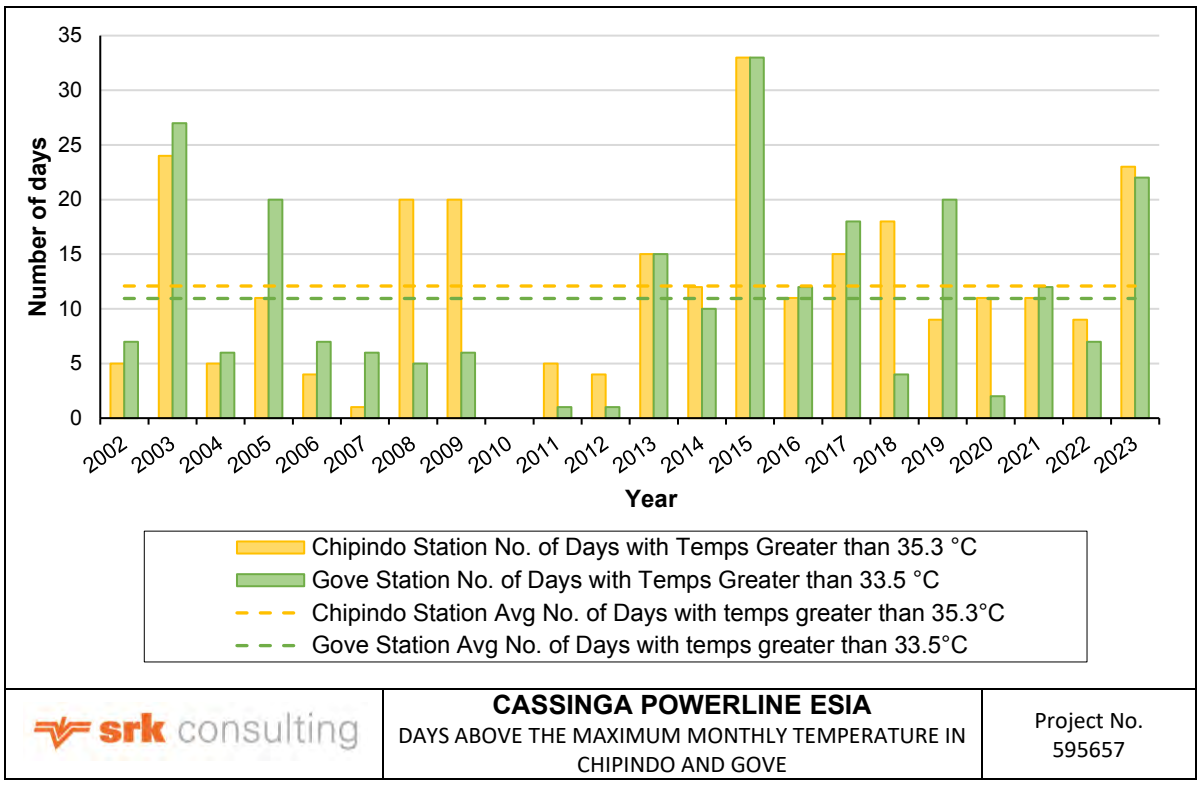


Figure 6-4: Days Above the Average Monthly Maximum Temperature in Chipindo and Gove

A heatwave is defined as a period of prolonged high surface temperatures relative to the average temperatures experienced. As such, heatwaves can be classified as a period greater than five consecutive days where the maximum daily temperature exceeds the average maximum temperature by 5 °C. Figure 6-5 and Figure 6-6 present the total number of heatwaves experienced between 2002 and 2023 in Cuvango and Jamba and Chipindo and Gove, respectively.

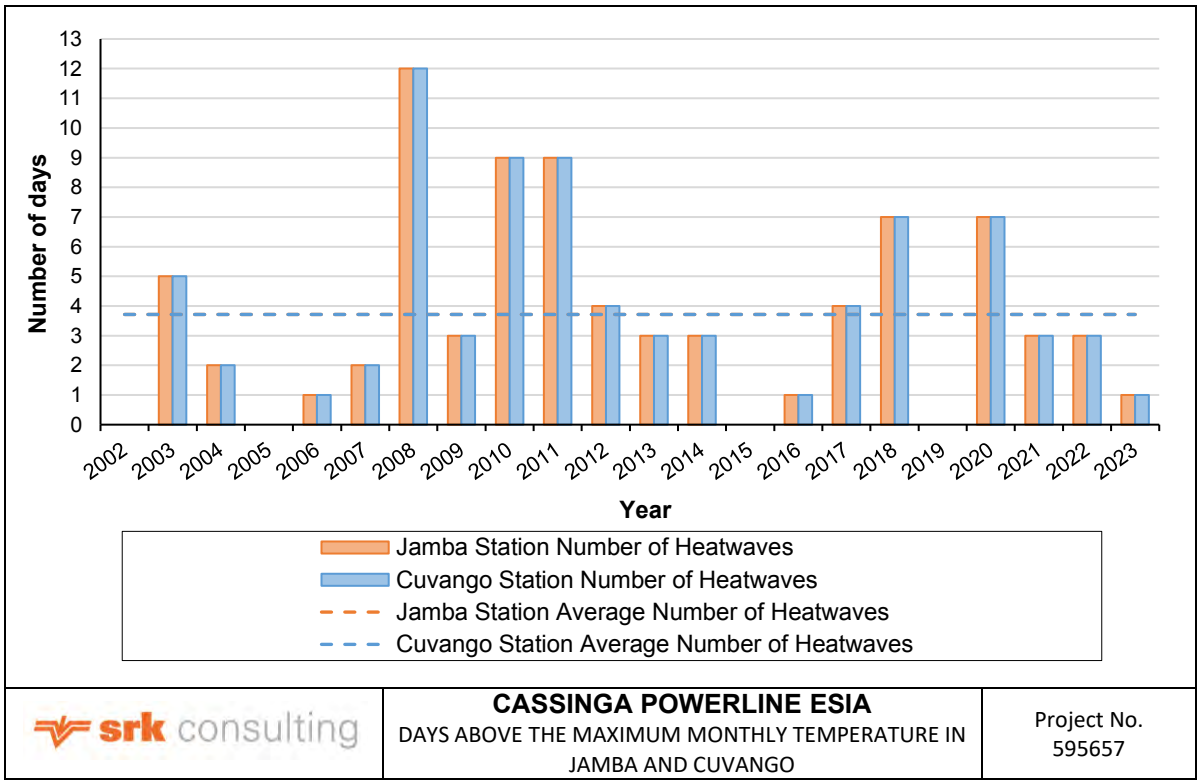


Figure 6-5: Heatwaves Experienced in Jamba and Cuvango

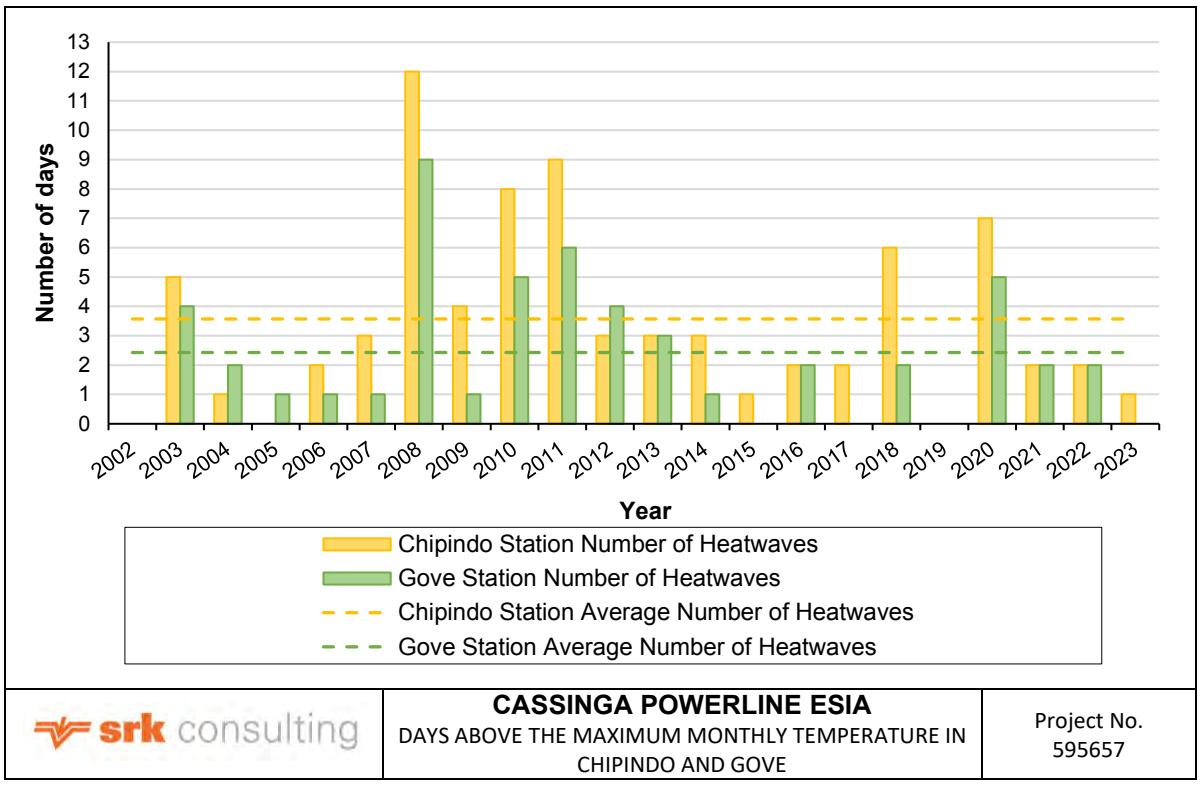


Figure 6-6: Heatwaves Experienced in Chipindo and Gove

No frost days (days with sub-zero temperatures) were observed at any of the virtual stations. As a result, the number of days with temperatures below 5°C was used as a proxy. Days with temperatures below 5 °C in Jamba and Cuvango are presented in Figure 6-7 alongside those for Chipindo and Gove in Figure 6-8. The highest number of days below 5 °C (65 days) were recorded in Jamba and Cuvango in 2020.

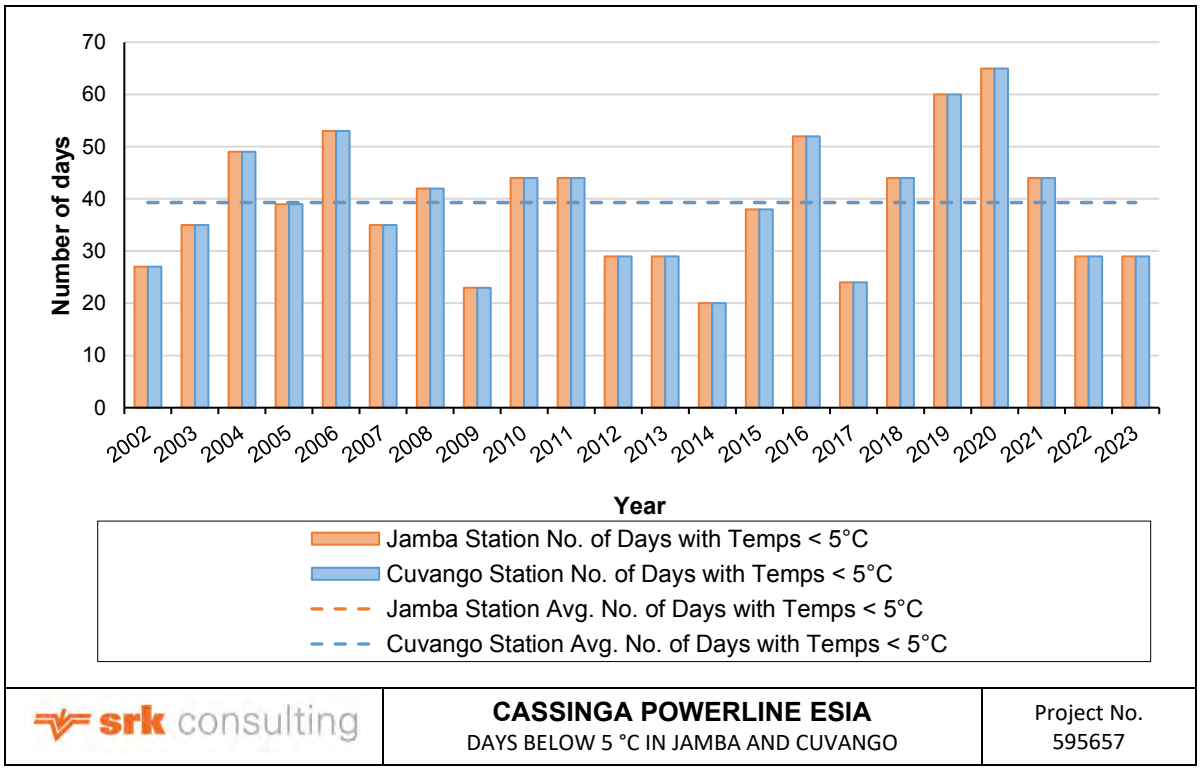


Figure 6-7: Days Below 5 °C in Jamba and Cuvango

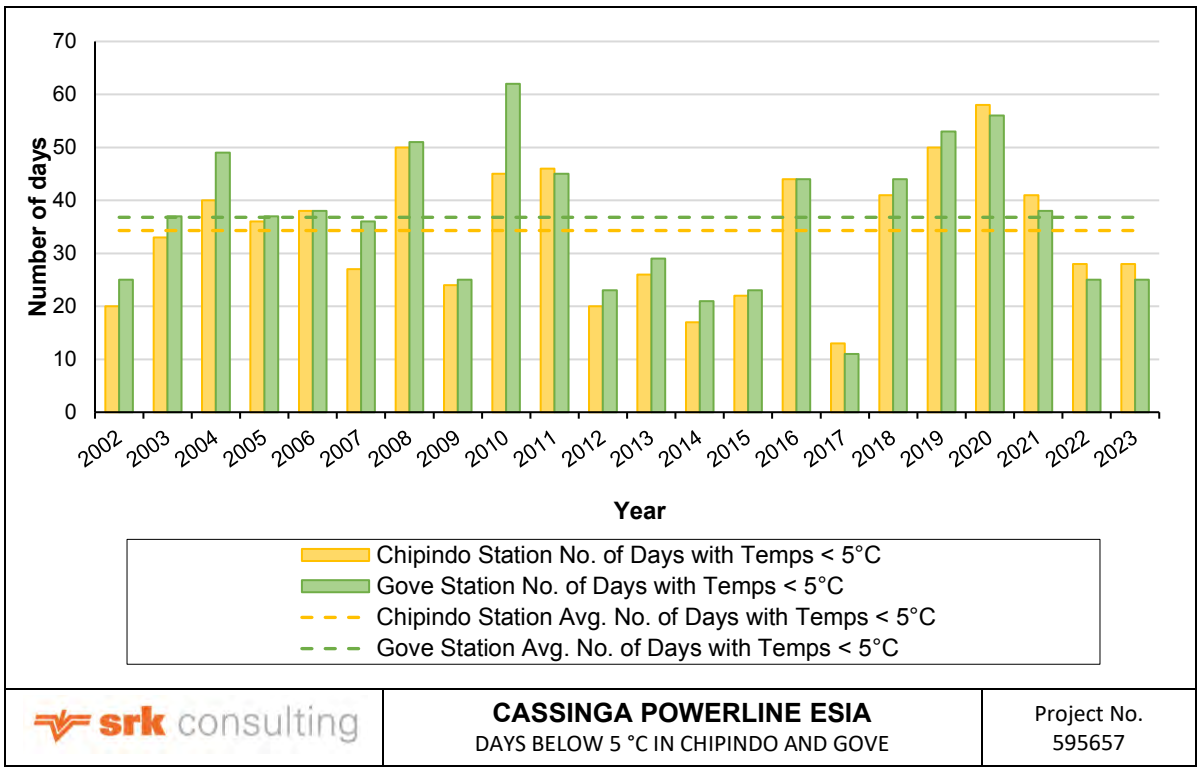


Figure 6-8: Days Below 5 °C in Chipindo and Gove

Net radiation, Rn, was approximated as per the equations set out in FAO 56 (the FAO Penman-Monteith method). The cumulative calculated annual radiation and average monthly solar irradiance across all four virtual sites are presented in Figure 6-9.

As per Figure 6-9, the highest average monthly solar irradiances recorded are:

- 24.0 kWh/m^2/day in Jamba (September);
- 24.2 kWh/m^2/day in Cuvango (September);
- 24.1 kWh/m^2/day in Chipindo (September; and
- 23.6 kWh/m^2/day in Gove (September).

All virtual sites recorded monthly solar irradiances above the average between August and February, irradiance eventually reaching a peak in September. Furthermore, solar irradiances across all sites are below average between March and July. Although the highest cumulative solar irradiance for the baseline period was recorded in Chipindo in 2015, all virtual sites experienced their maximum cumulative irradiance in 2015. Average cumulative annual solar irradiances are:

- 7 527.94 kWh/m^2/day in Jamba;
- 7 551.05 kWh/m^2/day in Cuvango;
- 7 535.10 kWh/m^2/day in Chipindo; and
- 7 342.22 kWh/m^2/day in Gove.

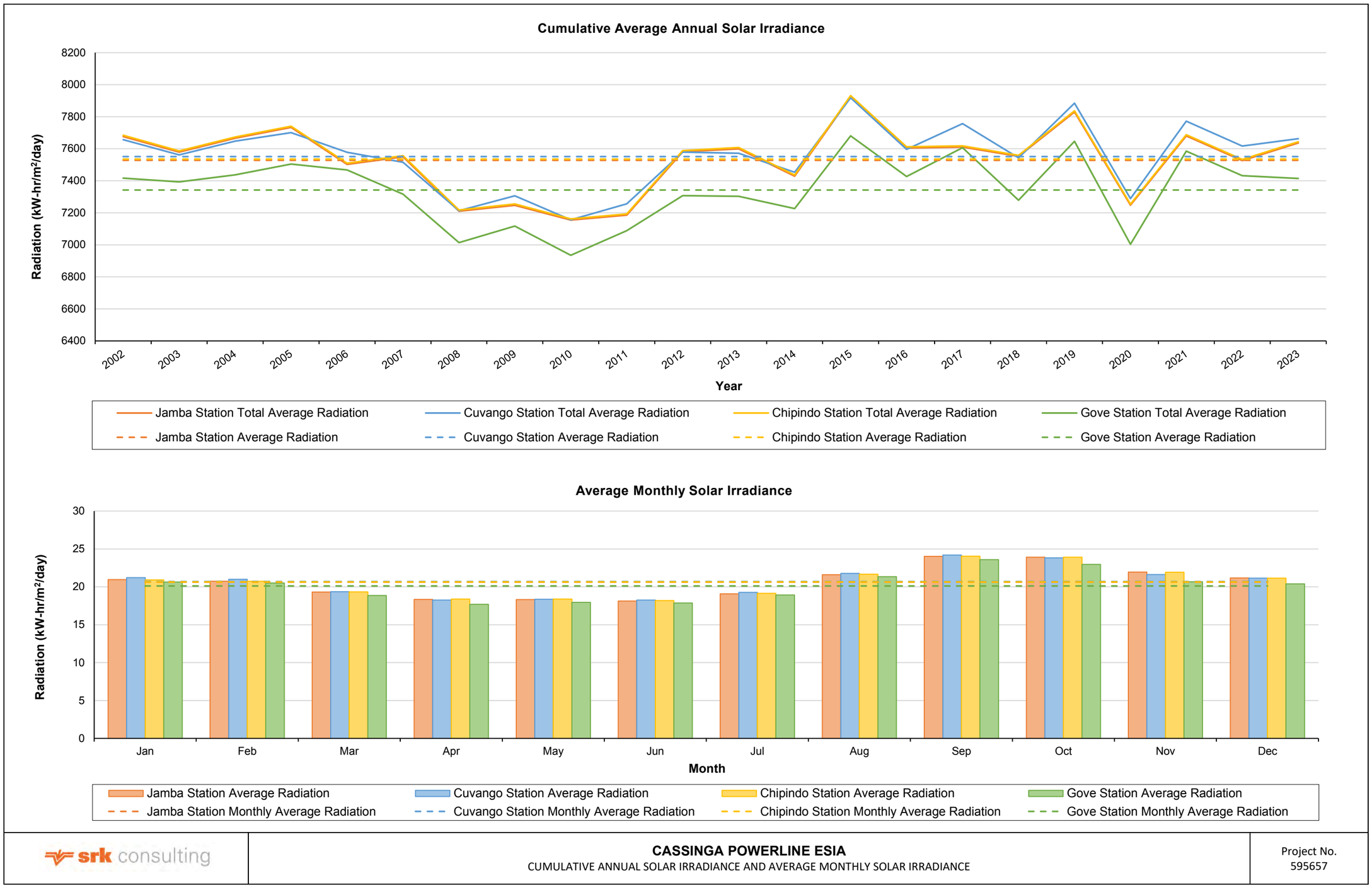


Figure 6-9: Cumulative Average Solar Irradiance and Average Monthly Solar Irradiance

6.2.2 Rainfall

The total annual rainfall in Jamba and Cuvango is presented in Figure 6-10 with annual rainfall in Chipindo and Gove following in Figure 6-11. Average annual rainfalls (indicated by the dashed lines) are approximately 936 mm (Jamba), 904 mm (Cuvango), 1092 mm (Chipindo) and 1060 mm (Gove). The lowest amount of rainfall (564.75 mm) was recorded in 2021 in Cuvango whilst the most rainfall (1362.46 mm) was recorded in 2003 in Chipindo. Since the cumulative annual rainfall measurements never exceeded 1400 mm, extremely high levels of precipitation (>2400 mm) in future are unlikely. It is noted, however, that the baseline is based on modelled rather than monitored data, and modelled data is generally poor at predicting extremes. Therefore, high annual rainfall may not reach extreme highs but short-term high rainfall, resulting in flooding. This should be confirmed through onsite monitoring.

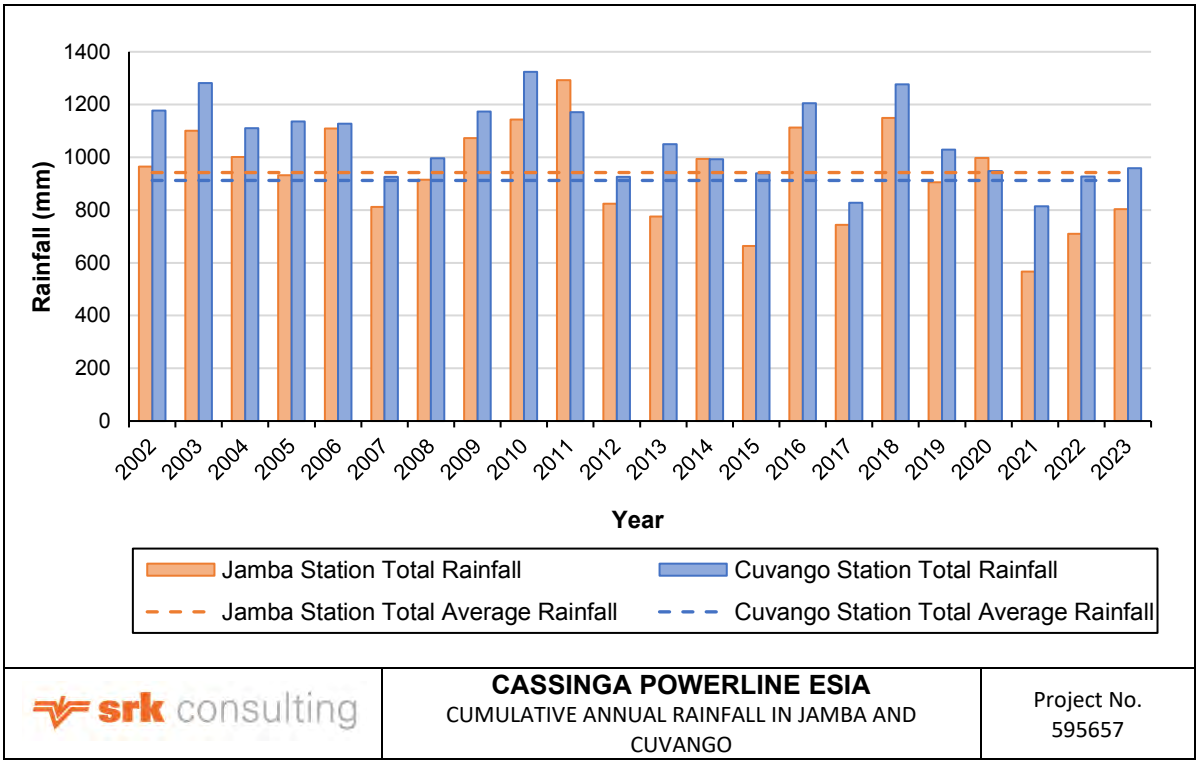


Figure 6-10: Cumulative Annual Rainfall in Jamba and Cuvango

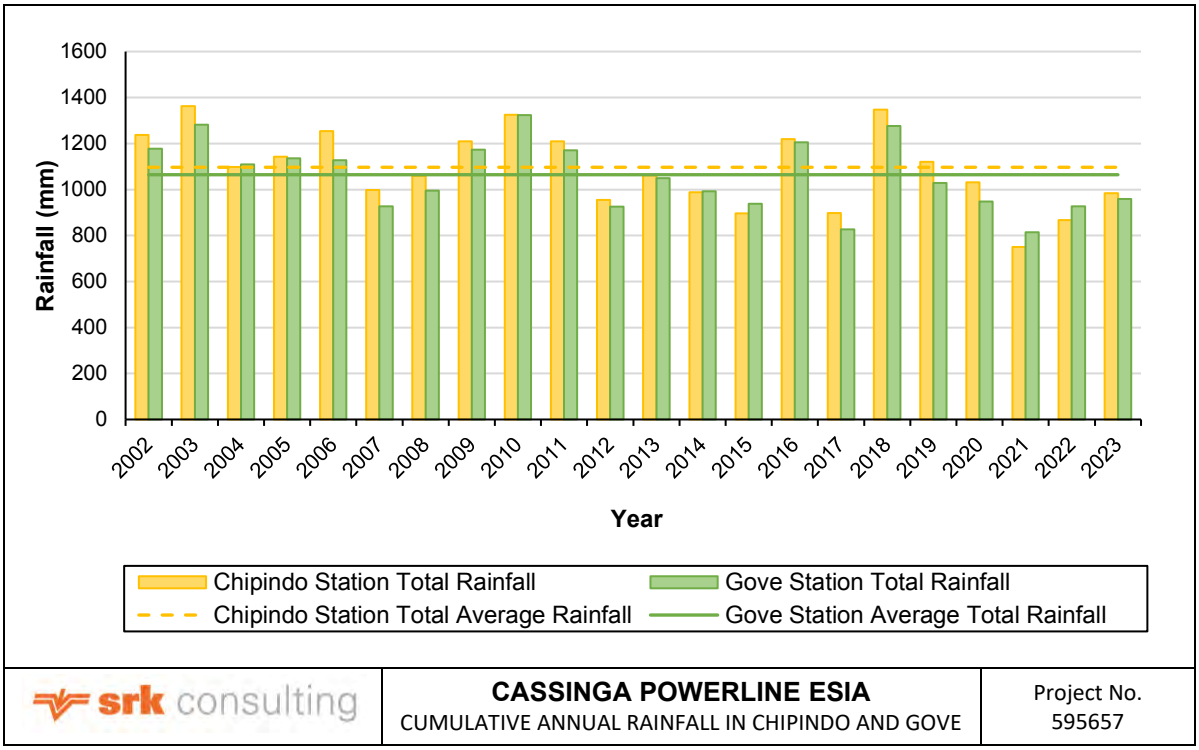


Figure 6-11: Cumulative Annual Rainfall in Chipindo and Gove

Comparing 2023's cumulative rainfall to 2002's cumulative rainfall across all virtual sites indicates that rainfall decreased by:

- 17% in Jamba;
- 19% in Cuvango and Gove; and
- 21% in Chipindo.

Furthermore, years below the average site-specific cumulative average rainfall are:

- 2005, 2007, 2008, 2012, 2013, 2015, 2017, 2019, 2021, 2022 and 2023 in Jamba (50% of the dataset);
- 2007, 2008, 2012, 2013, 2015, 2017, 2019, 2020, 2021, 2022 and 2023 in Cuvango (50% of the dataset);
- 2007, 2008, 2012, 2013, 2014, 2015, 2017, 2020, 2021, 2022 and 2023 in Chipindo (50% of the dataset); and
- 2007, 2008, 2012, 2013, 2014, 2015, 2017, 2019, 2020, 2021, 2022 and 2023 in Gove (55% of the dataset).

All sites along the proposed transmission line pathway thus experienced rainfall below the average for at least half the years in the dataset. Furthermore, all sites experienced below average rainfall in the last three years (2021 – 2023).

The number of rain event days per year in Jamba and Cuvango are presented in Figure 6-12 with the number of rain events in Chipindo and Gove following in Figure 6-13. The average number of rainfall days that can be expected are:

- 99 in Jamba;
- 101 in Cuvango; and
- 112 in Chipindo and Gove.

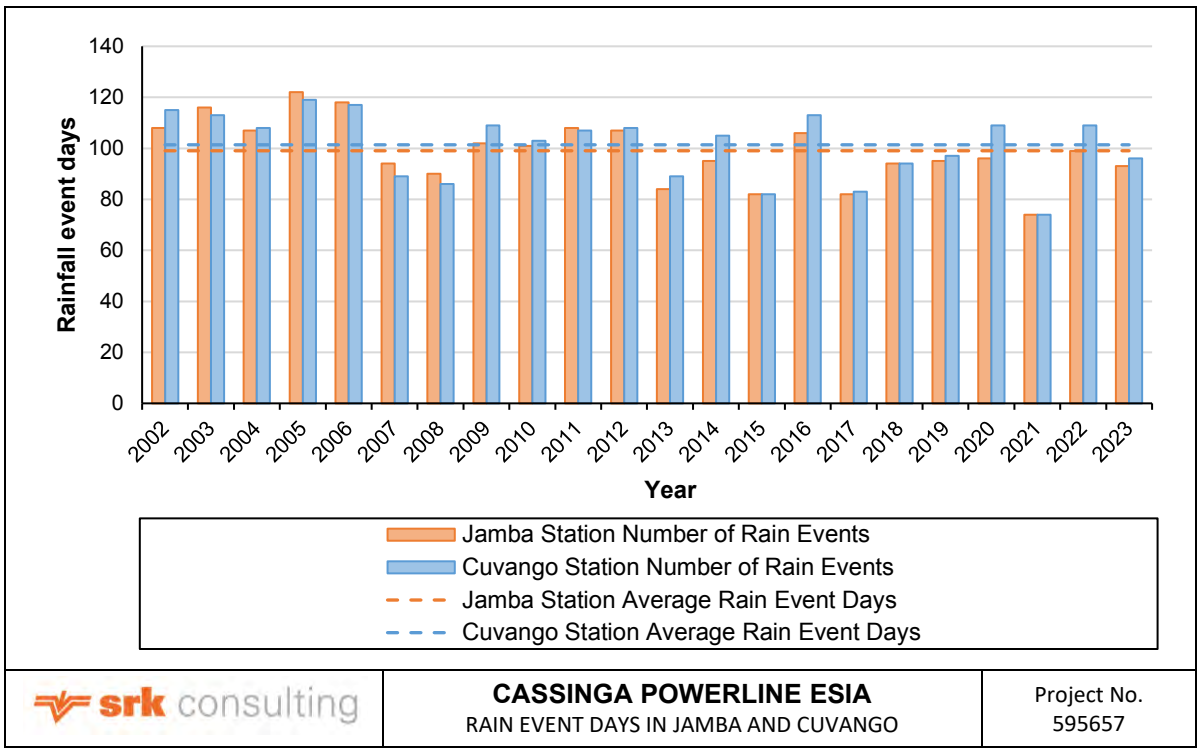


Figure 6-12: Number of Rain Event Days in Jamba and Cuvango

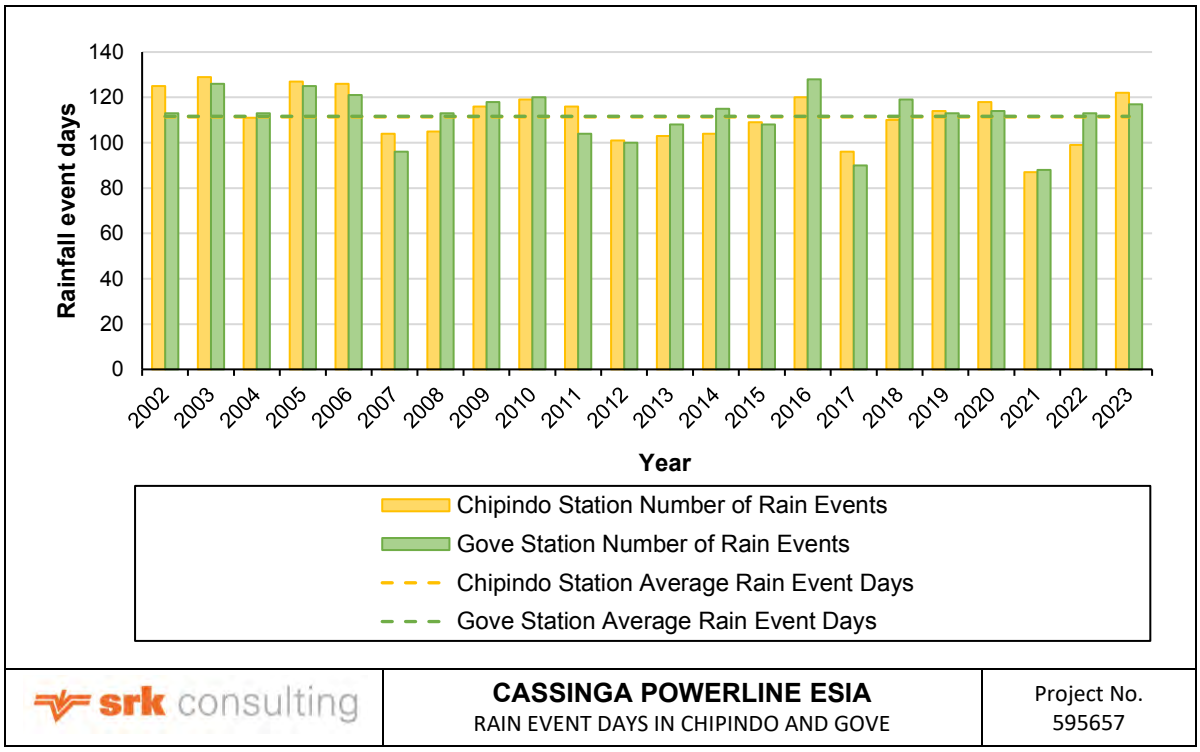


Figure 6-13: Number of Rain Event Days in Chipindo and Gove

The only years recording rainfall events >10 days below the average are:

- 2013, 2015, 2017 and 2021 in Jamba;
- 2007, 2008, 2013, 2015, 2017 and 2021 in Cuvango;
- 2012, 2017, 2021 and 2022 in Chipindo; and
- 2007, 2012, 2017 and 2021 in Gove.

As such, at least 18% of the baseline period had rainfall events >10 days below the average, Cuvango having the most years with >10 days below the average rainfall events.

The cumulative average monthly rainfall for the baseline period across all virtual sites is presented in Figure 6-14. Monthly average rainfall ranges from:

- 0 mm (July) to 199.6 mm (March) in Jamba;
- 0 mm (July) to 187.8 mm (January) in Cuvango;
- 0 mm (July) to 216.5 mm (December) in Chipindo; and
- 0 mm (July) to 208.6 mm (December) in Gove.

Furthermore:

- 99% of the rainfall in Jamba falls between October and April;
- 99.5% of the rainfall in Cuvango falls between October and April;
- 99.8% of the rainfall in Chipindo falls between October and April; and
- 98.8% of the rainfall in Gove falls between October and April.

As such, the rainy season across all sites lasts between October and April (late-Spring to mid-Autumn), the dry season following between May and September (late-Autumn to mid-Spring). No rain is to be expected in July as per the monthly minimums listed above.

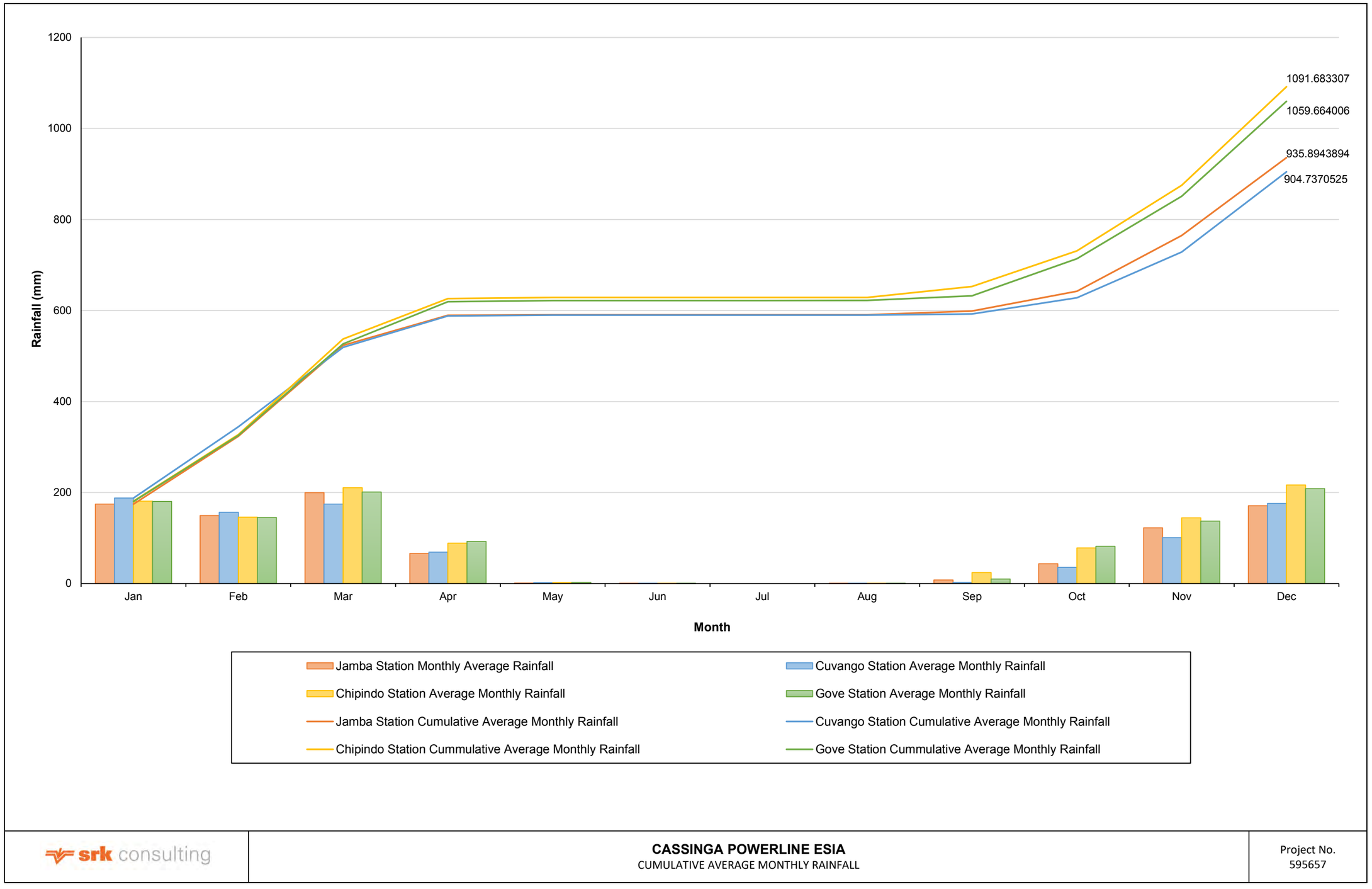


Figure 6-14: Cumulative Average Monthly Average Rainfall

Annual projected precipitation anomalies (heat maps) illustrating changes in rainfall from 2002 are presented in Figure 6-15 (Jamba), Figure 6-16 (Cuvango), Figure 6-17 (Chipindo) and Figure 6-18 (Gove).

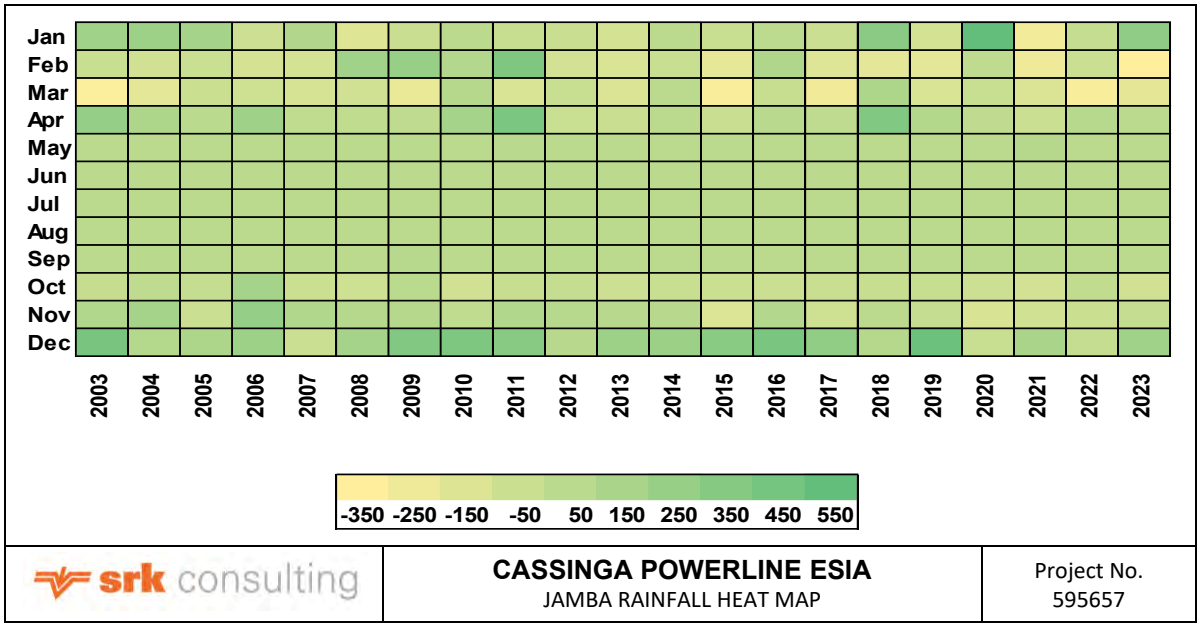


Figure 6-15: Jamba Rainfall Heat Map

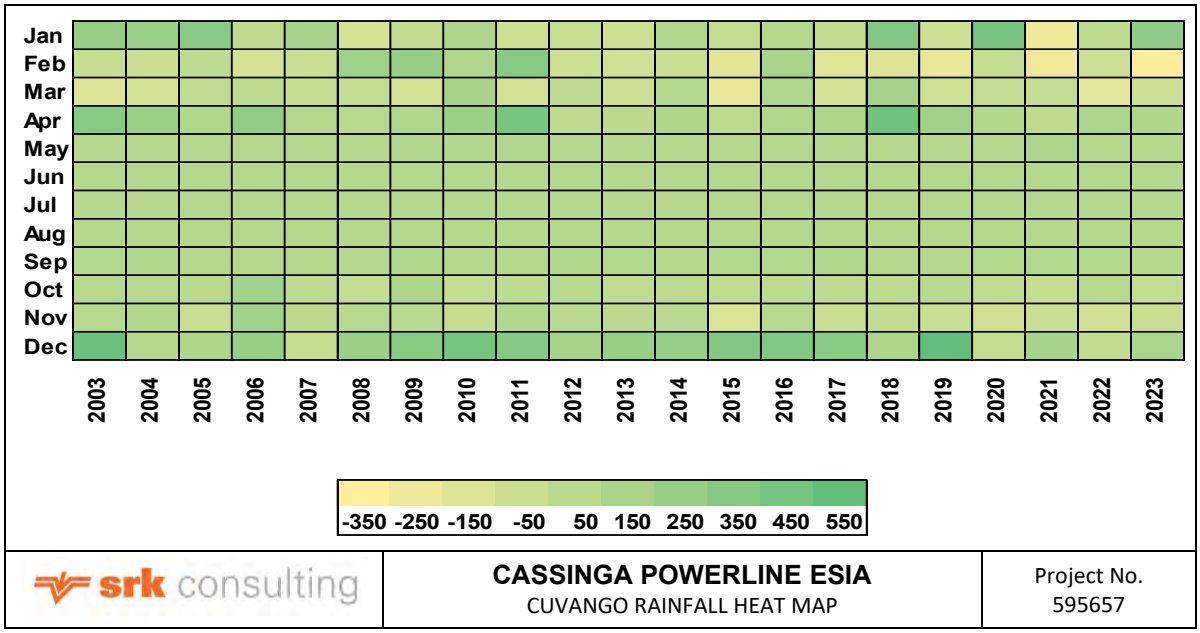


Figure 6-16: Cuvango Rainfall Heat Map

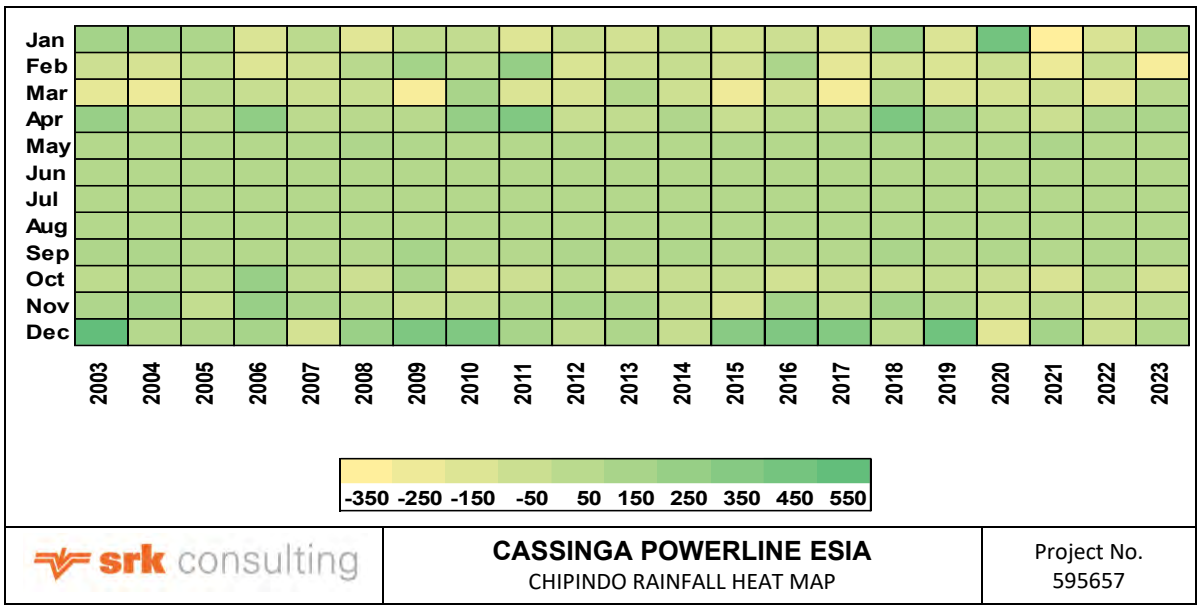


Figure 6-17: Chipindo Rainfall Heat Map

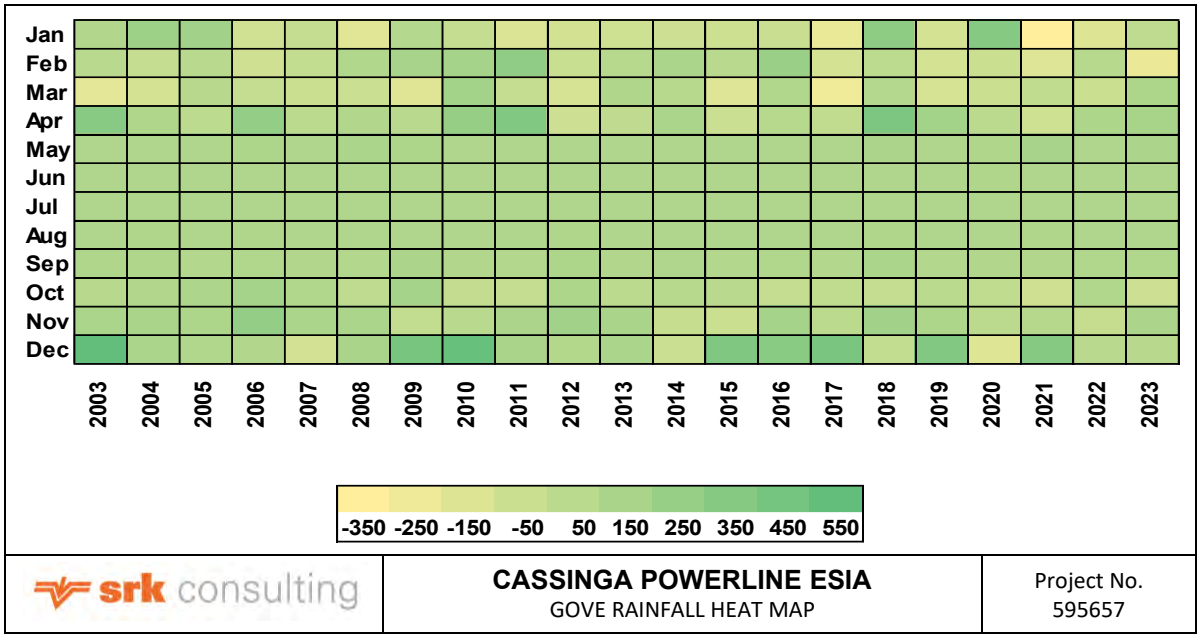


Figure 6-18: Gove Rainfall Heat Map

All heat maps provided above illustrate the decrease in rainfall across the baseline period. Although October – April is considered the rainy season as per Figure 6-14, rainfall has decreased substantially between December and March in the last three years (2021 – 2023). This is particularly evident in the southern portion of the proposed site (Jamba and Cuvango) as per the >350mm decrease in rainfall in February 2023. Rainfall between May and September (the dry season) remained constant across the baseline period regardless of the virtual site. As such, the decrease in rainfall between December and March may lead to a prolonged dry period in future, possibly resulting in droughts.

6.2.3 Relative Humidity

Humidity governs the increasing likelihood of heavier rainfall and more dangerous heatwaves. Average annual relative humidities for Jamba and Cuvango are presented in Figure 6-19; average annual humidities for Chipindo and Gove following in Figure 6-20. As per Figure 6-19 and Figure 6-20, relative humidity never falls below 40% — A minimum of 41.31% recorded in 2015 in Jamba and Cuvango with a maximum of 71.41% recorded in 2020 in Gove. An overall average annual relative humidity of

>50% is noted across all sites and relative humidity increases as the transmission line path moves north towards Gove. Overall average relative humidities recorded by the virtual stations are:

- 51.19% in Jamba and Cuvango;
- 54.68% in Chipindo; and
- 59.29% in Gove.

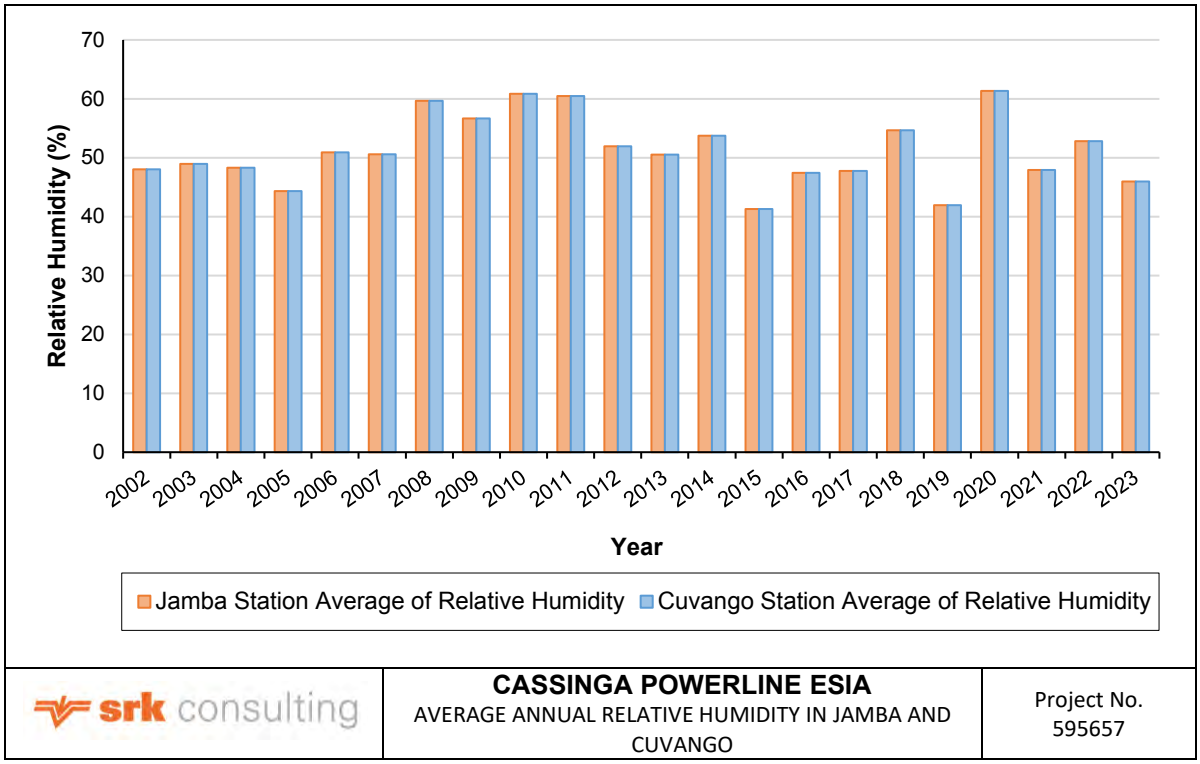


Figure 6-19: Average Annual Relative Humidity in Jamba and Cuvango

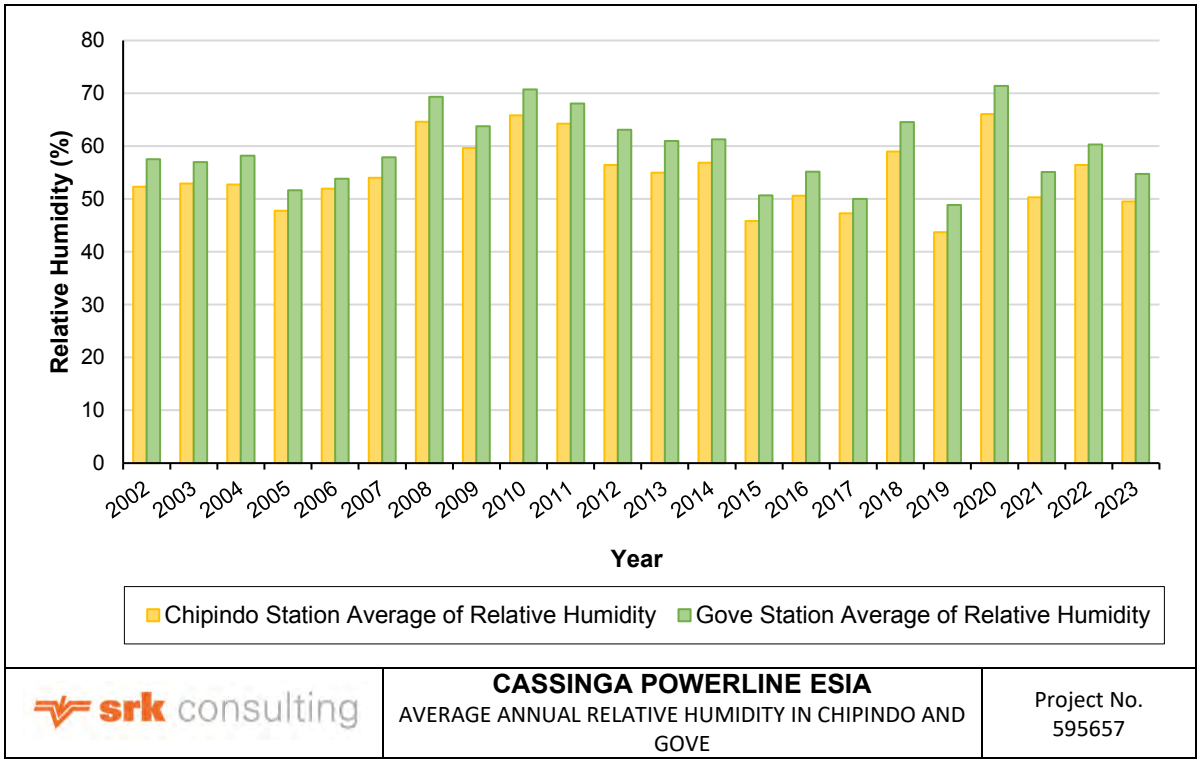


Figure 6-20: Average Annual Relative Humidity in Chipindo and Gove

Figure 6-21 reports the average monthly relative humidities. Humidity fluctuates between:

- 23.8% (August) and 73.2% (March) in Jamba and Cuvango;
- 28.4% (August) and 74.4% (March) in Chipindo; and
- 34.6% (August) and 76.7% (March) in Gove.

Monthly relative humidities recorded between May and October fall below the average monthly relative humidities (indicated by the dashed lines) at all virtual sites. Furthermore, humidity reaches its minimum in August and its maximum in March for all stations.

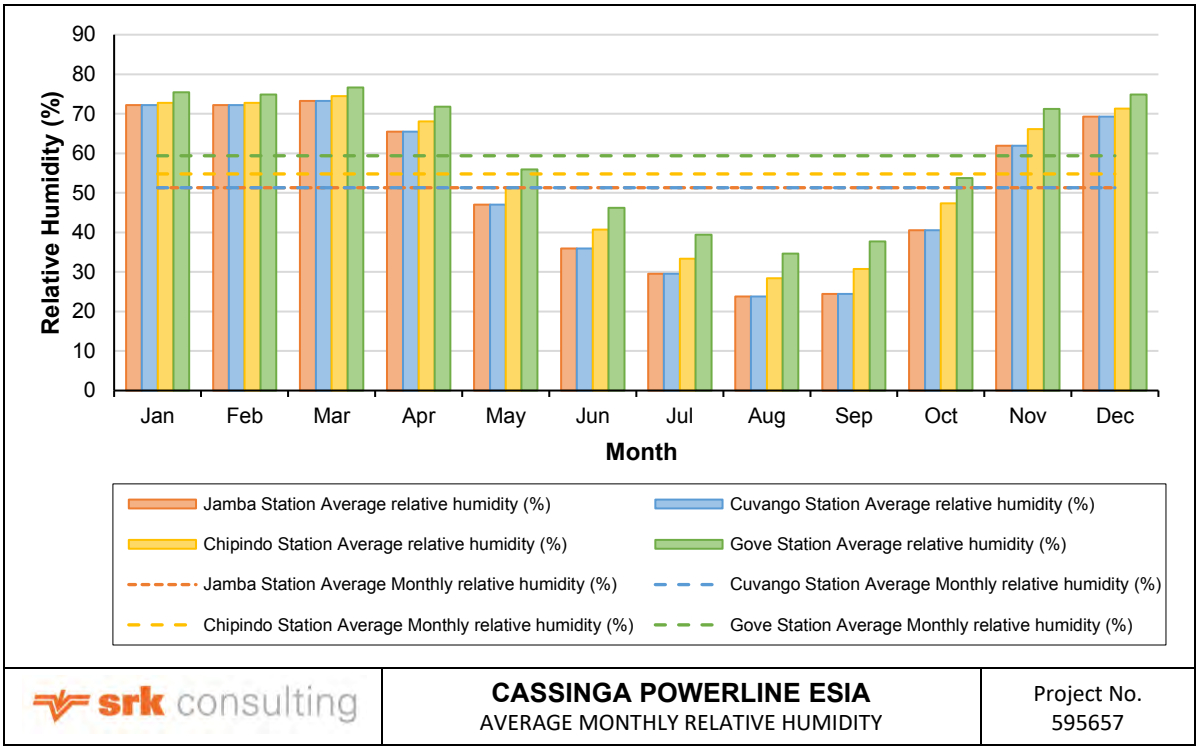


Figure 6-21: Average Monthly Relative Humidity

6.2.4 Evaporation

Actual evapotranspiration is dependent on vegetation to some extent but more so the hydraulics of the soil than the atmospheric demand. Evaporation for this dataset was calculated using Penman-Monteith estimates based on the temperature, solar radiation and humidity data presented above, as well as the windspeed data reported in Section 0. It therefore represents potential evapotranspiration (PET) and not actual evapotranspiration. Average annual PETs for Jamba) and Cuvango are presented in Figure 6-22. PETs for Chipindo and Gove follow in Figure 6-23.

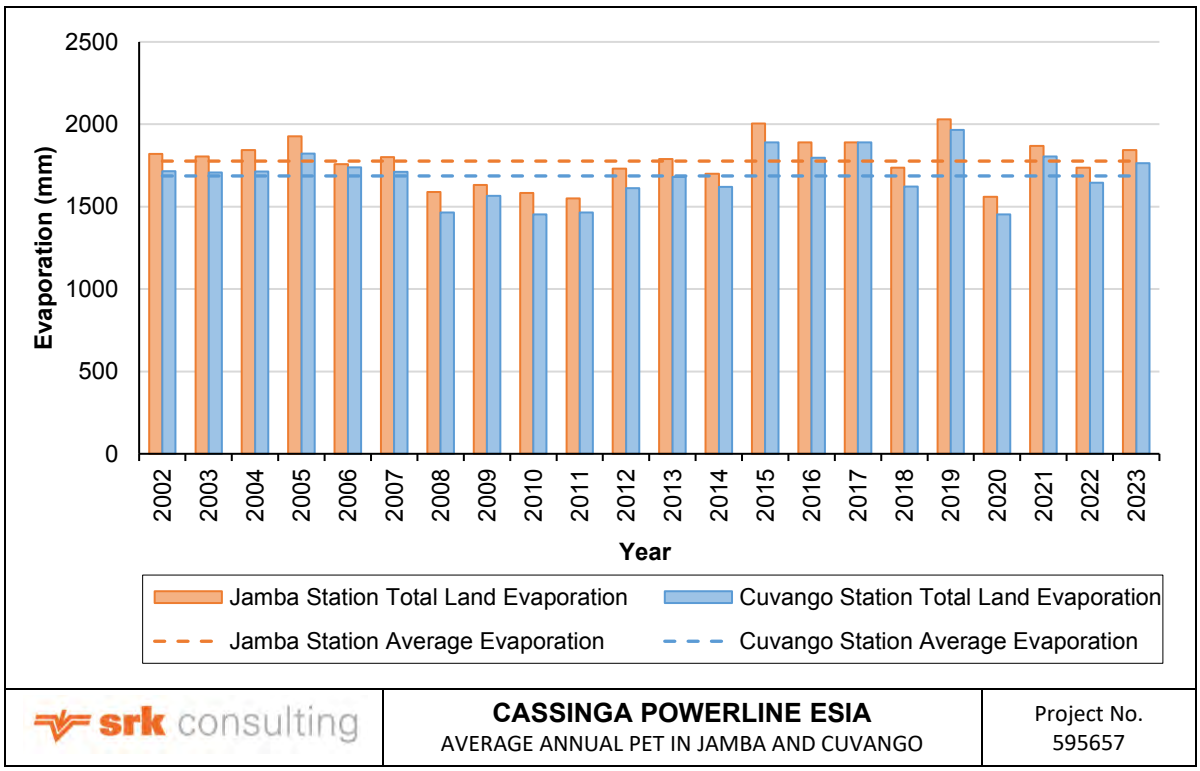


Figure 6-22: Average Annual PET in Jamba and Cuvango

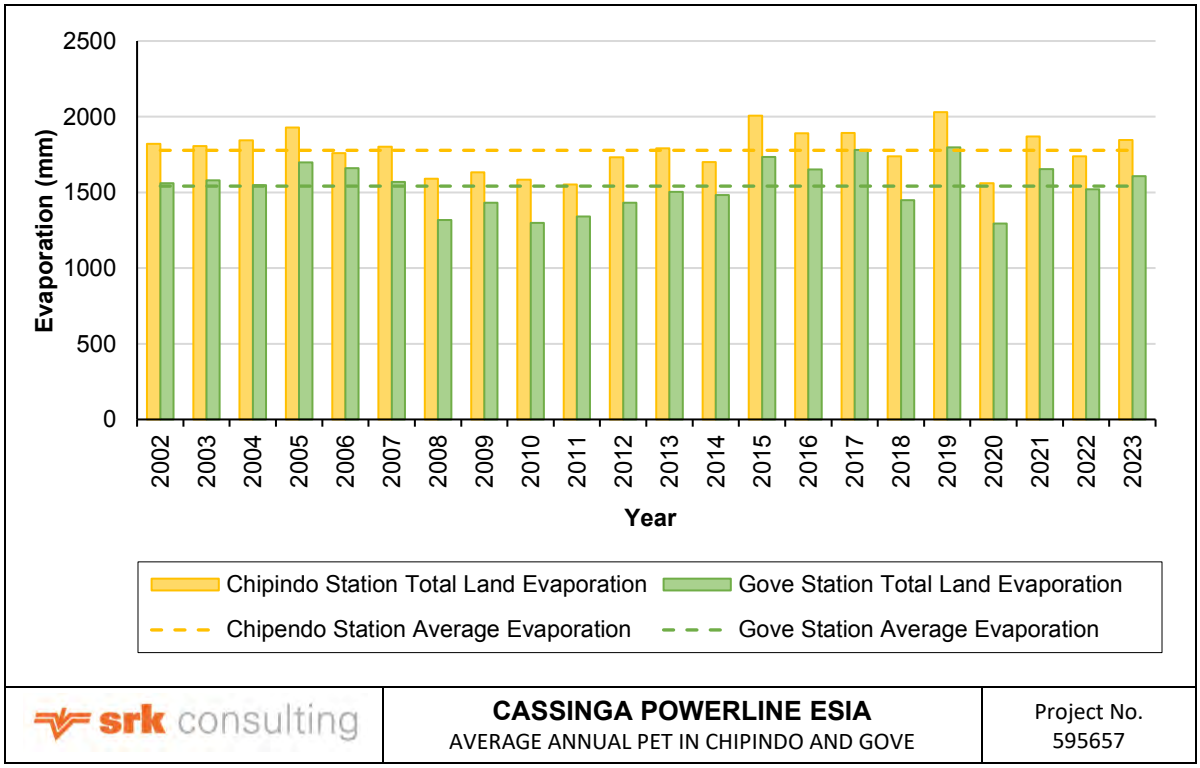


Figure 6-23: Average Annual PET in Chipindo and Gove

Average annual PETs of 1777 mm, 1687 mm, 1778 mm, and 1541 mm are recorded for Jamba, Cuvango, Chipindo and Gove, respectively. The maximum and minimum PET experienced across the baseline period are presented in Table 6-2 alongside their occurrence year. All stations recorded their maximum PET in 2019.

Table 6-2: Maximum and Minimum Evaporations Recorded by the Virtual Stations

Station Name	Minimum Evaporation (mm)	Maximum Evaporation (mm)
Jamba	1 550.88 (2011)	2 029.45 (2019)
Cuvango	1 453.08 (2020)	1 966.74 (2019)
Chipindo	1 551.89 (2011)	2 030.89 (2019)
Gove	1 294.34 (2020)	1 796.83 (2019)

Monthly PETs are presented in Figure 6-24. PET increases drastically during the dry season (May to September) reaching its peak in September. All monthly PETs calculated exceed the average monthly PETs between July and October. Increased PET rates coincide with the minimal monthly rainfall and below average relative humidities presented in Figure 6-14 and Figure 6-21, respectively.

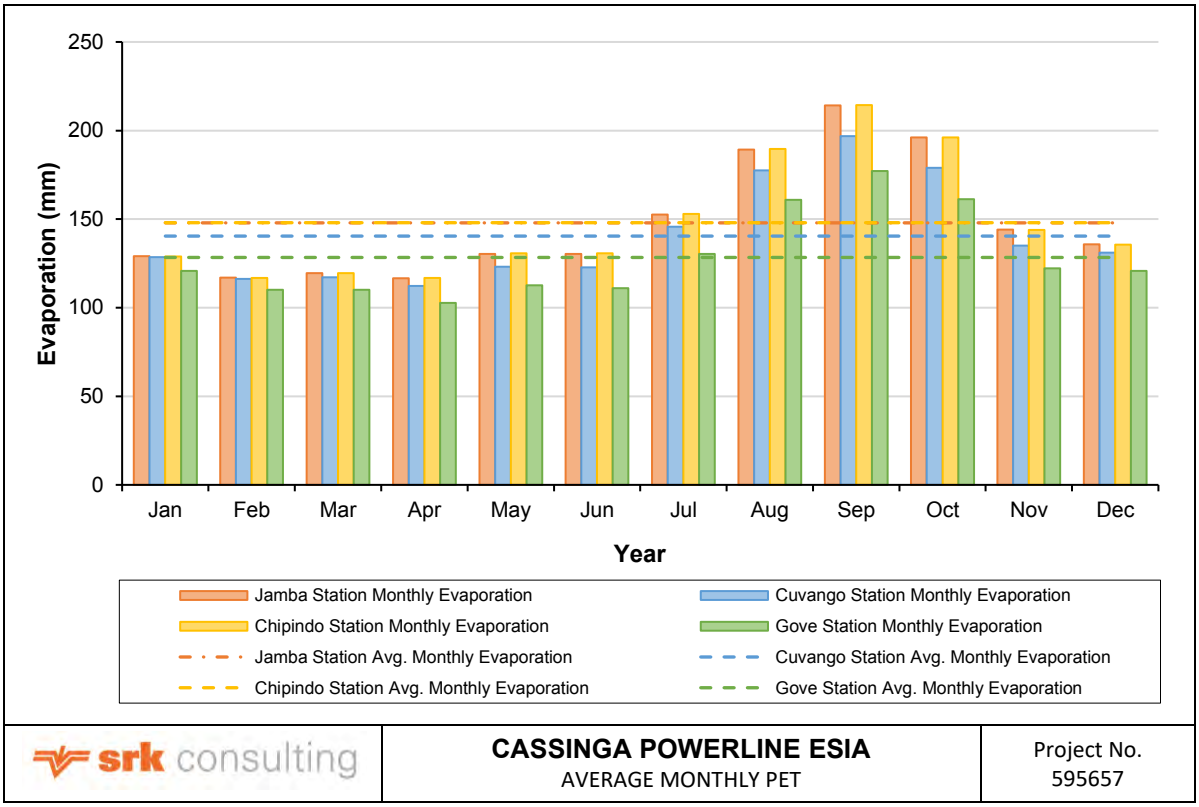


Figure 6-24: Average Monthly PET

Average, minimum and maximum monthly PETs are presented in Table 6-3. Minimum and maximum PETs calculated occur in April and September, respectively, across all sites.

Table 6-3: Average, Minimum and Maximum Monthly PET

Station Name	Min. Evap. (mm)	Avg. Evap. (mm)	Max. Evap. (mm)
Jamba	116.57 (April)	147.89	214.19 (September)
Cuvango	112.28 (April)	140.43	196.80 (September)
Chipindo	116.76 (April)	147.99	214.40 (September)
Gove	102.80 (April)	128.36	177.17 (September)

6.2.5 Windspeed

Windspeeds greater than 5.7 m/s are considered high windspeeds. Average monthly windspeeds fluctuate between:

- 1.84 m/s (November) and 2.72 m/s (September) in Jamba and Cuvango;
- 1.66 m/s (November) and 2.39 m/s (September) in Chipindo; and
- 1.65 m/s (November) and 2.29 m/s (September) in Gove.

Based on the wind class diagram for the four virtual sites (Figure 6-25), windspeeds exceeding 5.7 m/s are not likely to occur onsite. This is also indicated by the fact the only 1 day with windspeeds exceeding the upper limit was recorded across all virtual sites over the entire baseline period (1 day reported in 2008 for Cuvango and Jamba - Figure 6-26). It is noted, however, that the baseline is based on modelled rather than monitored data, and modelled data is generally poor at predicting extremes. That said, the low occurrence of windspeeds above 5.7 m/s indicates wind damage as unlikely. This prediction should be confirmed through onsite monitoring.

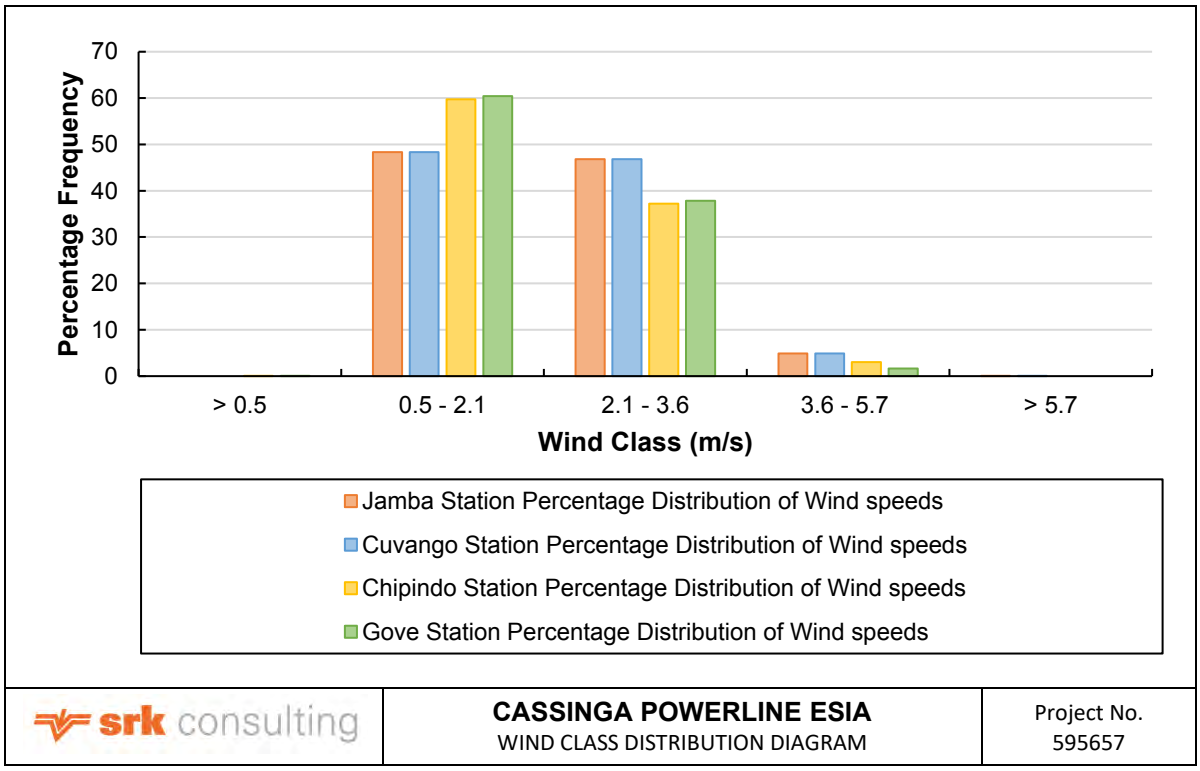


Figure 6-25: Wind Class Distribution Diagram

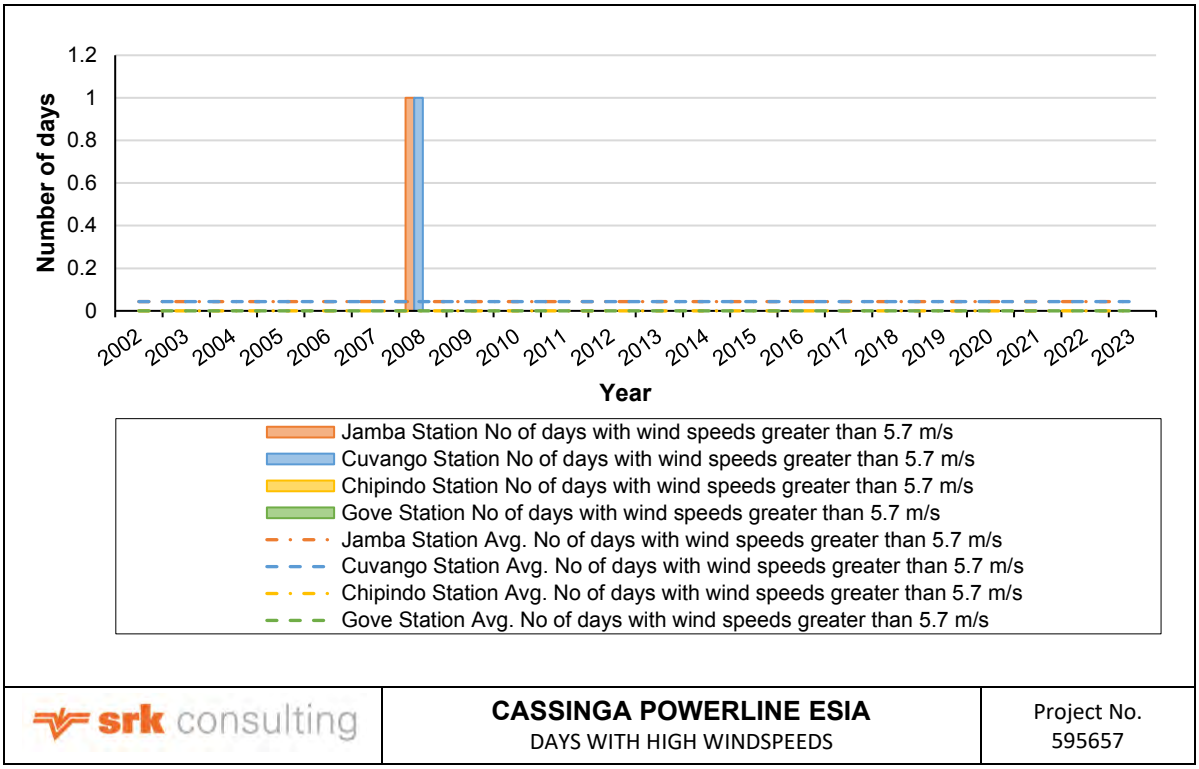


Figure 6-26: Days with High Windspeeds

Average windspeeds <3 m/s are experienced throughout the year across all sites (refer to Figure 6-27). Both Cuvango and Chipindo experience their minimum windspeeds in November and their maximum windspeeds in September. Jamba experiences its minimum and maximum windspeeds in October and July, respectively. Gove experiences its minimum and maximum windspeeds in November and August, respectively.

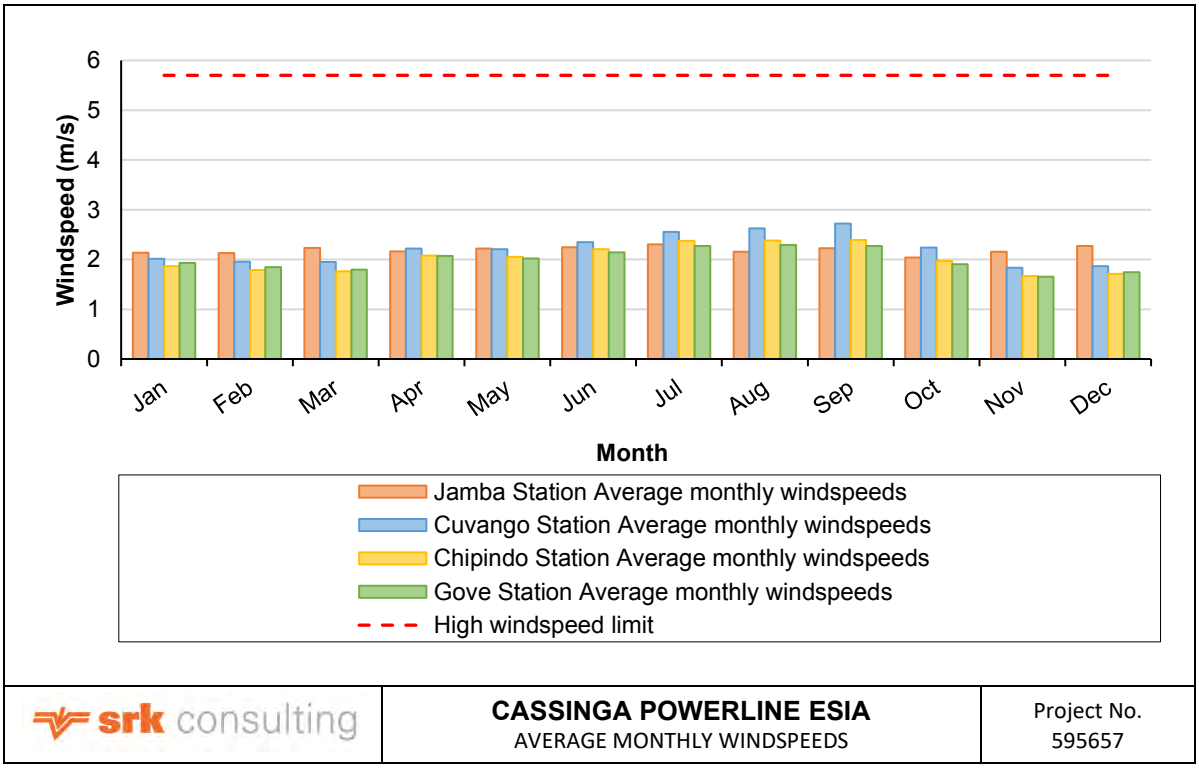


Figure 6-27: Average Monthly Windspeeds

7 Climate Predictions

7.1 Regional Climate Change Predictions

7.1.1 IPCC Regional Climate Change Predictions

The IPCC's AR6 translates scenario-based climate projections into GWLs by aggregating the ESMs response to GWLs for different scenarios. A key outcome of the assessment is the Working Group I Atlas that allows interrogation of the regional information and responses predicted by the models.

The identification of climate change projections was undertaken using the CIMP6.

The site falls in the West Southern Africa (WSAF) Region as delineated in the IPCC's AR6.

The WSAF region is expected to have the following changes relative to the period 1981-2010:

- Mean temperature increases between 1.7 °C (SSP1-2.6, 2021 – 2040) to 5.1 °C (SSP5-8.5, 2081-2100).
- Maximum temperature increases between 1.8 °C (SSP1-2.6, 2021 – 2040) to 5.2 °C (SSP5-8.5, 2081-2100).
- Total precipitation is expected to decrease between 4% (SSP1-2.6, 2021 – 2040) and 9.2% (SSP5-8.5, 2081-2100).
- Maximum 1-day rainfall however is expected to increase between 4.2% (SSP1-2.6, 2021 – 2040) and 3.5% (SSP5-8.5, 2081-2100).
- Maximum 5-day precipitation is also expected to increase (between 2.1% (SSP1-2.6, 2021 – 2040) and 6.5% (SSP5-8.5, 2081-2100).
- **Error! Reference source not found.**Consecutive dry days are expected to increase to between 6.5 days (SSP1-2.6, 2021 – 2040) and 21.3 days (SSP5-8.5, 2081-2100).
- Windspeeds are predicted to increase between 0.3% (SSP1-2.6 2041-2060) and 0.5% (SSP5-8.5, 2081-2100)

So, annual rainfall in this region will decrease but it is anticipated that rain will fall in short heavy bursts with fewer rainfall events and longer dry periods. Average annual temperatures, temperature extremes and windspeeds are all predicted to increase in the region.

7.1.2 World Bank Climate Portal Provincial Climate Change Predictions

The project falls within the Huila and Huambo in Angola. The CCKP predicts increases in annual average temperature and maximum temperature for both provinces.

Table 7-1: 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

CCKP predicts a variable rainfall change for both average and maximum rainfall in the two provinces.

Table 7-2: Predicted Temperature 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

Seasonal rainfall patterns demonstrate a trend towards reduced rainfall at the end of the dry season (October and November) and an increase in rainfall in the wet season (December to February) with the trend more pronounced in Huambo.

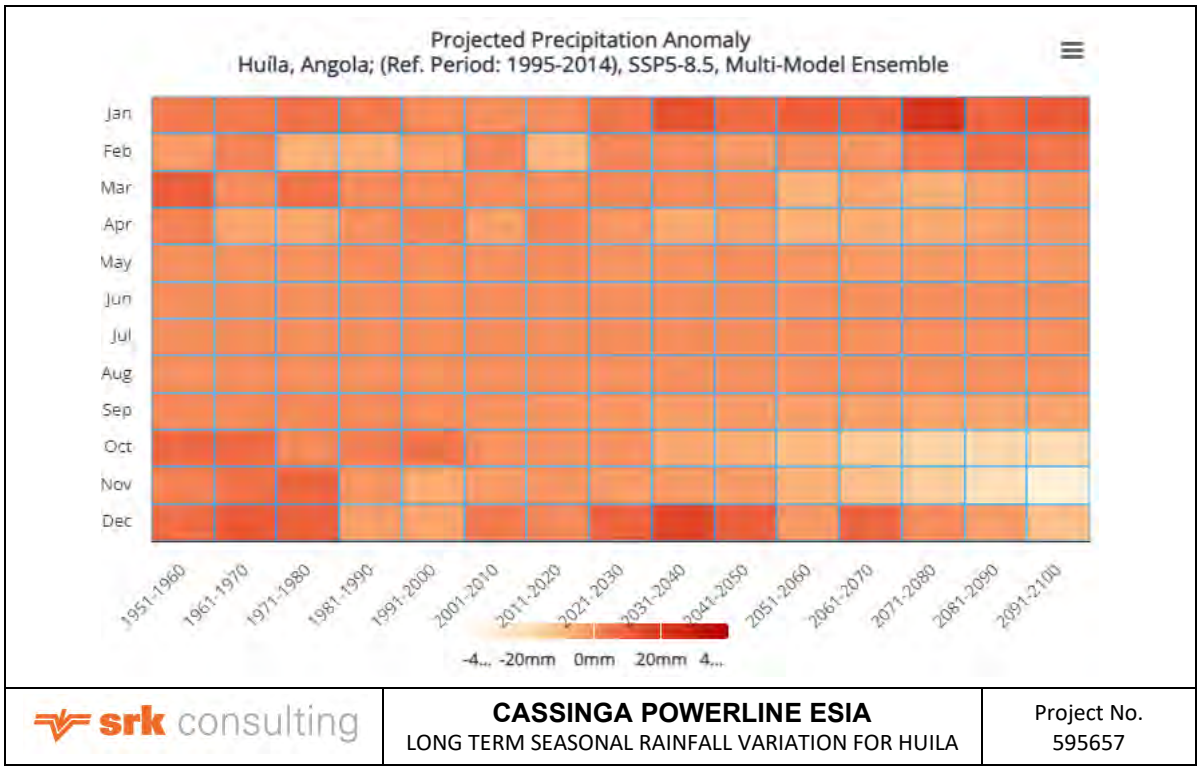


Figure 7-1: Long Term Seasonal Rainfall Variation for Huila

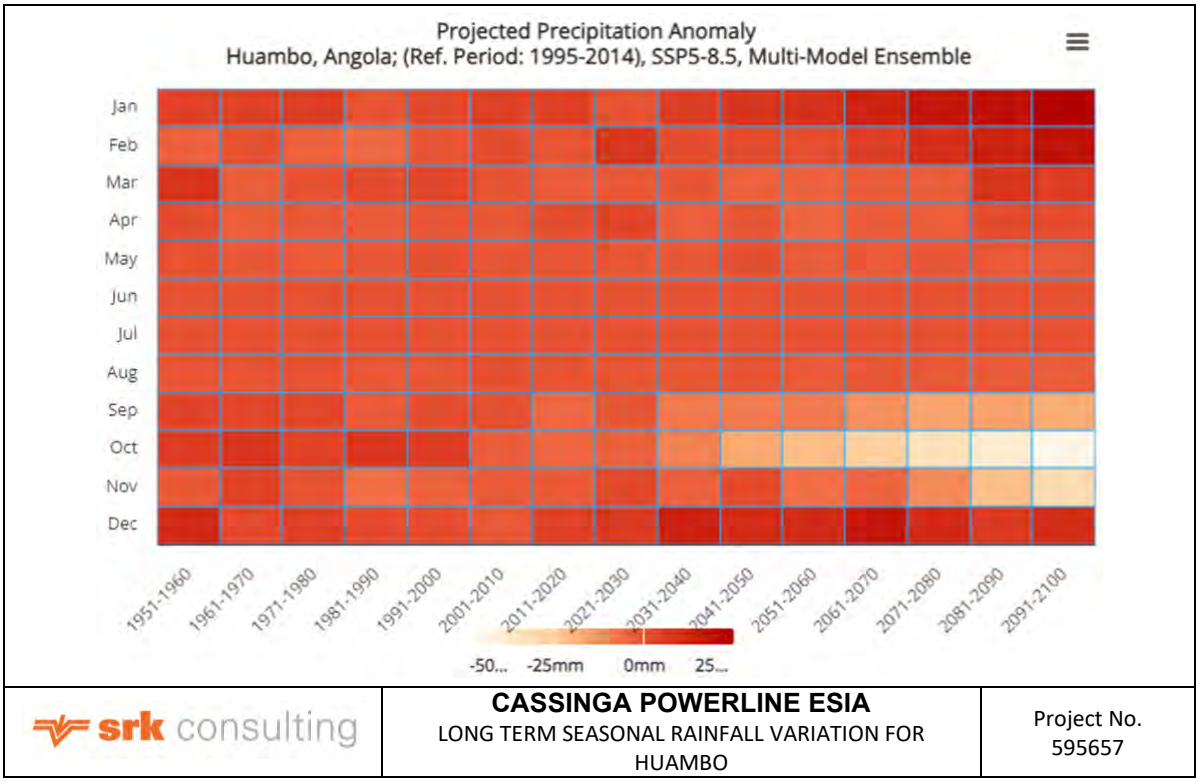


Figure 7-2: Long Term Seasonal Rainfall Variation for Huambo

7.2 Local Climate Change Predictions

The TCFD requires that the resilience of the organisation's strategy be assessed, taking into consideration different climate-related scenarios, including a 2 °C or lower scenario. Site-specific predictions therefore cover predicted changes for SSP1-2.6 to SSP5-8.5. For SSP1-2.6, the atlas only provides 1.5 °C for the period. Values for the 2°C period are provided for all the other SSP's. At the request of the Independent Environmental and Social Consultant (IESC), Ramboll, projections for the three timeframes (Construction Short Term (2021 – 2040), Operation Medium Term (2041 – 2060), Decommissioning Long Term (2081 – 2100)) were also included. In this regard the worst-case scenario (SSP5-8.5) is provided.

There is a variation in predicted changes between the northern and southern extent of the infrastructure. To present this variation, site-specific changes have been provided for the same four virtual weather stations as detailed in the baseline.

7.2.1 Chronic Predictions

Temperature

The predicted mean temperature increases relative to 1981-2010 for the site based on the CIMP6 are presented in Table 7-3. Near-term mean temperatures are predicted to increase up to 1.8 °C.

Table 7-3: 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 7-4. Annual average rainfall is likely to increase barring a few outliers.

Table 7-4: 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 7-5) indicate that minimal changes in average windspeeds are to be expected.

Table 7-5: 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

7.2.2 Acute Predictions

Temperature

The maximum temperature increases are presented in Table 7-6; changes in the predicted number of frost days following in Table 7-7.

Table 7-6: 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 7-7: 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 tempretures 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 7-8 while the predicted maximum 5-day rainfall changes presented in Table 7-9. Changes in consecutive dry days relative to 1981-2010 for the site are presented in Table 7-10.

Table 7-8: 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 7-9: 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 7-10: 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
SSP1-2.6 (1.5°C)	4.9	5.3	5	5
SSP2-4.5 (2°C)	9.2	9.2	9	9
SSP3-7.0 (2°C)	7.4	7.9	7.2	7.2
SSP5-8.5 (2°C)	5.6	6.7	4.5	4.5

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.
- 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.

8 Risk Identification

The risk identification has been developed based on the project description and available climate change modelling. Climate change risks result from an interaction between physical changes that result in climate-related hazards and the level of exposure and vulnerability of the affected human and ecological systems.

The IFC defines vulnerability as a “function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity”. Similarly, the IPCC defines vulnerability as “the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.

Hazards identified in terms of local climate change predictions include:

- Both the climate baseline and CIMP6 predictions indicate a trend of increasing temperatures.
- The CIMP6 predicts no changes to the number frost days for any of the periods or scenarios. This is supported by the fact that baseline does not demonstrate any specific trend in the number of cooler days.
- Observations indicate a small increasing trend in annual rainfall up to 2.9%.
- No trend has been observed in terms of short-term rainfall peaks, but predictions indicate an increase in maximum 1-day and 5-day rainfall. As such, the potential risk of flooding is noted. This is most likely to occur in January given a particular increase in rainfall in January (refer to Figure 7-1 and Figure 7-2**Error! Reference source not found.**).
- The number of consecutive dry days are predicted to increase. As such, droughts are likely to occur, especially since rainfall is predicted to decrease at the beginning and end of the dry season. This also indicates and increase in the likelihood of flooding; the increased rainfall anticipated concentrated over a shorter period.

Risks associated with specific phases of the project’s lifecycle have been identified for consideration in the sections below. Increased temperatures may result in the loss of vegetation in areas making areas more susceptible to landslides. However, the increase in extreme rainfall paired with the extension of the dry period are more likely to exacerbate landslide risks.

8.1 Construction/ Land Clearance

The following risk associated with construction/ land clearance 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.
- Acute - Increased possibility of landslides near Chipindo due to the geomorphic changes associated with land clearance and if large, cleared areas are left unvegetated.

8.2 Operation

The following direct acute risks to/ from project operational phase 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 provided 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.
- Increased possibility of landslides near Chipindo due to moderate-high landslide susceptibility.

Indirect risks which may influence mining operations are as follows:

- Chronic - Increased prevalence of vector borne diseases due to higher temperatures and rainfall in certain months (with specific relevance to malaria) and associated increases in humidity in an already humid climate.
- Acute - Disruption of transportation routes due to offsite/ remote flooding related infrastructure damage.
- Acute - Health and safety risks to staff associated with flooding.

Transitional risks/ opportunities:

- Chronic - The use of SF_6 as a substation arc quencher due to is significant global warming potential.
- Chronic/ Long term - Increasing the availability of electricity (hydroelectric) may in turn reduce the use of non-renewable fuels like paraffin or LPG. This is therefore a transitional opportunity or positive impact of the project.

8.3 Decommissioning

While SF_6 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.

9 Risk/ Impact Assessment

9.1 Construction Phase

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 SRK's understanding of the extent of land clearance required). Construction associated risks have been assessed in Table 9-1.

The sensitive receptor for increased run off and erosion would be the water sources affected and any community members making use of the water. These receptors are considered vulnerable leading to a higher magnitude impact.

The sensitive receptor for landslides would be community members in close proximity to the site and the site infrastructure. The community members are considered vulnerable while the infrastructure can be replaced leading to a moderate magnitude impact.

Table 9-1: Risk Assessment for Construction/ Land Clearance

Activity: Land Clearance								
Project phase: Construction								
Risk 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: Clearing for construction must ensure that cleared areas are kept to a minimum and are only cleared immediately prior to the start of construction and rehabilitated as soon as possible thereafter. 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*
Risk 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: Clearing for construction must ensure that cleared areas are kept to a minimum and are only cleared immediately prior to the start of construction and rehabilitated as soon as possible thereafter. 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*

9.2 Operation

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*". So, while the project and community would experience the same impact, the project 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 discussed and assessed in the following sections.

9.2.1 Increased Temperature

Given the areas hot climate (a maximum temperature of approximately 38°C), the predicted increase in maximum temperature (up to 1.9°C in the near-term and 2.5°C in the medium term) 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. An assessment of the risks pertaining to the anticipated temperature increase follows in Table 9-2.

The sensitive receptors are the staff and project infrastructure, both of which are considered resilient to climatic changes reducing the magnitude of the impact.

Table 9-2: Assessment of Risks Associated with the Anticipated Increase in Temperature

Activity: Operation of electrical infrastructure including lines and substations
Project phase: Operation
Risk Summary: Temperatures exceed the designed operational limits of the equipment.
Risk Type: Acute

	Magnitude	Duration	Scale	Consequence	Probability	Significance	+ /-	Confidence
Before Management	*Moderate*	*Short term*	*Local*	***Medium***	*Possible*	***Medium***	-	*Medium*
Management Measures: Ensure all equipment is similarly designed for temperatures up to 50°C. Ensure Substations are fitted with a fire suppression system which is regularly maintained.								
After Management	*Moderate*	*Short term*	*Local*	***Medium***	*Unlikely*	***Low***	-	*Medium*
Risk 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: Create and roll out a toolbox talk to educate staff of heat stress and preventative measures. Make allowance in staff schedules to limit outside work during the hottest parts of the day. Make sufficient water and other PPE available to limit sun/ heat exposure.								
After Management	*Minor*	*Short term*	*Site*	***Low***	*Possible*	***Low***	-	*Medium*

9.2.2 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. As such, a significant downstream impact associated with the probable flooding is hazardous materials entering surface water sources. This is emphasised by the fact that the proposed transmission line's route crosses numerous rivers that may provide drinking and/ or irrigation water to local communities alongside essential goods and services to both the local community and local ecological biome.

Similarly, should wastewater treatment facilities not be able to accommodate the changing rainfall patterns (increased rainfall and flood frequency), it is likely that these facilities will overflow, ultimately releasing contaminated water into surface water resources. An assessment of rainfall risks identified follows in Table 9-3.

The receptor of these impacts is the immediate environment which is more vulnerable to climate change than the project infrastructure. This has resulted in higher magnitude impacts.

Table 9-3: Assessment of Risks Associated with Management of Wastewater and Storage of Hazardous Materials

Activity: Storage of hazardous materials as part of maintenance								
Project phase: Operation								
Risk Summary: Uncontrolled release of hazardous materials or waste to surrounding environment could occur should the hazardous storage facilities flood.								
Risk Type: Acute								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**Significance**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Possible*	***Medium***	-	*Low*
Management Measures:								

Implement appropriate stormwater management, taking predicted extreme rainfall into account to prevent any hazardous storage areas flooding. Store all hazardous materials in enclosed buildings and containers as specified in the MSDS.								
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								
Risk Summary: Failure of wastewater treatment facilities to contain increased volumes of contaminated water may result in overflow 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: Oil traps and other wastewater containment and treatment facilities should be designed to accommodate additional annual and extreme rainfall predicted. Oil traps and other wastewater containment and treatment facilities should be regularly inspected and drained as appropriate.								
After Management	*Minor*	*Medium term*	*Local*	***Low***	*Possible*	***Low***	-	*Low*

Although flooding offsite could disrupt electricity transmission and road transportation, onsite operations are considered resilient to these risks and resultant impacts. Damage to established infrastructure arising from flooding, lightning or high windspeeds will ultimately disrupt the electricity supply. Furthermore, although the risk of fires associated with substations has already been raised, the increased prevalence of lightning, but more so the extension of the dry period in the middle of the year, is likely to increase the prevalence and intensity of fires caused by operational infrastructure associated with the substations or wildfires started naturally near the substations. These probable intense fires will impact the substations, distribution networks and surrounding communities in tandem. Associated risks are discussed in Table 9-4.

This will impact project infrastructure which is not considered vulnerable despite the loss of power that would affect surrounding communities. The only exception would be the impact to communities as a result of fires caused by infrastructure. These communities are considered vulnerable which has been considered in the magnitude rating of the impact.

Table 9-4: Assessment of Risks Associated with Exacerbated Climatic Conditions (Flooding, Lightning, High Windspeeds) and Dry Periods

Activity: Operation of electrical infrastructure including lines and substations								
Project phase: Operation								
Risk 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: Undertake a flood line assessment, taking predicted changes to 1-day extremes into account and ensure all substations are located outside of the 1:100 year flood line.								

Implement appropriate stormwater management, taking predicted extreme rainfall into account to prevent any hazardous storage areas flooding.

After Management	*Moderate*	*Short Term*	*Site*	***Low***	*Unlikely*	***Low***	-	*Medium*

Risk 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:

It is noted that the infrastructure is fitted with lightning protection to reduce risks. The disaster management plan however should include measures to address damages to infrastructure as a result of lightning.

After Management	*Minor*	*Short Term*	*Local*	***Low***	*Unlikely*	***Low***	-	*Low*

Risk 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:

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*

Risk Summary: Increased prevalence or intensity of fires caused by infrastructure amidst extended dry periods.

Risk Type: Acute

	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**Significance**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Possible*	***Medium***	-	*Low*

Management Measures:

It is noted that fire suppression has been included in the design of the substations. Ensure the Emergency Response Plan details measures to reduce fire risk and manage the extent of damage to surrounding areas as a result of fires from the substations or the associated infrastructure.

After Management	*Moderate*	*Short Term*	*Local*	***Medium***	*Unlikely*	***Low***	-	*Low*

Risk Summary: The increased prevalence or intensity of wildfires amidst the extended dry period affecting infrastructure.

Risk Type: Acute

	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**Significance**	**+ /-**	**Confidence**
Before Management	*Minor*	*Medium term*	*Local*	***Low***	*Possible*	***Low***	-	*Low*

Management Measures:

Ensure the Emergency Response Plan addresses the risk of fires to the infrastructure and aims to reduce the extent of damage as a result of fires started offsite that might cause damage to the substations or any wooden poles used in distribution network.

After Management	*Minor*	*Short Term*	*Local*	***Low***	*Unlikely*	***Low***	-	*Low*

Risk 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: Ensure all areas have been revegetated as required in the environmental management plan. Undertake monitoring of steep slope areas to identify areas that become denuded of vegetation.								
After Management	*Minor*	*Medium term*	*Local*	***Low***	*Unlikely*	***Low***	-	*Medium*

9.2.3 Indirect Risks

It is expected 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 an acknowledged issue in Africa, but may apply to any vector borne diseases associated with water and/ or domestic effluent management. Given the prevalence of malaria in the region, it is expected that lost time injuries will be incurred.

Flooding onsite or offsite could damage road infrastructure. This will impact onsite operations, the supply of maintenance equipment, and prevent transportation that may be required to undertake necessary repairs. In extreme circumstances, however, floods may disrupt all supply lines, i.e., access to medical facilities, food, and other requirements for employees. Interruptions to transportation routes currently occur, and this only expected to worsen considering the predicted climate changes.

The sensitive receptor for these impacts are the staff undertaking operational maintenance. Given the support of staff health and safety and disaster management plans as well as project resources available in emergencies the staff are considered resilient which is reflected in the magnitude ratings.

Table 9-5: Assessment of the Indirect Risks Associated with Climate Change

Activity: Operation of electrical infrastructure including lines and substations								
Project phase: Operation								
Risk Summary: Increased prevalence of vector borne diseases due to higher temperatures and rainfall in certain months (with specific relevance to malaria).								
Risk Type: Chronic								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**Significance**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Short Term*	*Site*	***Low***	*Possible*	***Low***	-	*Medium*
Management Measures: Create and roll out a staff awareness campaign to educate staff of vector borne diseases and preventative measures. Provide any equipment/ vaccines or other materials to support staff in preventing disease.								
After Management	*Moderate*	*Short Term*	*Site*	***Low***	*Unlikely*	***Low***	-	*Medium*
Activity: Maintenance of electrical infrastructure including lines and substations								
Project phase: Operation								
Risk 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: Identify and map all alternative access route. 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*
Risk 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: Disaster Management Plan to include emergency evacuation routes and protocols during flood events for staff that may be undertaking infrastructure maintenance. 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*

9.2.4 Transitional Risks and Opportunities

It has been indicated that SF_6 will be used in the substations. SF_6 gas is compressed and stored in high-pressure reservoirs within circuit breakers. During operations (mainly when arcs occur in the breaker), the highly compressed SF_6 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.

SF_6-containing equipment (substations, for example) is 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 SF_6 to escape.

Increasing the availability of electricity may in turn reduce the use of non-renewable fuels. It is noted that wood and charcoal are largely used in these areas for cooking. Furthermore, lighting is, in some instances, provided for using diesel generators or lamps (possibly paraffin or LPG lamps). This project therefore offers a transitional opportunity (positive impact).

In this case the sensitive receptor would be the earth atmosphere at a global scale which is considered highly vulnerable to climate change. This has been reflected in the significance ratings.

Table 9-6: Assessment of Transitional Risks and Opportunities

Activity: Operation of electrical infrastructure including lines and substations								
Project phase: Operation								
Risk Summary: Use of SF_6 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:								

Regular maintenance of the substations specifically the arc quenchers (breakers) must be undertaken to limit the potential for leaks. Consider the use of alternative refrigerants with a lower global warming potential.								
After Management	*Minor*	*Medium*	*Regional (Global)*	***Medium***	*Definite*	***Medium***	-	*Medium*
Risk Summary: Increasing the availability of electricity which in turn could reduce 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: Promote the use of electrical appliances over non-renewable energy alternatives through subsidies.								
After Management	*Moderate*	*Long Term*	*Regional (Global)*	***High***	*Definite*	***High***	+	*High*

9.3 Decommissioning

While SF_6 emissions during normal operations are considered negligible (likely to occur due to leaks in aging equipment), end-of-life treatment is a significant source of emissions. According to the IPCC's Fifth Assessment Report (AR5), the Global Warming Potential for SF_6 is 23,500. This means that one tonne of SF_6 has the same impact on global warming as 23 500 tonnes of CO_2.

Although the amount of SF_6 present in the substations has not been quantified, it is likely to result in a substantial impact if released. This will ultimately impact Angola's ability to achieve their NDC commitments. This would be considered a decommission risk. In this case the sensitive receptor would be the earth atmosphere at a global scale which is considered highly vulnerable to climate change. This has been reflected in the significance ratings.

Table 9-7: Assessment of Decommission Risks

Activity: Decommissioning of electrical substations								
Project phase: Decommissioning								
Risk Summary: Use of SF_6 as quencher for the substations given its high global warming potential.								
Risk Type: Chronic								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**Significance**	**+ /-**	**Confidence**
Before Management	*Major*	*Long Term*	*Regional (Global)*	***High***	*Definite*	***High***	-	*High*
Management Measures: Consider the use of alternative refrigerants with a lower global warming potential. Alternatively, investigate options to capture all SF_6 gas during decommissioning.								
After Management	*Moderate*	*Medium*	*Regional (Global)*	***High***	*Possible*	***Medium***	-	*Medium*

10 Conclusion and Recommendations for the ESMP

A comprehensive climate baseline assessment was conducted for the period 2002 to 2023 along the proposed transmission line in Angola, using data from four virtual stations: Jamba, Cuvango, Chipindo, and Gove. The study made use of available modelled meteorological data and equations in the absence of monitored data. Modelled data generally performs poorly when predicting extremes, and

results in a lower level of confidence in the generated baseline and ultimately the preparation of the risk assessment. This was however determined to be the best data available after review of all available monitored data identified. It was notable that a more than 4°C increase in temperatures has been observed on site in the last 20 years.

Climate projections for the region suggest a shift in rainfall patterns. For the site average annual temperatures, temperature extremes, and windspeeds are all expected to increase. Despite some outliers, the annual average rainfall is projected to increase for the site which is different from the regional prediction. The noticeable rise in maximum 1-day and 5-day rainfall events is however consistent. The number of consecutive dry days is also expected to grow, suggesting a higher risk of flooding during heavy rainfall and increased drought occurrences, especially at the dry season's end.

Wind predictions show little change in average windspeeds, but as predictive models do not account for changes in maximum windspeeds or wind gusts, the possibility of changes to extreme winds remains. The site-specific climate change projections were based on the mean modelled predictions which again decreases the confidence in the accuracy of the predictions, if not the trends.

All risks have medium to low significance pre management which can be reduced to low post management with the exception of those associated with the use of SF_6 in the substations. One significant opportunity has been identified that associated with a shift away from the use of fossil fuels for lighting (albeit small) to ward electricity, specifically because this line will supply hydroelectric power to the site. Measures to reduce negative impacts and increase the positive impact have been identified in the risk assessment and are included in the summary table presented in the Executive Summary. These measures are presented in Table 10-1 on the following page.

Table 10-1: Risks Identified and Associated Management Methods

Project Phase	Potential Risk(s)	Management Measure	Responsible Person(s)	Monitoring Mechanism	Indicator/ Performance Criteria
Construction	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.	Clearing for construction must ensure that cleared areas are kept to a minimum and are only cleared immediately prior to the start of construction and rehabilitated as soon as possible thereafter.	Construction Contractor	Construction timetable	Time between clearing and revegetation less than 4 months and not during December or January
		Land clearing should be avoided during December and January when heavy rainfall is most likely to occur.			
	Increased possibility of landslides near Chipindo due to the geomorphic changes associated with land clearance and if large, cleared areas are left unvegetated.	Clearing for construction must ensure that cleared areas are kept to a minimum and are only cleared immediately prior to the start of construction and rehabilitated as soon as possible thereafter.			
		Land clearing should be avoided during December and January when heavy rainfall is most likely to occur.			
Operation	Temperatures exceed the designed operational limits of the equipment.	Ensure all equipment is similarly designed for temperatures up to 50°C.	Design Engineers	Design specifications	All equipment is designed for ambient temperatures above 50°C.
		Ensure Substations are fitted with a fire suppression system which is regularly maintained.	Design Engineers	Design specifications	Designs include fire suppression for the substations
			Maintenance	Maintenance Schedule	Maintenance Schedule reflects the timing for and completion of maintenance and servicing of the fire suppression system for the substations.
	Increased staff heat stress, demand for cooling and associated increase in GHG emissions.	Create and roll out a toolbox talk to educate staff of heat stress and preventative measures.	Foreman	Attendance register	Registers indicate all staff have received the toolbox talk prior to working outside in the summer months.
		Make allowance in staff schedules to limit outside work during the hottest parts of the day.	Foreman	Shift/ work logs	Occupational Health Nurse to determine maximum time working outside at different temperatures.
		Make sufficient water and other PPE available to limit sun/ heat exposure.	Foreman	PPE issue register	All staff issued with appropriate PPE for working in hot conditions.

Project Phase	Potential Risk(s)	Management Measure	Responsible Person(s)	Monitoring Mechanism	Indicator/ Performance Criteria
	Uncontrolled release of hazardous materials or waste to surrounding environment could occur should the hazardous storage facilities flood.	Implement appropriate stormwater management, taking predicted extreme rainfall into account to prevent any hazardous storage areas flooding.	Design Engineers and Construction Contractor	Design specifications	Stormwater management designs are prepared taking the predicted extremes into account and are constructed as designed.
		Store all hazardous materials in enclosed buildings and containers as specified in the MSDS.	Design Engineers	Design specifications	Designs comply with requirements.
	Failure of wastewater treatment facilities to contain increased volumes of contaminated water may result in overflow of contaminated water to the environment.	Oil traps and other wastewater containment and treatment facilities should be designed to accommodate additional annual and extreme rainfall predicted.	Design Engineers	Design specifications	Designs comply with requirements.
		Oil traps and other wastewater containment and treatment facilities should be regularly inspected and drained as appropriate	Maintenance	Maintenance Schedule	Proportional capacity of the storage areas are maintained at an appropriate level.
	Operational disruptions or damage to project infrastructure due to flooding.	Undertake a flood line assessment, taking predicted changes to 1-day extremes into account and ensure all substations are located outside of the 1:100 year flood line.	Design Engineers	Design specifications	Layout includes 1:100 year flood line (current and predicted future) and no substations are located within the flood line.
		Implement appropriate stormwater management, taking predicted extreme rainfall into account to prevent any substations areas flooding.	Design Engineers and Construction Contractor	Design specifications	Stormwater management designs are prepared taking the predicted extremes into account and are constructed as designed.
	Operational disruptions or damage to project infrastructure due to lightning.	It is noted that the infrastructure is fitted with lightning protection to reduce risks. The disaster management plan however should include measures to address damages to infrastructure as a result of lightning.	Disaster Management	Emergency Response Plan	Plan includes lightning contingency and measures to reduce lightening risk and manage the extent of damage.
	Operational disruptions or damage to project infrastructure due to high windspeeds.	Update baseline meteorological data sets every 5 years with available monitoring data and implement infrastructure upgrades/ reinforcement as applicable.	Disaster Management	Emergency Response Plan	Plan includes high wind contingency and measures to reduce risk of damage during high winds and manage the extent of damage should damage occur.
	Increased prevalence or intensity of fires caused by infrastructure amidst extended dry periods.	It is noted that fire suppression has been included in the design of the substations. Ensure the Emergency Response Plan details measures to reduce fire risk and manage the	Disaster Management	Emergency Response Plan	Plan includes fire contingency and measures to reduce fire risk and manage the extent of damage as a result of fires.

Project Phase	Potential Risk(s)	Management Measure	Responsible Person(s)	Monitoring Mechanism	Indicator/ Performance Criteria
		extent of damage to surrounding areas as a result of fires from the substations or the associated infrastructure.			
	The increased prevalence or intensity of wildfires amidst the extended dry period affecting infrastructure.	Ensure the Emergency Response Plan addresses the risk of fires to the infrastructure and aims to reduce the extent of damage as a result of fires started offsite that might cause damage to the substations or any wooden poles used in distribution network.			
	Increased possibility of landslides near Chipindo due to moderate-high landslide susceptibility.	Ensure all areas have been revegetated as required in the environmental management plan.	Design Engineers and Construction Contractor	Design specifications	Contractor completion certificates only provided once revegetation has been undertaken.
		Undertake monitoring of steep slope areas to identify areas that become denuded of vegetation.	Foreman	Site inspection checklist	Steep slope areas are regularly checked to ensure they are well vegetated.
	Increased prevalence of vector borne diseases due to higher temperatures and rainfall in certain months (with specific relevance to malaria).	Create and roll out a staff awareness campaign to educate staff of vector borne diseases and preventative measures.	Foreman	Attendance register	Registers indicate all staff have received training and refreshers annually.
		Provide any equipment/ vaccines or other materials to support staff in preventing disease.	Foreman/ Occupational Nurse	PPE/ Medical issue register	All staff issued with appropriate equipment/ vaccines or other materials to support staff in preventing disease.
	Disruption of transportation routes due to offsite/ remote flooding related infrastructure damage.	Identify and map all alternative access route.	Disaster Management	Emergency Response Plan	Emergency Response Plan includes alternative access routes.
		Identify local community members to be upskilled to undertake emergency maintenance (e.g., Safely empty oil traps during heavy rainfall).	Disaster Management/ Maintenance	Schedule of local/ emergency staff	Emergency Response Plan includes a schedule of local individuals that can assist with maintenance/ repairs in an emergency.
	Health and safety risks to staff associated with flooding.	Disaster Management Plan to include emergency evacuation routes and protocols during flood events for staff that may be undertaking infrastructure maintenance. The emergency evacuation routes and protocols	Disaster Management	Emergency Response Plan	Plan includes emergency evacuation routes and protocols during flood events for staff that may be undertaking infrastructure maintenance.

Project Phase	Potential Risk(s)	Management Measure	Responsible Person(s)	Monitoring Mechanism	Indicator/ Performance Criteria
		must form part of induction and be included annually in safety training.		Induction and safety training content and registers	All staff undertaking work onsite are aware of the emergency evacuation routes and protocols.
	Use of SF_6 as quencher for the substations given its high global warming potential.	Regular maintenance of the substations specifically the arc quenchers (breakers) must be undertaken to limit the potential for leaks.	Maintenance	Maintenance Schedule/ records	Maintenance Schedule reflects the timing for and completion of maintenance and servicing of the breakers in substations and the volume of SF_6 used during maintenance is any.
		Consider the use of alternative refrigerants with a lower global warming potential.	Design Engineers	Document offering alternatives and reasons why alternatives would not be feasible.	Alternative selected or document demonstrates why all alternatives would not be feasible.
	Increasing the availability of electricity which in turn could reduce the use of non-renewable fuels.	Promote the use of electrical appliances over non-renewable energy alternatives through subsidies.	Client	Change from fossil fuels to electricity for lighting	Increasing trend in the use of electricity over fossil fuels for lighting.
Decommissioning	Use of SF_6 as quencher for the substations given its high global warming potential.	Consider the use of alternative refrigerants with a lower global warming potential.	Design Engineers	Document offering alternatives and reasons why alternatives would not be feasible.	Alternative selected or document demonstrates why all alternatives would not be feasible.
		Investigate options to capture all SF6 gas during decommissioning.	Design Engineers for decommissioning	Decommissioning contractor design specifications	No SF_6 released during decommissioning.

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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Appendices

Appendix A: Risk Assessment Methodology

Impact assessment methodology

Potential impacts (direct, indirect, cumulative) will be assessed using information gathered during the baseline assessment in combination with previously collected desktop data and compared with the detailed project description.

Impact significance rating

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 involves the following 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.

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 1: Method for rating 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
	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

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**
SPATIAL SCALE OR POPULATION	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	Medium	High
		Short term	Low	Medium	Medium
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

After determining the significance rating, practicable management measures are suggested for each specific impact. The impact description should indicate the significance rating prior to and following mitigation/optimisation. As explained above:
"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 is then re-assessed with assumed management measures in place ("after management"). Specialists also recommend and describe 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 11-1.

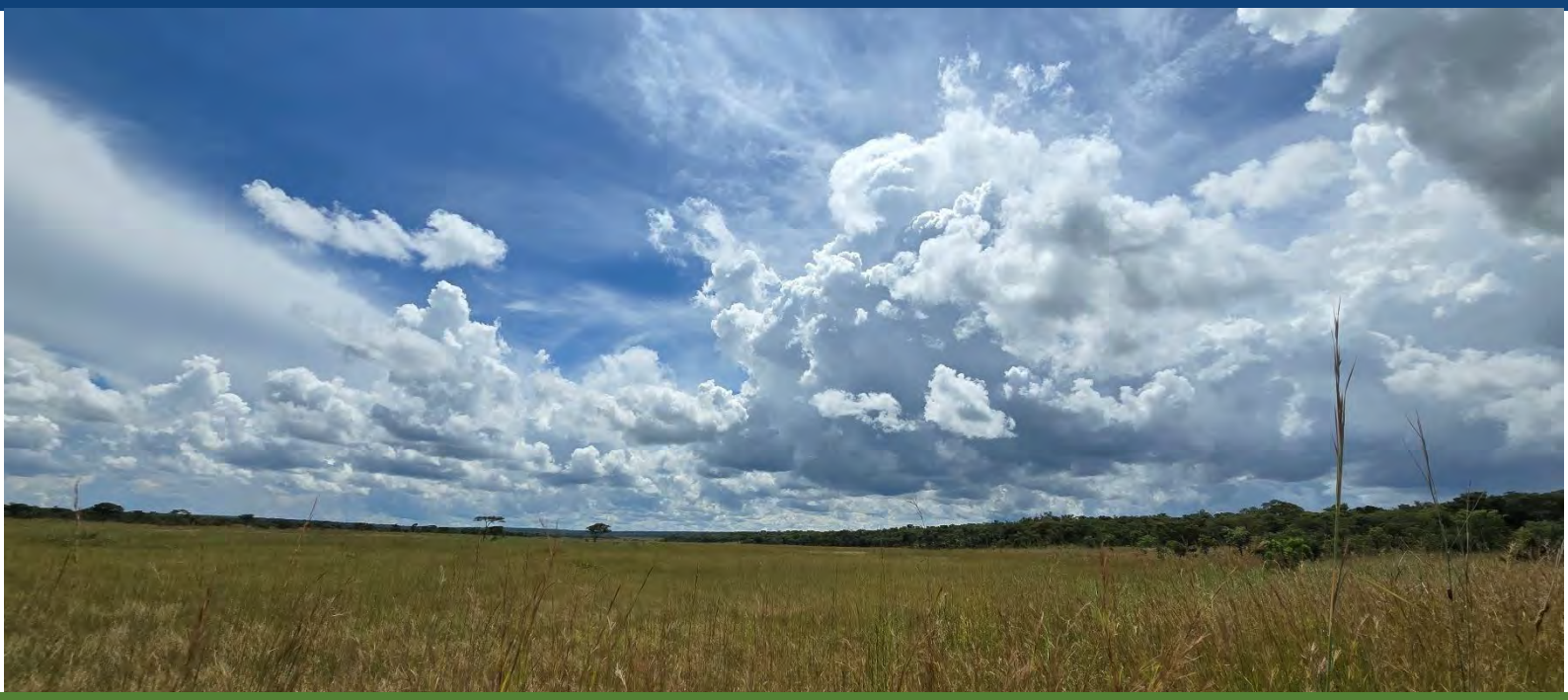
Table 11-1: Impact significance rating and mitigation measures for the impact.

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*

Appendix C: Hydrogeology impact statement

HCVAfrica

HIGH CONSERVATION VALUE



SPECIALIST STUDY: Hydrology Impact Assessment

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED CASSINGA ELECTRICAL SUPPLY PROJECT

September 2024

Disclaimer

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EXECUTIVE SUMMARY

This project requires an Environmental and Social Impact Assessment (ESIA) to be conducted in compliance with relevant Angolan legislation and regulations, and in conformance with international standards. HCV Africa was appointed (via Geolab) by SRK Consulting to conduct this ESIA. This report is the hydrology specialist study report for the ESIA.

The Project is located South of the centre of Angola, in the provinces of Huila and Huambo. The Project powerline extends for about 170 km, crossing three municipalities which include Jamba, Cuvango, Chipindo. The power line has 104 points where it crosses rivers or streams. Most of these streams are first order streams, being tributaries of larger river systems in the area. The main river systems that flow through the study area are:

- Cuandeja River (a tributary of the Cunene River)
- Cubango River
- Cunene River

The main works will be carried out largely in Huila Province near the Gove Hydro Dam (Huambo) 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 associated with the electrification of villages at Chipindo, Cuvango and Jamba will be constructed. The project will also include a 30 kV Medium Voltage OHL network to the new substations and a Low Voltage network to supply electricity to 1 000 homes in each of the three villages.

The area of influence (AoI) for this study considered the 220 kV overhead line, substations and smaller distribution lines within Jamba, Cuvango and Chipindo. During the construction, operations and closure periods, downstream impacts on all river systems that are crossed are expected. These impacts are expected to be mainly during the construction period. The impacts are likely to be small. Considering this, the AoI for the hydrology study was established to be the first and second order streams that the power lines cross or where substations are located. The impacts are likely to be insignificant due to dilution by the time streams reach their third order. Stream orders refer to the Strahler stream order system (top-down system). This AoI would account for buffers for the infrastructure – 100 m (50 either side) for HV line, 18 m either side for MV/LV lines and 3ha for substations.

Potential surface water impacts are:

- Siltation of receiving streams
- Hydrocarbon pollution in receiving streams
- High flow events may cause scouring around pylon foundations if they are constructed within flow zones
- Climate change may increase the flood peaks and therefore flood levels

These impacts will be limited to the wet season where normal surface runoff will wash the pollutants into the receiving streams and rivers.

Surface water impacts are expected to be small and limited to the first and second order streams (Strahler stream order system). The disturbed footprints are very small compared to the footprints disturbed by agriculture. The incremental surface water siltation impacts will be unnoticed third order streams in areas where agriculture is present and will be limited to river reaches near construction works. Impacts will occur during the wet season only.

If the construction and maintenance fleet are well-maintained, hydrocarbon pollution is expected to be negligible.

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

Acronym	Meaning
AoI	Area of Influence
CH	Critical Habitat
DEM	Digital Elevation Model
ESIA	Environmental and Social Impact Assessment
IDF	Intensity Duration Frequency
IFC	International Finance Corporation
km	Kilometre
kV	Kilo volt (1 000 volts)
m	Metre
mamsl	Meters above mean sea level
MAE	Mean annual evaporation
MAP	Mean annual precipitation
mm	Millimetre
MV	Medium voltage
MVA	Megavolt-amperes
OHL	Overhead line
SCS	United States Department of Agriculture *Soil Conservation Service*

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1 INTRODUCTION

The Republic of Angola, through its Ministry of Energy and Water (MINEA), is embarking on a significant enhancement of its electrical infrastructure with the Cassinga Project, aiming to boost electric power supply across various communities within the Province of Huíla. The Project is structured around the establishment of a new 220 kV Overhead Line (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. Furthermore, the Project includes the laying down of medium voltage overhead lines for distribution, along with the necessary low voltage 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 OHL 220 kV interconnection to Cuchi/Menongue.

An estimated power demand of 80 MW has been calculated for the Cassinga 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. A Technical Specification for Metallic Structures for Lines and Substations, adhering 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 Cassinga Electric Power Supply Initiative represents a significant leap forward in Angola's energy infrastructure development. The Project 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 Hydro Plant to the Cassinga Project and the future OHL 220 kV interconnection to Cuchi/Menongue.

1.1 Proposed Infrastructure

The Project involves the construction of three new substations and the establishment of a new 220 kV Overhead Line 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 medium voltage OHL network to the new substations and a Low Voltage network to supply electricity to 1 000 homes in each of the three villages.

1.1.1 Transmission lines and towers

Transmission line conductors are strung on in-line suspension towers and bend (strain) towers. The structures proposed to be used for the majority of the 220 kV transmission line are metallic towers type Y, adequate to the angle of the overhead line. These towers are approximately 50 m in height. A total footprint area of 80 m x 50 m is required for each tower. The average span between two towers is 400 m.

The cross-rope suspension tower is typically used along the straight section of the servitude, while the self-supporting angle towers and inline strain towers are used where there is a bend in the powerline alignment. Angle towers are cumbersome and more steel-intensive than suspension towers, making them more visually intrusive and expensive to construct. Therefore, transmission line routes are planned with as few bends as possible.

1.1.2 New substations

Three new substations will be constructed at Chipindo, Cuvango and Jamba.

1.1.3 Overhead line infrastructure

Overhead line infrastructure will be constructed in two stages:

- Stage 1: The Gove – Chipindo – Cuvango section of the overhead line.
- Stage 2: The section from Cuvango to Jamba.

1.1.4 Electrification of community homes and public lighting

The electrification of Chipindo, Cuvango and Jamba will consist of medium and low voltage network to supply grid electricity to approximately 1 000 homes in each village. The medium voltage 30 kV OHL (MV network) – yellow lines and transformation stations – red triangle in the villages is illustrated in ***Figure 1-1*** – Chipindo, ***Figure 1-2*** – Cuvango and ***Figure 1-3*** – Jamba.



Figure 1-1: MV network and transformation Station sites - Jamba



Figure 1-2: MV network and transformation Station sites - Cuvango

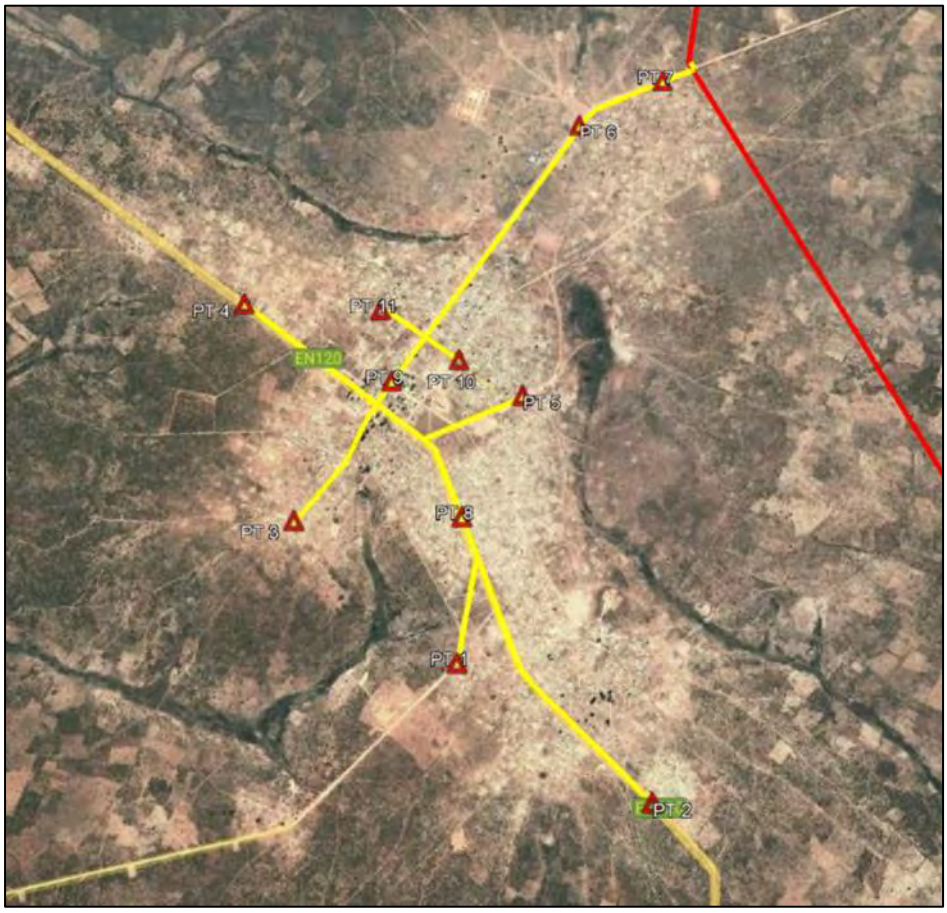


Figure 1-3: MV network and transformation Station sites - Chipindo

1.2 Purpose of Study

This project requires an Environmental and Social Impact Assessment (ESIA) to be conducted in compliance with relevant Angolan legislation and regulations, and in conformance with international standards. HCV Africa was appointed (via Geolab) by SRK Consulting to conduct this hydrology study to inform the ESIA.

Note that it is possible the layout (dimensions, quantities, and components) may change during detailed design phase.

1.3 Terms of Reference

The terms of reference for the hydrology specialist study are limited to baseline studies and impacts related to surface water flows and flow depths. Groundwater, wetlands, fauna and flora around surface water studies are detailed in separate specialist studies.

Baseline daily rainfall and monthly average evaporation data was supplied by SRK Consulting. This data is further processed for use in this study. The sources of this data, the description of this data and the results of the post processing are described in this report.

1.4 Assumptions, Exclusions and Limitations

The study includes hydrological and hydraulic calculations of 104 river crossings. A 100 m corridor of detailed LIDAR survey was available along the power line route. Survey outside of this corridor was sourced from the publicly available FABDEM DEM. The FABDEM DEM is calculated from satellite survey and has a 30 m resolution. This is a significant improvement on the publicly available SRTM DEM which has a 90 m resolution, but not as detailed as a LIDAR survey with ground control.

The FABDEM DEM was used for catchment delineation. This data is well suited to catchment delineation. The LIDAR survey was used to determine Normal flow depths at the river crossing sites. Accurate hydraulic flow depths are not required for impact prediction purposes but may be required for pylon placement.

Many of the river crossings are in remote areas that are inaccessible by vehicle. However, a site inspection of many of the river crossings that were accessible by vehicle or within practical walking distance of a road, showed that hydraulically unique river systems appear to be rare. A good indication of hydraulic characteristics can be estimated from available aerial photography, supplemented with field observations.

Floodlines for all 104 crossings are not included in the scope of work. However, accurate cross sections were taken at each river crossing location and Normal flow depths were calculated at each of these, based on assumed roughness inputs and measured channel slopes. The Normal flow depths and corresponding water surface elevations exceed the requirements for impact assessment purposes and provide adequate information for pylon placement. To alleviate the need for detailed floodlines of all 104 river crossings, conservative offsets from the stream centerline are provided in Appendix B.

Where pylons are required to be placed within these offsets, backwater analyses may be required to determine flow velocities at pylon plinths. This will account for backwater effects of any downstream controls in channels that have subcritical flow regimes.

Additionally, the following general assumptions and limitations are of relevance:

- The results of the assessment must be interpreted based on the knowledge that no medium – or long-term hydrological measurements are available. All data is based on singular collection efforts from a a single site visit;
- The results of the impact assessment must be interpreted with caution.

1.5 Information Sources

1.5.1 Topography

A 100 m corridor of detailed LIDAR survey was available along the power line route. Survey outside of this corridor was sourced from the publicly available FABDEM (30 Meter Resolution Bare Earth DEM from Fathom) database.

1.5.2 Rainfall data

Rainfall data from 4 locations was provided by SRK Consulting. The four rainfall locations are:

- Cuanja (14.68°S, 16.04°E, altitude: 1 468 mamsl)
- Cuvango (14.48°S, 16.27°E, altitude: 1 454 mamsl)
- Chipindo (13.80°S, 15.80°E, altitude: 1 642 mamsl)
- Gove (13.45°S, 15.87°E, altitude: 1 562 mamsl)

The data was sourced from the CHIRPS database. Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS) data has become a popular data source in ungauged or poorly gauged areas. CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring. (https://developers.google.com/earth-engine/datasets/catalog/UCSB-CHG_CHIRPS_DAILY). CHIRPS was created in collaboration with scientists at the USGS Earth Resources Observation and Science (EROS) Center to deliver complete, reliable, up-to-date data sets for a number of early warning objectives, like trend analysis and seasonal drought monitoring. (https://www.chc.ucsb.edu/data/chirps).

1.5.3 Evaporation data

Evaporation data was calculated using a Penman Monteith equation for the same locations as the rainfall stations listed in Section 1.5.2.

1.5.4 Powerline route and substation locations

The infrastructure locations were provided by SRK Consulting as a kmz file.

2 KEY LEGISLATIVE FRAMEWORKS AND LENDER REQUIREMENTS

To provide the relevant information in support of the ESIA, international guidelines and standards were reviewed and applied where applicable. A summary of the applicable standards, guidelines and principles are provided below.

2.1.1 Local guidelines and standards

In terms of Angolan national legislative requirements, adherence to the Presidential Decree 117 of 2020 concerning Environmental Impact Assessments is required.

The National Assembly of Angola approved the new Constitution of the Republic of Angola on 5 February 2010, to replace the 1992 Constitution. The Constitution provides the basis for the Environmental Framework Law through Article 39. This Article 39 (Environmental Rights) provides 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 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.

3. Acts that endanger or damage conservation of the environment shall be punishable by law.

Angolan legislation is issued at the national level through:

- Laws, which are issued by the National Assembly;
- Presidential Decrees, which are issued by the President's office; and
- Regulations (executive decrees), joint executive decrees and resolutions, which are normally issued by a ministry or ministries.

Note that other legislative, regulatory, and administrative requirements may pertain to the proposed projects, which will be elaborated on in the ESIA as relevant. The summary provided below is intended to highlight key environmental legislation and obligations only.

2.1.2 International Finance Corporation Performance Standards

The International Finance Corporation (IFC) has published a number of Performance Standards (1-8) on Environmental and Social Sustainability (IFS PS, 2012). Of these, Performance Standard 1 (IFC PS1) and 6 (IFC PS6) are of greatest relevance to the assessment of impacts on biodiversity.

Performance Standard 1 establishes the importance of the following aspects:

- Integrated assessment which identifies the environmental and social impacts, risks, and opportunities of proposed projects;
- Effective community engagement through disclosure of project related information and consultation with local communities on aspects that affect them; and
- The client's management of environmental and social performance throughout the life of the project.

It is therefore applicable for all projects to have studies which identify environmental and social risks and impacts. Additional aspects to considered under IFC PS1 include the following:

- The developer is required to establish and implement monitoring and management programmes.
- Implement the mitigation hierarchy which favours avoidance over minimisation.

Performance Standard 6 establishes the importance of the following aspects:

- This standard recognises the protection and conservation of biodiversity and sustainable management of natural resources;
- Three types of habitat with differing biodiversity importance are recognised under IFC PS6 - Modified Habitat, Natural Habitat and Critical Habitat (CH);
- Modified habitats are areas that a large proportion of plant or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition;
- Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, or where human activity has not modified an area's primary ecological functions and species composition;
- CH's are areas with high biodiversity value, including
    - (i) habitat of significant importance to Critically Endangered and/or Endangered 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. Requirements for mitigation of impacts in these three areas differ significantly.

2.1.3 Equator Principles

The equator principles (Version 4, 2020), provide a framework for financial institutions to assess environmental and social due diligence. These principles align with undertakings such as the 2015 Paris Agreement, United Nations Guiding Principles on Business and Human Rights and the United Nations Sustainable Development Goals. The Equator Principles apply the mitigation hierarchy. Climate change, IFC Performance standards, as well as the World Bank Group's Health and Safety Guidelines are key assessment criteria for the Equator Principles.

2.1.4 Other international guidelines and standards

For international requirements, alignment to the following standards and guidelines are required where applicable:

- IFC Environmental, Health and Safety (EHS) General Guidelines (2007).
- IFC EHS Guidelines for Electric Power Transmission and Distribution (2007).
- United Nations Sustainability Development Goals (2015).
- United Nations Guiding Principles on Business and Human Rights (2011).
- United Nations Global Compact (2000).
- OECD Guidelines for Multinational Enterprises (2011).
- OECD Due Diligence Guidance for Responsible Business Conduct (2018).
- Standard Chartered (latest internal policies and statements).
- EKN Sustainability Policy (2023).
- SEK Sustainable Finance Policy (2023).
- ILO Conventions.
- International Bill of Human Rights.
- UN Convention on the Rights of the Child.
- UN Global Compact.
- Thun Group of Banks – The Guiding Principles: an interpretation for banks.
- OECD Due Diligence Guidelines for Responsible Corporate Lending and Securities Underwriting.
- Danish Institute for Human Rights Human Rights Impact Assessment: Guidance and Toolbox.

3 APPROACH AND METHODOLOGY

3.1 Objectives

This report provides information related to the hydrology baseline condition, the anticipated impacts to these resources and mitigation measures to minimise risks and avoid significant impacts to these resources. This ESIA process is exclusively for the Cassinga Project. Based on the required aspects to support the ESIA the following aims and objectives were established:

- Establish expected Area of Influence (AoI);
- Identify hydrology resources in the AoI;
- Establish baseline condition of the identified hydrology resources by:
    - Defining baseline rainfall and evaporation;
    - Defining the catchment boundaries;
    - Defining water chemistry; and
    - Defining flow regimes.
- Establish anticipated risks to the hydrologicaland hydraulic environment that may be attributed to the proposed activities; and
- Define and provide actions to avoid, minimise and mitigate potential impacts to the hydrological environment.

3.2 Methodology

3.2.1 Peak rainfall calculation

The CHIRPS rainfall data sets for the four locations discussed in Section 1.5.2 were statistically analysed to produce the annual maximum series for each rainfall station. A Log Pearson Type 3 distribution provided a good fit to the annual maximum series for the Cuanja, Cuvango and Chipindo stations. These are shown in ***Figure 3-1*** to ***Figure 3-3***. A Log Extreme Value Type 1 distribution provided a good fit to the annual maximum series for the Gove station. These distributions were used to generate peak 24-hr rainfall depths for each station. This is shown in ***Figure 3-4***.

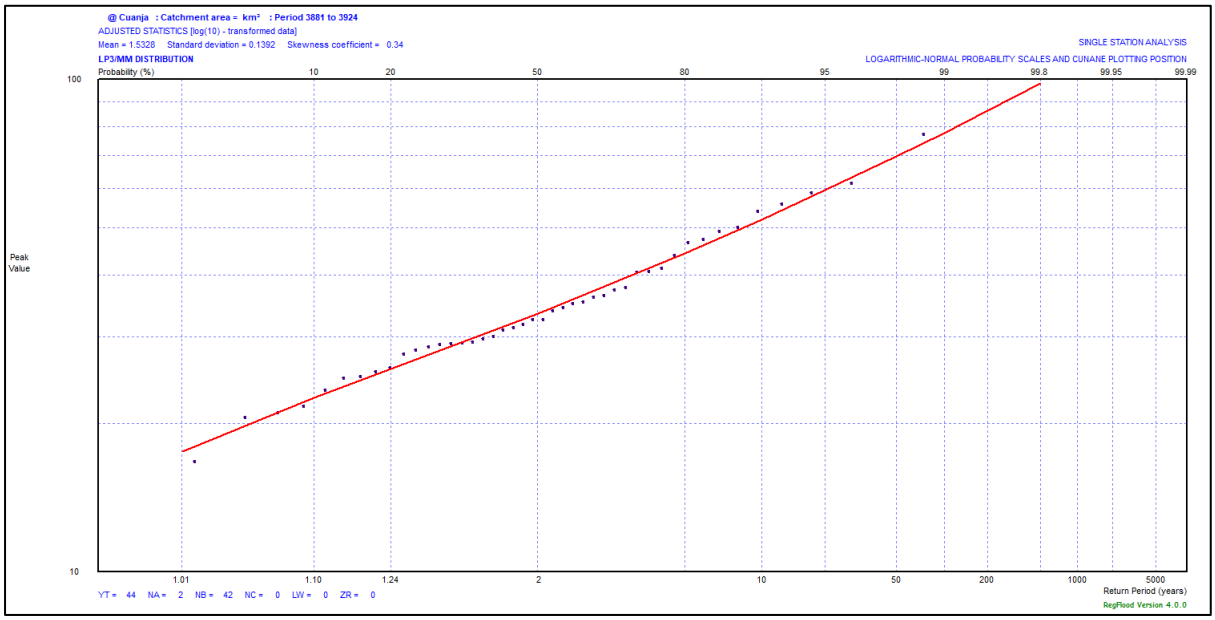


Figure 3-1: Log Pearson Type 3 distribution fitted to the Cuanja annual maximum series

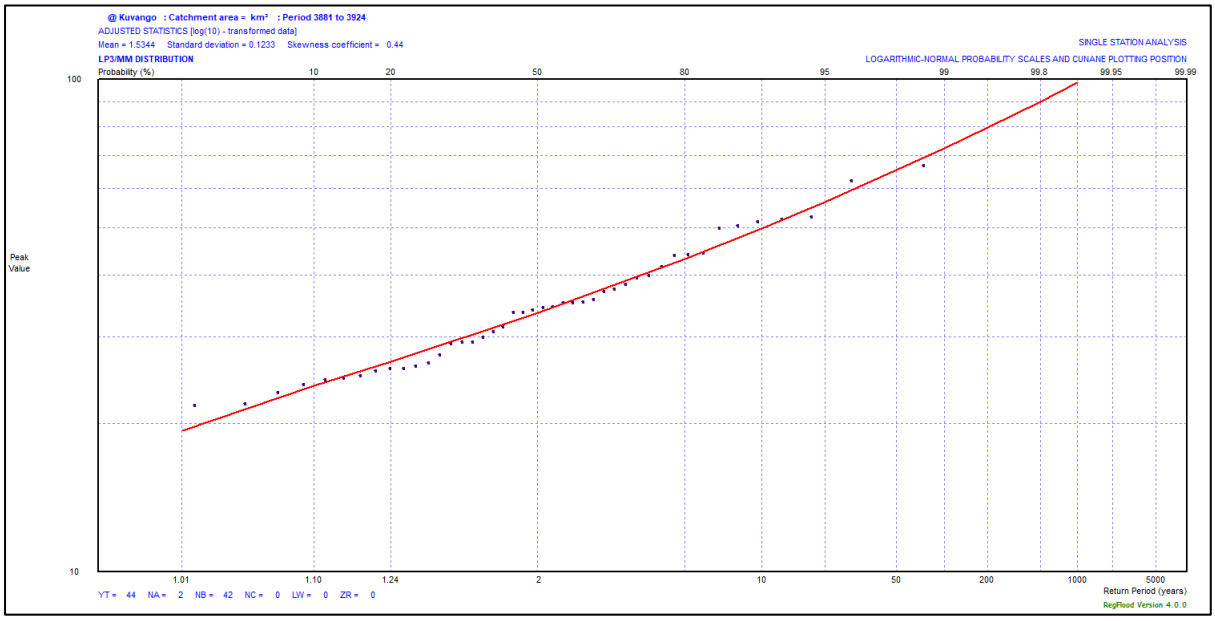


Figure 3-2: Log Pearson Type 3 distribution fitted to the Cuvango annual maximum series

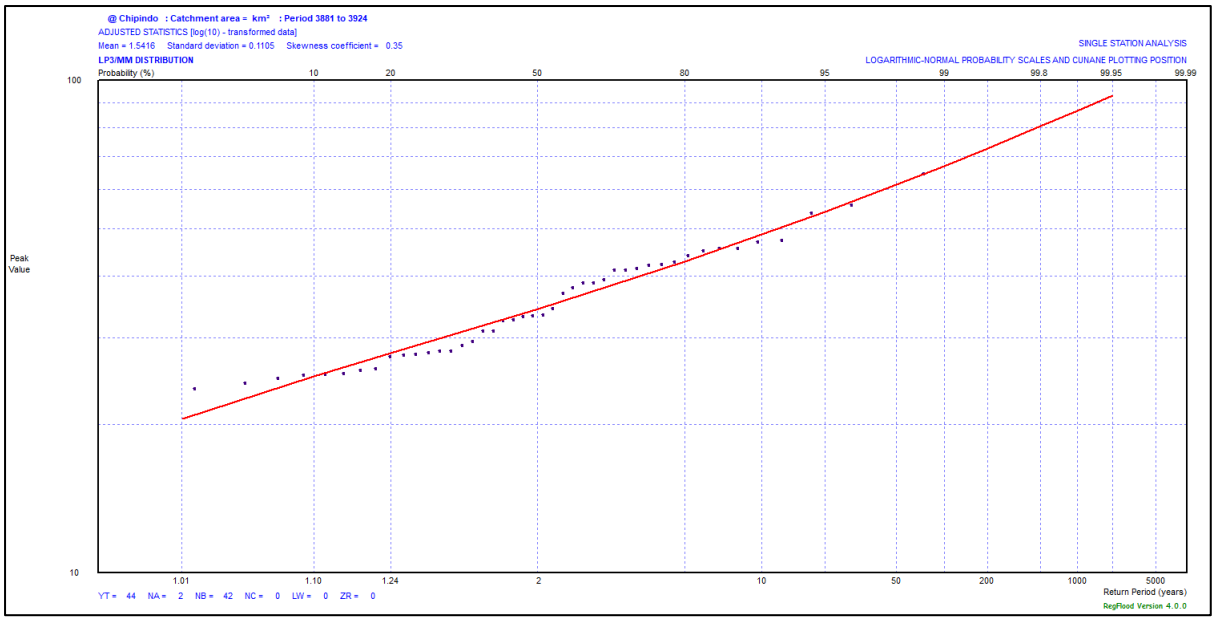


Figure 3-3: Log Pearson Type 3 distribution fitted to the Chipindo annual maximum series

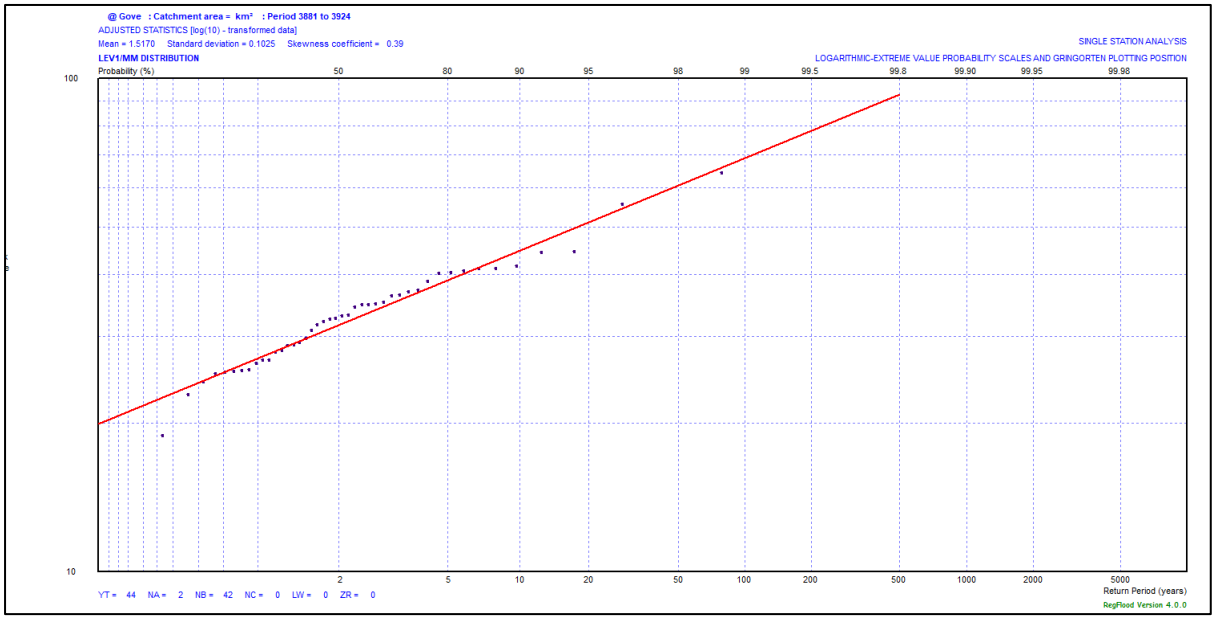


Figure 3-4: Log Extreme Value Type 1 distribution fitted to the Gove annual maximum series

D-hr storm depths were calculated based on Adamson's TR102 (1981) ratios of D-hr storm depths to the 24-hr storm depths. The inland R_1 zone was used. The data is presented in Section 5.3.2.

3.2.2 Catchment delineation

The catchments for all 104 potentially impacted streams and rivers were calculated using the FABDEM DEM. The locations of the river crossings are listed in Appendix A, and these catchment areas are listed in Appendix B.

3.2.3 Storm water flows and mean annual runoff

No flow gauging data is available on the potentially impacted streams. Literature research and previous work done provided no suitable flow or runoff data either. Mean annual runoff was therefore estimated based on work done in the region in a similar climate and with similar stream orders, vegetation and catchment sizes.

The Rational method is suitable for calculating flood peaks from rural catchment less than 30 km^2 in extent. The Rational method was used to calculate flood peaks for 87 of the catchments, with catchment sizes varying from 0.1 km^2 to 27 km^2. The old South African Department of Water Affairs' calculation sheet was used to determine the runoff coefficients. The time-to-concentration of the sub-catchments was calculated using the SCS method which is suitable for undeveloped catchments. Time to concentrations varied from 15 minutes to 1.3 hours.

The SCS method (with unit hydrographs) was used to calculate the flood peaks for eleven of the catchments, measuring between 40 km^2 and 540 km^2. The catchments are generally similar and a curve number of 85 was used. Storm durations varied between a 2-hour storm duration and a 17-hr storm duration.

The Francou Rodier envelope curves were used for the largest two catchments, which measured 1 622 km^2 and 7 549 km^2. RMF Zone 4 was assumed. The 100-yr flood peaks were scaled from the RMF flood peaks using the relationships provided in Kovacs (1988).

3.2.4 Water quality

Water quality was sampled during the dry season survey, on 15 July 2024 (due to limitations during the wet season in terms of access and ease of sampling). The sampling locations are detailed in Table 3-1 and shown in ***Figure 3-5***.

Table 3-1: 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	Ralitively 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
WQX	-14.11778	16.09406	Cuvango River tributary with lots of agriculture in catchment, cf WQ7

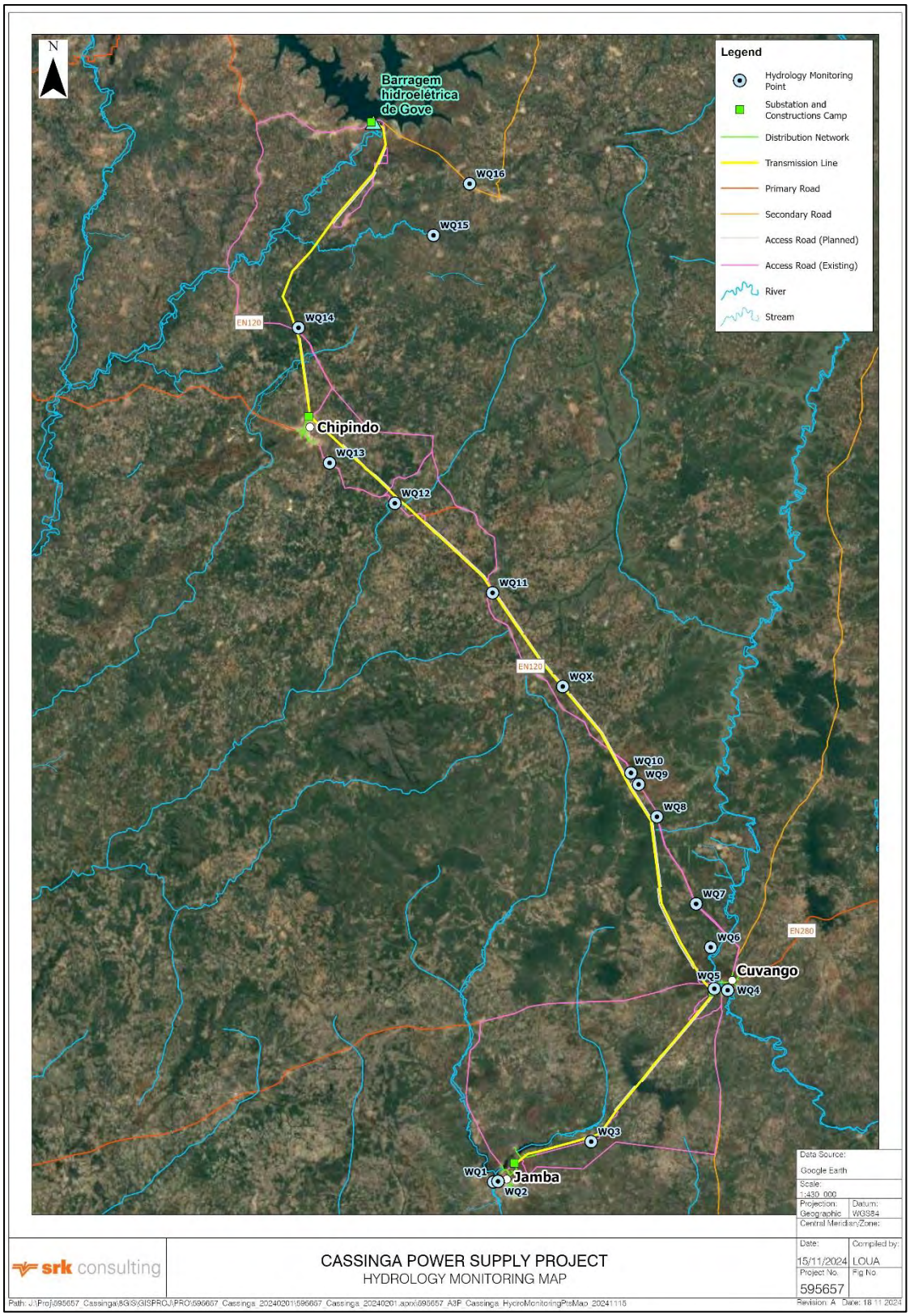


Figure 3-5: Water quality monitoring points

The water quality constituents considered in this study are presented in Table 3-2. The water quality samples were analysed by a professional laboratory. The water quality data was compared to water quality limits stated in Presidential Decree 261/11 of Angolan Law – Annex I (Class A1 – Physical Treatment and Disinfection) – Quality of Freshwater for Production of Water for Human Consumption. These are shown in Table 3-2. The emphasis is on human consumption. A comprehensive water quality analysis, focusing on aquatic water use, will likely be undertaken as part of the aquatic specialist study.

Total content refers to all present mass of the parameter in question. Dissolved metals are typically cations in solution or particulate metals in suspension. There are no guideline values for suspected solids. It is typical for Total suspended solids to be high in rainy season, especially in rural areas where agriculture takes place along watercourses. In the Angolan context, farmers typically farm the "nacas" (area between low flow level and high flow level of the river/stream). This then results in a loose substrate in the watercourse which contributes to suspended solids in the early rainy season. These impacts will be temporal and transient. These impacts will be highly variable as they are dependent on amount of activity present, and frequency, duration and timing of high-flow events, and whether stabilising vegetation has had a chance to recover or not.

Table 3-2: 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	

Iron	mg/l Fe	0.1	0.3
Fluoride	mg/l F	0.7-1	1.5
Phosphates	mg/l P_2O_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		
Sulphate	mg/l SO_4	150	250
Total organic carbon	mg/l C		
Zinc	mg/l Zn	0.5	3

4 PROJECT ACTIVITIES POSING POTENTIAL IMPACTS

The impacts on the project are divided into the construction phase, the operational phase, and the closure and rehabilitation phase of the project. These are discussed below:

4.1 Construction Phase

4.1.1 Access road (and possible river crossing) construction

Access road construction will involve vegetation clearing. Road and foundation building material will be stockpiled close to the construction activities. If bridges or river crossings are required to allow access roads to cross water courses, significant but local disturbances to the river banks and channel will occur.

These activities may introduce silt into the local streams and rivers. Annual runoff and flood flows are not expected to be changed. The river morphology may be changed if sediment beds being introduced are large enough to create sand banks.

4.1.2 Laydown areas, Pylon and substation foundation construction

Vegetation clearing and the likely removal of topsoils and upper subsoils will be required to prepare pylon and substation foundations. These soils will likely be stockpiled close to the construction area. In the case of the laydown areas, it is expected that vegetation will be cleared and area graded. These activities may introduce silt into the nearby streams and rivers.

4.1.3 Construction vehicle activities

Construction vehicles will be active along the length of the power line and at substations. Hydrocarbon leaks from these vehicles could be transported into the local streams and rivers. In addition, laydown areas and possible field service areas for these vehicles may also introduce hydrocarbon pollutants into nearby streams and rivers.

4.1.4 Construction camp grey and black water management

The construction of the power line will require the establishment of a construction camp/s at appropriate location/s along the route. Construction camps will be sited at the contractor's discretion according to their construction schedule and needs. It is estimated that a campsite will be built approximately every 80 km and will be required to house up to 100 people. Once construction activities have been concluded, the construction camp will be closed off and the area rehabilitated concurrently. The grey and black water from the construction camps has the potential to pollute nearby river systems.

4.1.5 Transformer oil leaks

The transformers at the substations may leak (or discharge, if ruptured) oil. This oil can be washed into local river systems.

4.2 Operational Phase

4.2.1 Maintenance vehicle activities

During the operational phase, maintenance vehicles will be active along the length of the power line and at substations. Hydrocarbon leaks from these vehicles could be transported into nearby streams and rivers. In addition, laydown areas and possible field service areas for these vehicles may also introduce hydrocarbon pollutants into nearby streams and rivers.

4.2.2 Access road erosion

Erosion from access roads may also introduce silt into the local streams and rivers.

4.2.3 Scouring at pylon foundations

The pylon foundations will not alter flows or flood peaks in the rivers and streams, but if these foundations are located within flow areas, scouring around the pylon foundations may cause damage to the infrastructure and may release additional sediment into the streams.

4.2.4 Climate change

Most climate change models predict that peak rainfall will increase by the turn of the century. Some predict a reduction in peak rainfall. Of those that predict an increase in peak rainfall, the magnitude of this increase is predicted to be from single digit percentage to over 100% increase. The 100% increases are considered unlikely and are not considered in this study. Increases of 10%-20% are often cited and 20% is used to assess the impacts on flood levels in this study.

Hydraulic calculations show that the changes in flood levels increase with increasing catchment size and thus flood peak. A small catchment measuring 0.5 km^2 will experience an increase in flood water level of less than 5 mm. The largest catchment in this study, upstream of crossing 24 produces a 100-yr flood peak of 2 109 m^3/s. This will increase to 2 530 m^3/s if increased by 20%. The resultant increase in flood water level at crossing point 24 is 210 mm (0.21 m).

4.3 Closure and Rehabilitation

4.3.1 Construction camp removal

After the completion of construction activities, concurrent rehabilitation will be conducted when a campsite is removed, this area will be cleared and cleaned of any debris, topsoil re-established and revegetated. During decommissioning, similar activities to the construction phase will take place. These activities may introduce silt and hydrocarbons into nearby streams and rivers.

5 BASELINE CONDITIONS

5.1 Site Description/Project Location

The Project is located South of the centre of Angola, in the provinces of Huila and Huambo (***Figure 5-1***). The Project powerline extends for about 170 km, crossing six municipalities which include Jamba, Kuvango, Dongo, Galangue, Chipindo and Kalima.

The main works will be carried out largely in Huila Province near the Gove Hydro Dam (Huambo) 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 associated with the electrification of villages at Chipindo, Cuvango and Jamba will be constructed. The project will also include a 30 kV Medium Voltage OHL network to the new substations and a Low Voltage network to supply electricity to 1 000 homes in each of the three villages (refer to ***Figure 1-1*** to ***Figure 1-3*** on page 10 and 11).



Figure 5-1: Location of the proposed 220 kV OHL and the towns it will supply with electricity

5.2 Local and Regional Context

5.2.1 Hydrological setting

The project is a 170 km long linear project that has 104 points where it crosses rivers or streams. Most of these streams are first order streams, being tributaries of larger river systems in the area. The main river systems that flow through the study area are:

- Cuandeja River (a tributary of the Cunene River)
- Cubango River
- Cunene River

These are shown in ***Figure 5-3***.

5.2.2 Area of Influence

The area of influence (AoI) for this study considered the 220 kV overhead line, substations and smaller distribution lines within Jamba, Cuvango and Chipindo (refer to ***Figure 5-1***). During the construction, operations and closure periods, downstream impacts on all river systems that are crossed are expected. These impacts are expected to be mainly during the construction period. The impacts are likely to be small. Considering this, the AoI for the hydrology study was established to be the first and second order streams that the power lines cross or where substations are located (refer to ***Figure 5-2***). The impacts are likely to be insignificant due to dilution by the time streams reach their third order. Stream orders refer to the Strahler stream order system (top-down system).

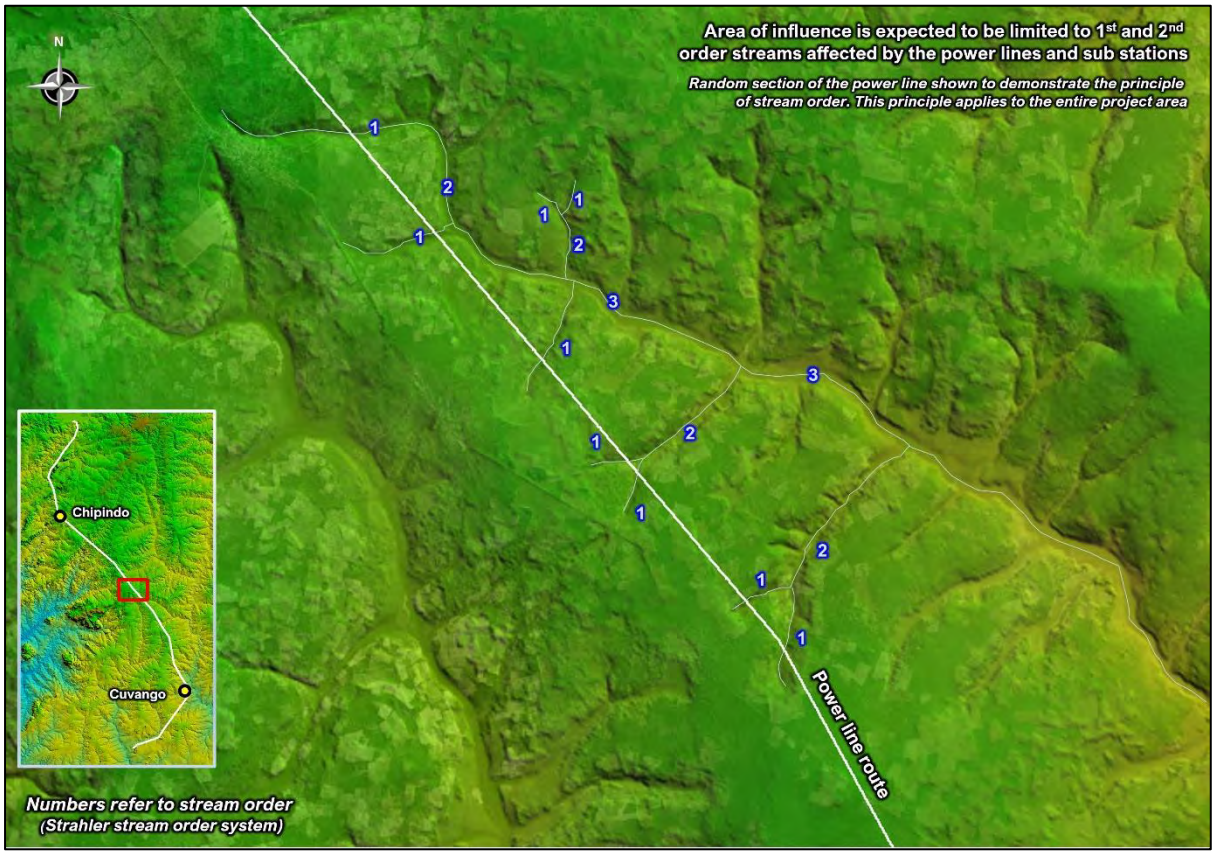


Figure 5-2: Area of influence

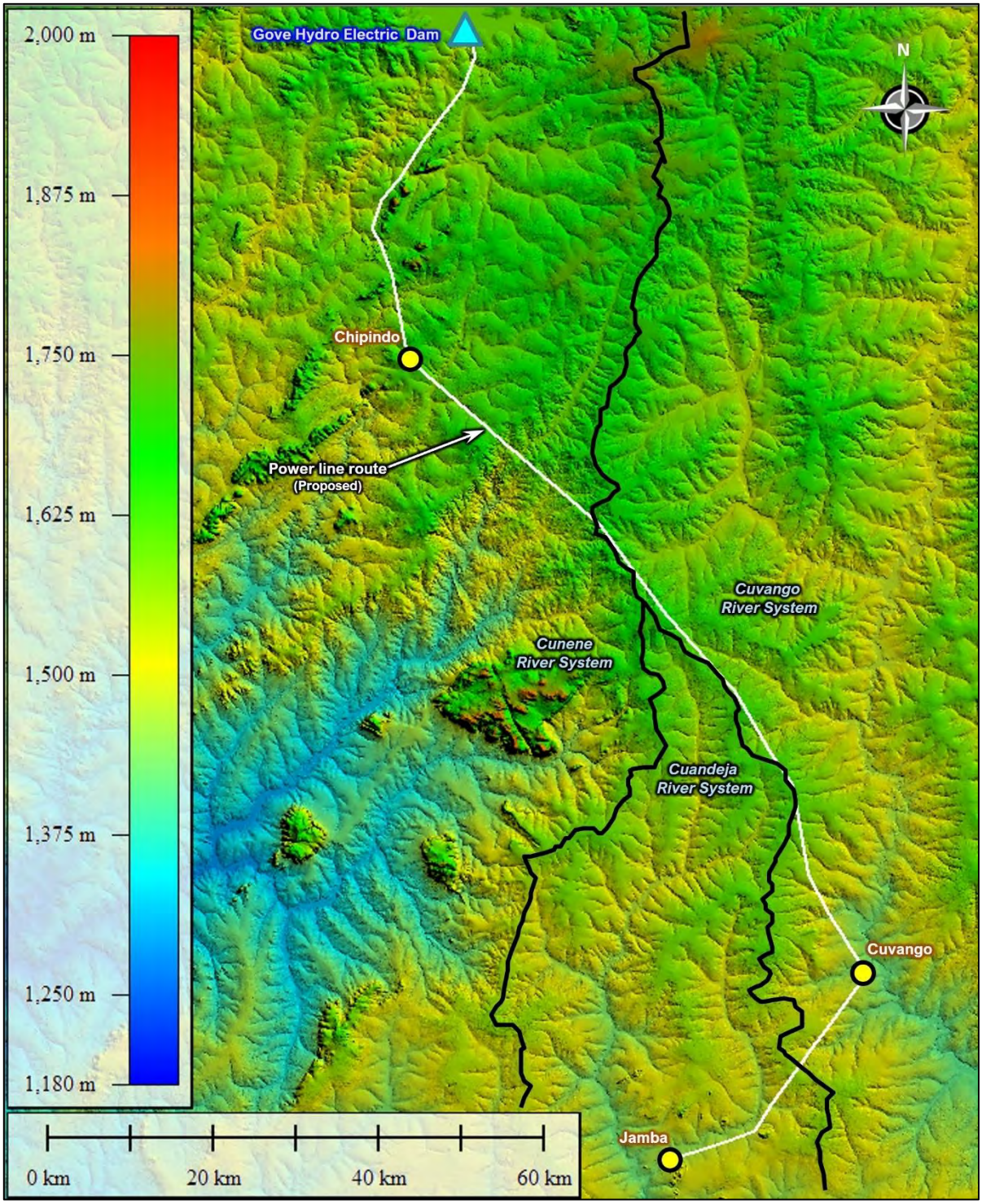


Figure 5-3: Main river systems

5.3 Ambient Conditions

5.3.1 Baseline rainfall and evaporation

The baseline rainfall and evaporation data for each gauge are provided in ***Figure 5-4*** to ***Figure 5-7***.

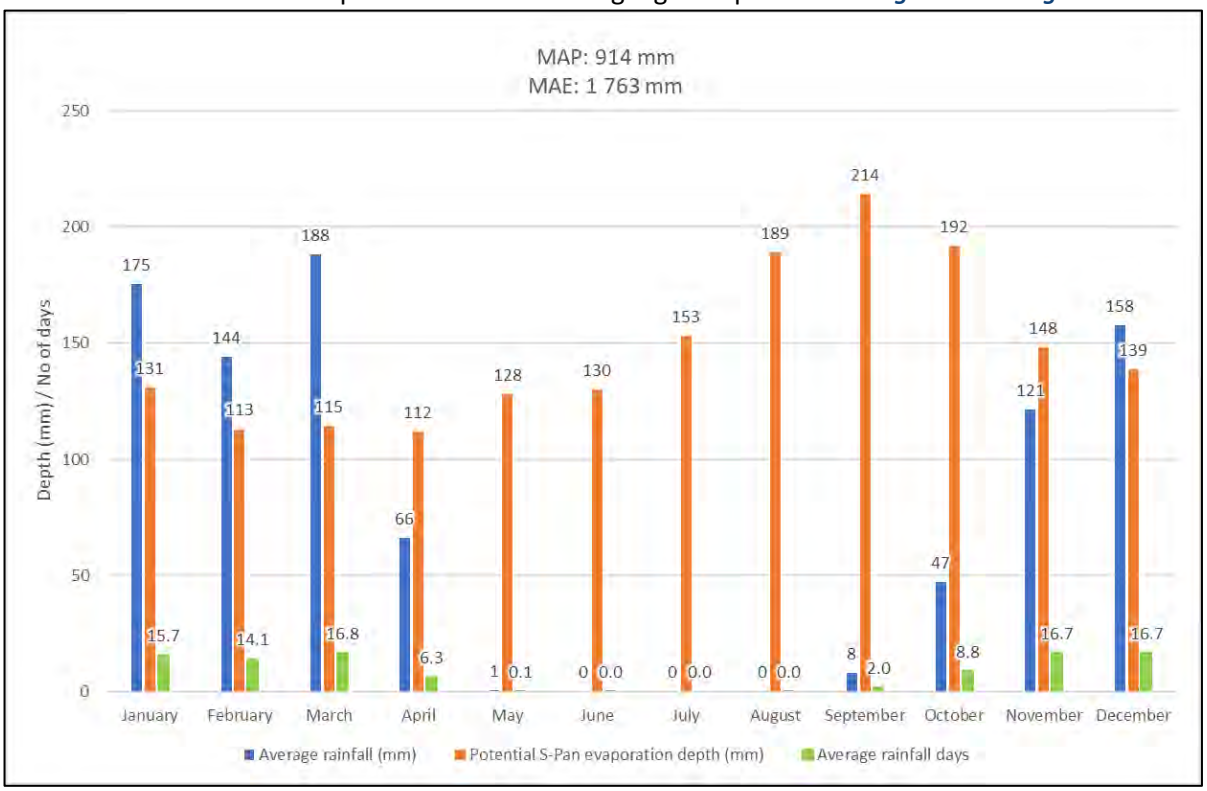


Figure 5-4: Baseline rainfall and evaporation (Cuanja)

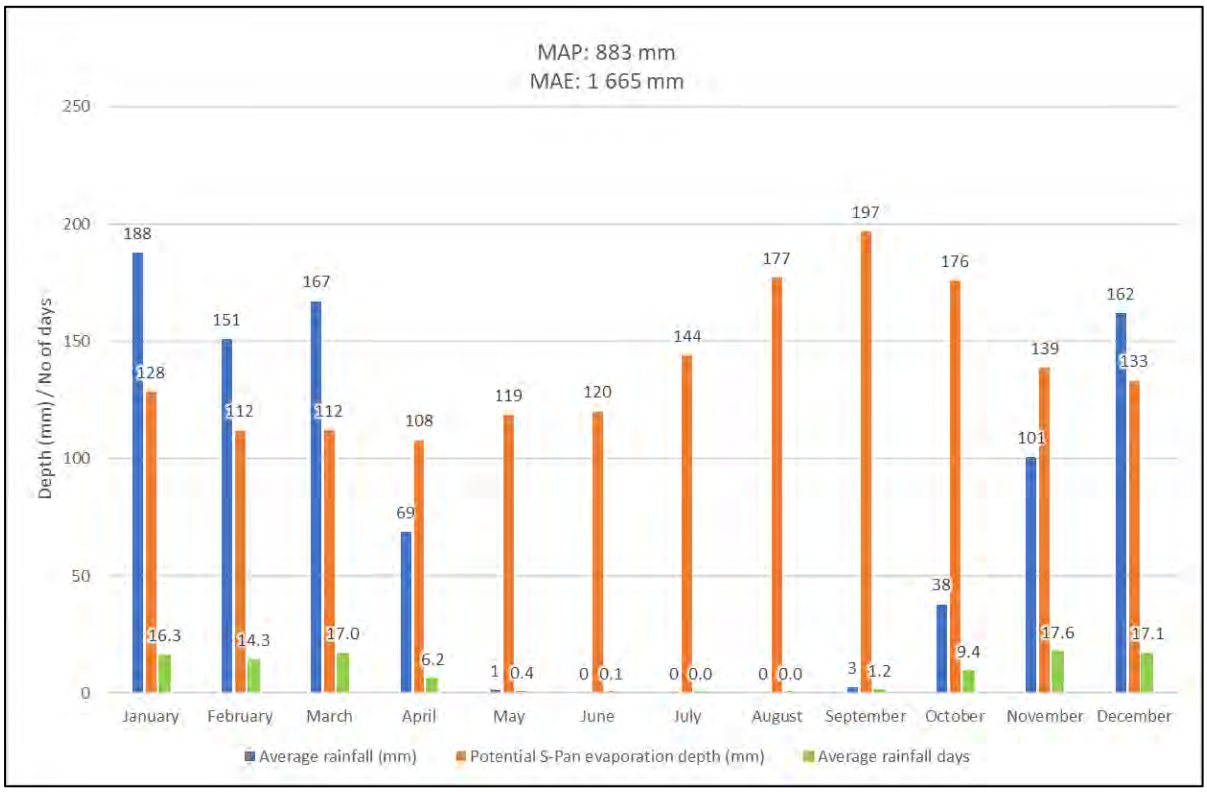


Figure 5-5: Baseline rainfall and evaporation (Cuvango)

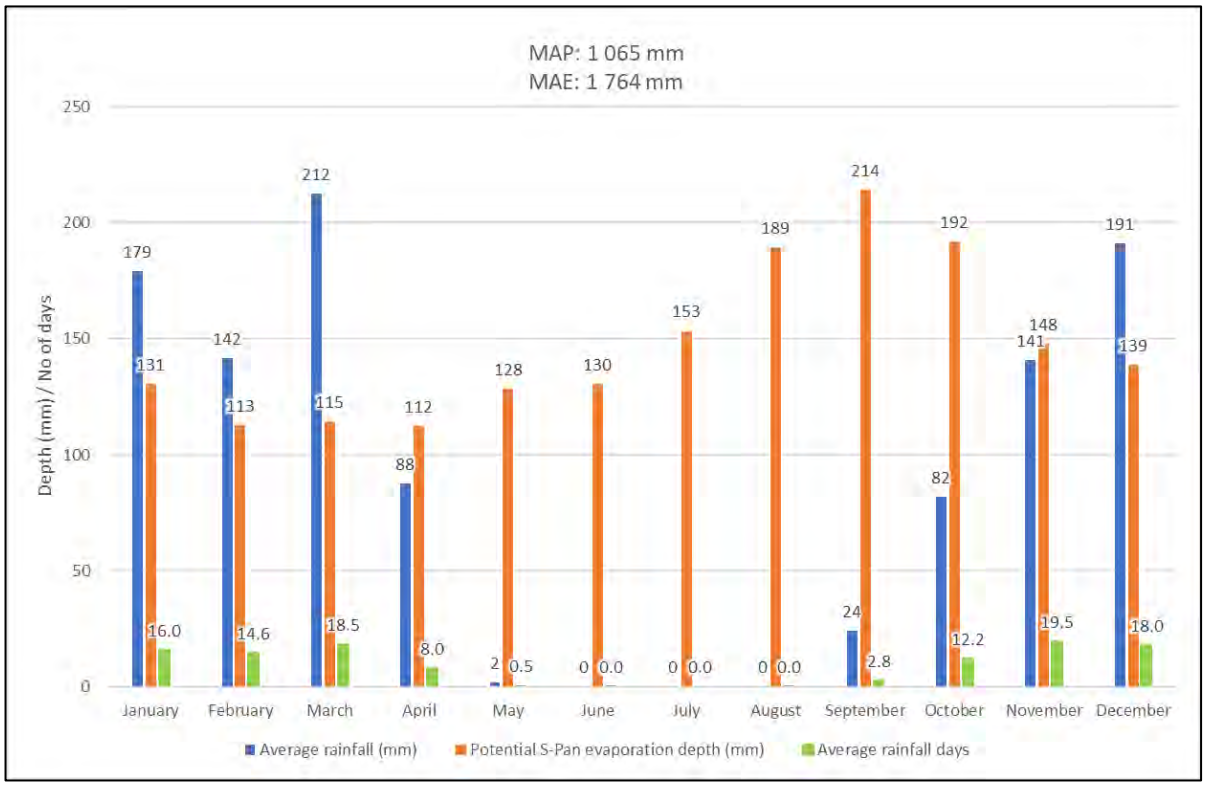


Figure 5-6: Baseline rainfall and evaporation (Chipindo)

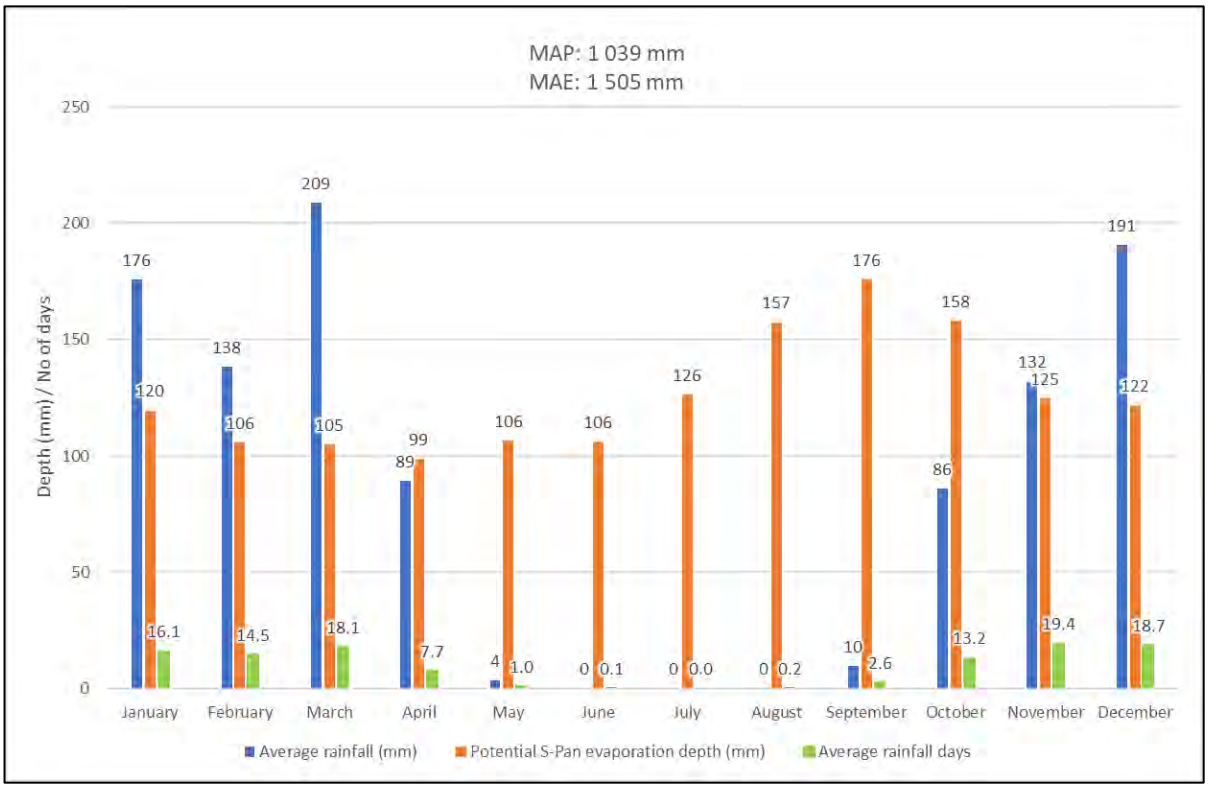


Figure 5-7: Baseline rainfall and evaporation (Gove)

5.3.2 Peak rainfall

The IDF storm depths calculated for each gauge are presented in Table 5-1 to Table 5-4.

Table 5-1: IDF storm depths (Cuanja)

Duration	Recurrence interval (yr)							
(hr)	10	20	50	100	200	500	1000	10000
0.1	9	10	12	13	15	17	18	24
0.25	17	19	22	25	28	31	35	46
0.5	24	27	32	36	40	45	50	66
1	31	35	42	47	52	59	65	86
2	37	42	50	56	62	71	78	103
3	41	46	55	61	67	76	84	112
4	43	48	57	64	71	80	89	117
5	44	50	59	66	72	82	91	120
6	45	51	61	68	75	85	94	124
7	46	52	62	69	76	87	96	127
8	47	53	63	70	77	88	97	129
9	47	54	64	71	78	89	98	130
10	48	54	64	72	79	90	99	132
11	48	55	65	73	80	91	100	133
12	49	55	66	73	81	92	102	134
13	49	56	66	74	81	93	102	135
14	50	56	67	74	82	93	103	136
15	50	57	67	75	83	94	104	137
16	50	57	68	75	83	95	104	138
17	51	57	68	76	84	95	105	139
18	51	58	69	76	84	96	106	140
19	51	58	69	77	85	96	106	141
20	51	58	69	77	85	97	107	141
21	51	58	69	77	85	97	107	142
22	52	59	70	77	85	97	107	142
23	52	59	70	78	86	98	108	143
24	52	59	70	78	86	98	108	143

Table 5-2: IDF storm depths (Cuvango)

Duration	Recurrence interval (yr)							
(hr)	10	20	50	100	200	500	1000	10000
0.1	9	10	11	12	14	15	17	22
0.25	16	18	21	23	26	29	31	41
0.5	23	26	30	33	37	41	45	59
1	30	34	39	43	48	54	59	77
2	36	40	47	52	58	65	71	93
3	39	44	51	56	62	70	76	101
4	41	46	53	59	66	74	80	106
5	42	47	55	60	67	76	82	108
6	44	49	57	63	70	78	85	112
7	44	50	58	64	71	80	87	114
8	45	50	59	65	72	81	88	116
9	46	51	59	66	73	82	89	117
10	46	52	60	66	74	83	90	119
11	47	52	60	67	74	84	91	120
12	47	53	61	68	75	85	92	121
13	47	53	62	68	76	85	93	122
14	48	53	62	69	76	86	93	123
15	48	54	62	69	77	86	94	124
16	48	54	63	70	77	87	95	125
17	49	55	63	70	78	88	95	126
18	49	55	64	71	78	88	96	126
19	49	55	64	71	79	89	96	127
20	49	55	64	71	79	89	97	127
21	50	55	64	71	79	89	97	128
22	50	56	65	72	79	89	97	128
23	50	56	65	72	80	90	98	129
24	50	56	65	72	80	90	98	129

Table 5-3: IDF storm depths (Chipindo)

Duration	Recurrence interval (yr)							
(hr)	10	20	50	100	200	500	1000	10000
0.1	8	9	10	11	12	14	15	19
0.25	16	17	20	21	23	26	28	35
0.5	23	25	28	31	34	37	40	50
1	29	32	37	40	44	49	52	65
2	35	39	44	48	53	58	63	78
3	38	42	48	52	57	63	68	85
4	40	44	50	55	60	66	71	89
5	41	45	51	56	61	68	73	92
6	43	47	53	58	64	70	76	95
7	43	48	54	59	65	72	77	96
8	44	49	55	60	66	73	78	98
9	45	49	56	61	66	74	79	99
10	45	50	56	62	67	75	80	100
11	46	50	57	62	68	75	81	101
12	46	51	57	63	69	76	82	102
13	46	51	58	63	69	77	82	103
14	47	51	58	64	70	77	83	104
15	47	52	59	64	70	78	84	105
16	47	52	59	65	71	78	84	105
17	48	53	59	65	71	79	85	106
18	48	53	60	66	72	79	85	107
19	48	53	60	66	72	80	86	107
20	48	53	60	66	72	80	86	108
21	49	53	60	66	72	80	86	108
22	49	54	61	67	73	80	86	108
23	49	54	61	67	73	81	87	109
24	49	54	61	67	73	81	87	109

Table 5-4: IDF storm depths (Gove)

Duration	Recurrence interval (yr)							
(hr)	10	20	50	100	200	500	1000	10000
0.1	8	9	10	10	11	12	13	16
0.25	14	16	18	20	21	23	25	31
0.5	21	23	26	28	30	34	36	45
1	27	30	34	37	40	44	47	58
2	32	36	40	44	48	53	56	70
3	35	39	44	48	51	57	61	76
4	37	41	46	50	54	60	64	80
5	38	42	47	51	55	61	66	81
6	39	44	49	53	57	64	68	84
7	40	44	50	54	58	65	69	86
8	41	45	50	55	59	66	70	87
9	41	46	51	56	60	66	71	88
10	41	46	52	56	61	67	72	89
11	42	47	52	57	61	68	73	90
12	42	47	53	57	62	69	73	91
13	43	47	53	58	62	69	74	92
14	43	48	53	58	63	70	74	92
15	43	48	54	59	63	70	75	93
16	44	48	54	59	64	71	75	94
17	44	49	55	59	64	71	76	94
18	44	49	55	60	65	72	76	95
19	44	49	55	60	65	72	77	95
20	44	49	55	60	65	72	77	96
21	45	50	55	60	65	72	77	96
22	45	50	56	61	66	73	77	96
23	45	50	56	61	66	73	78	97
24	45	50	56	61	66	73	78	97

5.3.3 Runoff

The daily average stream flow and mean annual runoff at each crossing point are shown in Appendix B.

The flows presented in Appendix B are consistent with site observations, and the flows are therefore deemed representative of the flows in the river systems.

Agricultural practices in the catchments are resulting in deforestation. Forests (technically Miombo woodlands) are cleared to make way for subsidence and low-intensity commercial agricultural activities. The original forests are generally left in the vicinity of the larger rivers. This deforestation will alter catchment response to rainfall events. The common theory that deforestation increases runoff is not necessarily the case (FAO, 2005).

Interception/canopy storage will be significantly reduced with deforestation, resulting in additional water available for runoff. Drier, more exposed soils may result in higher initial infiltration rates following storm events. Ploughing will increase depression storage. These two additional losses will counter and could even exceed the loss of interception/canopy storage, resulting in reduced runoff. The problem is complex though and will depend on many factors such as agricultural practices, topography, geomorphology, geology, catchment size, rainfall event size and many more factors. The increased infiltration and depression storage will increase recharge, which will return to the streams as baseflow again, albeit delayed. No data is available to confirm this supposition, or to suggest an increase or decrease in runoff in the AoI, as the bulk of the deforestation occurred years before the start of the project and no streamflow data is available during the time when the forests existed untouched. It is suggested that the deforestation may not be significantly affecting runoff in the AoI.

5.3.4 Water quality

The analysed water quality data is summarised in Table 5-5. Shaded values exceed recommended allowable limits set out in Table 3-2, on page 21.

The water quality is poor from a bacteriological perspective with Salmonella and coliforms present in most samples, including WQ8 which has limited upstream agricultural activity and no urban settlements. WQ9 has the highest Coliform bacteria count, but Salmonella is absent. This sampling point is located between 2 villages. It is also one of 3 sampling locations with an elevated APHA colour. The other two being WQ1 and WQ2 which are impacted by Jamba.

Iron is elevated in WQ1, 2, 12 and 14. These catchments do not share any development characteristic that may cause elevated Iron content and the elevated Iron concentrations are thus attributed to natural background conditions.

Ammonium and CBO_5 are elevated at all sampling locations.

Hydrocarbons and elevated salts and metals are absent in all samples. The background water quality shows significant human impact in all streams.

Table 5-5: Water quality results

Determinant	Units	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ8	WQ9	WQ10	WQ12	WQ13	WQ14	WQ16	WQX
Coliform Bacteria	Counts/100ml	52	236	52	24	308	261	179	1414	6	326	108	727	649	75
E coli	Counts/100ml	4	3	1	<1	4	<1	<1	3	<1	1	4	11	39	<1
Feacal coliforms	Counts/100ml	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/100ml	2	2	1	<1	19	15	1	17	2	<1	<1	9	81	11
Pseudomonas aeruginosa	Counts/100ml	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)
CBO_5 (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)
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_2O_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)
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)

DL: Detection limit

Shaded values exceed recommended allowable limits set out in Table 3-2.

5.4 Photographs



Figure 5-8: Bridge at river crossing point 1



Figure 5-9: Wide, poorly defined channel, common to many of the river systems that are crossed



Figure 5-10: Bridge at crossing point 24



Figure 5-11: Crossing point 23



Figure 5-12: Crossing point 49



Figure 5-13: Crossing point 77



Figure 5-14: Crossing point 84



Figure 5-15: Crossing point 104

6 IDENTIFICATION OF ISSUES

The impacts on the project are divided into the construction phase, the operational phase, and the closure and rehabilitation phase of the project. These are discussed below:

6.1 Construction Phase

The following potential impacts could occur during the construction phase:

- Siltation of receiving streams
- Hydrocarbon pollution in receiving streama

These impacts will be limited to the wet season where normal surface runoff will wash the pollutants into the receiving streams and rivers.

6.2 Operational Phase

The following potential impacts could occur during the operational phase:

- Siltation of receiving streams
- Hydrocarbon pollution in receiving streama

These impacts will be limited to the wet season where normal surface runoff will wash the pollutants into the receiving streams and rivers.

High flow events may cause scouring around pylon foundations if they are constructed within flow zones.

Climate change may increase the flood peaks and therefore flood levels.

6.3 Closure and Rehabilitation Phase

The following potential impacts could occur during the closure and rehabilitation phase:

- Siltation of receiving streams
- Hydrocarbon pollution in receiving streama

These impacts will be limited to the wet season where normal surface runoff will wash the pollutants into the receiving streams and rivers.

7 PERMIT REQUIREMENTS

It is common practice to construct all infrastructure outside of a defined floodline. In this case, it is considered best practice to construct outside of the 100-year floodline.

8 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS FOR THE CONSTRUCTION, OPERATION AND DECOMMISSIONING PHASES

8.1 Impact Statement

Surface water impacts are expected to be small and limited to the first and second order streams (Strahler stream order system). The disturbed footprints are very small compared to the footprints disturbed by agriculture. The incremental surface water siltation impacts will be unnoticed third order streams in areas where agriculture is present and will be limited to river reaches near construction works. Impacts will occur during the wet season only.

If the construction and maintenance fleet are well-maintained, hydrocarbon pollution is expected to be negligible.

8.2 Impact Assessments

8.2.1 Construction phase

Table 8-1: Impact 1: Siltation of receiving river systems – access road (and possible river crossing) construction

Activity: Access road (and possible river crossing) construction								
Project phase: Construction phase								
Impact Summary: Siltation of river systems, local disturbance to river banks and channels								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Definite*	***Medium***	-	*Medium*
Management Measures: • **The revegetation of disturbed non active cleared areas must take place within 1 month of completing the construction phase**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Definite*	***Low***	-	*Medium*

Table 8-2: Impact 2: Impact 2: Siltation of receiving river systems – pylon foundation construction

Activity: Pylon foundation construction								
Project phase: Construction phase								
Impact Summary: Siltation of river systems								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*
Management Measures: • **The revegetation of disturbed non active cleared areas must take place within 1 month of completing the construction phase**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

Table 8-3: Impact 3: Hydrocarbon pollution – vehicle traffic, overnight laydown and in-field servicing

Activity: Construction vehicle traffic, overnight laydown and in-field servicing								
Project phase: Construction phase								
Impact Summary: Hydrocarbon pollution								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Short term*	*Local*	***Low***	*Possible*	***Medium***	-	*Medium*
Management Measures: • **Regular inspections (and repair when necessary) of construction plant** • **In-field service areas to be roofed and bunded**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

Table 8-4: Impact 4: Hydrocarbon pollution – transformer oil leaks (or discharge if ruptured)

Activity: Transformers at the substations may leak (or discharge if ruptured) oil.								
Project phase: Operational phase								
Impact Summary: Hydrocarbon pollution								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Short term*	*Local*	***Medium***	*Possible*	***Medium***	-	*Medium*
Management Measures: • **Transformers to be located within bunded areas**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Unlikely*	***Low***	-	*Medium*

Table 8-5: Impact 5: River pollution

Activity: Construction camp grey and black water management								
Project phase: Construction phase								
Impact Summary: River pollution								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Short term*	*Local*	***Medium***	*Possible*	***Medium***	-	*Medium*
Management Measures: • **French drains to be adequately sized if used** • **Septic tanks to be emptied regularly if used**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

8.2.2 Operational phase

Table 8-6: Impact 6: Hydrocarbon pollution

Activity: Construction vehicle traffic, overnight laydown and in-field servicing								
Project phase: Operational phase								
Impact Summary: Hydrocarbon pollution								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Short term*	*Local*	***Low***	*Possible*	***Medium***	-	*Medium*
Management Measures: • **Regular inspections (and repair when necessary) of construction plant** • **In-field service areas to be roofed and bunded**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

Table 8-7: Impact 7: Siltation of receiving river systems – access road erosion

Activity: Access road (and possible river crossing) construction								
Project phase: Operational phase								
Impact Summary: Siltation of river systems								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor*	*Long term*	*Local*	***Medium***	*Possible*	***Medium***	-	*Medium*
Management Measures: • **Erosion gullies repaired immediately**								
After Management	*Minor*	*Long term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

Table 8-8: Impact 8: Siltation of receiving river systems – pylon foundation scouring

Activity: Pylon foundation scouring								
Project phase: Operational phase								
Impact Summary: Siltation of river systems								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor*	*Long term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*
Management Measures: • **Pylons to be constructed outside of the 100-yr floodlines where practical. Conservative offsets from the stream centerlines have been provided in Appendix B to approximate the 100-yr floodlines. Pylons required to be built within these offsets may require backwater analyses to determine flow velocities at pylon plinths.**								
After Management	*Minor*	*Long term*	*Local*	***Low***	*Unlikely*	***Low***	-	*Medium*

Table 8-9: Impact 9: Climate change impacts on flood levels

Activity: Climate change								
Project phase: Operational phase								
Impact Summary: Increase in flood level								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor*	*Long term*	*Local*	***Low***	*Possible*	***Low***	-	*High*
Management Measures: • **No mitigation required. The impacts are less than typical wave heights**								
After Management	*Minor*	*Long term*	*Local*	***Low***	*Possible*	***Low***	-	*High*

8.2.3 Closure and rehabilitation

Table 8-10: Impact 10: Siltation of receiving river systems – construction camp removal

Activity: Construction camp removal								
Project phase: Closure and rehabilitation								
Impact Summary: Siltation of river systems								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Definite*	***Medium***	-	*Medium*
Management Measures: • **The revegetation of disturbed non active cleared areas must take place within 1 month of completing the construction phase**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

8.3 Cumulative Impacts

Agriculture dominates almost all catchments that are being affected by the power line. Much of this land has been cleared of natural vegetation and the land lies exposed for many months of the year, including some of the wet season. Erosion and sedimentation from these extensive areas will be orders of magnitude larger than erosion and sedimentation from the activities linked to the power line. The cumulative impacts are therefore negligible in these catchments. The cumulative sedimentation impacts in the few catchments that are not dominated by agricultural (less than 10% of the catchments) are also negligible due to the anticipated small sedimentation impacts.

Hydrocarbon pollution is unlikely to occur in most of the smaller river systems. The bigger river systems will have limited hydrocarbon pollution, but dilution effects will likely render hydrocarbon concentrations very low to undetectable. Cumulative hydrocarbon pollution impacts are expected to be low due to the anticipated low hydrocarbon pollution impacts.

8.4 Summary of Impacts

A summary of impacts is presented in Table 8-11.

Table 8-11: Summary of impacts

Impact	Table reference	Pre mitigation significance	Post mitigation significance
Impact 1: Siltation of receiving river systems – access road construction	Table 8-1	Medium	Low
Impact 2: Impact 2: Siltation of receiving river systems – pylon foundation construction	Table 8-2	Low	Low
Impact 3: Hydrocarbon pollution – vehicle traffic, overnight laydown and in-field servicing	Table 8-3	Medium	Low
Impact 4: Hydrocarbon pollution – transformer oil leaks (or discharge if ruptured)	Table 8-4	Medium	Low
Impact 5: River pollution	Table 8-5	Medium	Low
Impact 6: Hydrocarbon pollution	Table 8-6	Medium	Low
Impact 7: Siltation of receiving river systems – access road erosion	Table 8-7	Medium	Low
Impact 8: Siltation of receiving river systems – pylon foundation scouring	Table 8-8	Low	Low
Impact 9: Climate change impacts on flood levels	Table 8-9	Low	Low
Impact 10: Siltation of receiving river systems – construction camp removal	Table 8-10	Medium	Low

9 RECOMMENDATIONS FOR THE ESMP

Hydrocarbon pollution monitoring should be undertaken on streams near construction vehicle overnight laydown, and in-field servicing areas, contractor camps, and substations. This monitoring should be done monthly initially. If no signs of hydrocarbon pollution are found after three consecutive months, the monitoring frequency can be reduced to quarterly and then bi-annually.

In addition to hydrocarbon monitoring at these locations, the parameters listed in Table 3-2 must be monitored monthly. If possible, an upstream and downstream (of the construction related infrastructure) sample must be taken. The hydrocarbon sample should only be taken upstream of the construction related facility if hydrocarbons are found. This will confirm whether the hydrocarbon pollution is coming from upstream of the construction related facility or not.

10 CONCLUSION AND IMPACT STATEMENT

The results of the baseline assessment indicate a negatively impacted river system. This is currently based on visual observations made during the site visit. This will be confirmed with water quality monitoring data when this becomes available. These impacts are water quality impacts, mainly due to the agricultural and domestic activities within most of the river catchments. Flow and flood peak impacts due to the agricultural activities in the catchments are suggested to be negligible.

The outcomes of the impact assessment indicated that the proposed infrastructure may intersect with delineated and possibly sensitive freshwater habitats.

All power transmission infrastructure should be constructed above the 100-year floodline where practical. In areas where this is not practical, scour protection must be constructed around the pylon foundation footings. To alleviate the need for detailed survey of all 104 river crossings, conservative offsets from the stream centerline are provided in Appendix B. Where pylons are required to be placed within these offsets, backwater analyses may be required to determine flow velocities at pylon plinths. This will account for backwater effects of any downstream controls in channels that have subcritical flow regimes.

All substations must be constructed above the 100-yr floodline. In areas where this is not practical, or in areas where infrastructure is located close to the floodline, a levee must be constructed to protect infrastructure from flooding. The levee specifications must account for the hydraulic characteristics of the flow against the levee.

A water quality monitoring program must be set up. Monthly water quality monitoring must be done as outlined in Section 9 of this report.

With adequate mitigation measures put in place, the impacts on the surface water resources are expected to be low.

11 REFERENCES

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Appendix A
Crossing locations

Point	X	Y	LATITUDE	LONGITUDE
	UTM 35S			
1	-689293.895	8345484.692	14° 42' 05.4704" S	16° 00' 44.0302" E
2	-688657.803	8345651.074	14° 42' 01.1559" S	16° 01' 05.1782" E
3	-687458.308	8345805.548	14° 41' 58.1071" S	16° 01' 44.8007" E
4	-686438.625	8344133.252	14° 42' 53.1422" S	16° 02' 15.5723" E
5	-688158.291	8347454.633	14° 41' 04.3177" S	16° 01' 24.4872" E
6	-684292.831	8349645.51	14° 40' 00.3742" S	16° 03' 34.8912" E
7	-683624.032	8349834.061	14° 39' 55.3950" S	16° 03' 57.1467" E
8	-682820.332	8350093.129	14° 39' 48.3723" S	16° 04' 23.9434" E
9	-680695.178	8350804.883	14° 39' 28.9428" S	16° 05' 34.8430" E
10	-679176.862	8351309.152	14° 39' 15.1918" S	16° 06' 25.4908" E
11	-677091.817	8352087.05	14° 38' 53.5711" S	16° 07' 35.1800" E
12	-675314.681	8353435.559	14° 38' 13.2261" S	16° 08' 35.6688" E
13	-673978.4	8355589.364	14° 37' 06.4495" S	16° 09' 22.9591" E
14	-670443.631	8360446.851	14° 34' 36.6187" S	16° 11' 26.6780" E
15	-669212.479	8362250.138	14° 33' 40.8585" S	16° 12' 09.9315" E
16	-668899.295	8362664.894	14° 33' 28.0787" S	16° 12' 20.8640" E
17	-668625.095	8363020.482	14° 33' 17.1305" S	16° 12' 30.4236" E
18	-666902.4	8365266.932	14° 32' 07.9430" S	16° 13' 30.4951" E
19	-666759.618	8365464.325	14° 32' 01.8499" S	16° 13' 35.4910" E
20	-665737.176	8366865.286	14° 31' 18.6168" S	16° 14' 11.2438" E
21	-665138.593	8367685.739	14° 30' 53.2957" S	16° 14' 32.1734" E
22	-662976.671	8370647.682	14° 29' 21.8725" S	16° 15' 47.7503" E
23	-662483.126	8372371.919	14° 28' 27.4850" S	16° 16' 06.6311" E
24	-661827.936	8373227.192	14° 28' 01.1276" S	16° 16' 29.4622" E
25	-664774.349	8375336.731	14° 26' 49.2102" S	16° 14' 56.0541" E
26	-664914.046	8375570.684	14° 26' 41.5179" S	16° 14' 51.8341" E
27	-666699.54	8378366	14° 25' 09.4351" S	16° 13' 57.5986" E
28	-668044.269	8380879.884	14° 23' 47.0228" S	16° 13' 17.3913" E
29	-668207.756	8381184.522	14° 23' 37.0353" S	16° 13' 12.5017" E
30	-669499.213	8384008.026	14° 22' 04.8090" S	16° 12' 34.5261" E
31	-669756.932	8385488.062	14° 21' 17.1010" S	16° 12' 28.3693" E
32	-670534.722	8389938.678	14° 18' 53.6369" S	16° 12' 09.7556" E
33	-673727.873	8397884.78	14° 14' 34.7966" S	16° 10' 37.3506" E
34	-675082.119	8400122.77	14° 13' 21.2174" S	16° 09' 56.4188" E
35	-678142.464	8405398.276	14° 10' 27.9841" S	16° 08' 24.2712" E
36	-678675.793	8406040.674	14° 10' 06.6494" S	16° 08' 07.7883" E
37	-680464.156	8408044.895	14° 08' 59.9024" S	16° 07' 12.2921" E
38	-680578.616	8408172.417	14° 08' 55.6546" S	16° 07' 08.7393" E
39	-681945.763	8409704.824	14° 08' 04.6229" S	16° 06' 26.3204" E
40	-682768.512	8410626.899	14° 07' 33.9169" S	16° 06' 00.7947" E
41	-683085.32	8410982.152	14° 07' 22.0871" S	16° 05' 50.9665" E
42	-683560.062	8411514.206	14° 07' 04.3696" S	16° 05' 36.2388" E
43	-684903.211	8413019.846	14° 06' 14.2332" S	16° 04' 54.5745" E

Point	X	Y	LATITUDE	LONGITUDE
	UTM 35S			
44	-686210.253	8414486.002	14° 05' 25.4144" S	16° 04' 14.0360" E
45	-687489.914	8416116.637	14° 04' 31.3824" S	16° 03' 34.6513" E
46	-689021.637	8418174.463	14° 03' 23.3228" S	16° 02' 47.6771" E
47	-689757.642	8419164.672	14° 02' 50.5759" S	16° 02' 25.1098" E
48	-691301.765	8421246.752	14° 01' 41.7274" S	16° 01' 37.7755" E
49	-692900.195	8423429.074	14° 00' 29.5978" S	16° 00' 48.8239" E
50	-692986.467	8423546.711	14° 00' 25.7096" S	16° 00' 46.1818" E
51	-694762.785	8425837.384	13° 59' 09.8549" S	15° 59' 51.5831" E
52	-695471.283	8426449.553	13° 58' 49.2327" S	15° 59' 29.3445" E
53	-696676.158	8427491.577	13° 58' 14.1323" S	15° 58' 51.5296" E
54	-696732.722	8427540.498	13° 58' 12.4844" S	15° 58' 49.7545" E
55	-696952.486	8427730.287	13° 58' 06.0910" S	15° 58' 42.8572" E
56	-697117.571	8427873.537	13° 58' 01.2666" S	15° 58' 37.6772" E
57	-699491.818	8429926.657	13° 56' 52.1097" S	15° 57' 23.1738" E
58	-700145.44	8430493.468	13° 56' 33.0206" S	15° 57' 02.6681" E
59	-700639.642	8430906.96	13° 56' 19.0690" S	15° 56' 47.1412" E
60	-700788.797	8431014.701	13° 56' 15.4031" S	15° 56' 42.4289" E
61	-701644.874	8431739.169	13° 55' 50.9739" S	15° 56' 15.5469" E
62	-702824.755	8432770.999	13° 55' 16.2402" S	15° 55' 38.5512" E
63	-703136.814	8433044.999	13° 55' 07.0188" S	15° 55' 28.7687" E
64	-704284.084	8434047.782	13° 54' 33.2629" S	15° 54' 52.7986" E
65	-704754.959	8434459.977	13° 54' 19.3888" S	15° 54' 38.0372" E
66	-704852.87	8434545.576	13° 54' 16.5074" S	15° 54' 34.9678" E
67	-705098.269	8434733.601	13° 54' 10.1326" S	15° 54' 27.2338" E
68	-705546.738	8435046.322	13° 53' 59.4695" S	15° 54' 13.0526" E
69	-707872.952	8437141.697	13° 52' 49.0451" S	15° 53' 00.2315" E
70	-709042.873	8438183.28	13° 52' 14.0188" S	15° 52' 23.5936" E
71	-709654.331	8438681.146	13° 51' 57.1981" S	15° 52' 04.3744" E
72	-710059.957	8438987.626	13° 51' 46.7996" S	15° 51' 51.5887" E
73	-710299.64	8439151.914	13° 51' 41.1920" S	15° 51' 44.0079" E
74	-710548.118	8439444.943	13° 51' 31.4598" S	15° 51' 36.3383" E
75	-711580.753	8440288.976	13° 51' 02.9505" S	15° 51' 03.8899" E
76	-711858.155	8440570.738	13° 50' 53.5348" S	15° 50' 55.2584" E
77	-714507.565	8442907.567	13° 49' 34.9215" S	15° 49' 32.2834" E
78	-717999.226	8446762.814	13° 47' 26.5617" S	15° 47' 44.1526" E
79	-718730.736	8450663.337	13° 45' 20.9264" S	15° 47' 26.2692" E
80	-719153.461	8452917.883	13° 44' 08.3098" S	15° 47' 15.9314" E
81	-719248.362	8453426.489	13° 43' 51.9291" S	15° 47' 13.6139" E
82	-719437.032	8454430.187	13° 43' 19.6008" S	15° 47' 08.9947" E
83	-719812.31	8456204.146	13° 42' 22.4011" S	15° 46' 59.4636" E
84	-720367.471	8457683.135	13° 41' 34.3499" S	15° 46' 43.6048" E
85	-720739.482	8458673.37	13° 41' 02.1780" S	15° 46' 32.9766" E
86	-721196.346	8459803.22	13° 40' 25.4223" S	15° 46' 19.7919" E
87	-721870.042	8462244.054	13° 39' 06.4897" S	15° 46' 01.5359" E

Point	X	Y	LATITUDE	LONGITUDE
	UTM 35S			
88	-721792.384	8462482.734	13° 38' 58.9861" S	15° 46' 04.4363" E
89	-721320.471	8463931.476	13° 38' 13.4406" S	15° 46' 22.0570" E
90	-721143.58	8464473.955	13° 37' 56.3859" S	15° 46' 28.6601" E
91	-719733.823	8466448.57	13° 36' 55.4468" S	15° 47' 17.6909" E
92	-718118.94	8468624.488	13° 35' 48.3770" S	15° 48' 13.7146" E
93	-715130.197	8473152.698	13° 33' 28.2179" S	15° 49' 58.1301" E
94	-714570.216	8473883.682	13° 33' 05.7031" S	15° 50' 17.5116" E
95	-714182.832	8474389.188	13° 32' 50.1326" S	15° 50' 30.9184" E
96	-713790.813	8474900.988	13° 32' 34.3673" S	15° 50' 44.4854" E
97	-712980.369	8475958.51	13° 32' 01.7907" S	15° 51' 12.5305" E
98	-712064.118	8477154.894	13° 31' 24.9325" S	15° 51' 44.2352" E
99	-711964.15	8477285.621	13° 31' 20.9046" S	15° 51' 47.6945" E
100	-711360.173	8478072.364	13° 30' 56.6668" S	15° 52' 08.5889" E
101	-710981.237	8478835.056	13° 30' 32.8653" S	15° 52' 22.1010" E
102	-709987.795	8481499.748	13° 29' 09.2182" S	15° 52' 58.5151" E
103	-710070.879	8484084.261	13° 27' 46.5524" S	15° 52' 59.6663" E
104	-711413.353	8485001.629	13° 27' 15.2917" S	15° 52' 17.2297" E

Appendix B
Hydrology at crossing locations

Stream crossing location	Catchment area (km^2)	Daily average stream flow (l/s)	Mean annual runoff (Mm^3/annum)	100-yr flood peak (m^3/s)	100-yr flood elevation (approx. mamsl)	Conservative estimated floodline offsets (m from centre)*
1	1 622	8270	261	838	1 436.68	35
2	8.3	42	1.3	35	1 465.77	85
3	6.7	34	1.1	30	1 451.46	120
4	1.6	8	0.3	11	1 477.79	55
5	417	2125	67.1	286	Weir structure	N/A
6	2.6	13	0.4	15	1 485.58	40
7	2.0	10	0.3	12	1 484.41	25
8	3.2	16	0.5	17	1 480.95	20
9	5.9	30	1.0	27	1 491.28	35
10	3.0	15	0.5	17	1 488.12	25
11	17.9	91	2.9	61	1 488.07	40
12	5.6	28	0.9	26	1 493.04	25
13	41.6	212	6.7	129	1 491.91	90
14	1.1	6	0.2	7.6	1 539.96	15
15	16.3	83	2.6	52	1 506.75	65
16	1.1	6	0.2	7.4	1 509.19	20
17	1.8	9	0.3	11	1 510.85	20
18	0.2	1	0.0	1.9	1 519.87	15
19	0.1	0	0.0	1.0	1 520.07	15
20	5.2	27	0.8	23	1 491.90	40
21	2.1	10	0.3	12	1 493.38	20
22	4.8	25	0.8	22	1 470.14	25
23	82.9	423	13.3	163	1 451.52	35
24	7 549	53 599	1 691	2 109	1 426.58	105
25	8.4	43	1.3	33	1 476.84	60
26	7.9	40	1.3	31	1 479.19	65
27	24.8	127	4.0	71	1 480.17	40
28	1.0	5	0.2	7.1	1 522.13	30
29	27.2	139	4.4	76	1 517.39	25
30	1.2	6	0.2	7.9	1 564.86	30
31	11.0	56	1.8	40	1 556.03	70
32	3.2	16	0.5	16	1 593.50	15
33	1.9	10	0.3	11	1 604.55	65
34	17.1	87	2.8	54	1 574.53	30
35	1.0	5	0.2	7.0	1 608.39	15
36	0.8	4	0.1	6.2	1 607.84	15
37	0.9	5	0.1	6.6	1 609.03	15
38	1.4	7	0.2	9.1	1 609.50	15
39	1.9	10	0.3	11	1 610.70	15
40	1.2	6	0.2	7.9	1 610.63	15
41	0.3	2	0.0	2.9	1 614.08	15
42	2.7	14	0.4	14	1 610.94	15

Stream crossing location	Catchment area (km^2)	Daily average stream flow (l/s)	Mean annual runoff (Mm^3/annum)	100-yr flood peak (m^3/s)	100-yr flood elevation (approx. mamsl)	Conservative estimated floodline offsets (m from centre)*
43	3.7	19	0.6	18	1 633.86	25
44	1.1	6	0.2	7.0	1 670.39	15
45	2.8	14	0.4	14	1 647.31	15
46	4.6	23	0.7	20	1 632.31	35
47	1.0	5	0.2	6.4	1 631.35	15
48	4.9	30	1.0	21	1 631.00	35
49	0.7	4	0.1	5.1	1 654.29	15
50	0.8	5	0.2	5.5	1 655.23	15
51	0.5	3	0.1	4.1	1 656.28	15
52	6.7	41	1.3	26	1 628.78	50
53	0.2	1	0.0	2.0	1 647.65	15
54	0.2	1	0.0	2.2	1 644.41	15
55	0.6	3	0.1	4.3	1 634.81	15
56	0.5	3	0.1	3.8	1 630.77	15
57	24.7	150	4.7	66	1 594.39	60
58	1.7	11	0.3	10	1 591.29	20
59	8.1	49	1.6	29	1 588.38	35
60	3.7	23	0.7	17	1 589.31	35
61	0.3	2	0.1	2.7	1 622.55	15
62	0.3	2	0.1	2.7	1 630.85	15
63	0.5	3	0.1	4.0	1 626.31	15
64	0.8	5	0.1	5.4	1 597.80	15
65	0.1	1	0.0	1.7	1 592.65	15
66	260	1 586	50.0	179	Weir structure	N/A
67	261	1 592	50.2	179	1 586.73	30
68	267	1 630	51.5	184	1 585.33	45
69	2.5	15	0.5	13	1 644.07	15
70	3.6	22	0.7	16	1 626.60	35
71	11.8	72	2.3	39	1 619.57	30
72	12.5	76	2.4	40	1 614.90	50
73	3.6	22	0.7	16	1 614.47	15
74	0.0	0	0.0	0.2	1 612.73	15
75	20.4	125	3.9	57	1 601.72	45
76	66.0	403	12.7	194	1 597.31	60
77	211	1 287	40.6	226	1 591.16	85
78	0.7	4	0.1	5.2	1 640.62	15
79	8.6	53	1.7	31	1 594.64	25
80	54.3	331	10.4	119	1 567.98	55
81	2.3	14	0.4	12	1 574.27	15
82	1.5	9	0.3	8.7	1 604.61	15
83	2.7	16	0.5	13	1 634.50	40
84	2.7	16	0.5	13	1 618.59	15
85	4.2	30	0.9	18	1 634.58	45

Stream crossing location	Catchment area (km^2)	Daily average stream flow (l/s)	Mean annual runoff (Mm^3/annum)	100-yr flood peak (m^3/s)	100-yr flood elevation (approx. mamsl)	Conservative estimated floodline offsets (m from centre)*
86	22.8	162	5.1	62	1 587.49	25
87	0.5	3	0.1	3.9	1 595.36	15
88	0.7	5	0.2	4.9	1 589.74	15
89	2.1	15	0.5	11	1 582.28	15
90	2.5	17	0.6	13	1 585.30	20
91	2.4	17	0.5	12	1 607.07	15
92	560	3 976	125	438	1 572.68	15
93	3.5	25	0.8	17	1 583.14	15
94	0.9	6	0.2	6.3	1 586.96	15
95	1.5	11	0.3	9.1	1 580.35	30
96	0.8	6	0.2	5.8	1 588.85	25
97	0.5	4	0.1	4.3	1 602.39	15
98	1.2	8	0.3	7.6	1 586.90	30
99	0.5	4	0.1	4.3	1 585.12	25
100	3.7	26	0.8	17	1 583.59	30
101	0.3	2	0.1	3.0	1 607.77	15
102	43.2	306	9.7	79	1 580.39	20
103	5.1	36	1.1	22	1 569.56	15
104	4 667	0	0.0	0.0	Dam outlet controlled	N/A

** To alleviate the need for detailed floodlines of all 104 river crossings, conservative offsets from the stream centerline are provided. Where pylons are required to be placed within these offsets, backwater analyses may be required to determine flow velocities at pylon plinths. This will account for backwater effects of any downstream controls in channels that have subcritical flow regimes.*

Appendix C
HCV Africa profile

Experience excellence and tailored solutions with HCV Africa.

At HCV Africa, we embody a collective of independent, seasoned environmental scientists and social specialists united by a steadfast commitment. Our mission is clear: to provide outstanding consulting services across Africa and in growing economies throughout Asia and the Middle East.
Drawing upon our extensive international expertise across key sectors (such as mining, oil and gas, renewable energy, agri-business, heavy industry, and large-scale civil infrastructure), we specialise in developing sustainable solutions through carefully tailored consulting services.
Our deep understanding of various international norms and experienced insights into African business environments, supported by long-standing partnerships with local consulting firms and experienced experts, enables us to efficiently translate complex global knowledge into practical, locally tailored solutions for our clients.
Explore our comprehensive range of environmental management services, which include:

- Applying the relevant international standards such as IFC/World Bank Standards and Equator Principles in Environmental and Social Impact Assessments (ESIA).
- Skilful navigation of legal processes, dispute resolution, directives, and rectification of environmental and water issues.
- Develop and meticulously implement environmental and social management plans/programs.
- Assurance of capital investments through thorough environmental and social audits and due diligence.
- Strategic design and seamless execution of environmental and social management systems.
- Conducting thorough environmental, social and health risk assessments.
- Specialised studies and assessments of ecosystem services.
- Design and implementation of robust environmental, social and health monitoring plans.
- Efficient management of environmental and water legal administrative functions.
- Provision of expert opinions and advisory services.

Embark on a journey with HCV Africa, and let us work together to shape a sustainable future.
For further insights, we encourage you to visit our website: www.hcvafrica.com

Appendix D

Specialist CV

CURRICULUM VITAE

Dr Bruce Randell

EDUCATION AND QUALIFICATIONS

PR Eng

BSc (Civil Engineering) University of Witwatersrand, Johannesburg, 1996

PhD, University of Witwatersrand, Johannesburg, 2002

MDP, Unisa SBL, Johannesburg, 2007

Microsoft Certified Professional (TCP/IP) – NT4, 1998

EXPERIENCE

Dr Bruce Randell is an ECSA registered professional Water Resource Engineer with over 23 years' experience in applied hydrology, hydrological and hydraulic modelling and design of stormwater and tailings dam related infrastructure. Bruce has skills in water balance modelling, water resource modelling, stormwater management plans (concept through to detailed design), ESIA specialist studies, streamflow modelling and measurement.

Dr Randell has extensive experience in ESIA surface water specialist studies (hydrology baseline as well as impact studies) throughout Africa for mining developments.

Dr Randell has experience in setting up flow and water quality monitoring programs in remote areas where limited infrastructure is available. Locations include Angola, Mozambique, the DRC and Indonesia.

Appendix D: Heritage

HERITAGE IMPACT ASSESSMENT

For the proposed Cassinga Electrical Power Supply Project, Angola

Client:

srk consulting

Report Prepared by:

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Project Reference:
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DOCUMENT PROGRESS
Heritage Impact Assessment

Document status

Project Name	Heritage Impact Assessment for the Cassinga Electrical Power Supply Project
Authoring Company	Beyond Heritage
Client	srk consulting
Consulting Archaeologists	Jaco van der Walt Daniel Viljoen Lara Kraljevic

Statement of Independence

Lead Specialist	Jaco van der Walt
Declaration of Independence	I declare, as a specialist appointed that: • I will act as an independent consulting heritage specialist with no affiliation with or vested financial interests in the proponent, other than remuneration for work performed during the Project. • I have no conflicting interests in the undertaking of this project and have no interests in secondary developments resulting from the authorization of this project. • Remuneration for my services by the proponent is not linked to approval by any decision-making authority responsible for authorising this development.
Signature	
Date	**22/04/2024**

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EXECUTIVE SUMMARY

0.1 Introduction to the Project

Beyond Heritage was appointed to compile a Heritage Baseline and Impact Assessment report in support of the Environmental and Social Impact Assessment (ESIA) required for the Cassinga Electrical Power Supply Project. The powerline extends for about 170 km. The Project is located South of the centre of Angola, namely, in the provinces of Huila and Huambo.

0.2 Purpose of the Study

This baseline report describes the range of cultural resources expected in the Project footprint relative to:

- area of influence (AOI) and study boundaries;
- methods;
- baseline condition:
    - trends in condition and sensitivity to change
    - ecosystem services
    - sensitivity rankings
- key considerations.

It serves to assess the impact of the Project on these resources, and to submit appropriate recommendations regarding the responsible cultural resources management measures that might be required to assist the developer in managing cultural resources in a responsible manner.

0.3 Summary of Findings

The range of heritage resources that could be affected by the Project were categorized as follows:

Category 1 – tangible cultural heritage (archaeological and paleontological resources)

Category 2 – tangible cultural heritage with strong intangible elements (burial sites/ places of worship occur in the larger area)

Category 3 – intangible cultural heritage with a less well-defined tangible component (sites that may be used for music making, dance, storytelling, and other rituals)

0.4 Summary of Sensitivities

No sites that could be classified as critical heritage were recorded. Category 1 and 2 sites could occur in the powerline corridor, but these sites can be mitigated through micro siting etc. A pre-construction heritage walkdown will confirm the locations of heritage sites and appropriate mitigation measures.

0.5. Summary of Main Impacts

During the preconstruction phase impacts to heritage resources can include destruction or partial destruction of heritage and palaeontological resources due to demining, clearing and levelling activities as well as excavations. In terms of International Finance Corporation (IFC) Performance Standard (PS) 8 no critical cultural heritage occur in the study area and no known sites will be directly affected. Cultural heritage sites that could be impacted on by the Project is considered as replicable cultural heritage and can be mitigated. Additionally, the project could have an impact on the sense of place at sensitive sites such as places of worship and burial sites in the pre-construction and construction phases. Impacts are mostly expected to occur during the pre-construction and construction phase. During the operation phase impacts are mainly related to restricted access to cultural sites. Impacts to heritage resources are once off, permanent, and irreversible.

0.6. Summary of Cumulative Impacts

- Increased human presence in the area may further expose or damage heritage resources, especially the looting of archaeological sites for artefacts.
- Informal or smaller infrastructure developments outside the areas covered by the ESIA and ESMP may impact or expose further heritage resources not currently documented and recorded.
- The proposed infrastructure and associated construction activities could restrict access to cemeteries and cultural heritage resources for family and community members; and
- The various projects in the vicinity of the study area can result in the depletion of heritage resources putting the archaeological record at risk, therefore increasing the importance of managing cultural resources in a responsible manner.

0.7. Summary of Mitigation and Management Requirements

- Pre-construction heritage survey of the final alignment and all associated infrastructure;
- Monitoring of heritage features during construction and routine monitoring of land-clearing activities;
- Implementation of a Chance Find Procedure;
- Avoidance and management of known features;
- Development and implementation of a heritage site development plan that address access protocols for safe access to burial and spiritual sites; and
- 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.

0.8. Summary of Limitations and Gaps

Due to the subsurface nature of cultural remains, safety concerns (landmines) and access restrictions, there is a possibility that some cultural remains may not have been recorded. Artefacts and skeletal material may be uncovered during construction as well as natural factors such as erosion. Due to the aforementioned limitations the final alignment must be systematically surveyed prior to construction.

0.9. Conclusion and Recommendations

This report presents the results of a heritage baseline and impact assessment conducted for the proposed Cassinga Power Project. The desktop-based baseline was supplemented by information obtained from the reconnaissance survey (26th to 29th February 2024) and a Socio-economic survey (17 to 22 March 2024).

The powerline corridors and associated infrastructure were not subjected to a systematic heritage survey and sites or artefacts dating to the Stone Age, Iron Age/historical and historical periods could occur. The Project area is not of high paleontological sensitivity. Burial sites and places of worship occur in the larger area.

With the implementation of the management and mitigation measures recommended in this report the impacts to cultural resources can be mitigated to an acceptable level. From a heritage perspective the Project is viable as no sites of outstanding value occur in the impact areas. If the above management measures are adhered to, we are of the opinion that the development can continue as the impacts to cultural resources can be mitigated to an acceptable level.

ABBREVIATIONS

AIA:	Archaeological Impact Assessment
ANC:	African National Congress
AoI:	Area of Influence
ASAPA:	Association of Southern African Professional Archaeologists
BC:	Before Christ
CES	Cultural Ecosystems Services
CFPs:	Chance Find Procedures
CMP:	Conservation Management Plan
CRR:	Comments and Response Report
CRM:	Cultural Resource Management
EAP:	Environmental Assessment Practitioner
ECO:	Environmental Control Officer
EIA:	Environmental Impact Assessment*
EIA:	Early Iron Age*
EIS:	Environmental Impact Study
EMP:	Environmental Management Plan
EMPP:	Environmental Management Plan of the Project
EO:	Environmental Officer
ES:	Ecosystem Services
ESA:	Early Stone Age
ESIA:	Environmental and Social Impact Assessment
ESMS:	Environmental and Social Management System
FAPLA:	The People's Armed Forces of Liberation of Angola (FAPLA)
FPIC:	Free, Prior, and Informed Consent
FS:	Feasibility Study
GIS:	Geographical Information System
GPS:	Global Positioning System
Ha:	Hectare
HMP:	Heritage Management Plan
ICOMOS:	International Council of Monuments and Sites
IFC:	International Finance Corporation
Km	Kilometre
LIA:	Late Iron Age
LSA:	Later Stone Age
LOM:	Life of mine
MIA:	Middle Iron Age
MSA:	Middle Stone Age
OHL:	Overhead Line
PS:	Performance Standard
PSL:	Present surface level
UNESCO:	United Nations Educational, Scientific and Cultural Organization
UNITA:	National Union for the Total Independence of Angola
SEIA:	Social and Environmental Impact Assessment
SADC:	Southern African Development Community
SWANU:	South West Africa National Union
SWAPO:	South West Africa People's Organization

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1. Introduction

The Republic of Angola, through its Ministry of Energy and Water (MINEA), is embarking on a significant enhancement of its electrical infrastructure with the Cassinga Project, aiming to boost electric power supply across various communities within the Province of Huíla. SRK Consulting (South Africa) (Pty) Ltd (SRK) was appointed to conduct an Environmental and Social Impact Assessment (ESIA) for the Cassinga Electrical Power Supply Project (the "Project"). Beyond Heritage (Pty) Ltd was appointed by SRK to compile a Heritage Impact Assessment (HIA) for the proposed Project in support of the ESIA.

The heritage baseline and impact assessment consist of a desktop study, the results of the reconnaissance survey and the social survey site visits to the Project area to identify, document and assess the importance of cultural heritage sites; as well as evaluating negative impacts on non-renewable heritage resources. A review of the Project components and legislation is outlined in Section 1.1.1 and Section 2, followed by an outline of the approach and methodology in section 3 and the results of the study in section 5.

General site conditions and site features were recorded by means of photographs, GPS location, and description followed by an impact assessment as discussed in Section 7. Appropriate recommendations to assist in managing heritage resources within the framework provided by heritage legislation and IFC PS 8 are provided in section 8.

1.1. Overview of Project

The following project background is obtained from SRK (2024). "The Republic of Angola, through its Ministry of Energy and Water (MINEA), is embarking on a significant enhancement of its electrical infrastructure with the Cassinga Project, aiming to boost electric power supply across various communities within the Province of Huíla. The Project is structured around the establishment of a new 220 kV Overhead Line (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 overhead lines for distribution, along with the necessary low voltage 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 OHL 220 kV interconnection to Cuchi/Menongue.

- An estimated power demand of 80 MW has been calculated for the Cassinga 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. A Technical Specification for Metallic Structures for Lines and Substations, adhering 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 Cassinga Electric Power Supply Initiative represents a significant leap forward in Angola's energy infrastructure development. The Project 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 Hydro Plant to the Cassinga Project and the future OHL 220 kV interconnection to Cuchi/Menongue.

."

1.1.1. Project components

The Project involves the construction of three new substations and the establishment of a new 220 kV Overhead Line (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 Medium Voltage OHL network to the new substations and a Low Voltage network to supply electricity to 1 000 homes in each of the three villages.

Transmission line conductors are strung on in-line suspension towers and bend (strain) towers. The structures proposed to be used for the majority of the 220 kV Transmission line are metallic towers type Y, adequate to the angle of the OHL (**Error! Reference source not found.**). These towers are approximately 50 m in height and a total footprint area of 80 m x 50 m is required for each tower. The average span between two towers is 400 m.

The cross-rope suspension tower is typically used along the straight section of the servitude, while the self-supporting angle towers and inline strain towers are used where there is a bend in the powerline alignment. Angle towers are cumbersome and more steel-intensive than suspension towers, making them more visually intrusive and expensive to construct. Therefore, transmission line routes are planned with as few bends as possible.

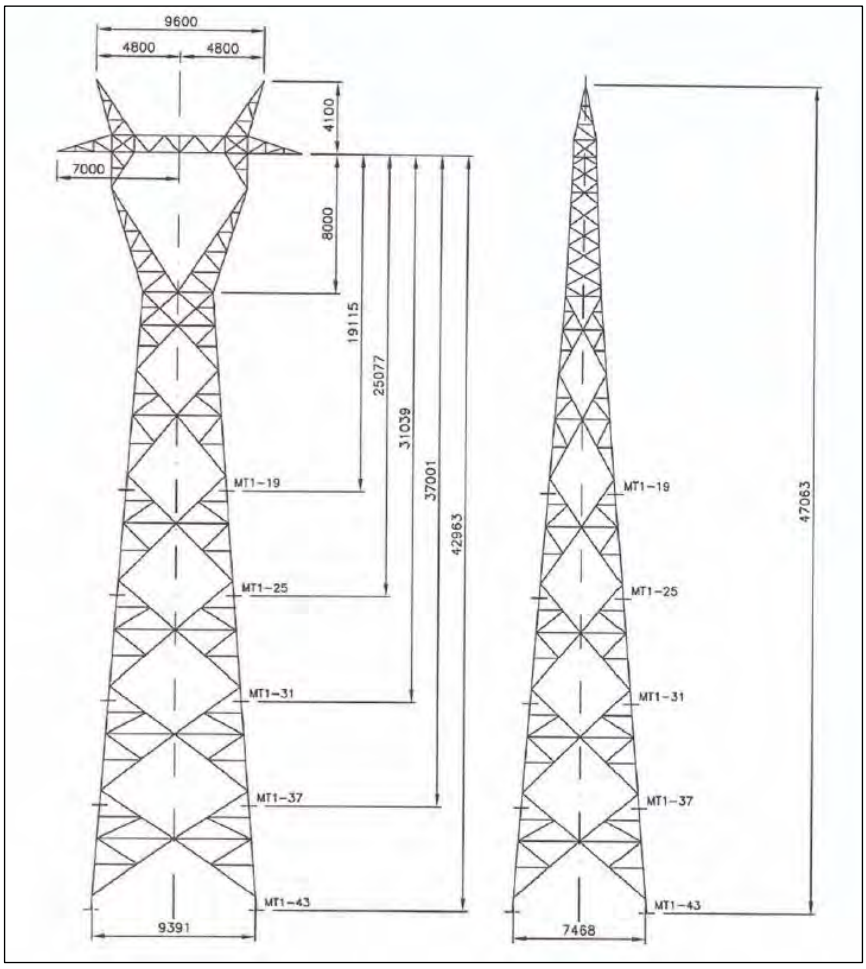


Figure 1.1. Example of a MT Tower (MT1).

1.1.1.1. 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 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 1.1 represents the requirements needed to implement the new substations at the proposed locations of Chipindo, Cuvango and Jamba. Figure 1.2 presents the draft layout for the 220/30 kV – 20 MVA substation.

Table 1.1. 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

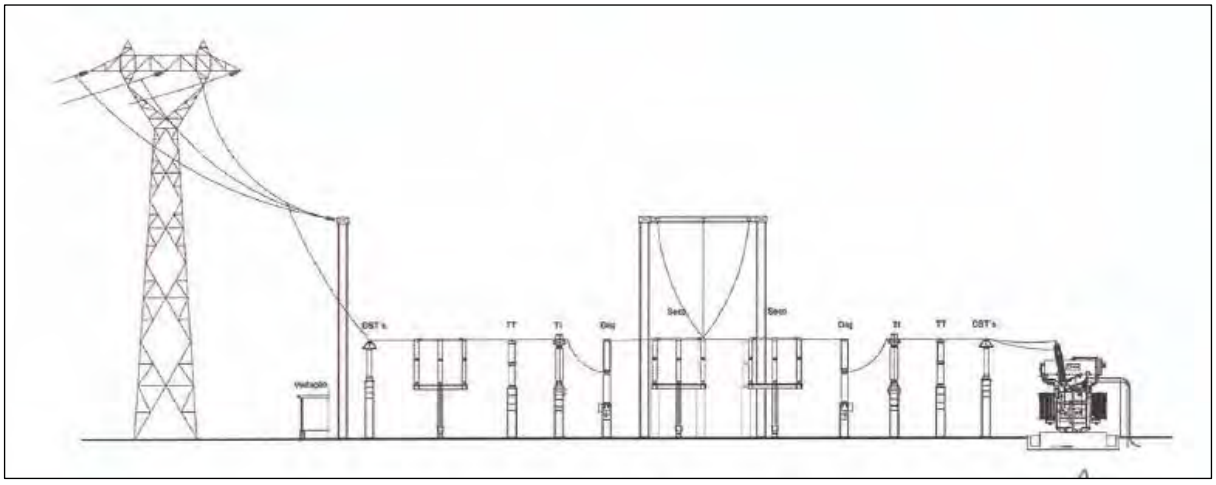


Figure 1.2. Draft layout for the 220/30 kV – 20 MVA substation.

1.1.1.2. 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, with the requirements of these OHL presented in Table 1.2.

Table 1.2. 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 479mm²	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 will comprise the following components:

- High Voltage Transmission Line, between Gove Hydro and New Cuvango 220/30 kV Substation, energized 220 kV single circuit, for approximately 135 km.
- Metallic Towers type Y, adequate to the angle of the OHL.
- Three-Phase OHL 220 kV bundled conductor “YEW” Cable 479 mm^2 (2 by phase).
- 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 will comprise the following components:

- High Voltage Transmission Line, between New Substation at Cuvango and New Jamba 220/30kV Substation, energized 220 kV single circuit, for approximately 35 km.
- Metallic Towers type Y, adequate to the angle of the OHL.
- Three-Phase OHL 220 kV bundled conductor “YEW” Cable 479 mm^2 (2 by phase). Two Guard Wires will be installed, one conventional “Guinea” and another type “OPGW” with 24 Optical Fibres.

1.1.1.3 Electrification of community homes and public lighting

The electrification of Chipindo, Cuvango and Jamba requires several infrastructure components, which are detailed in **Error! Reference source not found.**. The installation of these components within each community will establish a medium and low voltage network to supply grid electricity to approximately 1 000 homes in each community, including public lighting.

Table 1.3. Electrification component details.

Component	Description	Specifications	Quantity (For Each Community)
MV Network 30 kV	To interconnect power transformation stations	Conductor ACSR 110 mm², 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 mm², Luminaires 150 W - VS	As per design
Home Connections	To supply electricity to homes	Connection accessories	Approx. 1 000 homes

Electrification of Chipindo

To electrify the town of Chipindo from New Substation 220/30 kV (Figure 1.3), the following scope will be considered:

- 30 kV Medium Voltage 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.
- Construction of Low Voltage Network to supply Grid electricity to around 1 000 Homes, including public lighting.

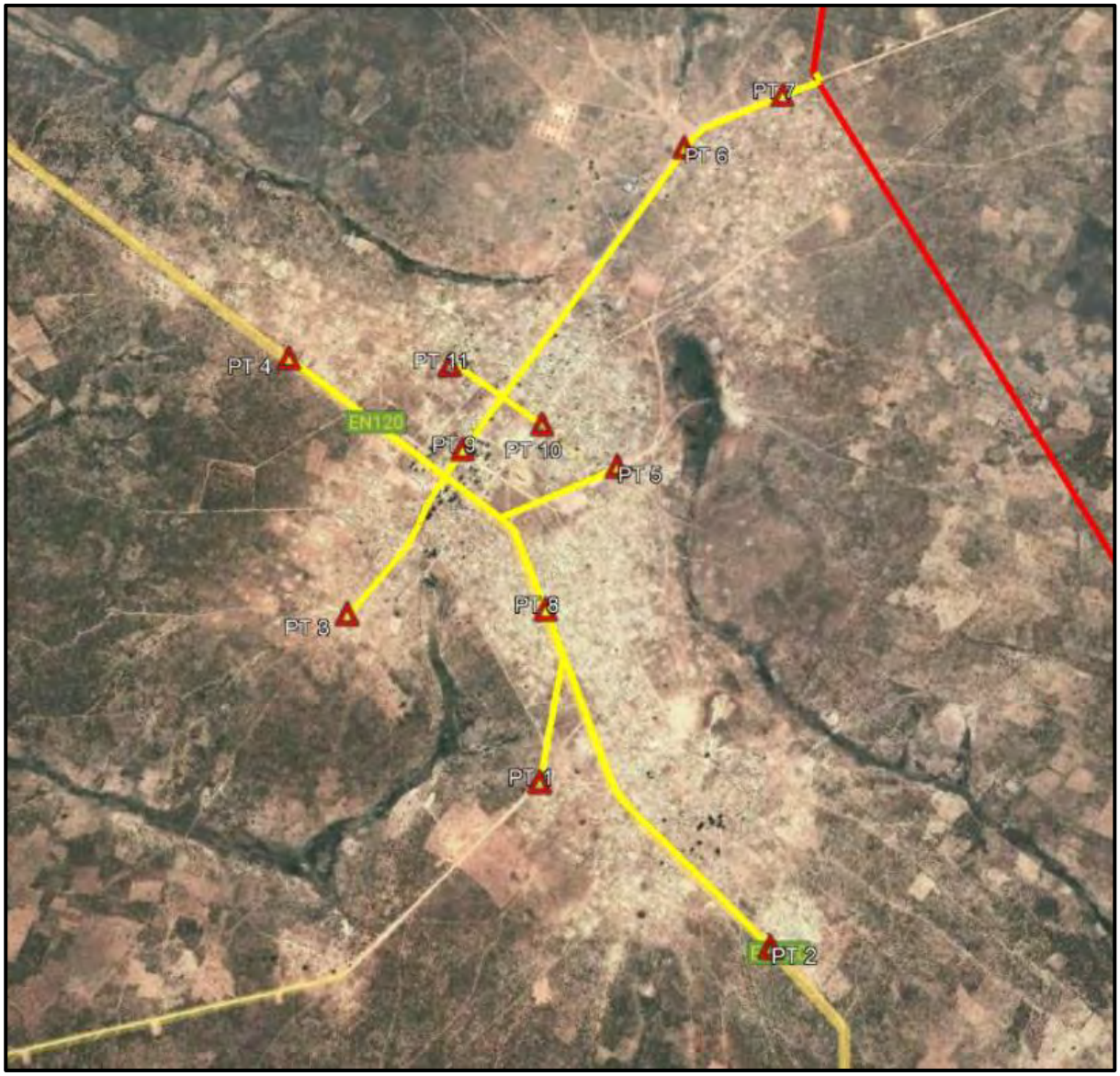


Figure 1.3. MV Network and Transformation Station Sites – Chipindo.

Electrification of Cuvango

To electrify the town of Cuvango from New Substation 220/30 kV (**Error! Reference source not found.**), the following scope will be considered:

- 30 kV Medium Voltage OHL Network, with approximately 13 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.
- Construction of Low Voltage Network to supply Grid electricity to around 1 000 Homes, including public lighting.



Figure 1.4. MV Network and Transformation Station Sites – Cuvango.

Electrification of Jamba

In order to electrify the town of Jamba from New Substation 220/30 kV (Figure 1.5), the following scope will be considered:

- 30 kV Medium Voltage OHL Network, with approximately 17,5 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.
- Construction of Low Voltage Network to supply Grid electricity to around 1 000 Homes, including public lighting.

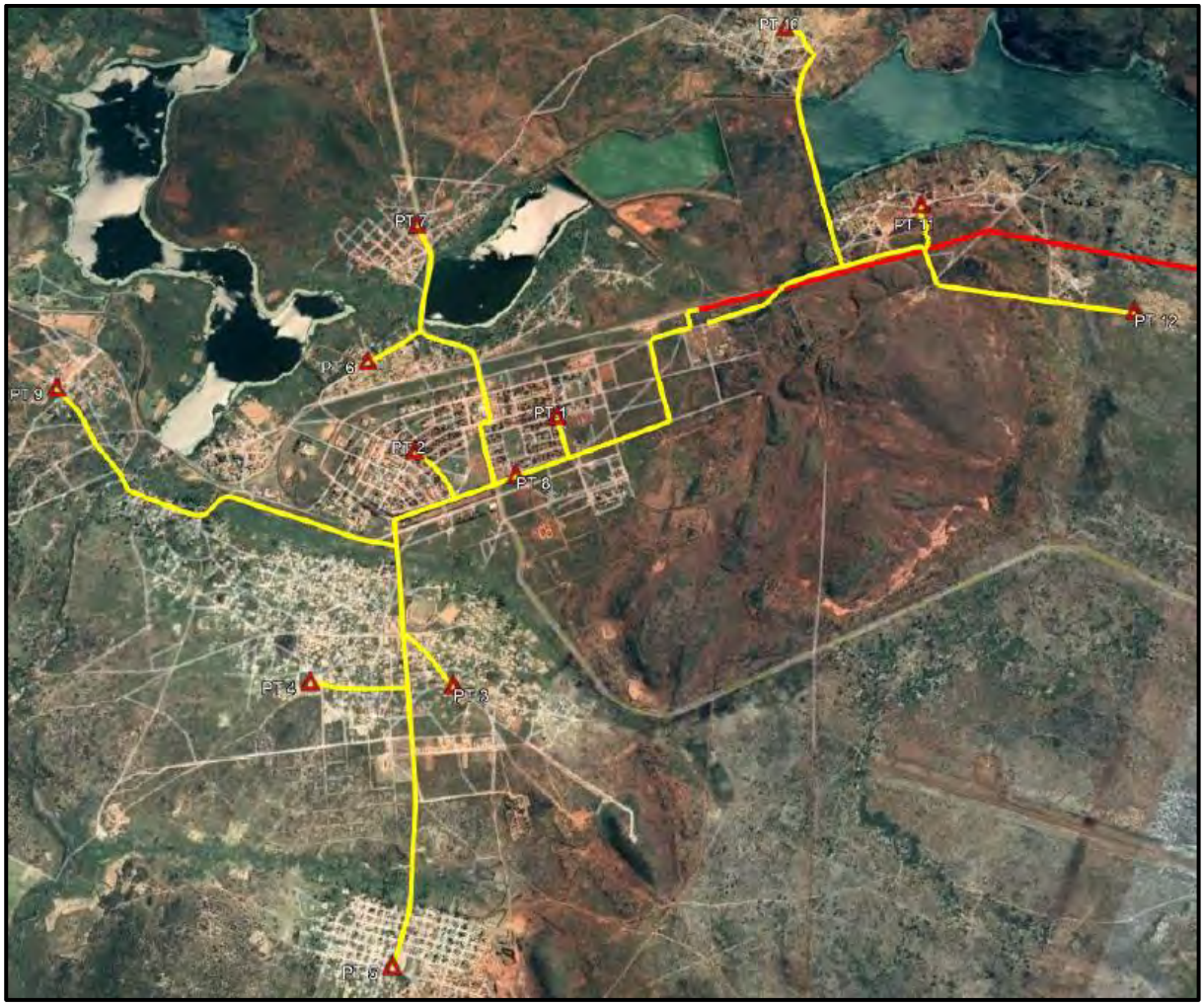


Figure 1.5. MV Network and Transformation Station Sites – Jamba.

1.1.2. Additional Infrastructure

The project will also include the upgrade and maintenance of existing roads that will be used as access roads – these will be 4m wide with an additional 2m on either side for the “disturbance zone” e.g., for activities such as soil stockpiling, movement of graders/other machinery etc. N*ew* access roads and associated disturbance zones will fall within the 100m OHL AoI and are assessed as part of this footprint.

1.1.3. Alternatives

Consideration of alternatives is one of the most critical elements of the environmental assessment process. Its role is to provide a framework for sound decision-making based on the principles of sustainable development.

The different categories of alternatives that can be identified may include activity alternatives, location alternatives, process alternatives, demand alternatives, scheduling alternatives, input alternatives, routing alternatives, site layout alternatives, scale alternatives and design alternatives. The range of categories of alternatives should be considered along with the “no go” alternative. Alternatives will be included in the ESIA.

1.2. Purpose of the Study

The Cassinga Electrical Power Supply Project requires an ESIA to align with IFC PS requirements and Beyond Heritage was appointed by SRK to conduct an HIA as part of this process. The objective of the ESIA for the Project is to identify and assess potential environmental, social, health and safety impacts from the planned developments being considered here and outline mitigation, as well as management actions. The Project will be undertaken to meet the IFC and other applicable legislation. The IFC Environmental and Social Performance Standards will be considered for this Project and in terms of the HIA The PS relevant to the Project is PS8: Cultural Heritage.

In support of the ESIA, the HIA aims to assess the impact of the Project on non-renewable heritage resources, and to submit appropriate recommendations regarding the responsible cultural resources management measures that might be required to assist the developer in managing heritage resources in a responsible manner.

1.3. Terms of Reference

The study includes a heritage baseline study as well as an impact assessment of the Project on the cultural heritage in the Project area. Cultural heritage provides continuity in tangible and intangible forms between the past, present and future. The assessment focussed on heritage Categories outlined below:

- **Category 1** – tangible cultural heritage (archaeological and paleontological resources);
- **Category 2** – tangible cultural heritage with strong intangible elements (burial sites/ places of worship) and
- **Category 3** – intangible cultural heritage with a less well-defined tangible component (sites that may be used for music making, dance, storytelling, and other rituals)

For the purposes of the HIA, the areas of influence, i.e., the area likely to be affected by the Project, including its ancillary aspects, is divided into the following categories.

1.3.1. Direct Area of Influence

The Direct Area of Influence (Direct AoI) is an area where potentially direct impacts caused by the Project could occur at the same time and place. Direct impacts to heritage resources are always destructive and permanent. Therefore, the footprint of the Project components is considered important. For this Project, the Direct AoI is the Construction and Operational corridor of the powerline (100 m) as well as associated substations and other infrastructure and activities outlined under Section 1 and 4 of this report.

1.3.2. Indirect Area of Influence

The Indirect Area of Influence (Indirect AoI) refers to an area where potentially indirect impacts caused by the Project could occur either later in time or a distance away from the activity but are reasonably foreseeable. Indirect impacts can occur through secondary activities surrounding the direct area of impact (indirect area of influence) such as laydown areas, construction camps etc. The Indirect area of influence can include the wider cultural landscape and sense of place as well as the cultural context and values of heritage sites and communities in the area. The area affected visually or by noise, dust and vibration or restriction of access beyond the physical footprint is also included in the Indirect AoI.

1.4. Assumptions, exclusions, and limitations.

The following assumptions apply to the heritage assessment:

- Due to the often-ephemeral nature of cultural remains, there is a possibility that some heritage sites or features may not have been identified. Thus, the possibility of the occurrence of heritage sites or features and unmarked graves cannot be excluded.
- 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.
- Natural factors like erosion might also expose sites not detected previously. To mitigate against this, a recommended chance find procedure is included in Section 8.
- 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. This was addressed in the Social Study, but if additional information is obtained on this aspect, it will be addressed accordingly during the ESIA process.
- 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.

1.5. Information Sources

Aside from a literature review this report was informed by a reconnaissance survey (26th to 29th February 2024) and a Socio-economic survey (17 to 22 March 2024). The reconnaissance site visit was undertaken by project team members from SRK Consulting (Lead ESIA Consultant), Geolab (Angolan In-country ESIA Partner), Pak Yatirim (Client) and Rede Nacional de Transporte de Electricidade (RNT) (Angolan National Electricity Transmission Network Company). Prior to the site visit, a site visit programme was developed to plan various stakeholder engagements and observation/data gathering along the overhead line (OHL) route.

As part of the stakeholder engagement process, pre-consultation engagements were held with local authorities impacted by the proposed Project, namely the Jamba, Cuvango and Chipindo local authorities. Even though there were challenges (the absence of the demining team and time constraints) the survey was completed successfully.

In terms of socio-economic fieldwork, 16 neighbourhood/villages across Jamba, Cuvango and Chipindo were surveyed. This included 58 household questionnaires and 16 leadership questionnaires (including questions on the presence of both tangible and intangible cultural heritage sites as well as graves) which were applied.

2. Key legislative frameworks and lender requirements

The Environmental Framework Law No. 5/98 (EFL) was promulgated in accordance with Articles 12 and 24 of the 1992 Angolan Constitution (reformed in 2010). The EFL is the overarching law governing environmental legislation in Angola. Under the EFL, The Ministry of Environment (MINAMB) has developed a number of policies and regulations to ensure sustainable development. In terms of Cultural Heritage, the following article is of relevance:

Article 12 – (Environmental Heritage) “The Government must ensure that the environmental heritage, and in particular natural, historical and cultural, is the subject of permanent measures and defence appreciation, through environmental protection associations.

In addition, the Environmental Impact Assessment Law (51/04 of 23 July), Article 7 defines Technical Activities of the Environmental Impact Study:

- Part 1c states: “The environmental assessment of the project's area of influence and description, analysis environmental resources and their interactions, as they exist in order to characterise the environmental situation of the area before the project implementation, considering:
    - c. The socio-economic environment, the use and occupation of land, water use and sociocultural component, highlighting the sites and monuments archaeological, historical and cultural community, relationships dependence between the local community, environmental resources and potential future use of these resources.”
- Additionally, the Cultural Heritage Law (Law 14/05) defines material and immaterial cultural heritage and the need for its protection by authorities and law.

The present assessment is carried out in response to these and international requirements, with specific reference to IFC PS 8: Cultural Heritage. Cultural heritage is protected by various national laws and international policy frameworks and guidelines. The proposed project must comply with these laws and frameworks as outlined below.

2.2. International Legal Framework

2.2.1. UNESCO

The most important international agreements regarding the protection of cultural resources are United Nations Educational, Scientific and Cultural Organization's (UNESCO's) Convention for the Protection of the World's Cultural and Natural Heritage (1972) and its Convention on the Means of Prohibiting and Preventing the Illicit Import, Export or Transfer of Ownership of Cultural Goods (1970). Angola ratified to the Convention on Thursday, 7 November 1991 and has one property inscribed on the World Heritage List namely the Mbanza Kongo, Vestiges of the Capital of the former Kingdom of Kongo (2017). The site is not located close to the Project area and will not be impacted on by the current Project. There are also 13 sites on the tentative list. These sites are not located close to the Project area.

2.2.2. International Finance Corporation (IFC)

The International Finance Corporation (IFC) has developed as series of Performance Standards (IFC, 2012) to assist project proponents in assessing the environmental and social risks associated with a project and assisting the project proponent in identifying and defining roles and responsibilities regarding the management of risk. Table 2.1. outlines the IFC PS 8 regarding Cultural Heritage to manage risks and impacts associated with archaeological, heritage and cultural risks related to the proposed Project. Requirements with respect to tangible forms of cultural heritage are contained in Sections 6–16 of PS 8 and are addressed below.

Table 2.1:Summary of the International Finance Corporation Performance Standard 8 and its relevance for this study

PERFORMANCE STANDARD 8: CULTURAL HERITAGE		
IFC PS:8 Section number	**Requirement/ Principle**	**Implications for this Study**
Section 6 and 7	*Internationally recognized practices:* In addition to complying with applicable Angolan law that implements the host country's obligations under the Convention Concerning the Protection of World Cultural and Natural Heritage, the client will identify and protect cultural heritage by ensuring that internationally recognized practices for the protection, field-based study, and documentation of cultural heritage are implemented.	In accordance with Section 6 and 7 of the IFC Performance Standard 8 Guidelines, a professional archaeologist was appointed for this Project to assess potential impacts to heritage resources stemming from Project activities. A desktop-based baseline study was conducted, supplemented by results of the reconnaissance survey (26 to 29 February 2024) and a Social Economic Survey (17 to 22 March 2024). Findings are reported on in Section 5 of this report.
Section 8	*Chance Find Procedures:* The client is responsible for siting and designing a project to avoid significant adverse impacts to cultural heritage. When the proposed location of a project is in areas where cultural heritage is expected to be found, either during construction or operations, the client will implement chance find procedures established through the Environmental and Social Impact Assessment. The client will not disturb any chance finds further until an assessment by competent professionals is made and actions consistent with the requirements of this Performance Standard are identified.	In accordance with Section 8 of the IFC Performance Standard 8 Guidelines, the archaeologist assessed the findings in the Project area and made constructive recommendations for the management of sites that may be impacted by construction and operational activities. Archaeological and heritage monitoring and management measures (including chance find procedures) will be incorporated as part of the EMPR to ensure that sites of archaeological and heritage significance are protected during all phases of the Project. Chance Find Procedures are included in Section 8 of this report.
Section 9	*Consultation*: Where a project may affect cultural heritage, the client will consult with Affected Communities within the host country who use, or have used within living memory, the cultural heritage for longstanding cultural purposes. The client will consult Affected Communities to identify cultural heritage of importance, and to incorporate into the client's decision-making process the views of the affected communities on such cultural heritage.	In accordance with Section 9 of the IFC Performance Standard 8, relevant community authorities were consulted during the site visits. The SIA process will ensure that affected communities are consulted on potential impacts to cultural heritage. Results are reported on in Section 5 of this report.
Section 10	*Community Access:* Where the client's project site contains cultural heritage or prevents access to previously accessible cultural heritage sites being used by, or that have been used by, Affected Communities within living memory for long-standing cultural	Community access restrictions could occur at cemeteries located within the proposed development footprint. This will require a second phase of study to mitigate to an acceptable level.

	purposes, the client will, based on consultations, allow continued access to the cultural site or will provide an alternative access route, subject to overriding health, safety, and security considerations.	Recommendations are included in Section 8.
Section 11 and 12	*Removal of Cultural Heritage*: Most cultural heritage is best protected by preservation in its place, since removal is likely to result in irreparable damage or destruction of the cultural heritage.	In accordance with Section 11 and 12 of the IFC Performance Standard 8 Guidelines, the Project will not remove any cultural heritage, unless: • There are no technically or financially feasible alternatives to removal; • The overall benefits of the Project outweigh the anticipated cultural heritage loss from removal; and/or • Any removal of cultural heritage is conducted by the best available technique. Recommendations for management of heritage resources are included in Section 8.
Section 13 and 14	*Critical Cultural Heritage:* Critical cultural heritage consists of: Internationally recognized heritage of communities who use, or have used within living memory the cultural heritage for long-standing cultural purposes; and Legally protected cultural heritage areas, including those proposed by host governments for such designation.	In accordance with Section 13 and 14 of the IFC Performance Standard 8 Guidelines, the Project will not significantly alter, damage, or remove any critical cultural heritage without following best international practices. Recommendations for management of heritage resources are included in Section 8.
Section 15	*Legally protected cultural heritage areas:* In circumstances where a proposed project is located within a legally protected area or a legally defined buffer zone, the client, in addition to the requirements for critical cultural heritage cited above, will meet the following requirements: Comply with defined national or local cultural heritage regulations or the protected area management plans; Consult the protected area sponsors and managers, local communities and other key stakeholders on the proposed project.	In accordance with Section 15 of the IFC Performance Standard 8 Guidelines, the EMPP will make provision to ensure that the proposed Project area is not located within a legally protected cultural heritage area or a legally defined cultural heritage buffer zone or ensure that best international practices are followed for operating in such areas. As part of the environmental impact study, all relevant national and local environmental and social policies, plans and guidelines should be implemented for all development activities associated with the Project. The Legislation that was considered is included in Section 2.

This report is written taking cognisance of international guidelines but recognizing that at this point it is not practical to conduct a heritage walk through of the 170 km line as the final pylon positions and associated infrastructure were only finalised later in the process (September 2024) but the authors made every reasonable effort to ensure that legal aspects and international best practice would be considered at every step and limitations are mitigated by the implementation of the recommendations in the report.

3. Approach and Methodology

The following methodology was employed to determine the potential occurrence of archaeological and heritage sites and the significance of these sites. The desktop-based baseline was supplemented by information obtained from the reconnaissance survey (26th to 29th February 2024) and a Socio-economic survey (17 to 22 March 2024).

3.1. Scope of work

The scope of work for the assignment includes a Heritage Impact Assessment (HIA) and comprises of the following tasks:

- Review of existing heritage information;
- Input into a baseline report;
- Undertake an impact assessment;
- Develop mitigation measures to avoid, minimise, rectify, or reduce impacts; and
- Provide input into to the Heritage Impact Assessment report.

3.2. Objectives

The HIA aims to assess the impact of the proposed Project on non-renewable heritage resources, and to submit appropriate recommendations regarding the cultural resources management measures.

3.3. Methodology

3.3.1. Literature Review

This step was aimed at gathering information relating to known archaeological and heritage resources within and surrounding the proposed Project area. Project information and data was obtained through literature research, where three kinds of sources were utilized: published data (publications and books), unpublished data (cultural heritage specialist reports) and archaeological databases/archives. Key references are listed in Section 10.

3.3.2. Social baseline survey

Consultation with stakeholders was conducted by the social team between 17 and 22 March 2024 . In terms of socio-economic fieldwork, 16 neighbourhood/villages across Jamba, Cuvango and Chipindo were surveyed. This included 58 household questionnaires and 16 leadership questionnaires which were applied.

The questionnaire regarding Cultural/traditional practices included the following heritage related themes:

- Are you aware of known heritage sites/ features (tangible and intangible) in the area?
- Are you aware of any burial sites in the area?
- Are there any shrines or culturally important sites in the area?

The results are discussed in Section 5.3.5 of this report.

3.3.2. Cultural Heritage Survey Approach

The study is informed by field work conducted for the reconnaissance and social impact surveys and concentrated on heritage resources as classified in Section 5.3.3. Intangible forms of culture (such as practices of communities embodying traditional lifestyles) were covered under the SIA and is discussed under section 5.

The assessment focussed on the Project footprint However the entire corridor could not be covered during initial site visits. A strategy for the fieldwork phase was formulated by Beyond Heritage based on existing data. Information collected during the initial Reconnaissance survey and Socio-Economic Baseline survey was recorded and reported on. It should be noted that access restraints severely impacted on field work coverage and this limitation will be addressed by the implementation of a chance find procedure and pre-construction field survey.

3.3.4. Data Recording

This assessment was aimed at describing the potential range of archaeological and heritage sites and their significance that the proposed Project could impact on and was informed by the Reconnaissance and Socio-Economic Baseline surveys. During these surveys general site conditions and features on site were recorded by means of photographs, GPS location and description where necessary.

3.3.5. Data Interpretation: Assessment of Heritage Significance

The identified archaeological and heritage resources were assessed to determine their information potential and heritage value. Potential impacts on the heritage resources were assessed in terms of the assessment methodology provided by SRK in Section 3.3.6.

Beyond Heritage bases site importance on five interrelated criteria: (1) primary versus secondary context; (2) amount of deposit; (3) number and variety of features; (4) uniqueness; (5) potential to answer present research questions and (6) tourism potential.

Sites with no importance do not require management; low to medium significant sites may require limited management, while sites of high significance require extensive management.

It is recommended that sites identified as outstanding, including critical cultural heritage sites should be avoided. For the purpose of this study, no critical cultural heritage sites have been identified in the development footprint. Recognizable graves and living heritage sites have high social value regardless of their archaeological importance.

3.3.6. Impact Assessment Methodology

The impact assessment will be conducted in an integrated manner that links the socio-economic components with the biophysical components of the environment. The assessment is divided into issue identification, impact definition, and impact evaluation. Iteration of these parts occurs in each stage of an ESIA process to varying degrees.

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 **Error! Reference source not found.** and involves the following 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.
- 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 3.1: Method for rating 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
	Short term	Up to 18 months.

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**
DURATION	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	Medium	High
		Short term	Low	Medium	Medium
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.

3.3.7. Management recommendations and post management significance

After determining the significance rating, practicable management measures are suggested for each specific impact. The impact description should indicate the significance rating prior to and following mitigation/optimisation. As explained above:

“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 is then re-assessed with assumed management measures in place (“after management”). Specialists also recommend and describe 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 3.2.

Table 3.2: 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*

4. Project activities posing potential impacts.

The main cause of impacts to cultural heritage resources is physical disturbance of the material itself and its context during removal of topsoil and vegetation as well as the excavations associated with the establishment of infrastructure. The following activities (as detailed per Project phase and provided by SRK) are proposed for the Project and can negatively impact on heritage resources.

4.1. Planning and construction

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 demining activities, 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.

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 220 kV Overhead Line (OHL) network stretching approximately 170 km; and establishment of medium voltage 30kV OHL for electricity distribution. The low voltage network, public lighting and home connections within the communities of Chipindo, Cuvango, and Jamba will also be established.

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.

4.2. Demining

Demining activities can include surveys, mapping and minefield marking, as well as the actual clearance of mines from the ground. A chance find procedure must be implemented during this process to avoid accidental damage to heritage resources.

4.3. 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.

4.4. 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 to safeguard animals and people from injury. All foundations will be backfilled, stabilised through compaction, and capped with concrete at ground level.

4.5. 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 generally 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.

4.6. Access roads and OHL servitude route

The Project will mainly follow existing roads, especially the Gove – Chipindo – Cuvango route as there is limited space for an access path between the existing roads and working sites. If clearing of access paths are required, it is anticipated that approximately 50 m will be required every 2 km of OHL route. In order to reduce potential impacts associated with the construction of new access paths, existing roads will be used as far as possible where available and new access paths will be constructed by means of ‘two-tracks’ over the vegetation where possible to avoid permanent removal of the existing vegetation. Maintenance of some paths may be required for ongoing maintenance during operations and will be undertaken in accordance with the specifications of the ESMP. Other paths not required for ongoing maintenance will be rehabilitated concurrently.

Service roads for construction purposes will be sitting along 95% of the OHL route. The OHL route will have to be cleared of trees and shrubs to allow construction teams access. The OHL servitude will be maintained for the Project. Service roads will also be constructed by means of ‘two-tracks’ over the vegetation where possible to avoid permanent removal of the existing vegetation.

4.7. Temporary laydown and assembly areas

An area of approximately 5 000 m^2 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 400 m intervals and need to be cleared of vegetation. The exact siting of the temporary laydown and assembly areas must take cognisance of any no-go and sensitive areas identified through the EIA process. All temporary laydown and assembly areas will be rehabilitated concurrently after use.

4.8. Construction camps

This construction of the powerline will require the establishment of a construction camp/s at appropriate location/s along the route. Construction camps will be sited at the Contractor’s discretion according to their construction schedule and needs. It is estimated that a campsite will be built approximately every 80 km. The exact siting of the construction camps may require negotiation with the relevant landowner/s and must take cognisance of any no-go and sensitive areas identified through the EIA process. Once construction activities have been concluded, the construction camp will be closed off and the area rehabilitated concurrently.

4.9. 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.

The operation phase will also focus on maintaining high safety standards to protect both the workforce and the local communities, alongside continuous environmental monitoring to ensure compliance with national regulations and international standards and guidelines. 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.

4.10. 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.

5. Baseline Conditions

5.1. Site description/ Project Location

The Project is structured around the establishment of a new 220 kV Overhead Line (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 and a series of medium to low voltage lines, to efficiently distribute the generated power to these villages. The Project is located South of the centre of Angola, namely, in the provinces of Huila and Huambo (Figure 5.1). The cultural heritage baseline is compiled based on background information and previous studies. This section provides a description of the three categories of heritage resources that can be expected to occur in the Project area.

5.2. Local and Regional Context

The Cassinga Power Project extends from Jamba into a north-eastern direction towards Cuvango, and from Cuvango it diverts into a north-western direction towards Chipindo. From Chipindo it reaches north in the direction of Sange, before diverting into a north-easterly direction through the Gobi Forest and ending at the Gove Hydroelectric plant, 75 km south of Huambo City. The dam on which the Gove hydroelectric plant is situated extends from the Cunene River, one of the few perennial rivers in the area, and which ends its course at the Ruacaná Falls.

The study area crosses central Angola from centre to south, crossing a landscape dominated by areas of Miombo woodland, most of the corridor (about 60%) is occupied by small agricultural plots practicing rainfed agriculture with unsustainable traditional practices, such as slash and burn. The agricultural areas are interspersed with scattered patches of bushland and vegetation in regeneration.

The Gobi Forest has also been modified and is interspersed by plantations and associated industrial facilities. Topographical focal points such as elevated areas and water sources could have been focal points for settlement in antiquity and could be of heritage potential. Currently low-lying and flat areas are utilised for crop cultivation and some areas have been cleared for housing and access roads. Most recent human settlement appears to be located along the roads rather than the less accessible areas.

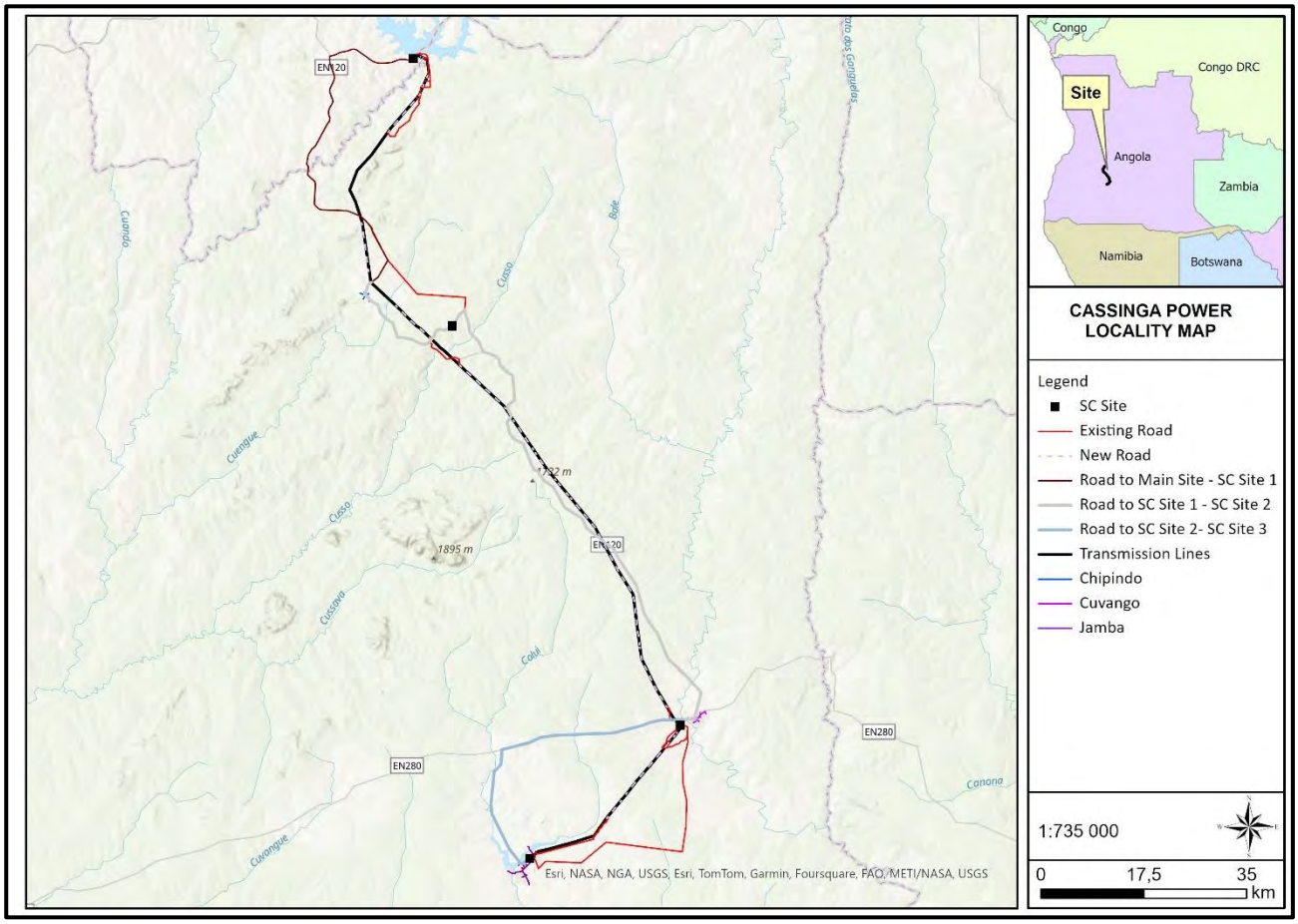


Figure 5.1. Locality map of the Project. .

5.3. Heritage Baseline

The heritage baseline includes the paleontological, cultural heritage and social components and is discussed below.

5.3.1. Categories of Heritage Resources

Development activities (roads and settlements as well as agricultural activity) could have impacted on surface indicators of heritage sites in the Project area. The desk-based assessment, reconnaissance survey and social baseline field survey provided information to describe heritage resources expected in the study area. The range of potential resources expected in the Project area is categorised as follows:

- **Category 1** – tangible cultural heritage:
    - Archaeological & paleontological sites
- **Category 2** – tangible cultural heritage with strong intangible elements:
    - Cemeteries and graves
    - Religious places where worship associated with the main established religions is practiced (such as churches or places of worship)
- **Category 3** – intangible cultural heritage with a less well-defined tangible component:
    - Sites with an intangible component and/or traditional value, the importance of which is not always a factor of geography but of belief and ritual. Such sites may be used for music making, dance, storytelling, and other rituals. This category may also include rituals that are not linked to any particular site but to a particular group of people.

The Socioeconomic Baseline and Stakeholders Consultation report (2024) indicated that the culture sector in Huíla province has been carrying out work to survey, study, protect and enhance cultural heritage, as part of its strategic programme.

The Huíla Provincial Directorate of Culture has inventoried 180 monuments and historical sites, as well as 121 Ombalas (soba villages) that need to be classified. Features include monuments and sites of civil, military, religious and funerary architecture, historical sites, historical, landscape and natural areas. Some points of can be considered tourism attractions, including: the Caconda Catholic Mission, the Huíla commune Catholic Mission, the building housing the Huíla Provincial Directorate of Culture, the Christ the King statue, the Chapel of Our Lady of the Mount, the National Assembly center building, the Huíla Regional Museum and the Jau Catholic Mission (Chibia municipality) (Socioeconomic Baseline and Stakeholders Consultation report 2024). The features are located towards Lubango in the Huila Province (approximately 300 km away).

Below is a brief description of attributes associated with each category.

5.3.1.1. Category 1: Archaeological and Palaeontological

Focal points such as rivers and ridges in the powerline corridor could potentially be of heritage significance and contain sites dating to the following periods. This should be confirmed during a pre-construction survey.

5.3.1.1.1. Paleontological Heritage

The Project footprint lies entirely on rocks of the Lower Proterozoic that are composed of metamorphosed clastic sediments and carbonates (Figure 5.2). These rocks also include some reworked material from the unconformably underlying Archaean rocks.

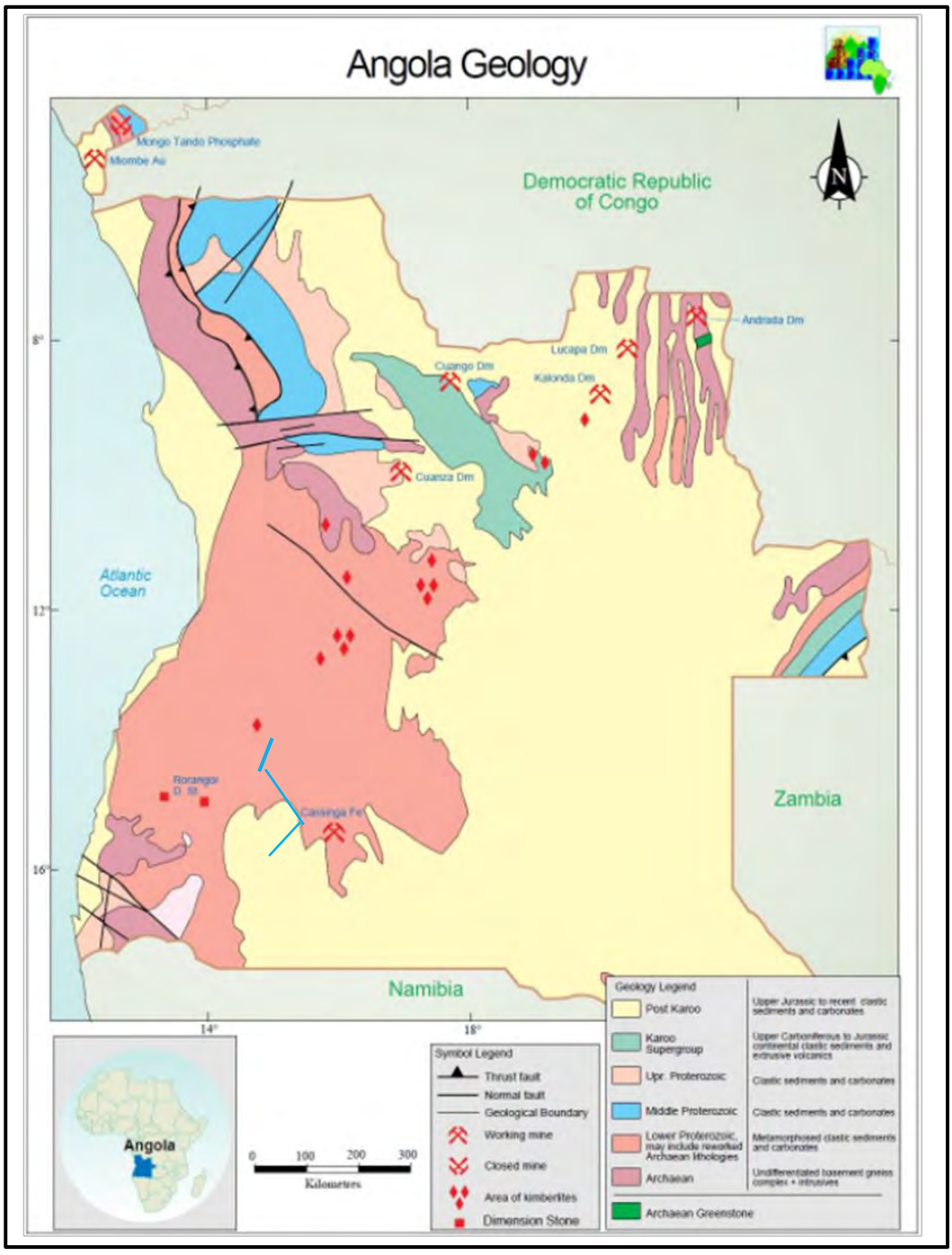


Figure 5.2. Geology map of Angola to show the major rock types and ages. The proposed OHPL route is shown by the blue line. Map from Mindat (online resources) downloaded on 25 April 2024.

No Palaeo sensitivity map could be found for Angola, and the fossil literature is very sparce, focussed on the coastal marine and terrestrial deposits of Cretaceous to Miocene age. The eastern part of the country is covered by Quaternary sands and alluvium. It is not expected that the Cassinga Power Project will impact the palaeontological heritage of Angola (Bamford 2024).

5.3.1.1.2. Archaeological Sites

The archaeological sequence of the study area includes the Stone Age, Iron Age and the historical period as described below. Additionally, heritage resources are categorised and detailed, and trends in conditions and sensitivity to change as well as Eco System Services are discussed below.

Stone Age

In archaeology south of the Sahara, the Stone Age is classified differently from contemporary European and North African paleolithic classifications, instead trifurcating the paleolithic into the Early Stone Age (ESA), Middle Stone Age (MSA) and Later Stone Age (LSA) (Barham & 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 & Mitchell, 2008; Hublin, et al., 2017; Kiura, 2019).
- 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 & Mitchell, 2008; Daggett, 2015, p. 2).

Angola can be classified into three ecological-cultural Stone Age zones (Figure 5.3), 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 Later Stone Age (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.
- 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.

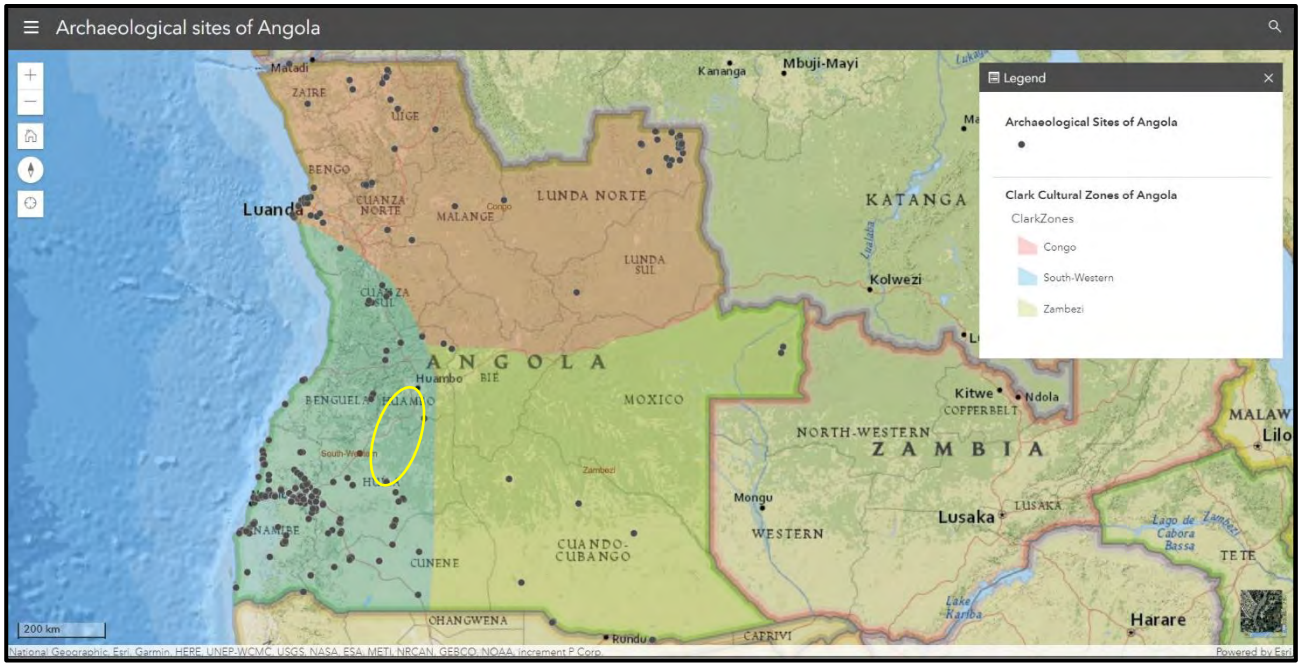


Figure 5.3. Map that illustrates the three ecological-cultural Stone Age zones and indicates known heritage sites in the area.

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 & Woodborne, 2021, p. 1) 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.
- 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.

- 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.
- 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 5.4). It should be considered as having the possibility of being affected by development.



Figure 5.4. Map indicating the position of Feti (280) 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 & 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 USSR 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.

It is therefore pertinent to be cognisant of the fact that 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 around the area of development which have not been identified during this baseline survey.

5.3.1.2. Category 2: Tangible Cultural Heritage with strong intangible elements

Places of Worship

Several places of worship occur in the larger Project area and almost every village has at least one. The ruins of the Sangueve Catholic Mission in Chipindo are located in the larger area and attests to the impact of the Catholic Church in the region. The Socioeconomic Baseline and Stakeholders consultation report (2024) indicated that according to the Cuvango Municipal Directorate of Culture, there is a proposal to classify buildings including the Padre Ernesto Lecont Historical Monument and the Parish of Vila (Imaculada da Conceição), both located in the municipal center of Cuvango. The sites are of high significance. Below is a short description of these features, as provided:

Father Ernesto Lecont historical monument

According to historical data, Lecont landed in Angola in 1884 to evangelise the peoples of the south, including the Ngagela people. The monument (Figure 5.5) was built in honour of this Catholic missionary, Father Ernesto Lecont, who was executed by Mwene Thyawako. Lecont contributed to the evangelisation of the municipality's indigenous community. 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 5.5 Front of the Father Ernesto Lecont Monument (Source: Socioeconomic Baseline and Stakeholders consultation report 2024)

Town parish

The parish church (Figure 5.6) is also on the list of Cuvango's historical and cultural monuments to be classified. Founded in 1940 by the Spiritan Missionaries, the church was built using raw bricks produced locally, i.e. in the old ceramics factory that existed in the municipality. The feature is located approximately 25 m from the proposed powerline. It is recommended that existing roads should be used for access.



Figure 5.6 Front of the Vila parish church (Source Socioeconomic Baseline and Stakeholders consultation report 2024)

Graves and Cemeteries

The following cemeteries were noted during the Socioeconomic baseline and stakeholders' consultation survey (2024):

- Village of Tchicunho, Cuvango municipality – Two small cemeteries (Village cemetery illustrated in Figure 5.7)
- Village of o Ngokue, municipality of Cuvango - Two small cemeteries
- Capuca village, Chipindo municipality - One approximately 3.5 kilometers from the village.

The cemeteries are located away from the proposed Project and no direct impact is expected on the cemeteries. It is likely that additional graves and cemeteries will be found during the pre- construction survey and assessment and RAP. Burial sites are of (social) high significance.



Figure 5.7. Tchicunho village cemetery (Source Socioeconomic Baseline and Stakeholders consultation report 2024)

Recorded features and coordinates are indicated in Table 5.1.

Table 5.1. Recorded Heritage features

Municipality	Heritage Feature	Coordinates
Jamba	Jamba Municipal cemetery	S 14°42'30.44664" E 16°2'28.64436"
Cuvango	Cemetery, Tchicunho village	S 13°58'59.26296" E 16°1'5.9106"
	Vila parish church	S 14° 27' 57.708" E 16° 17' 29.688"
	Father Ernesto Lecont historical monument	S 14° 27' 51.696" E 16° 17' 34.008"
Chipindo	Catholic Mission of Sangueve	S 13°53'18.19968" E 15°50'4.54812"
	Municipal Cemetery	S 13°49'14.24496" E 15°46'47.90208"

5.3.1.3. Category 3: Intangible Heritage

Religious and other intangible cultural heritage sites are difficult to define, as these may have no fixed location, boundary, or physical entity, and when they do (e.g., a sacred tree) the importance may be shared by people over a wider area.

In terms of religion communities in the study area are predominantly Catholic, Protestant (I.E.C.A), with some Adventists and Jehovah's Witnesses (JW). Traditional festivals include Alambamento (traditional marriage), the Efiko festival (which marks the transition of girls from adolescence to adulthood), Evanda or male circumcision (male festival of the passage from adolescence to adulthood), *Eyele (*first harvest ceremony) and and *Ekuivalenca*. The main leisure activities include football and socialising among the young and old and recreational activities with children on commemorative dates (Socioeconomic baseline and stakeholders consultation report 2024).

Recently (18 April 2024) the Ministry of Culture declared the Tchianda and Kizomba (traditional dances) and the Quissanje and Marimba (traditional instruments) as National Intangible Heritage (www.verangola.net)
The Project and its components are not expected to impact negatively on the intangible cultural aspects of the surrounding communities.

5.3.1.4. Previous Cultural Heritage Assessments

In 2015, an Environmental and Social Impact Assessment (ESIA) for the Huambo to Lubango 400kV transmission line was conducted. This study mentioned heritage sites in the area dating mainly from the Iron Age, being represented both in fortified settlements and rock art stations (Barham & Mitchell, 2008), the study also recorded cemeteries and intangible heritage (sacred trees). No other commercial or CRM reports were obtained for the area in question.

5.3.2. Heritage Sensitivity in the Project Area

Recorded sites include burial sites, Iron Age and Stone Age sites as well as structures (discussed in Section 5.3.1). Additionally, the study area was subjected to a heritage predictive model to determine heritage potential based on land use paradigms and landscape features as described below.

The heritage sensitivity predictive model was developed for the study area considering existing Landscape Use paradigms (Table 5.2), to identify areas with the greatest archaeological potential or sensitivity.

Table 5.2. Brief Summary of Main Land Use Paradigms

	Focal Point or Land Form	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	Sampson1985 & 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 River Bed	Marks 2015
	Spring eyes & seasonal seeps	Sampson 1998
Later Stone Age	Widespread	Deacon 1998
	Ephemeral River Bed	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	Cultivatable soil, koppies and hills	Huffman 2007

The Predictive sensitivity model for the study area (Graphically represented in Figure 5.7) based on the landscape use outlined above also took into account the ecological sensitivity maps (that include focal points highlighted in Table 5.2) for the area and included the following natural criteria (Table 5.3):

- Elevation;
- Drainage Lines; and
- Local geology.

Table 5.3. Natural criteria and GIS Methodology

Criteria	Description and GIS Methodology
Elevation	GIS data sourced from a private third party provided elevation data for the Digital Elevation Model (DEM) with a five-meter accuracy. From a landscape approach, the micro topography for the PV facility is important. Although elevation is mostly flat, elevated areas occur that are archaeologically speaking of interest and the field survey concentrated on these areas.
Pans and Drainage Lines	The importance of water sources is highlighted in Table 1. The ArcGIS “Buffer Wizard” tool was utilised to delineate a 100 m buffer around these features.
Geology	Studies in the area showed that palimpsest of Stone Age Material occur in areas where raw material suitable for knapping occurs. In addition, stone walled settlements in the Iron Age are constructed near building material

Based on the above criteria a map illustrating potential heritage sensitive areas within 2 km of the proposed Project was compiled and is included in Figure 5.7 and 5.8.

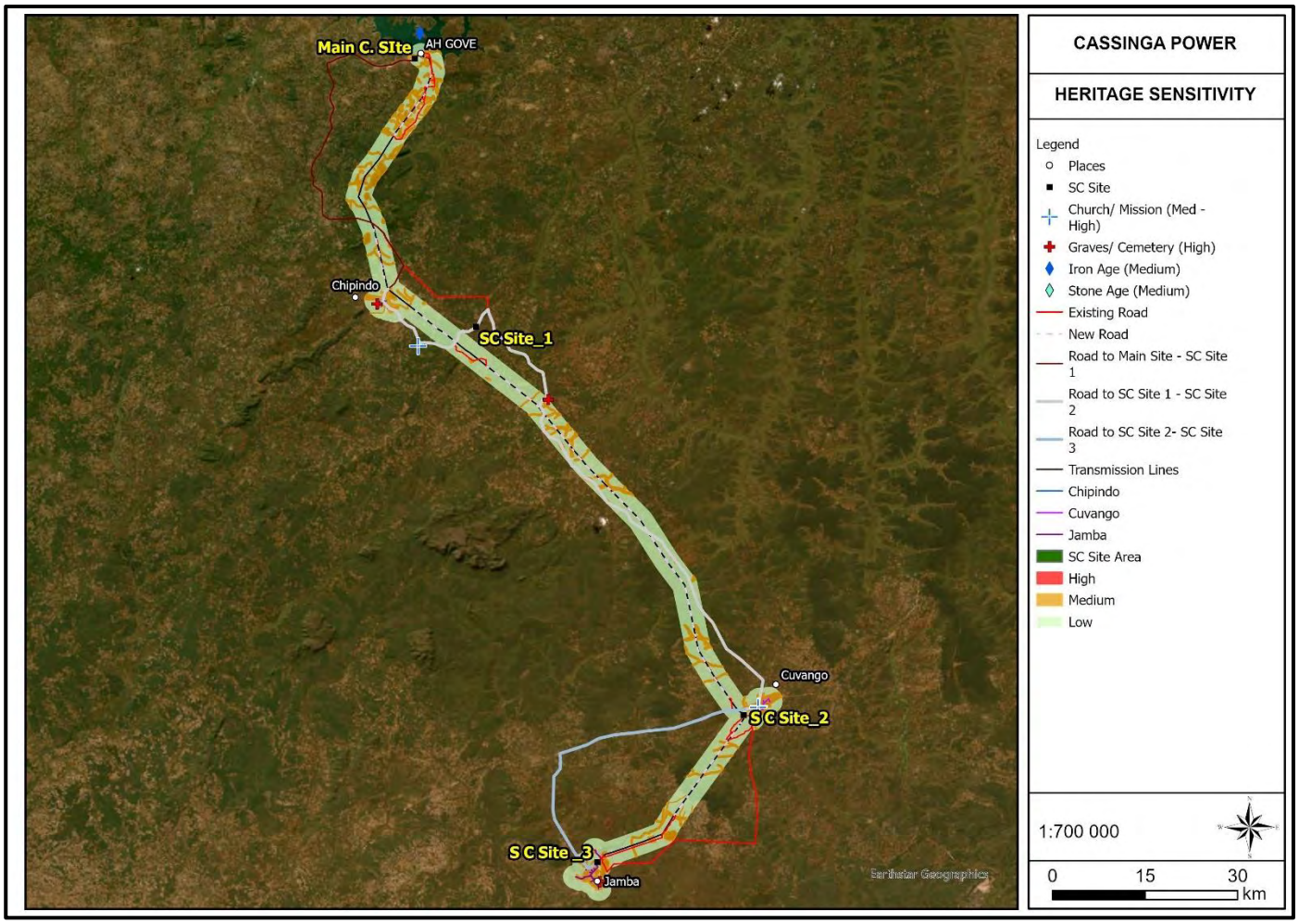


Figure 5.7 Aerial map that illustrates the overall potential heritage sensitivity of the Project area (within 2 km of the proposed powerline) showing areas of low, medium and high heritage potential as well as known sites.

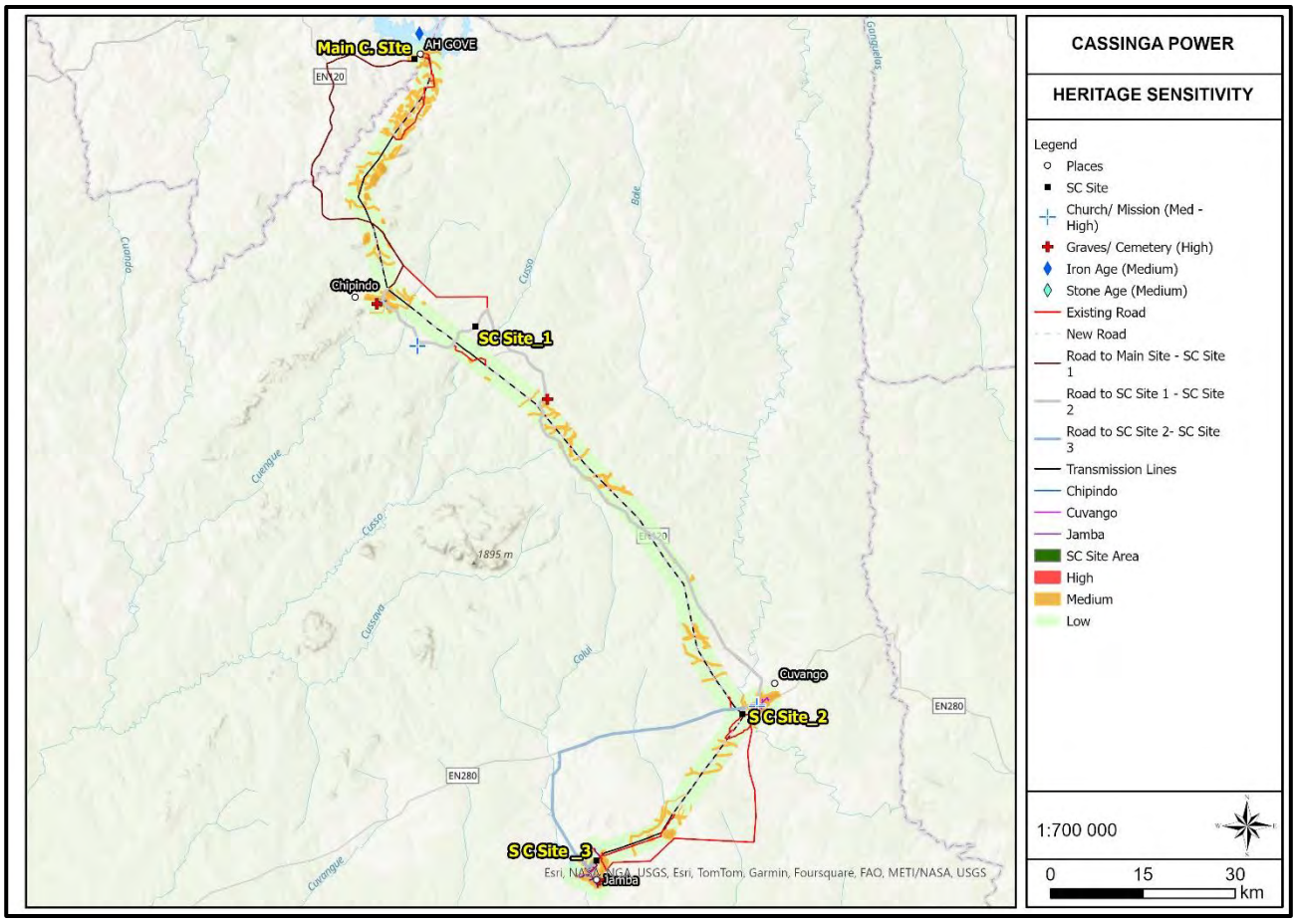


Figure 5.8. Topographic map that illustrates the overall potential heritage sensitivity of the Project area within 2 km of the powerline showing areas of low, medium, and high heritage potential as well as known sites.

5.3.3. Trend in condition and sensitivity to change.

Limited information exists on trends in condition of cultural heritage sites in the general area surrounding the Project. Agriculture, expansion and new settlements, infrastructure, mining activities, and other developments have negatively affected the cultural heritage baseline. Based on professional experience no sites within the AOI are of Outstanding Universal Value (OUV). However, this does not diminish the potential archaeological interest of sites and the cultural values associated with tangible forms of cultural heritage. Therefore, a precautionary principle is followed that acknowledges that tangible sites may be unique even if superficially like others. The approach adopted is that tangible features are a finite resource.

5.3.4. Eco System Services

Within the context of the Cultural Value of Ecosystem Services (ES), Cultural services are defined as the "nonmaterial benefits people obtain from ecosystems" and include the "cultural diversity, spiritual and religious values, knowledge systems, educational values, inspiration, aesthetic values, social relations, sense of place, cultural heritage values, recreation and ecotourism" of an ecosystem. Based on this definition it is closely related to Intangible Heritage discussed under section 5.3.1.3. of this report. According to Holmgaard et al (2017) there is a lack of consensus about what cultural heritage refers to within the ES context, furthermore these services are often considered subjective, intangible, and difficult to quantify in monetary terms (Xu et al 2019).

However, 'cultural services, like all other ES, must demonstrate a significant relationship between ecosystem structures and functions specified in the biophysical domain' (Daniel et al. 2012). Therefore, Holmgaard and colleagues argue that Cultural Ecosystem Services (CES) are derived from the ecosystem, and intrinsically linked to nature – often defined as landscapes. Religious beliefs and rituals, traditions, and customs of local communities seen as intangible heritage often have embedded conservation ethics and have influenced the biophysical conditions of an ecosystem. These landscapes could include sacred groves and fountains (Xu et al 2019). No such landscapes are on record for the study area and therefore the Project is not expected to severely impact on the cultural value of the ecosystems in the area.

In terms of Eco System services, the Socioeconomic baseline and stakeholders' consultation (2024), provided the following information - the communities in the Project area depend on the land for subsistence and well-being. The ecosystem's provisioning services include soil, water (abstraction from the rivers), groundwater (cacimbas and wells to obtain water for domestic and drinking purposes), wood and firewood (used for fuel and building houses) and hunting. Some residents produce charcoal to sell and earn some income.

5.3.5. Social Baseline Consultation

The Stakeholder consultation was conducted as per the schedule in Table 5.4:

Table 5.4. Stakeholder consultation schedule.

Date	Meetings	Activities
Initial enquiries From 26th to 29th February 2024	Meeting with the Jamba Municipal Administration. Meeting with the Cuvango Municipal Administration. Meeting with the Chipindo Municipal Administration. Meeting with Gove Dam officials	- Pre-consultation with local authorities to present the project and alert them to the ESIA process. - Identify the main environmental and socio-economic aspects to be taken into account in specialised studies. -Identify the issues that will influence logistical planning and the mobilisation of specialists for field studies. - Receive comments and concerns about the project and clarify them with the participants.
Local Environmental and Social Baseline Study Phase 18 to 21 March 2024	Surveys of traditional leaders (sobas) Village household survey: - Cacola - Lucunga A - Kuandja - Eyela - Hill I - Km 50 - Shamrock - Aunge - Ngokue - Cavinga - 1st May - Vingolo - Bulletproof - Capuca - Oko - Labourer	- Formal meetings with the municipal and communal administration and traditional leaders (sobas). The meetings with the authority included a presentation of the project and distribution of the basic information documents; - Prior selection of the villages to be visited (based on the project map) and households to be surveyed; - Surveys of at least 4 households in each village visited; - Visits to sacred sites, socio-economic infrastructures; - Request from municipal authorities basic information on the municipal profile, master plans for different areas to support the preparation of the ESIA.

As part of the stakeholder engagement process, pre-consultation engagements were held with local authorities impacted by the proposed Project, namely the Jamba, Cuvango and Chipindo local authorities. The outcomes of the local authority engagements are presented in the Reconnaissance survey report.

The Socioeconomic baseline and stakeholders' consultation (2024) provided the following feedback:

- Various methods were used to involve stakeholders during the baseline study phase as outlined below:
    - Household survey - 16 villages and/or towns were visited, previously selected from the project's cartographic maps, and based on size, proximity to the project route and accessibility to the localities were the criteria associated with selecting the villages to visit. The survey aimed to gather basic socio-economic information and an opportunity to build trust and establish relationships with the communities, which should continue throughout the life of the project.
    - Survey of village leaders (sobas) - The survey aimed to collect basic socio-economic information on village demographics, number of houses, households, livelihood activities, available services/infrastructure and others; and
    - Before the surveys were carried out, the consultants distributed the Background Information Documents (BID), a brief presentation of the project in Portuguese, sometimes with a translation into the local language as not all heads of household understand Portuguese fluently.

A total of 58 questionnaires were administered to households and 16 to traditional leaders. Socio Economic findings are presented in the Socioeconomic baseline and stakeholders' consultation report.

5.4. Photographs illustrating the baseline conditions.



Figure 5.9. General site conditions indicating vegetation in the Miombo woodland area (Photograph provided by SRK)



Figure 5.10. Plantation and general site conditions within the Gobi Forest (Photograph provided by SRK)



Figure 5.11. A maize field in one of the villages. The red and green flag represents UNITA. The areas are cleared of natural vegetation and cultivated. (Photograph provided by SRK)



Figure 5.12. Cultivation activities in the study area – note the sparse natural vegetation. (Photograph provided by SRK)



Figure 5.13. A field being prepared for cultivation. Natural vegetation has been removed and trees cut back (Photograph provided by SRK)



Figure 5.14. A footpath passing through the proposed site of the Jamba substation. The land is owned by RNT and was previously a thermal power plant and has been transformed. (Photograph provided by SRK)

6. Permit requirements.

This heritage assessment is conducted as a Phase 1 assessment with no provision for in country permitting but rather for best international industry practice focussing on IFC PS8.

7. Assessment of impacts and identification of management actions for the construction, operation, and decommissioning phases

The purpose of this section is to determine which heritage resources require protection or mitigation as a result of the Project. In this regard, heritage resources are different from other components of the environment in that they incorporate a 'sense of place', determined by cultural values of people at the time. This is one of the reasons why heritage resources are irreplaceable and their destruction irreversible.

Heritage Resources within the Project area is at risk of being damaged through direct and indirect impacts, especially during the Project's pre-construction/construction phase (Table 7.1). 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 (for management measures see section 8). The Vila parish church is located 25 m from powerlines 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 mostly located along existing infrastructure and roads. It should also be noted powerlines have a relatively small impact on heritage features due to the small footprint of the pylons as shown by Sampson (1985).

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 pre-construction and construction phase. The Project footprint including construction camps, laydown areas and access roads could also be of archaeological interest and these aspects should be considered further during a pre-construction survey.

Table 7.1. Summary of main impacts on heritage resources

Main Impact	Project activities	Secondary impacts anticipated
Damage or destruction of non-renewable heritage resources	Demining, clearing/ Levelling/ excavation/ construction activities	Loss of archaeological/ palaeontological record.
		Altered sense of place
Restriction of access to burial sites for family members	Powerline corridor, substations, and construction activities.	Cemeteries provide a cultural link to ancestors and the restriction of access causes a discord with the environment.

7.1. Evaluation of Potential Impacts on Heritage resources by the Cassinga Power Project

During the preconstruction phase impacts to heritage resources can include destruction or partial destruction due to clearing activities as well as excavations. In terms of heritage resources, it should be noted that impacts are mostly expected to occur during the pre-construction and construction phase as the operation phase is not foreseen to pose severe additional impacts. However, during the operational phase indirect impacts relating to the sense of place and access to burial sites can occur. Direct impacts to heritage resources are once off, permanent, and irreversible.

Impacts to heritage resources are assessed in Table 7.2 to 7.10 Mitigation measures are provided to manage the impacts to an acceptable level.

Table 7.2. Impacts to cemeteries by the Project during the pre-construction phase:

Impact of the project on recorded cemeteries/ burial sites during the pre-construction phase.								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Long term*	*Site / local*	***High***	***Unlikely***	***Medium***	-	*Medium*
Management Measures: • Pre-construction heritage survey of the final alignment and all associated infrastructure; • Monitoring of heritage features during construction and routine monitoring of demining and land-clearing activities; • Implementation of a chance find procedure; • Avoidance and management of known features; • Development of a heritage site development plan that address access protocols for safe access to burial sites; and • 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	*Minor*	*Long Term*	*Site / local*	***High***	***Unlikely***	***Low***	-	*Medium*

Table 7.3. Impact of the Project on recorded cemeteries during the construction phase

Impact of the project on recorded cemeteries/ burial sites during the construction phase								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Long term*	*Site / local*	***High***	***Unlikely***	***Medium***	-	*Medium*
Management Measures: • Monitoring of heritage features during construction and routine monitoring of land-clearing (including demining) activities; • Implementation of a chance find procedure; • Avoidance and management of known features; and • 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	*Minor*	*Long Term*	*Site / local*	***High***	***Unlikely***	***Low***	-	*Medium*

Table 7.4. Impact of the project on recorded cemeteries during the operational phase

Impact of the project on recorded cemeteries/ burial sites during the operations phase								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Long term*	*Site / local*	***High***	***Unlikely***	***Medium***	-	*Medium*
Management Measures: • Implementation of a heritage site development plan that address access protocols for safe access to burial sites and ongoing in-situ preservation of these sites. • Implementation of a chance find procedure. • Avoidance and management of known heritage features. • Monitoring of heritage features during operation and routine monitoring of maintenance and any land-clearing activities and; • 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	*Minor*	*Long Term*	*Site / local*	***Medium***	***Unlikely***	***Low***	-	*Medium*

Table 7.5. Impacts to recorded places of worship/ monuments during the preconstruction phase.

Impact of the project on places of worship/ monuments during the preconstruction phase.								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Long term*	*Site / local*	***Medium***	***Possible***	***Medium***	-	*Medium*
Management Measures: • Monitoring of heritage features during construction and routine monitoring of land-clearing activities; • Heritage sites should be indicated on development plans and avoided by all pre construction activities; • Existing infrastructure (access roads) should be used; • Implementation of a chance find procedure; • Avoidance and management of known features; • Pre-construction heritage survey of the final corridor areas; and • 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/ paleontological resources that may be discovered during land-clearance and mechanical excavation activities.								
After Management	*Minor*	*Long Term*	*Site / local*	***Medium***	***Unlikely***	***Low***	-	*Medium*

Table 7.6.Impacts to recorded places of worship/ monuments during the construction phase.

Impact of the project on places of worship/ monuments during the preconstruction phase.								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Long term*	*Site / local*	***Medium***	***Possible***	***Medium***	-	*Medium*
Management Measures: • Monitoring of heritage features during construction and routine monitoring of land-clearing activities; • Implementation of a chance find procedure; • Avoidance and management of known features; • Pre-construction heritage survey of the final corridor areas; and • 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/ paleontological resources that may be discovered during land-clearance and mechanical excavation activities.								
After Management	*Minor*	*Long Term*	*Site / local*	***Medium***	***Unlikely***	***Low***	-	*Medium*

Table 7.7. Impacts to recorded places of worship/ monuments during the operation phase.

Impact of the project on places of worship/ monuments by the project during the operation phase.								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor*	*Long term*	*Site / local*	***Medium***	***Possible***	***Medium***	-	*Medium*
Management Measures: • Monitoring of heritage features during construction and routine monitoring of maintenance and clearing activities; • Implementation of a chance find procedure; • Avoidance and management of known features; • 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/ paleontological resources that may be discovered during land-clearance and mechanical excavation activities.								
After Management	*Minor*	*Long Term*	*Site / local*	***Medium***	***Unlikely***	***Low***	-	*Medium*

Table 7.8. Impacts to potential heritage resources in the powerline line corridor during the pre-construction phase.

Impact of the Project on heritage resources during the preconstruction phase.								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor (scale not measurable)*	*Long term*	*Site / local*	***Medium***	***Possible***	***Medium***	-	*Medium*
Management Measures: • Monitoring of heritage features during construction and routine monitoring of land-clearing (including demining) activities; • Implementation of a chance find procedure; • Avoidance and management of known features; • Pre-construction heritage survey of the final corridor areas; and • 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/ paleontological resources that may be discovered during land-clearance and mechanical excavation activities.								
After Management	*Minor*	*Long Term*	*Site / local*	***Medium***	***Unlikely***	***Low***	-	*Medium*

Table 7.9. Impacts to potential heritage resources in the powerline corridor during the construction phase.

Impact of the Project on heritage resources during the construction phase.								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor (scale not measurable)*	*Long term*	*Site / local*	***Medium***	***Possible***	***Medium***	-	*Medium*
Management Measures: • Monitoring of heritage features during construction and routine monitoring of land-clearing activities; • Implementation of a chance find procedure; • Avoidance and management of known features; • 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/ paleontological resources that may be discovered during land-clearance and mechanical excavation activities.								
After Management	*Minor*	*Long Term*	*Site / local*	***Medium***	***Unlikely***	***Low***	-	*Medium*

Table 7.10. Impacts of the project on heritage resources during the operational phase.

Impact of the Project on heritage resources during the operation phase.								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor (scale not measurable)*	*Long term*	*Site / local*	***Medium***	***Possible***	***Medium***	-	*Medium*
Management Measures: • Monitoring of heritage features during construction and routine monitoring of land-clearing activities; • Implementation of a chance find procedure; • Avoidance and management of known features; • 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/ paleontological resources that may be discovered during land-clearance and mechanical excavation activities.								
After Management	*Minor*	*Long Term*	*Site / local*	***Medium***	***Unlikely***	***Low***	-	*Medium*

7.2. Cumulative Impacts

Cumulative impacts considered as an effect caused by the proposed action that results from the incremental impact of an action when added to other past, present, or reasonably foreseeable future actions. (Cornell Law School Information Institute, 2020) and the purpose of this section is to identify any future or currently constructed projects within the area of influence to inform potential cumulative impacts. Based on the principle of avoidance the Project will not impact directly on any known heritage resource and the cumulative impact is limited. Therefore, with the implementation of the mitigation measures in this report, the cumulative impact on heritage resources is expected to be low (Table 7.11).

Potential cumulative impacts may include the following:

- Increased human presence in the area may further expose or damage heritage resources, especially the looting of archaeological sites for artefacts.
- Informal or smaller infrastructure developments outside the areas covered by the ESIA and ESMP may impact or expose further heritage resources not currently documented and recorded.
- The various projects in the vicinity of the study area can result in the depletion of heritage resources putting the archaeological & palaeontological record at risk, therefore increasing the importance of managing cultural resources in a responsible manner.

Table 7.11. Cumulative Impact of the project on heritage resources.

Impact of the project on heritage resources								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor (scale not measurable)*	*Long term*	*Site / local*	***Medium***	***Possible***	***Medium***	-	*Medium*
Management Measures: • Implementation of a chance find procedure; • Indicate known features on development plan; • Demarcate features to be avoided; • Management of known heritage features; • Monitoring of heritage features during operation and routine monitoring of land-clearing activities; • Pre-construction heritage survey of final impact areas; and • 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/ paleontological resources that may be discovered during land-clearance and mechanical excavation activities.								
After Management	*Minor*	*Long Term*	*Site / local*	***Medium***	***Unlikely***	***Low***	-	*Medium*

7.3. Residual impacts

Although surface sites can be avoided or mitigated, there is a chance that completely buried sites would still be impacted on, but this cannot be quantified.

8. Recommendations for the ESMP

The following recommendations must be adhered to, in order to ensure that impacts on heritage resources are managed to an acceptable level:

- Pre-construction heritage survey of the final alignment and all associated infrastructure;
- Monitoring of heritage features during construction and routine monitoring of land-clearing activities;
- Implementation of a chance find procedure (as described and detailed below);
- Avoidance and management of known features;
- Development of a heritage site development plan that address access protocols for safe access to burial sites; and
- 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.

IFC Performance Standards require the development of an Environmental and Social Management System (ESMS) appropriate to the nature and scale of the Project and its associated risks and impacts. As part of the ESMS, specific mitigation measures should be identified for each significant aspect of the Project and is outlined in Table 8.1. For archaeological and heritage sites, potential mitigation and management measures to be considered include;

i. *Avoidance*: This option focuses on conservation of cultural heritage sites by avoiding disturbance of these locations where feasible. Depending on the importance of the resource and the economic viability of preservation, site conservation may be the only option available to the developer. A site HMP may be developed to describe management plans and actions.
ii. *Mitigation and partial conservation*: This option focuses on a combined approach of mitigation and avoidance or conservation. Portions of a site that cannot be avoided may be managed through archaeological study including such actions as shovel test pits, test excavations, detailed documentation and mapping. In areas where avoidance is feasible, conservation efforts should especially consider significant site features.
iii. *Site mitigation:* The entire site is mitigated through appropriate archaeological study and documentation before destruction.
iv. *Site destruction*: If a site is of little or no archaeological or cultural heritage significance, it may be destroyed.
v. *Alternatively,* Free, Prior, and Informed Consent (FPIC) from the community should be obtained to relocate or alter the site. (Performance Standard 7).

The conservation and protection of sites in their original location, is the preferred course of action and should be practically and economically viable. To protect the conserved sites further, monitoring and a site development management plan will be necessary.

Table 8.1. Management Plan for the Project

Potential Impact 1	**Aspect / Activity**	**Management / Mitigation Measure/s**	**Action Plan**	**Responsible Party**
Alteration or Destruction of heritage features in the construction and operational areas of the Cassinga Power Project	1. Clearing Activities 2. Excavations and construction 3. Movement of machinery	• Development of a heritage site development plan • Management of Chance Finds • Avoidance and in situ preservation of cemeteries. • Monitoring of heritage features during construction and routine monitoring of land-clearing activities. • Provide safe access to cemeteries. • 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. • Pre-Construction survey of the final alignment areas.	• Implement heritage site development plan. • Implementation of Chance Find Procedure • Indication of known heritage features on development plans and demarcation of features. • Monitoring by an archaeologist and Environmental management team. • Compile guideline to ensure safe access for communities to cemeteries. • Cultural training and awareness program as part of Health and Safety induction.	Suitably qualified archaeologist. Cassinga Power Project Managers
Potential Impact 2	**Aspect / Activity**	**Management / Mitigation Measure/s**	**Action Plan**	**Responsible Party**
Increased human activity.	Influx of people and increased activity in the area.	• Indication of known heritage features on development plans and demarcation of features. • Avoidance of known features.	• Indicate features on construction plan • Demarcate features to be avoided.	Cassinga Power Project Managers,
Potential Impact 3	**Aspect / Activity**	**Management / Mitigation Measure/s**	**Action Plan**	**Responsible Party**
Cumulative Impact of the Project on Heritage Resources.	Accidental impact on subsurface heritage resources	Chance Find Procedure	Implementation of chance find procedure.	Cassinga Power Project Managers
Potential Impact 4	**Aspect / Activity**	**Management / Mitigation Measure/s**	**Action Plan**	**Responsible Party**

Alteration or Destruction of unknown heritage resources.	• Clearing Activities • Excavations and construction • Movement of machinery	• Management of Chance Finds • Pre-construction survey.	• Implement heritage site development plan. • Implementation of Chance Find Procedure • Systematic survey of impact areas by an archaeologist and palaeontologist	Suitably qualified archaeologist. Cassinga Power Project Managers

8.1. Chance Find Procedure

The following procedural guidelines must be considered in the event that previously unknown fossils, heritage resources or burial grounds and graves are exposed or found during the life of the Project.

8.1.1. Initial Identification and/or Exposure (Chance Find)

If during the construction, operations, or closure phases of this Project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, find any artefact of cultural significance, this person must cease work at the site of the find. They must report this find to their immediate supervisor, and through their supervisor to the senior on-site manager. The following steps and legal requirements and reporting structure must be observed:

- A project archaeologist should be appointed for the Project.
- The person or group (identifier) who identified or exposed the heritage resource or burial ground must cease all activity in the immediate vicinity of the site;
- The identifier must immediately inform the senior on-site Manager of the discovery;
- The senior on-site Manager must make an initial assessment of the extent of the find, and confirm the extent of the work stoppage in that area and ensure that the site is secured and control access;
- The senior on-site Manager will inform the Environmental Officer (EO) and Health and Safety (H&S) officer of the chance find and its immediate impact on operations. The EO will then contact the Project archaeologist.

8.1.2. Chance Find Procedures: Heritage Resources and Fossils

In the event that previously unidentified heritage resources are identified and/or exposed during construction or operation of the Project, the following steps must be implemented subsequent to those outlined above:

- The Project archaeologist must be notified of the discovery;
- The Project archaeologist will visit the site for a field-based assessment of the finds and appropriate mitigation measures will then be presented to the client;
- Should the specialist conclude that the find is a heritage resource protected in terms of legislation, they must inform the relevant authority of their discovery;
- Based on the comments received from the authorities, the Project archaeologist will provide the developer with a Site Incident Report outlining the processes followed and the way forward.

8.1.3. Chance Find Procedures: Burials and Graves

In the event that previously unidentified burial grounds and graves are identified and/or exposed during construction or operation of the Project, the following steps must be implemented subsequent to those outlined above:

- The Project archaeologist must immediately be notified of the discovery in order to take the required further steps:
    - The local Police, traditional authority and NMCC should be notified;
    - The Project archaeologist will inspect the exposed burial and determine in consultation with the relevant authorities if any additional graves may exist in the vicinity as well as the temporal context of the remains, i.e.:
        - forensic
        - recent or historical; or
        - archaeological;
- Should the specialist conclude that the find is a heritage resource protected in terms of legislation, the lead consultant must notify the authorities following the Chance Find Procedure as outlined above.

8.1.4. Chance Find Procedure Conclusion

The Chance Find Procedures presented in this document serve as international best practice policy for the accidental discovery of heritage resources and burial grounds and graves guided by National Legislation. Based on the definitions provided within this document and the proposed lines of communication, the developer will be able to mitigate the accidental discovery of heritage resources and burial grounds and graves throughout the various phases of the Project.

The Project archaeologist will be available to assist with the recommendation of mitigation for the accidental discovery of heritage resources and burial grounds and graves and to liaise with the relevant authorities.

8.2. Monitoring Requirements

Site monitoring should be conducted by an experienced archaeologist or heritage specialist, however day to day monitoring can be conducted by the EO. The EO or other responsible persons should be trained along the following lines:

- *Induction training:* Responsible staff identified by the developer should attend a short course on heritage management and identification of heritage resources.
- *Site monitoring and watching brief*: As most heritage resources occur below surface, all earth-moving activities need to be routinely monitored in case of accidental discoveries. The greatest potential impacts are the initial soil removal and subsequent earthworks during construction. The EO should monitor all such activities daily. If any heritage resources are found, the chance finds procedure must be followed as outlined above.

Finally, a heritage specialist should assess any material change to the conceptual layout plan as part of the change management procedure for the Project. Monitoring requirements are provided in Table 8.2.

Table 8.2. Heritage Monitoring Requirements for the Project.

Heritage Monitoring					
Aspect	**Area**	**Responsible for monitoring and measuring**	**Frequency**	**Proactive or reactive measurement**	**Method**
Known Cemeteries	All	EO	Daily – During Construction Monthly – first year Yearly thereafter	Proactively	• Compare current conditions with recorded baseline conditions; • Status quo will be recorded through photographs; • Results will be maintained; and • Results will be reported in the progress reporting.
Known Places of Worship/ Monuments	All	EO	Daily – During Construction Monthly – first year	Proactively	• Compare current conditions with recorded baseline conditions; • Status quo will be recorded through photographs; • Results will be maintained; and

Heritage Monitoring					
Aspect	**Area**	**Responsible for monitoring and measuring**	**Frequency**	**Proactive or reactive measurement**	**Method**
			Yearly thereafter		• Results will be reported in the progress reporting; • Ensure that construction activities at existing access roads do not encroach on Places of Worship.
Clearing activities and Excavations	All	EO	Weekly – during construction phase Bi Weekly – During quarry excavations	Proactively	• If risks are manifested (accidental discovery of heritage resources) the chance find procedure should be implemented: 1. Cease all works immediately; 2. Report incident to the Sustainability Manager; 3. Contact an archaeologist to inspect the site; 4. Report incident to the competent authority; and 5. Employ reasonable mitigation measures in accordance with the requirements of the relevant authorities. • Only recommence operations once impacts have been mitigated.

9. Conclusion

This report presents the results of a heritage impact assessment conducted for the proposed Cassinga Power Project in Angola. The impact of the Project on cultural heritage resources are based on a desk-based assessment, a reconnaissance survey and a social baseline field survey that provided information to identify and describe the potential heritage resources in the study area. The following key considerations are identified:

- More features are likely to be identified in the final corridor and associated infrastructure impact areas after a systematic pre construction survey of these areas.
- Although SRK does not recommend resettlement for the current expansion programme, there is a possibility that future resettlement might be triggered. The issue of cemeteries in these communities will have to be addressed.

To mitigate the impacts arising from the key considerations the following management measures are recommended:

- Development and implementation of a heritage site development plan that address access protocols for safe access to burial sites.
- Implementation of a chance find procedure.
- Avoidance and management of known features.
- Monitoring of heritage features during construction and routine monitoring of land-clearing activities.
- Pre-construction heritage survey of final impact areas; and
- 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 demining, land-clearance and mechanical excavation activities.

From a heritage perspective the proposed Project is viable as no sites of outstanding value occur in the impact areas. If the management measures are adhered to, we are of the opinion that the development can be authorised as the impact of the development on heritage resources can be mitigated to an acceptable level.

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Appendix E: Soils and land capability



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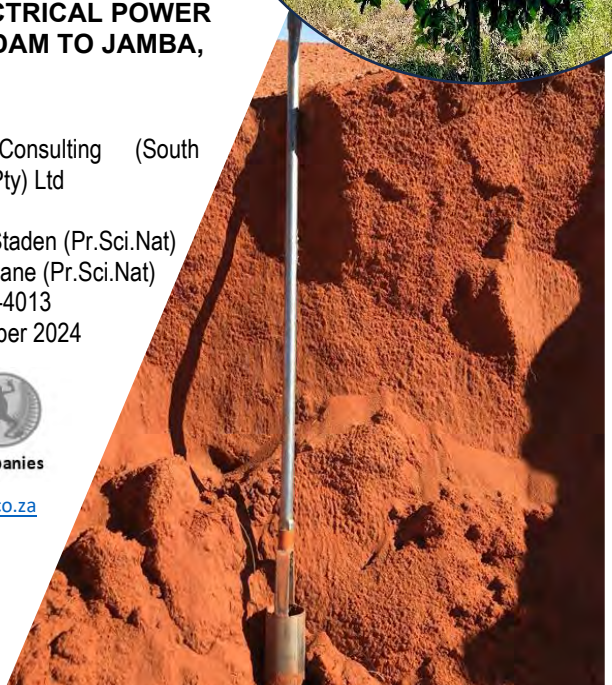
Soil, Land use and Land Capability Assessment

AS PART OF THE ENVIRONMENTAL AUTHORISATION PROCESS FOR THE PROPOSED CASSINGA ELECTRICAL POWER SUPPLY ESIA FROM GOVE DAM TO JAMBA, ANGOLA.

Prepared for:	SRK Consulting (South Africa (Pty) Ltd
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Date:	September 2024

Part of the SAS Environmental Group of Companies

Website: http://www.sasenvironmental.co.za





EXECUTIVE SUMMARY

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Authorisation (EA) process for the proposed construction of a new overhead line (OHL) 220 kV between Gove and Cuvango, through Chipindo, Angola. The proposed OHL has an associated 200 metre (m) assessment corridor (i.e., 100 m on either side of the overhead line), the assessment corridor will hereafter be referred to as the "study area".

The objective of this study was to determine the impact of the proposed OHL grid connection on the soil, land use, land capability and agricultural potential. The proposed project traverses soils which support agricultural practice and food production. Thus, it is crucial to consider the surrounding soils, land uses, and land potential to make sure that the proposed project takes into account high-potential agricultural land in accordance with the applicable Angolan Law.

During the site assessment, it was noted that the study area largely consists of agricultural fields as part of subsistence farming, grazing, Miombo woodland, plantations, wildlife/wilderness, residential areas as well as waterbodies. Crops observed within cultivated areas largely includes maize and beans with a small section comprising Cassava, while livestock such as cattle, goats, and chickens are also observed during the site visit. Wood harvesting activities were also noted in some portion of the study area although these activities did not seem to be practices on a large scale within the field verified areas. Fishing activities in areas near rivers was also observed and this is deemed to be an important economic activity, providing food and income for rural communities.

The project footprint areas are dominated by Ferralsols, Acrisols, Plinthosols, Leptosols and Anthrosols. These soils are largely range between moderately deep to very deep and are well drained, red and yellow soils. The topsoil is of most soils is of 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. Table A presents summarised findings of the soil investigation.

Table A: Summarised findings of the soil investigation

WRB Classification	Soil Depth (mm)	Land Capability Class	Areal Extent (ha)	Extent Percentage (%)	Land Potential
Ferralsols (Well drained)	<1200	Class II	455,50	10,94	Very High potential
Acrisols	800 - 1000	Class III	2 456,70	58,99	High potential
Plinthosols	700 - 900				
Leptosols	<400	Class VI	298,42	7,17	Moderate Potential
Fluvisols (Rivers and DLs)	400 -500	Class V	298,54	7,17	Watercourse
Gleysols (Valley Bottoms)					
Anthrosols	N/A	Class VIII	652,81	15,68	Very Low Potential
Total Enclosed Area			**= 4 164,37***	**100***	

***Substation = 2.4ha (0.06%)**

Following the assessment of the study area and the identified potential impacts as the result of the proposed development, the proposed OHL project and associated surface infrastructure development is deemed acceptable from a soil, land use and land capability point of view since the impact will largely be medium without mitigation and low with mitigatory measures adequately implemented during all phases of the development. Additionally, the proposed overhead line has the potential to co-exist concurrently with agricultural activities both cultivated and livestock grazing activities. The integrated mitigation measures provided must be implemented accordingly, with the aim of minimising potential impacts on the agricultural resources while considering the need for sustainable development.

GLOSSARY OF TERMS

Albic	Grey colours, apedal to weak structure, few mottles (<10 %)
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Chromic:	Having within ≤150 cm of the soil surface, a subsurface layer ≥30 cm thick, that has a Munsell colour hue redder than 7.5YR, moist.
Ferralic:	Having a ferralic horizon starting ≤150 cm of the soil surface.
Ferralic horizon:	A subsurface horizon resulting from long and intense weathering, with a clay fraction that is dominated by low-activity clays and contains various amounts of resistant minerals such as Fe, Al, and/or Mn hydroxides.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Lithic	Dominantly weathering rock material, some soil will be present.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Red Apedal	Uniform red colouring, apedal to weak structure, no calcareous
Runoff	Surface runoff is defined as the water that finds its way into a surface stream channel without infiltration into the soil and may include overland flow, interflow, and base flow.
Orthic	Maybe dark, chromic, or bleached
Salinity:	High Sodium Adsorption Ratio (SAR) above 15% are indicative of saline soils. The dominance of Sodium (Na) cations in relation to other cations tends to cause soil dispersion (deflocculation), which increases susceptibility to erosion under intense rainfall events.
Sodicity:	High exchangeable sodium Percentage (ESP) values above 15% are indicative of sodic soils. Similarly, the soil dispersion.
Soft Plinthic	Accumulation of vesicular Fe/Mn mottles (>10%), grey colours in or below horizon, apedal to weak structure
Integrated Environmental Management	Is a philosophy that is concerned with finding the right balance between development and the environment
Technosols	Man-made soil deposit with no recognisable diagnostic soil horizons, including soil materials which have not undergone paedogenesis (soil formation) to an extent that would qualify them for inclusion in another diagnostic horizon

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ACRONYMS

°C	Degrees Celsius.
AGIS	Agricultural Geo-Referenced Information Systems
BAR	Basic Assessment Report
CARA	Conservation of Agricultural Resources Act
DALRRD	Department of Agriculture, Land Reform and Rural Development
DFFE	Department of Forestry, Fisheries, and the Environment
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EHS	World Bank Environmental Health and Safety
EMP	Environmental Management Plan
EPFI	Equator Principles Financial Institution
ESMS	Environmental and Social Management System
ET	Evapotranspiration
FAO	Food and Agriculture Organization of the United Nations
GIIP	Good International Industry Practice
GIS	Geographic Information System
GPS	Global Positioning System
IFC	International Finance Corporation
m	Meter
MAP	Mean Annual Precipitation
MINEA	Ministry of Energy and Water
MTS	Main Transmission Substation
NEMA	National Environmental Management Act
OHL	Overhead line
OHL	Overhead Line
SACNASP	South African Council for Natural Scientific Professions
SOTER	Soil and Terrain
WRB	World Reference Base
ZRC	Zimpande Research Collaborative

1. INTRODUCTION

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Authorisation (EA) process for the proposed construction of a new overhead line (OHL) 220 kV between Gove and Cuvango, through Chipindo, Angola. The proposed OHL has an associated 200 metre (m) assessment corridor (i.e., 100 m on either side of the overhead line), the assessment corridor will hereafter be referred to as the "study area". Refer to Figures 1, 2 and 3 for the locality and layout of the proposed overhead line.

1.1 Background and Project Description

The Project is located South of the centre of Angola, namely, in the provinces of Huila and Huambo. The Project powerline extends for about 170 km, crossing six municipalities (Municípios) which include Jamba, Cuvango, Dongo, Galangue, Chipindo and Kalima.

The main works will be carried out largely in Huila Province near the Gove Hydro Dam (Huambo) 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 associated with the electrification of villages at Chipindo, Cuvango and Jamba will be constructed.

The Republic of Angola, through its Ministry of Energy and Water (MINEA), is embarking on a significant enhancement of its electrical infrastructure with the Cassinga Project, aiming to boost electric power supply across various communities within the Province of Huíla. The Project is structured around the establishment of a new 220 kV Overhead Line (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. Furthermore, the Project includes the laying down of medium voltage overhead lines for distribution, along with the necessary low voltage 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 OHL 220 kV interconnection to Cuchi/Menongue.

An estimated power demand of 80 MW has been calculated for the Cassinga Project, with an additional 10 MW anticipated for local community demands. This projection indicates 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.

Transmission lines and towers

Transmission line conductors are strung on in-line suspension towers and bend (strain) towers. The structures proposed to be used for the majority of the 220 kV Transmission line are metallic towers type Y, adequate to the angle of the OHL. These towers are approximately 50 m in height and a total footprint area of 80 m x 50 m is required for each tower. The average span between two towers is 400 m.

The cross-rope suspension tower is typically used along the straight section of the servitude, while the self-supporting angle towers and inline strain towers are used where there is a bend in the powerline alignment. Angle towers are cumbersome and more steel-intensive than suspension towers, making them more visually intrusive and expensive to construct. Therefore, transmission line routes are planned with as few bends as possible.

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 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.

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.

<u>Stage 1: Gove – Chipindo – Cuvango</u>

The Gove – Chipindo – Cuvango section of the OHL will comprise the following components:

- High Voltage Transmission Line, 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 mm^2 (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 will comprise the following components:

- High Voltage Transmission Line, 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.

Electrification of community homes and public lighting

The electrification of Chipindo, Cuvango and Jamba requires several infrastructure components. The installation of these components within each community will establish a medium and low voltage network to supply grid electricity to approximately 1 000 homes in each community, including public lighting.

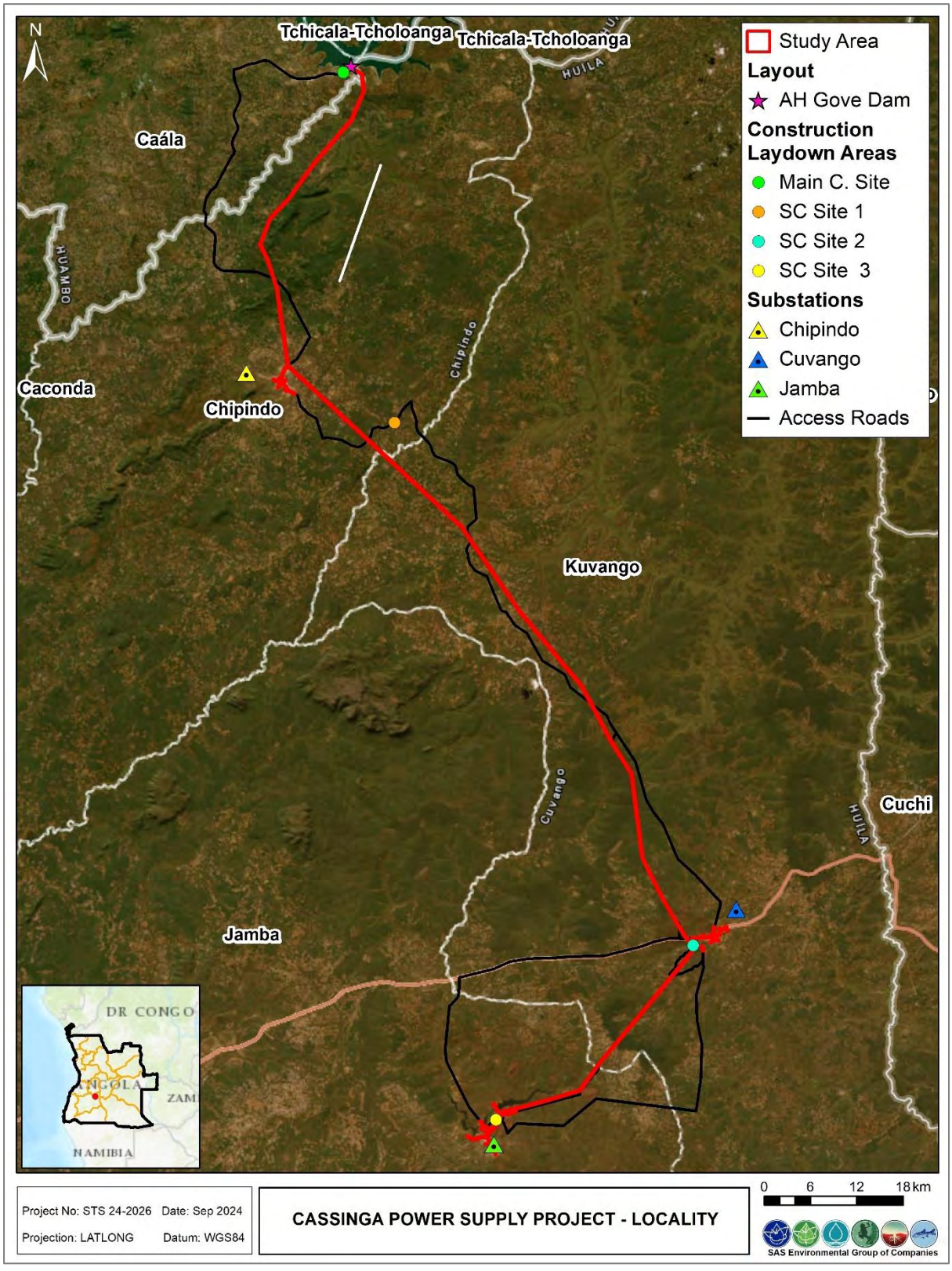


Figure 1: General locality map of the proposed Cassinga powerline project.

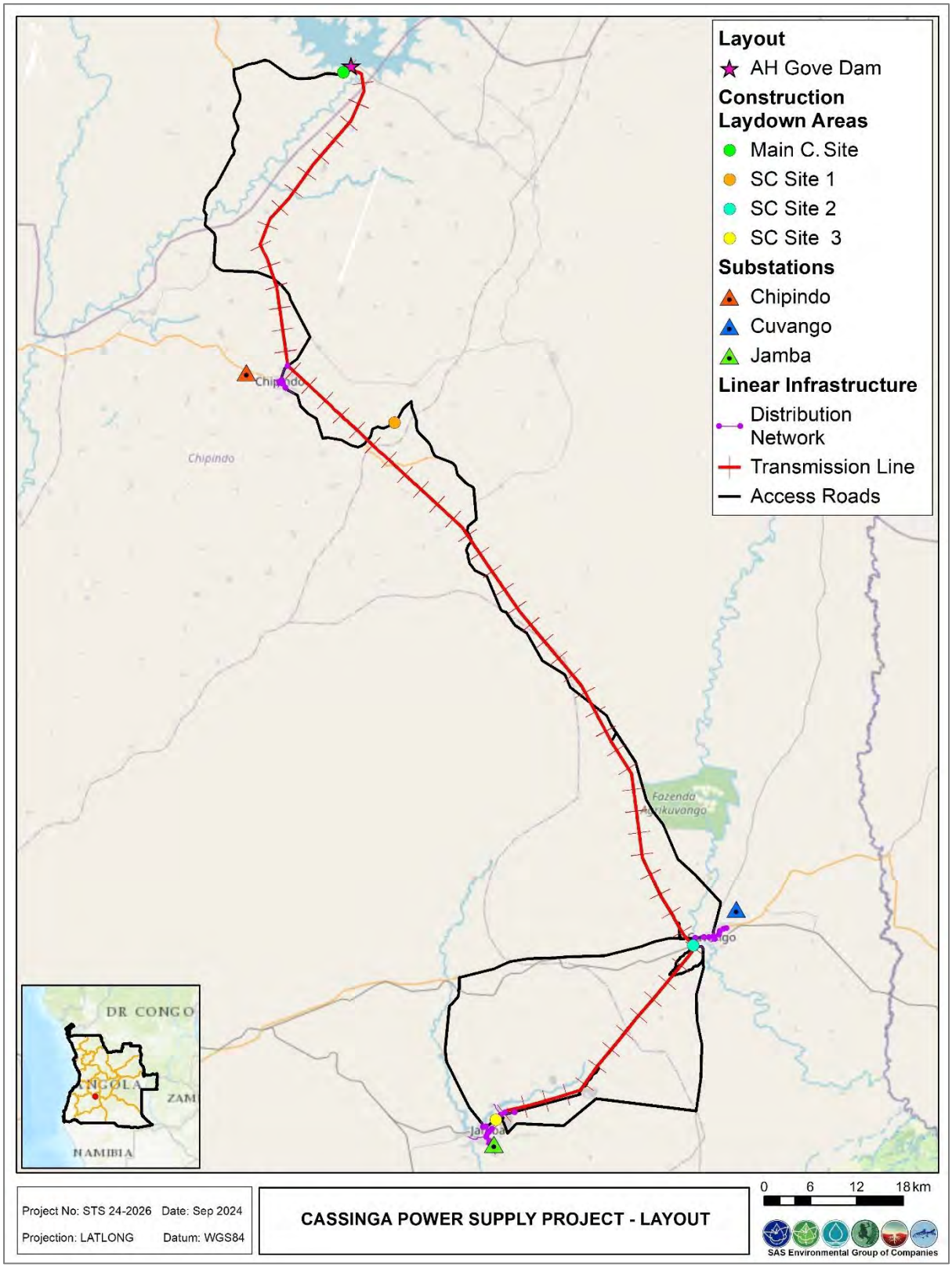


Figure 2: General locality map of the proposed Cassinga powerline project.

1.2 Purpose of Study

The proposed project traverses soils which support agricultural practice and food production. Thus, it is crucial to consider the surrounding soils, land uses, and land potential in order to make sure that the proposed project takes into account high-potential agricultural land in accordance with the applicable Angolan Law.

1.3 Assumptions, Exclusions and Limitations

For the purpose of this assessment, the following assumptions and limitations are applicable:

- It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used 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 information is useful as 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;
- Due to access constraints pertaining to access roads and terrain, some sensitive agricultural areas could not be accessed. Therefore, verification points were located along the access roads to be as representative as possible of the areas that are not accessible. The observations made are deemed sufficient to ensure that informed decision making can be undertaken;
- The soil survey conducted as part of the land capability assessment was confined within the study area outline. 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).

1.4 Information Sources

The information is source from various data sources and these sources include but not limited to:

- World Reference Base for Soil Resources (WRB, 2014);
- World Soil and Terrain database (SOTER, 2013); and
- Food and Agriculture Organization of the United Nations (FAO, 2022).

2. LEGISLATION, STANDARDS AND GUIDELINES

The subsections below present the summary of the national and international legislation, standard and guidelines requirements which the proposed project will abide by and ensures alignment with the Good International Industry Practice (GIIP) standards, including the Equator Principles and the International Finance Corporation (IFC) Performance Standards.

2.1 National Legislation and Guidelines

The subsections below present the summary of the national Legislation and guidelines. Detailed description of the legislation and guidelines are presented in Appendix B:

- The Constitution of the Republic of Angola (2010);
- The General Environmental Law No. 5/98;
- Decree No.117/20 on General Regulation for Environmental Impact Assessment and Environmental Licensing Procedure;
- Water Law No. 6/02;
- The Ministry of Agriculture and Forest (Ministério da Agricultura e Florestas – MINAGRIF);
- Presidential Decree No. 26/20 (National Biodiversity Strategy and Action Plan 2019-2025);
- Presidential Decree No. 194/11 on Liability on Environmental Damage;
- Presidential Decree No. 261/11 on Water Quality;
- Presidential Decree No. 190/12 on Waste Management; and
- Presidential Decree No. 82/14, approves the Regulation on the General Use of Water Resources.

2.2 International Standards

The following subsection focuses on the Good International Industry Practice (GIIP) standards:

2.2.1 International Finance Corporation (IFC) Performance Standards (2007)

- **Performance Standard 1**: Assessment and Management of Environmental and Social Risks and Impacts - Underscores the importance of managing environmental and social performance throughout the life of a project.
- **Performance Standard 3**: Resource Efficiency and Pollution Prevention - Recognizes that increased economic activity and urbanization often generate increased levels of

pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.1

- **Performance Standard 4**: Community Health, Safety, and Security - Recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.
- **Performance Standard 5**: Land Acquisition and Involuntary Resettlement - Recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land.
- **Performance Standard 6**: Biodiversity Conservation and Sustainable Management of Living Natural Resources - Recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development.

2.2.2 Equator Principles

The Equator Principles presented below deemed applicable to this proposed development.

Principle 1: Review and Categorisation

When a project is proposed for financing, the Equator Principles Financial Institution (EPFI) will, as part of its internal environmental and social review and due diligence, categorise the project based on the magnitude of potential environmental and social risks and impacts, including those related to human rights, climate change, and biodiversity. Overhead lines project is regarded as a category B since the projects have limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily measures addressed through mitigation.

Principle 2: Environmental and Social Assessment

The principle requires that an appropriate assessment process is conducted to address the relevant environmental and social risks and scale of impacts of a proposed Project. The assessment documentation should propose measures to minimise, mitigate, and where residual impacts remain, to compensate / offset / remedy for risks and impacts to workers, affected communities, and the environment, in a manner relevant and appropriate to the nature and scale of a proposed project.

Principle 3: Applicable Environmental and Social Standards

The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues.

Principle 4: Environmental and Social Management System and Equator Principles Action Plan

For all Category A and Category B the EPFI will require the client to develop and / or maintain an Environmental and Social Management System (ESMS).

Principle 9: Independent Monitoring and Reporting

A client must develop an Environmental Management Plan (EMP) to maintain and monitor any potential residual impacts on the environment.

2.2.3 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.
- **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

2.2.4 Food and Agriculture Organisation of the United Nations (FAO)

The World Reference Base (WRB) is the international standard for soil classification system endorsed by the International Union of Soil Sciences. It was developed by an international collaboration coordinated by the IUSS Working Group. It replaced the FAO/UNESCO Legend for the Soil Map of the World as international standard. The WRB borrows heavily from modern soil classification concepts, including Soil Taxonomy, the legend for the FAO Soil Map of the World 1988, the Référentiel Pédologique and Russian concepts. As far as possible, diagnostic criteria match those of existing systems, so that correlation with national and previous international systems is as straightforward as possible.

3. APPROACH AND METHODOLOGY

3.1 Scope of Work

- The desktop assessment will entail the following aspects:
  - Assess existing information;
  - Conduct a desktop assessment within the proposed area using the digital satellite imagery and other suitable digital aids;
  - Review historical as well as current land uses within the proposed area; and
  - Review and interpret existing Soil Maps and other relevant database(s) to establish broad baseline conditions and areas of environmental sensitivity and sensitive agricultural areas.
  - A detailed soil classification survey will be conducted within the proposed area;
  - Subsurface soil observations will be made by means of a manual hand auger; and
  - Consult the World Reference Base for Soil Naming – International Soil Classification System (ISCS) to classify and characterise the soils of the study area.
- Field assessment data will include a detailed description of physical soil properties including the following parameters:
  - Soil properties of survey points will be recorded using a Global Positioning System (GPS);
  - Terrain morphological units Landscape position;
  - Diagnostic soil horizons and their respective sequence;
  - Texture, estimated as % clay according to the *in-situ* hand feel method;
  - Depth of identified soil horizons;
  - Soil classification according to the World Reference Base (WRB, 2014) soil classification system; and
  - Depth to saturation (water table), if encountered.
- Group uniform soil patterns into map units, according to observed limitations;
- Evaluate land use impacts of the proposed activity on the receiving environment in relation to the identified soils using the impact assessment method providing by SRK Consulting (South Africa) Pty (Ltd);
- Determine agricultural potential of the identified soil types;
- Provide recommended mitigation measures to implement in order to manage the anticipated impacts and to comply with the applicable legislations; and

- Presented the findings of the assessment will be in the form of an electronic report.

3.2 Objectives

The objective of this study was to evaluate the potential impacts of the proposed project on the Soils, land use and agricultural potential of the area. This study therefore evaluated the following components to understand the agricultural potential of the landscape:

- Climatic conditions within the context of agricultural productivity and constraints;
- Landscape setting and land use;
- Soil physical properties; and
- Other current limitations to various agricultural related land use purposes.

3.3 Methodology

3.3.1 Literature and Database Review

As part of the desktop assessment, a background information relating to the study area and literature reviews were sourced from various databases such as the World Reference Base for Soil Resources (WRB, 2014), World Soil and Terrain database (SOTER, 2013) and Food and Agriculture Organization of the United Nations (FAO, 2022).) as well as other sources as listed under references were utilised to fulfil the objectives for the assessment.

3.3.2 Soil Classification and Sampling

A soil survey was conducted from between the 6th - 10th of September 2024 at which time the identified soils within the study area were classified into soil types according to the World Reference Base for Soil Resources (WRB, 2014). The soil survey was restricted to the study area. Subsurface soil observations were made using a manual hand auger to assess individual soil profiles, which will entail evaluation of physical soil properties and prevailing limitations to various land uses.

3.3.3 Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII, as presented in Table 2 below; with Classes I to III classified as prime agricultural land that is well suited for annual cultivated crops, whereas Class IV soils may be cultivated under certain circumstances and specific or intensive management practices, and Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of C1 to C8, as illustrated in Table 1. The land capability rating is therefore adjusted

accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating. The anticipated impacts of the proposed land use on soil and land capability were assessed to inform the necessary mitigation measures.

Slope percentage plays a vital role in land capability calculations. This therefore necessitates the need to group the relevant slope classes. The slope percentages (that contribute to land capability calculations) have been divided into five slope classes as per the methodology described in by Smith (2006) in the farming handbook as follows:

- Slope Class 1 (0-3%);
- Slope Class 2 (3-8%);
- Slope Class 3 (8-15%);
- Slope Class 4 (15-25%); and
- Slope Class 5 (>25%).

Table 1: South Africa's agricultural land capability (Smith 2006).

Land Capability Class	Increased Intensity of Use									Land Capability Groups	Limitations
I	W	F	LG	MG	IG	LC	MC	IC	VIC	Arable land	No or few limitations
II	W	F	LG	MG	IG	LC	MC	IC			Slight limitations
III	W	F	LG	MG	IG	LC	MC	IC			Moderate limitations
IV	W	F	LG	MG	IG	LC					Severe limitations
V	W	F	LG	MG						Grazing land	Water course and land with wetness limitations
VI	W	F	LG	MG							Limitations preclude cultivation. Suitable for perennial vegetation
VII	W	F	LG								Very severe limitations. Suitable only for natural vegetation
VIII	W									Wildlife	Extremely severe limitations. Not suitable for grazing or afforestation.
W- Wildlife					MG- Moderate grazing					MC- Moderate cultivation	
F- Forestry					IG- Intensive grazing					IC- Intensive cultivation	
LG- Light grazing					LC- Light cultivation					VIC- Very intensive cultivation	

Table 2: Climate Capability Classification (Scotney et al., 1987).

Climate Capability Class	Limitation Rating	Description
C1	None to slight	Local climate is favorable for good yield for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favorable 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.

The land potential assessment entails the combination of climatic, slope and soil condition characteristics to determine the agricultural land potential of the investigated study area. The classification of agricultural land potential and knowledge of the geographical distribution of agricultural viable land within an area of interest. This is of importance for making an informed decision about land use. Table 3 below presents the land potential classes, whilst Table 4 presents a description thereof, according to Guy and Smith (1998).

Table 3: Table of 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: 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.

4 PROJECT ACTIVITIES POSING POTENTIAL IMPACTS

The section aims to provide a description of aspects of the project that would potentially cause impacts in terms of the soils, land use, land capability and agricultural potential.

Table 5: Description of project activities posing a potential impact on the soil and land capability.

Proposed Activity	Activity Description
Construction Phase	
Site preparation prior to construction activities including clearing of vegetation within the development footprint.	The site preparation will take place prior to any construction activities associated with the project. This phase generally includes planning for infrastructure, access and site camps and laydown areas. In addition, site preparation includes vegetation clearing for servitudes and substation platforms, access paths construction and the establishment of temporary construction camps and laydown areas for materials and equipment.
Groundbreaking activities for construction of the proposed substations as well as the establishment of pylons and spanning of the proposed powerline.	This phase includes earthworks such as digging the ground/excavating for the construction of structural foundations, particularly for the electricity pylons including levelling the site to the required elevation.
Frequent movement of machinery and Transportation of infrastructure and storage of equipment.	This activity largely involves the movement of earth moving machinery as well as vehicles transporting tower support structures and cabling as well as personnel throughout the construction areas associated with the powerline project.
Operation Phase	
Operation and frequent movement of maintenance of the powerline infrastructure including substations and access route.	This activity includes the operation and maintenance of the powerline infrastructure including powerline servitude. Other general activities include clearing of vegetation within the servitude during routine maintenance or during operational failure.
Decommission and Closure Phase	
Removal and replacement of infrastructure as well as rehabilitation within disturbance areas associated with the proposed powerline.	This activity includes removal, and replacements of infrastructure and rehabilitation of areas that were disturbed during the construction phase of the powerline and associated infrastructure. This includes levelling, revegetation of cleared areas and removal of any rubble within construction footprint following construction activities.

5 BASELINE CONDITIONS

5.1 Desktop Assessment Results

As part of the desktop study, a background information relating to the study area and literature reviews were sourced from various databases. It should be noted that the desktop results are not field verified results and, thus, inaccuracies may exist in the data presented. The data however gives useful information of the soils within the study area investigated.

Table 6: Desktop based soil background information sourced from various databases.

Parameters	Description
Mean Annual precipitation (MAP)	The mean annual precipitation in Angola varies across different regions of the country. Generally, Angola experiences a tropical climate with distinct wet and dry seasons. In the northern part of the country, the mean annual precipitation ranges from around 1000 to 1500 millimeters (mm), with the heaviest rainfall occurring during the wet season from November to April. In contrast, the southern regions of Angola tend to receive less precipitation, with mean annual rainfall typically ranging from 500 to 1000 mm. The

Parameters	Description
	variability in precipitation across Angola influences agricultural practices and water resource management, with farmers adapting cultivation techniques and crop choices to suit the local climate conditions.
Mean Annual Evaporation (MAE)	Generally, Angola experiences high rates of evaporation, particularly in arid and semi-arid areas where temperatures can be high and precipitation levels are relatively low. This high evaporation rate can lead to challenges for agricultural production, as it can result in increased water stress for crops and soil moisture depletion. In regions with limited access to irrigation, such as parts of southern Angola, high evaporation rates can exacerbate drought conditions and reduce agricultural productivity. Farmers may need to implement water conservation measures, such as mulching and rainwater harvesting, to mitigate the effects of high evaporation and maintain soil moisture levels for crop growth.
Geology	The geological formation dominating the study area is of Granite Formation, while the remaining portions to the south of the study area are characterised by Schist geological formation. Granite lithology in Angola is prevalent in various regions, forming extensive outcrops and subsurface formations. Granitic soils can support agriculture under certain conditions, particularly in regions where soil fertility has been enhanced through organic matter additions and appropriate soil management practices. In Angola, Granitic soils may be found in areas where granite formations are prevalent, contributing to the country's agricultural landscape and providing opportunities for cultivation of crops suited to these soil types.
Landform type	The entire extent of the study area is characterised by the plain landform type. The plain landform comprises relatively flat terrain that is conducive to mechanised farming, facilitating the use of large-scale agricultural machinery for cultivation and harvesting. Additionally, the fertile soils often found in plains provide favourable conditions for crop production, supporting a variety of agricultural activities including the cultivation of cereals, vegetables, and cash crops. However, plains in Angola can also face challenges such as waterlogging during the rainy season and soil erosion due to intensive agricultural practices, highlighting the importance of sustainable land management strategies to optimize agricultural productivity while preserving soil health and environmental sustainability.
Soil pH	The entire extent of the study area is characterised a soil pH ranging between 4.2 – 5.6. A soil pH ranging from 4.2 to 5.6 indicates acidity, which can significantly impact agriculture. Soils within this pH range are considered acidic and may pose challenges for crop cultivation due to nutrient availability and toxicities induced by the low pH. In Angola, where various soil types prevail, acidic soils can be common, particularly in regions with granitic or lateritic lithologies. The low pH levels in these soils can lead to aluminum and manganese toxicity, inhibiting root growth and nutrient uptake in plants. Additionally, essential nutrients such as phosphorus, calcium, and magnesium become less available to plants at lower pH levels, further limiting crop productivity. To mitigate the effects of soil acidity, practices such as liming to raise pH levels and improve soil fertility may be considered in commercial operations. However, managing acidic soils effectively requires ongoing monitoring and careful attention to crop selection and soil amendment strategies to ensure sustainable agricultural production in affected areas.
The Soil and Terrain (SOTER Africa) soil classification	According to the SOTER African Database, the entire study area is comprised of Haplic Ferralsols. Haplic Ferralsols are a subtype of Ferralsols, characterised by their shallow depth and lack of significant horizon differentiation. Haplic Ferralsols exhibit properties similar to other Ferralsols, such as their reddish-brown coloration due to high iron oxide content and low fertility levels resulting from leaching of nutrients during weathering processes. Haplic Ferralsols still play important roles in agricultural systems, albeit with certain limitations. Soil management practices such as fertilization and erosion control may be required to optimise productivity and sustain agricultural activities on these soils.
Clay Content (%)	The entire study area is characterised by soils with a clay percentage ranging between 24-38%. Soils with clay content ranging from 24% to 38% can significantly influence agricultural productivity. Clay soils offer both advantages and challenges for crop cultivation. On one hand, clay soils have good water retention capabilities, which can be beneficial for crops during dry periods, helping to maintain soil moisture levels and reducing irrigation requirements. However, high clay content can also lead to challenges such as poor drainage and compaction, particularly in regions with heavy rainfall. In Angola, where agricultural practices vary across different regions and soil types, farmers may need to

Parameters	Description
	implement soil management techniques such as tillage practices and soil amelioration to improve soil structure and optimize crop growth. Additionally, careful selection of crop varieties suited to clay soils can help maximize agricultural productivity while minimizing the risks associated with soil characteristics within this clay content range.
Soil Drainage	The entire study area is characterised by moderately well-drained soils. These soils offer favourable conditions for agricultural crop production, striking a balance between adequate drainage and moisture retention. The moderate permeability and drainage rates of these soils provide a stable environment for root development and nutrient uptake by crops. Moderately well-drained soils contribute to sustainable farming practices by reducing the risk of waterlogging and soil erosion while retaining sufficient moisture for plant growth, especially during dry periods. The balanced drainage characteristics of these soils allow for more efficient irrigation management and enable farmers to cultivate a wide range of crops, including cereals, legumes, and vegetables. Overall, moderately well-drained soils play a crucial role in supporting agricultural productivity and food security in Angola, offering optimal growing conditions for diverse crop species.

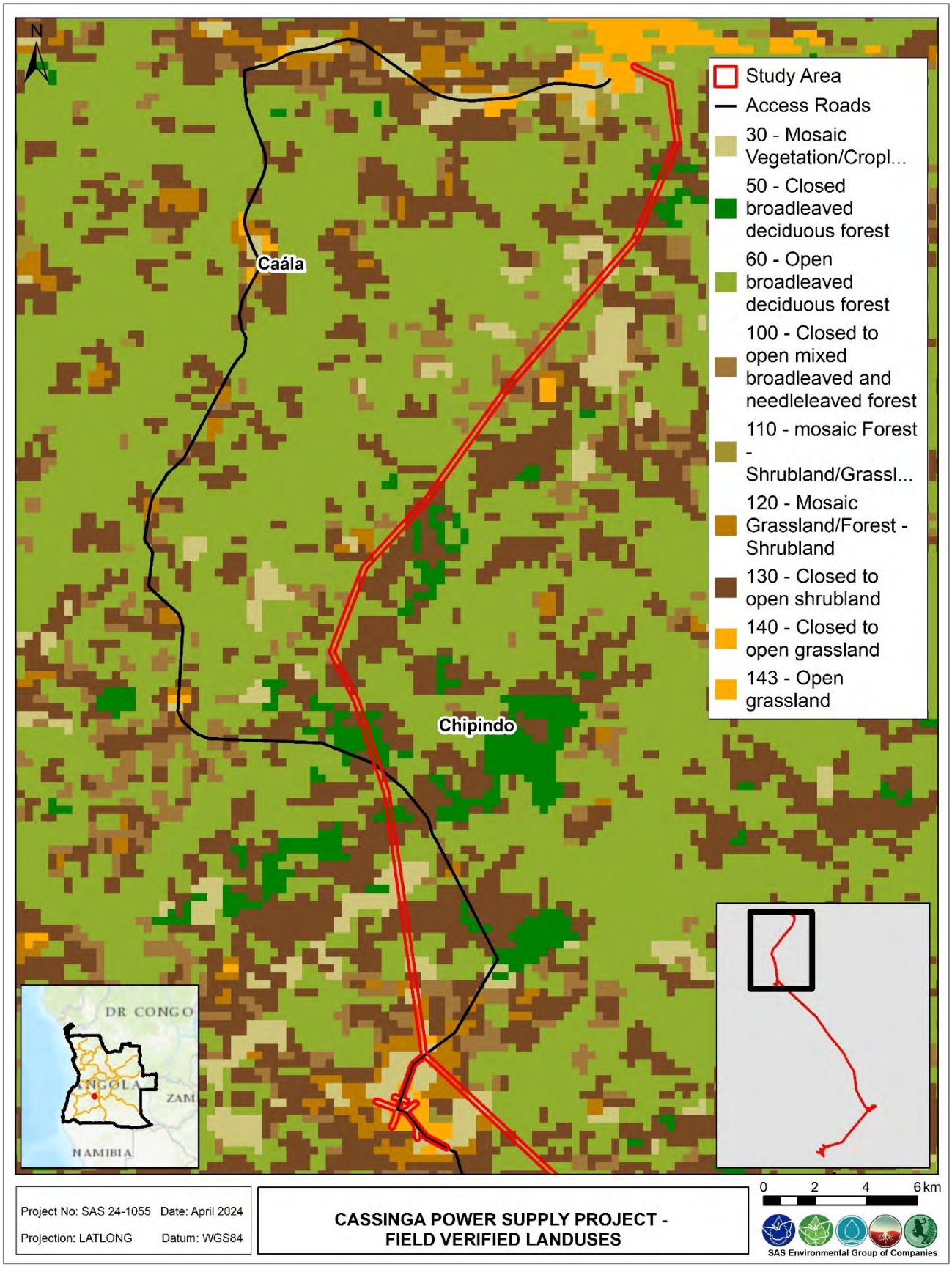


Figure 3: Desk-based landcover (2008) associated with the northern portion of the study area and surroundings.

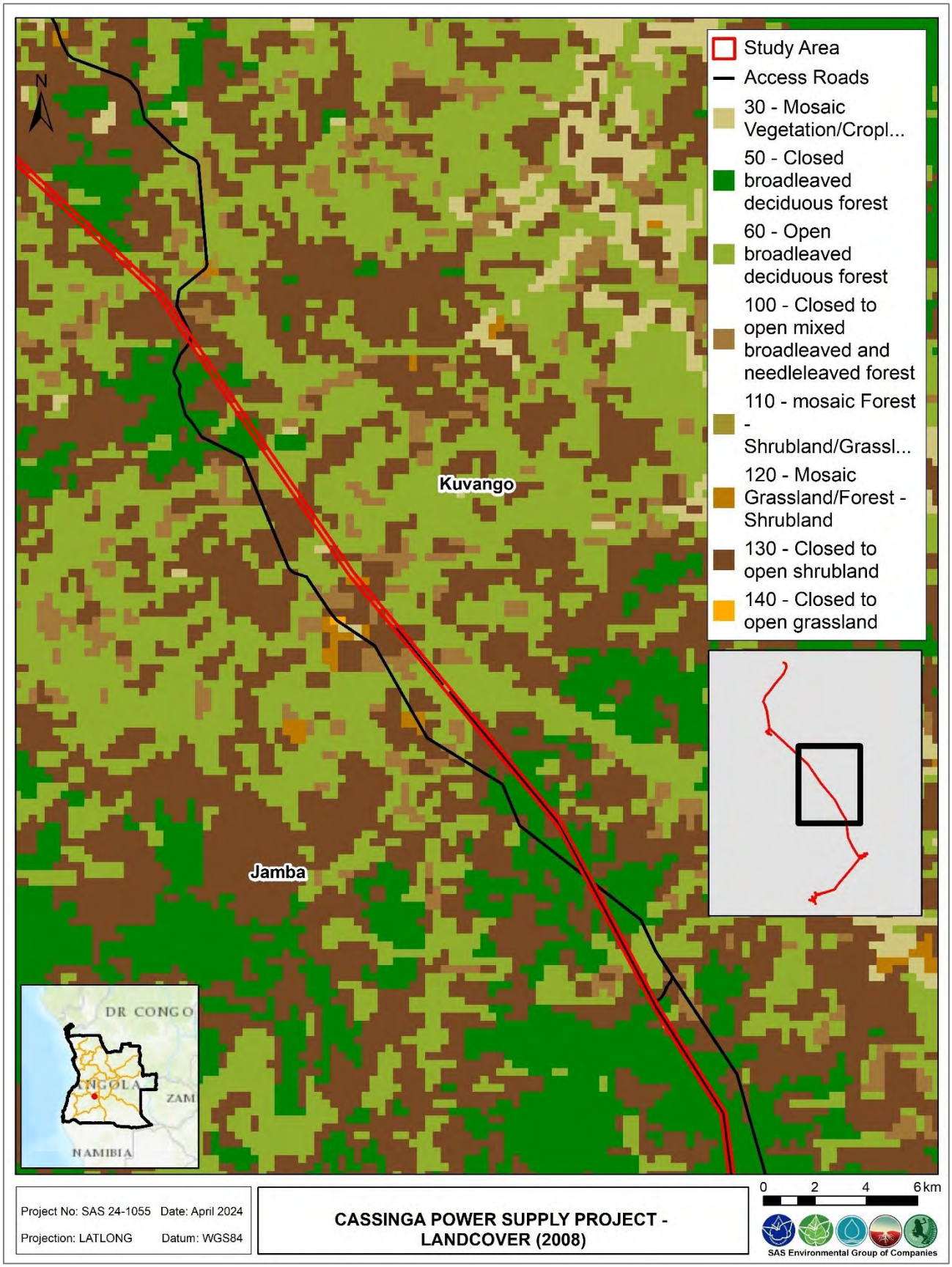


Figure 4: Desk-based landcover (2008) associated with the central portion of the study area and surroundings.

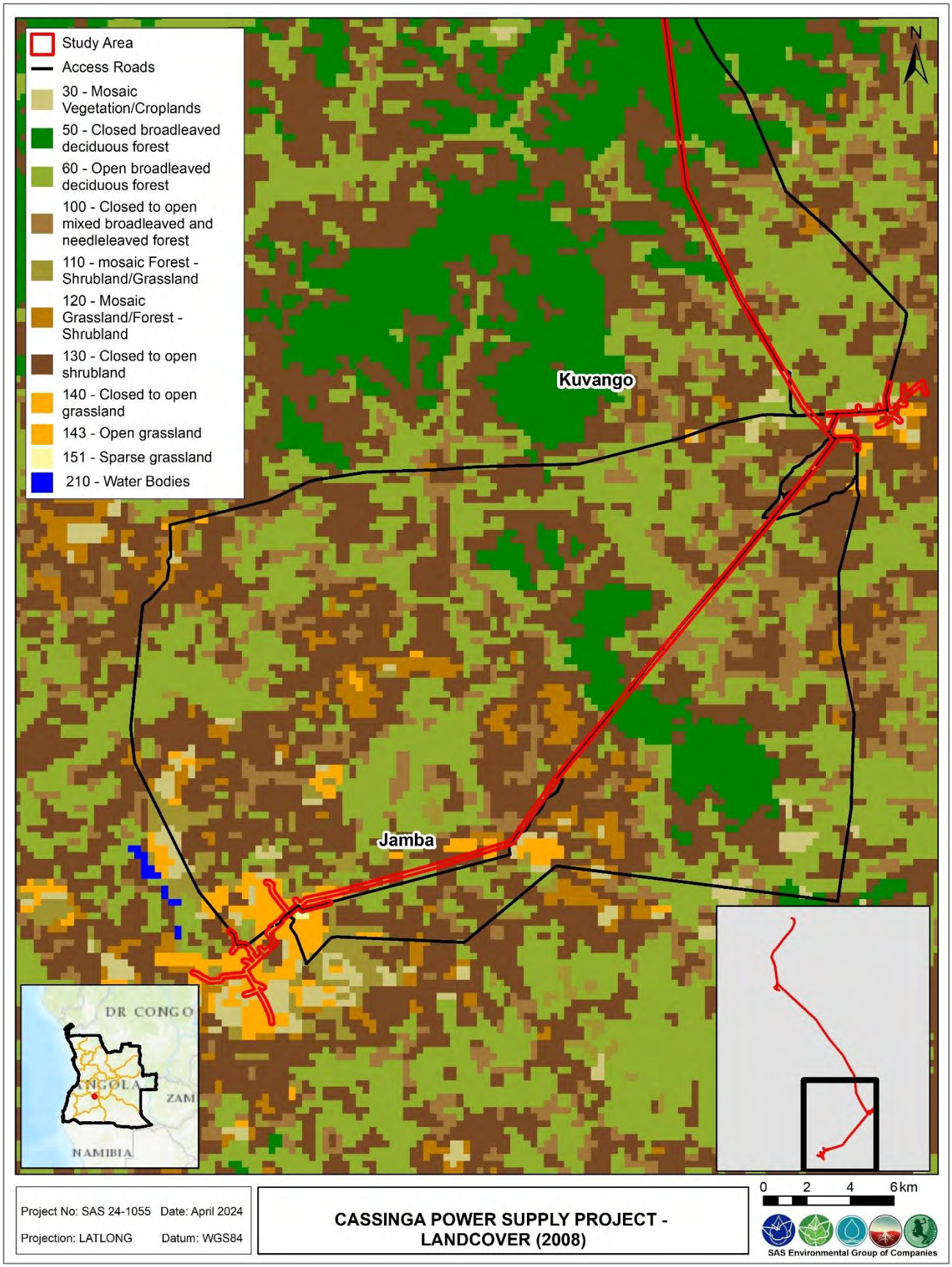


Figure 5: Desk-based landcover (2008) associated with the southern portion of the study area and surroundings.

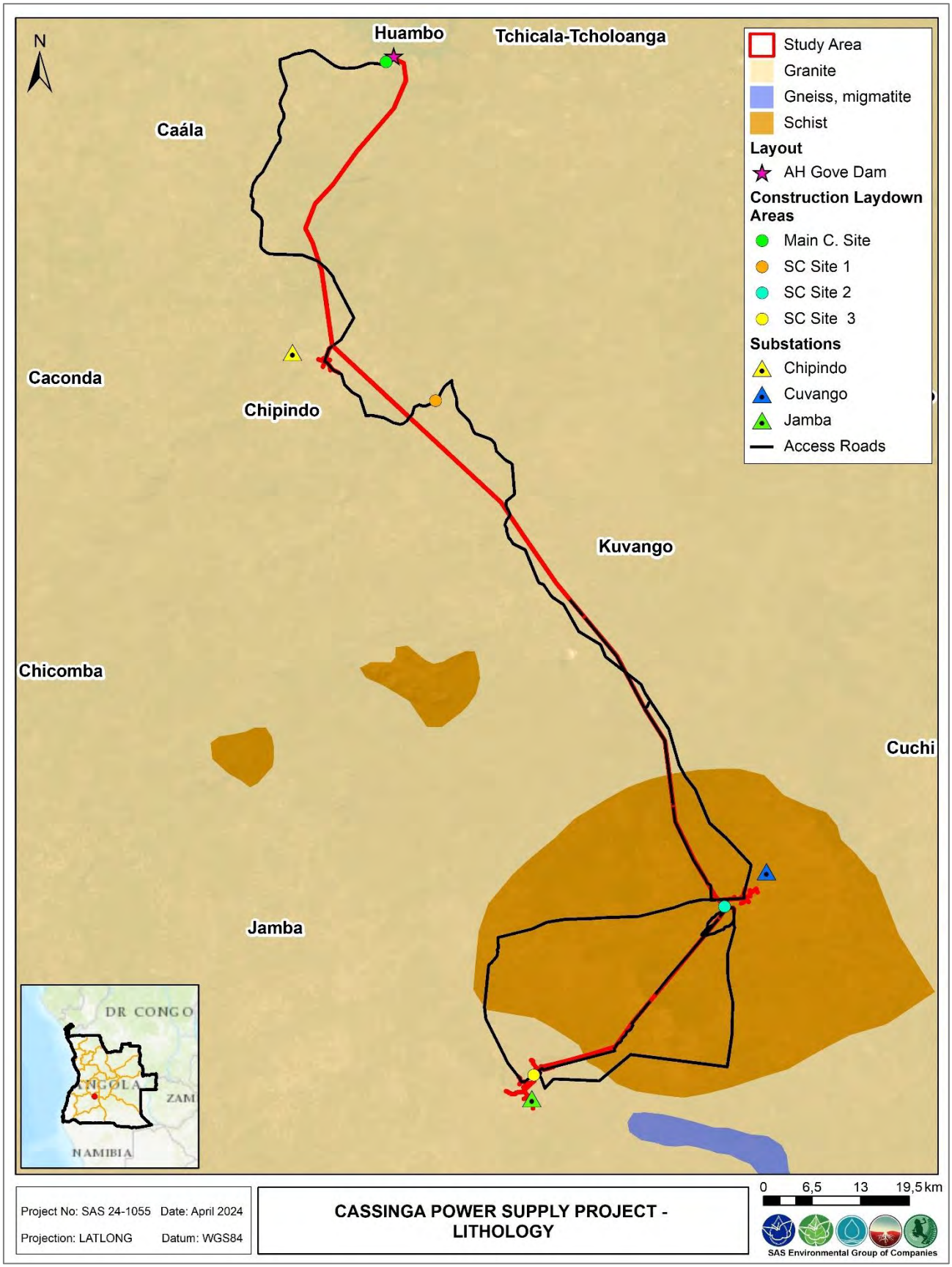


Figure 6: Lithology associated with the study area.

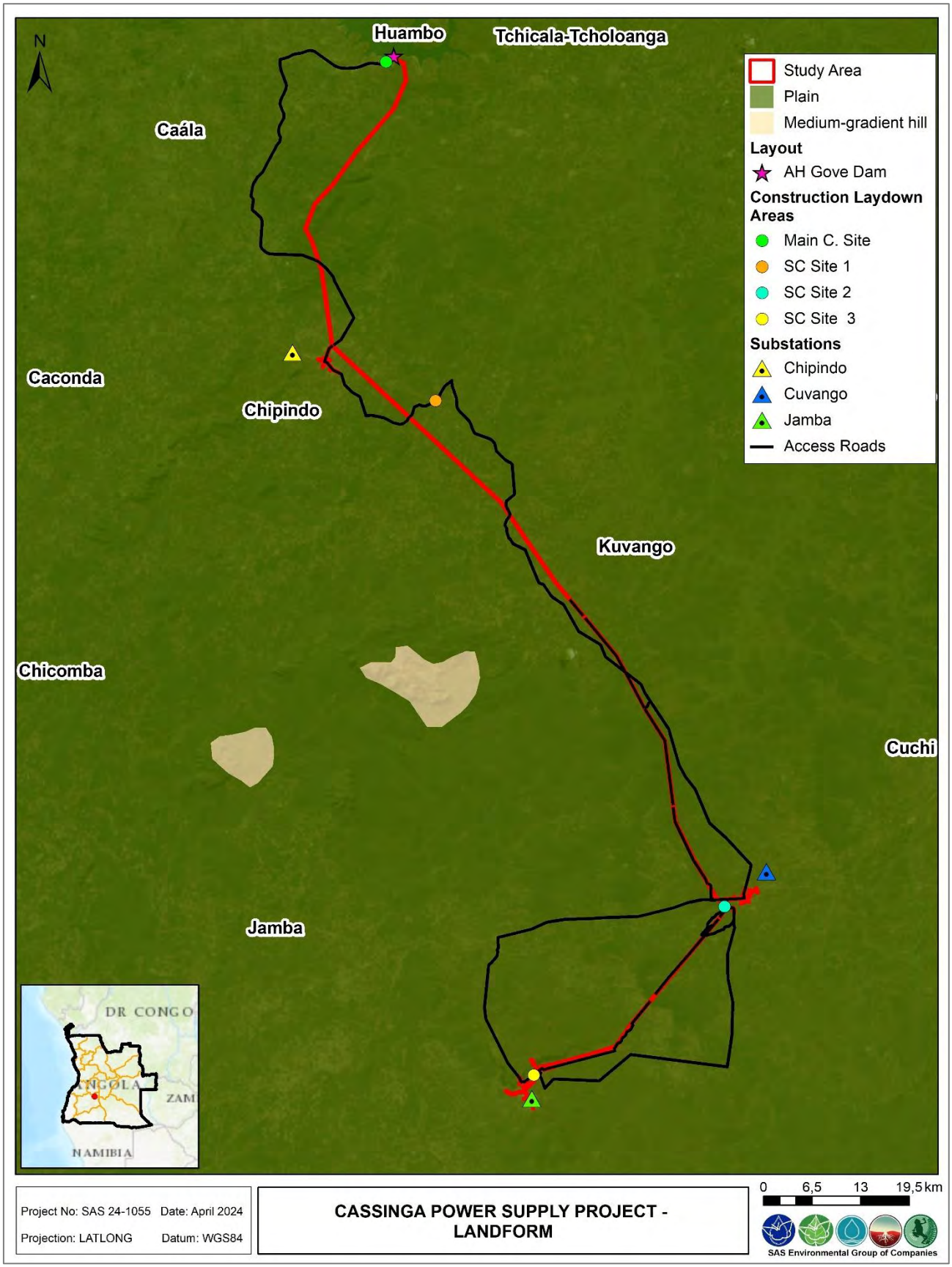


Figure 7: Landform type associated with the study area and immediate surroundings.

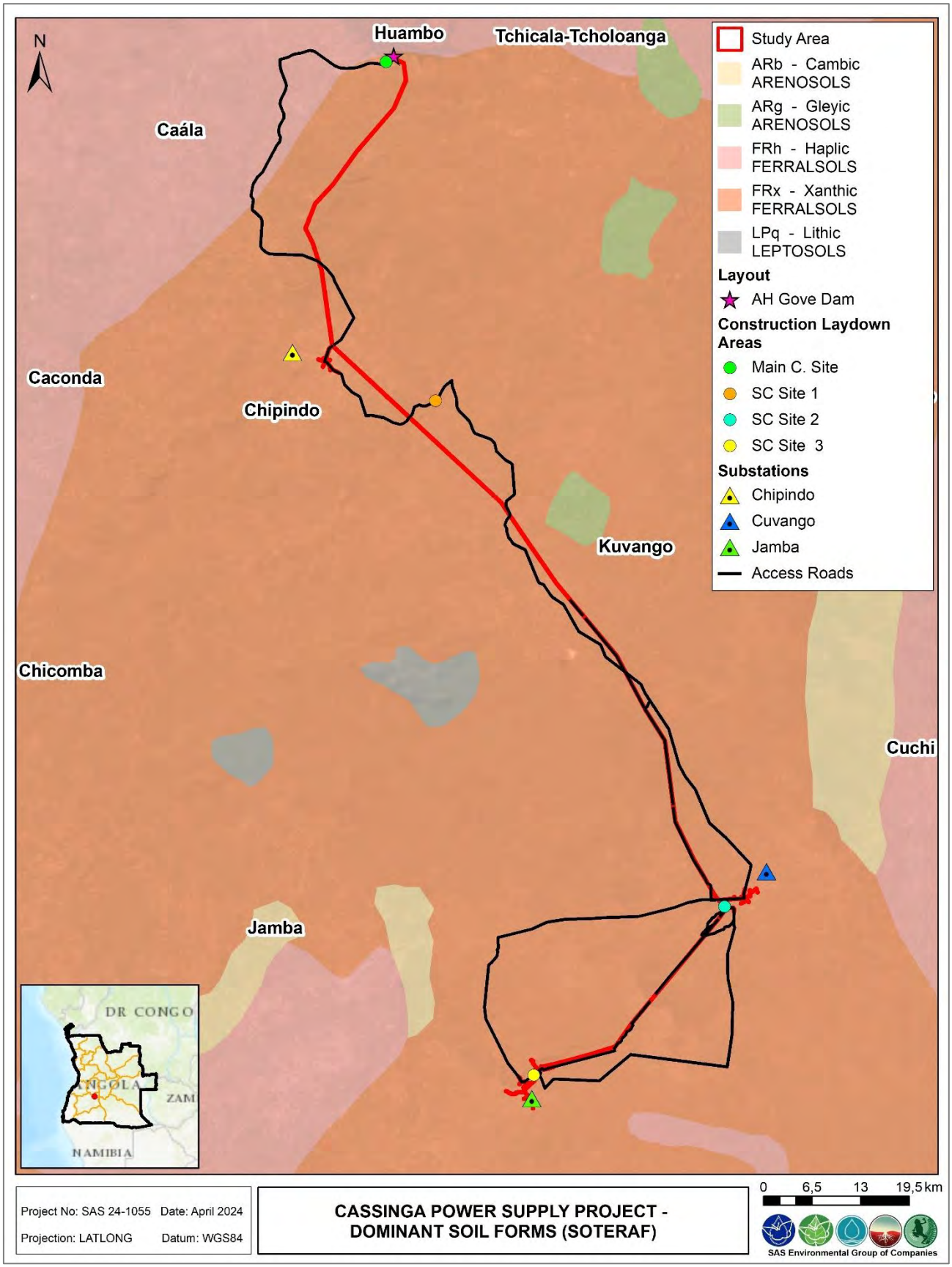


Figure 8: Soil and Terrain (SOTER, 2013) Dominant Soils associated with the study area and immediate surroundings.

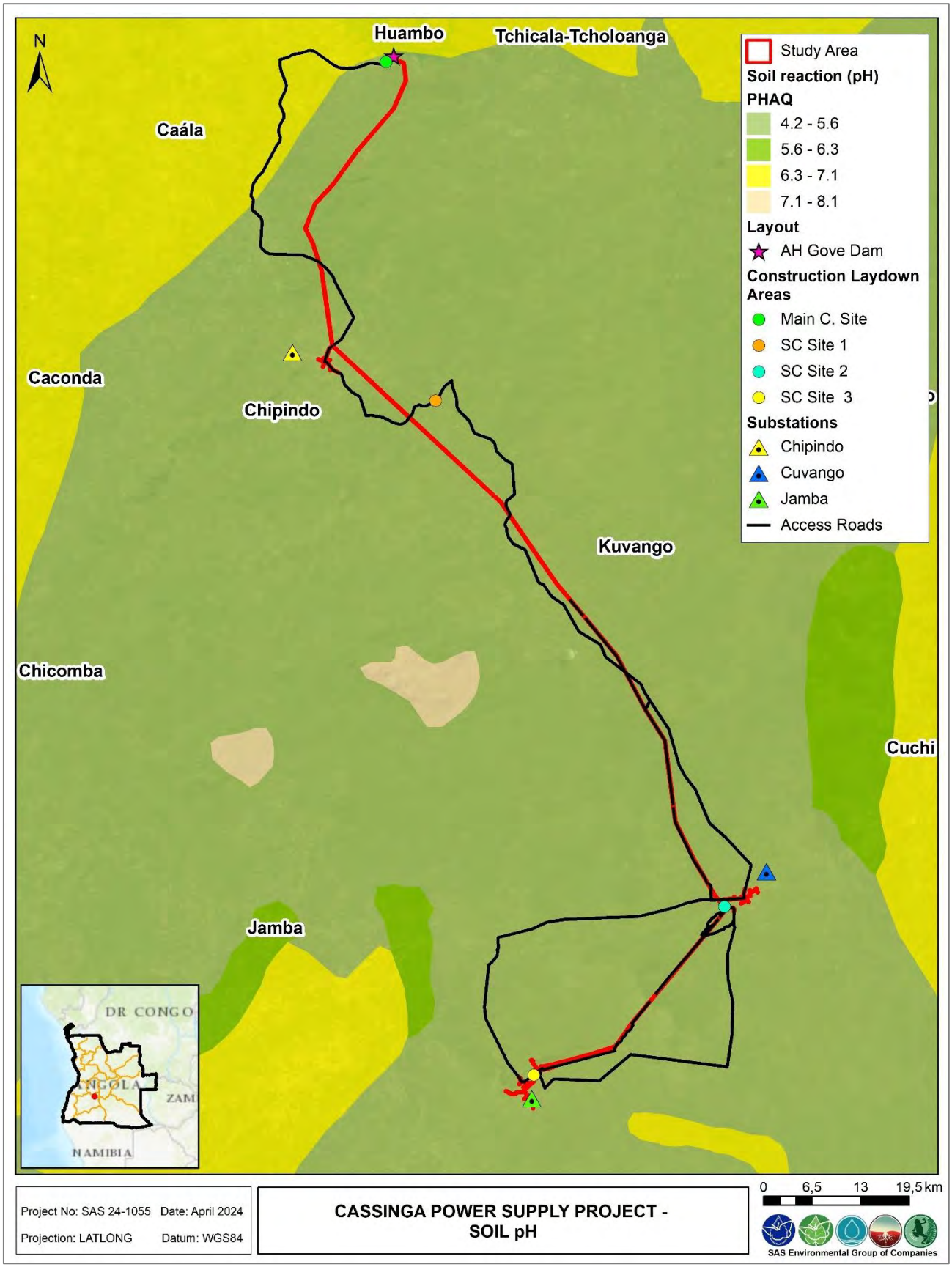


Figure 9: Soil pH associated with the soils within the study area and immediate surroundings.

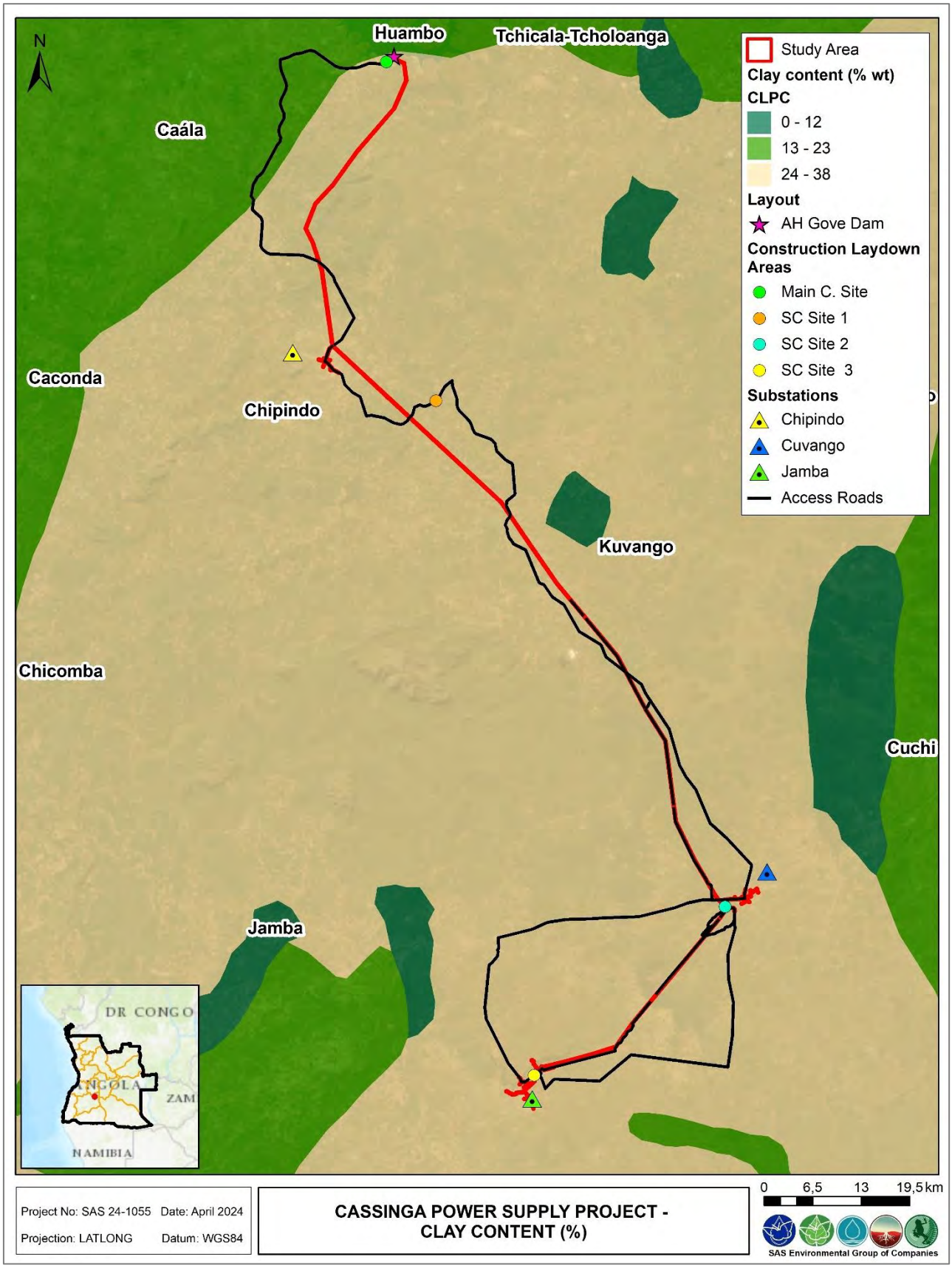


Figure 10: Clay percentage associated with soils within the study area.

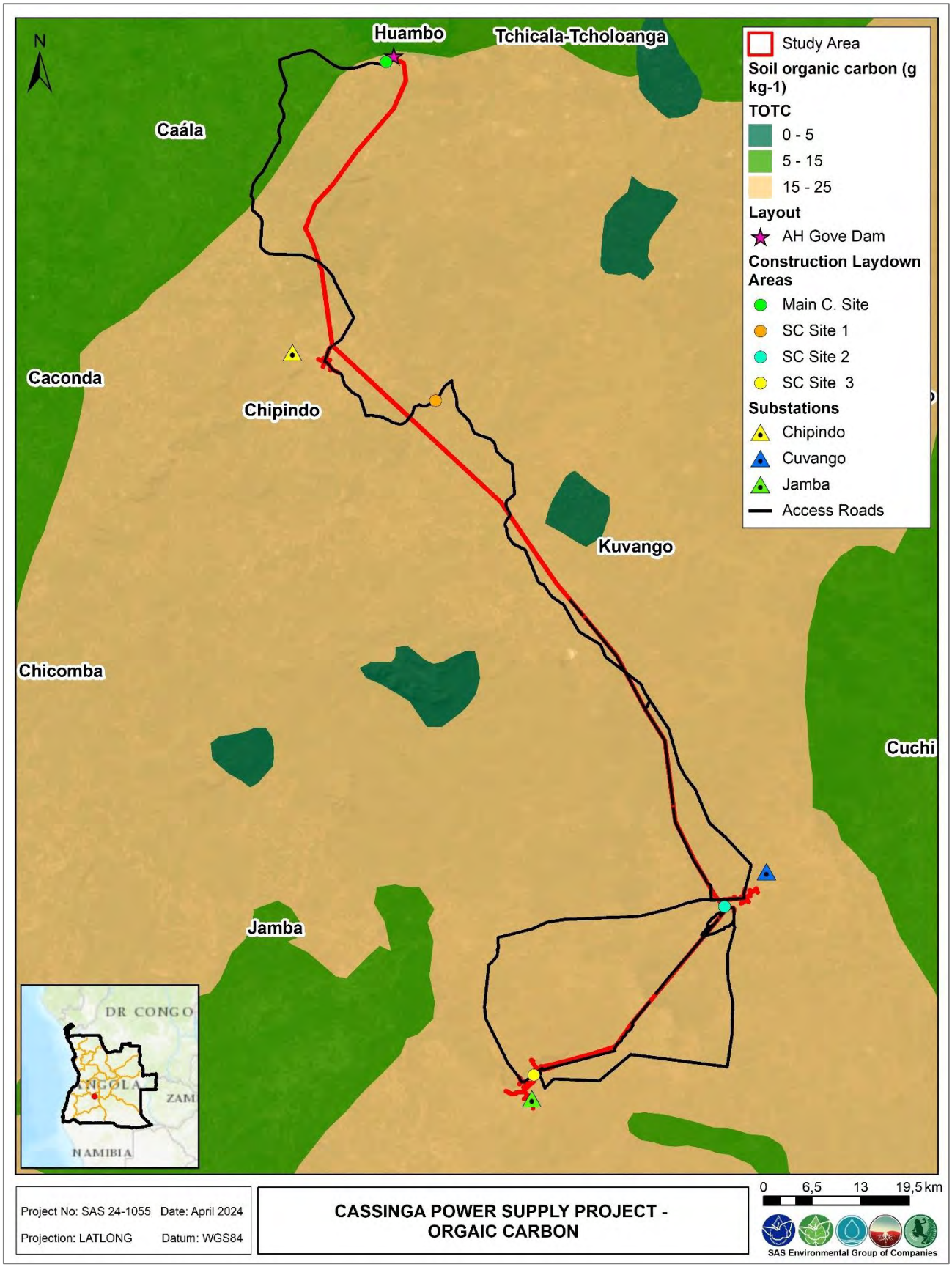


Figure 11: Organic carbon associated with soils within the study area.

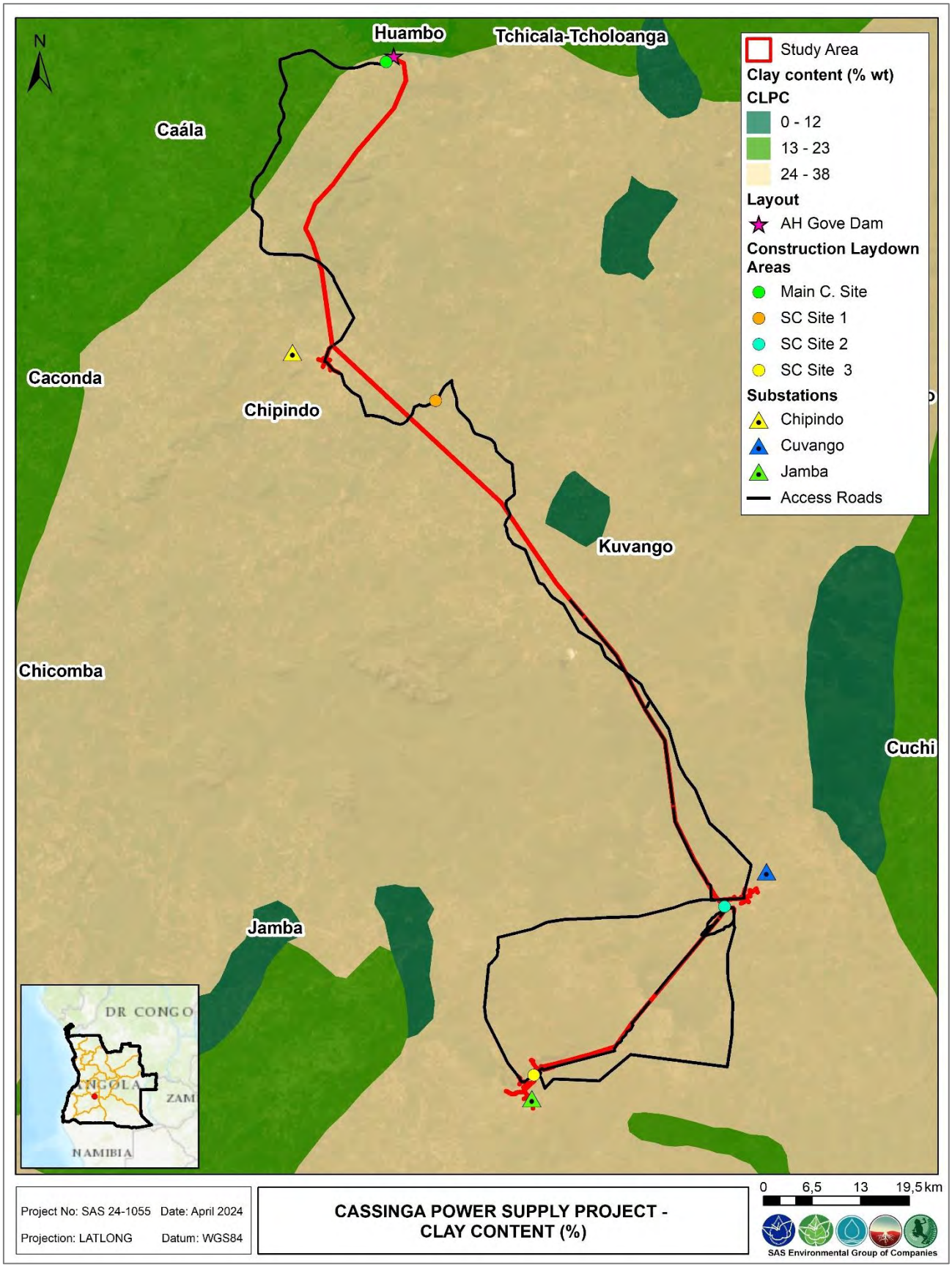


Figure 12: Soil Drainage characteristics.

6 Field Investigation Results

6.1.1 Current Land use

This section aims to provide an overview of the current land uses associated the study area based on:

- Field verified data;
- Through the scrutiny of the satellite imagery; and
- The World Soil and Terrain Land Cover (SOTERAF) data.

During the site assessment, it was noted that the study area largely consists of agricultural fields as part of subsistence farming, grazing, Miombo woodland, plantations, wildlife/wilderness, residential areas as well as waterbodies. Agriculture is a primary economic activity in rural parts of the country, with subsistence farming being common. Crops observed within cultivated areas largely include maize and beans with a small section comprising Cassava, while livestock such as cattle, goats, and chickens are also observed during the site visit. Wood harvesting primarily for household use, and for charcoal manufacturing also noted in some portion of the study area although these activities did not seem to be practices on a large scale within the field verified areas. Fishing activities in areas near rivers was also observed and this is deemed to be an important economic activity, providing food and income for rural communities. Figure 13 below depicts the associated land use within the study area.

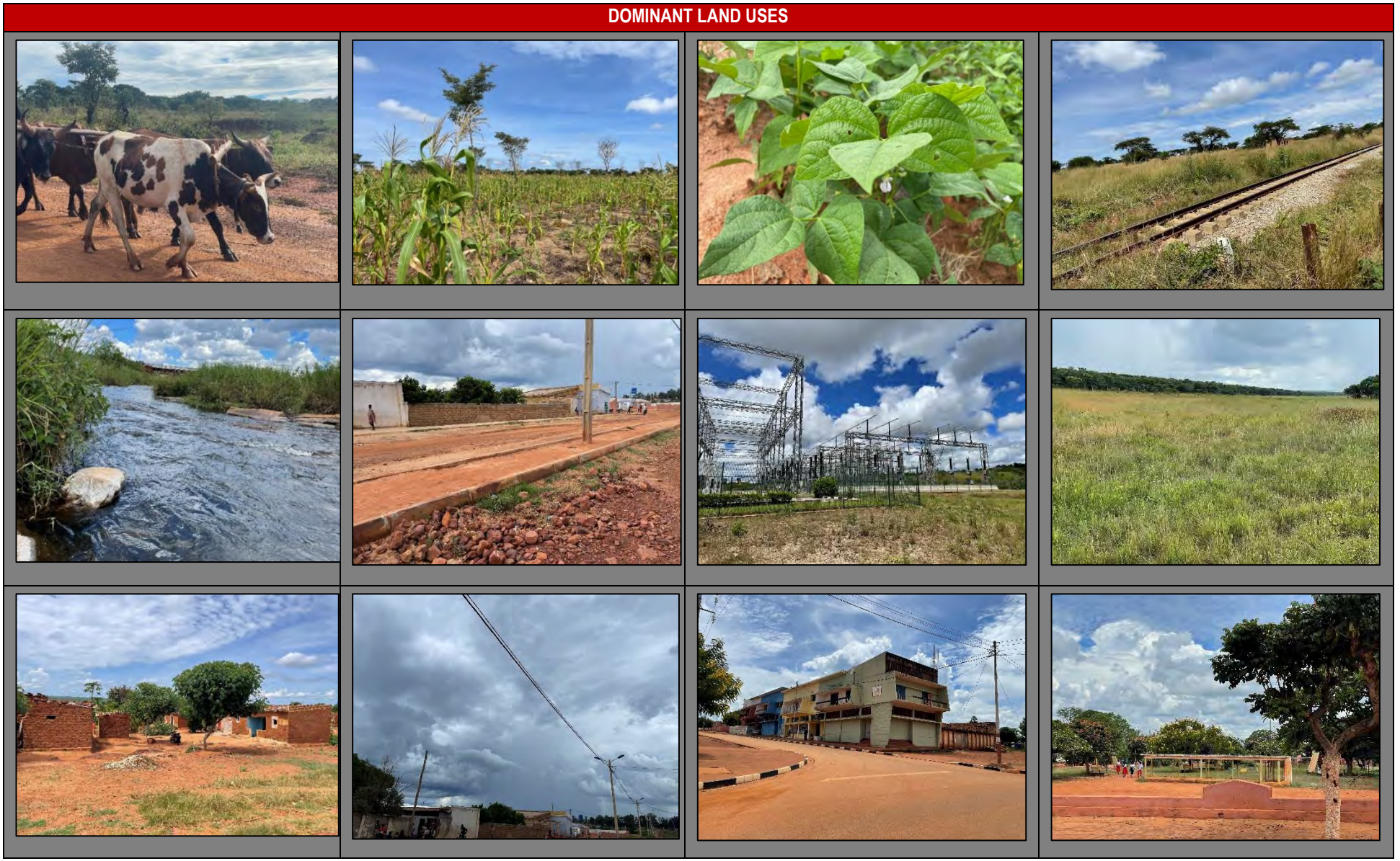


Figure 13: Land uses associated with the study area.

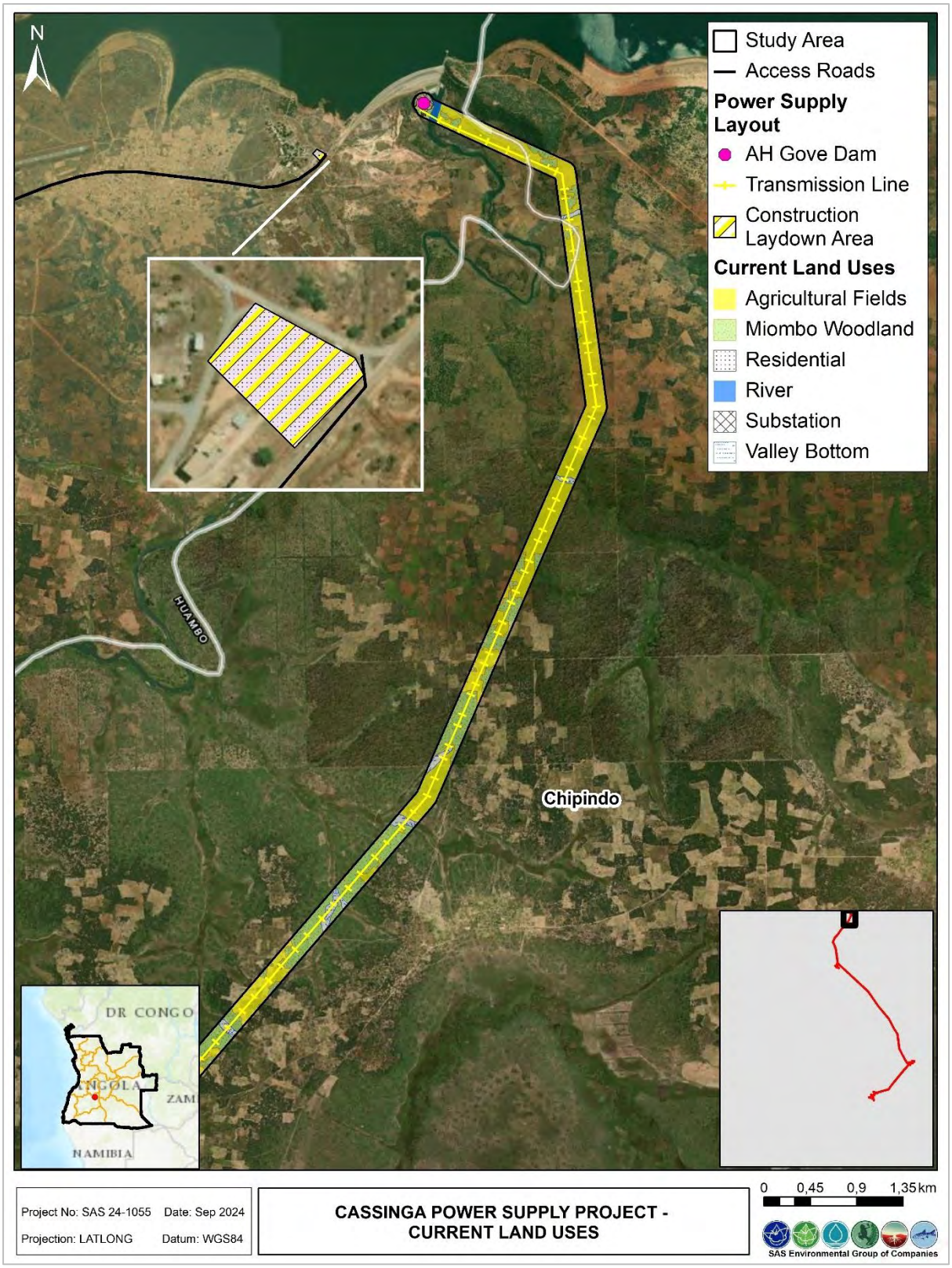


Figure 14: Land uses associated with northern section of the study area.

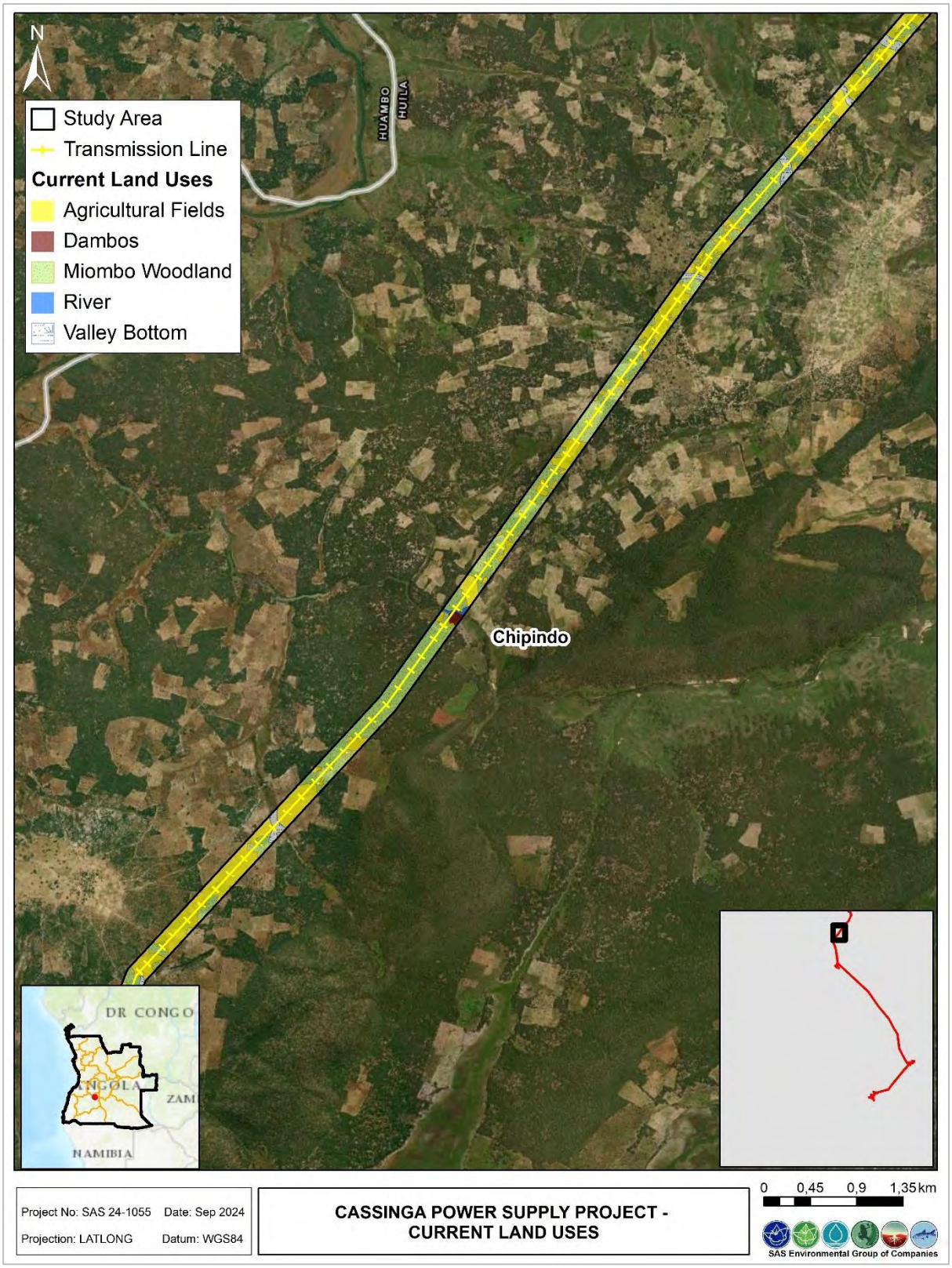


Figure 15: Land uses associated with northern section of the study area.

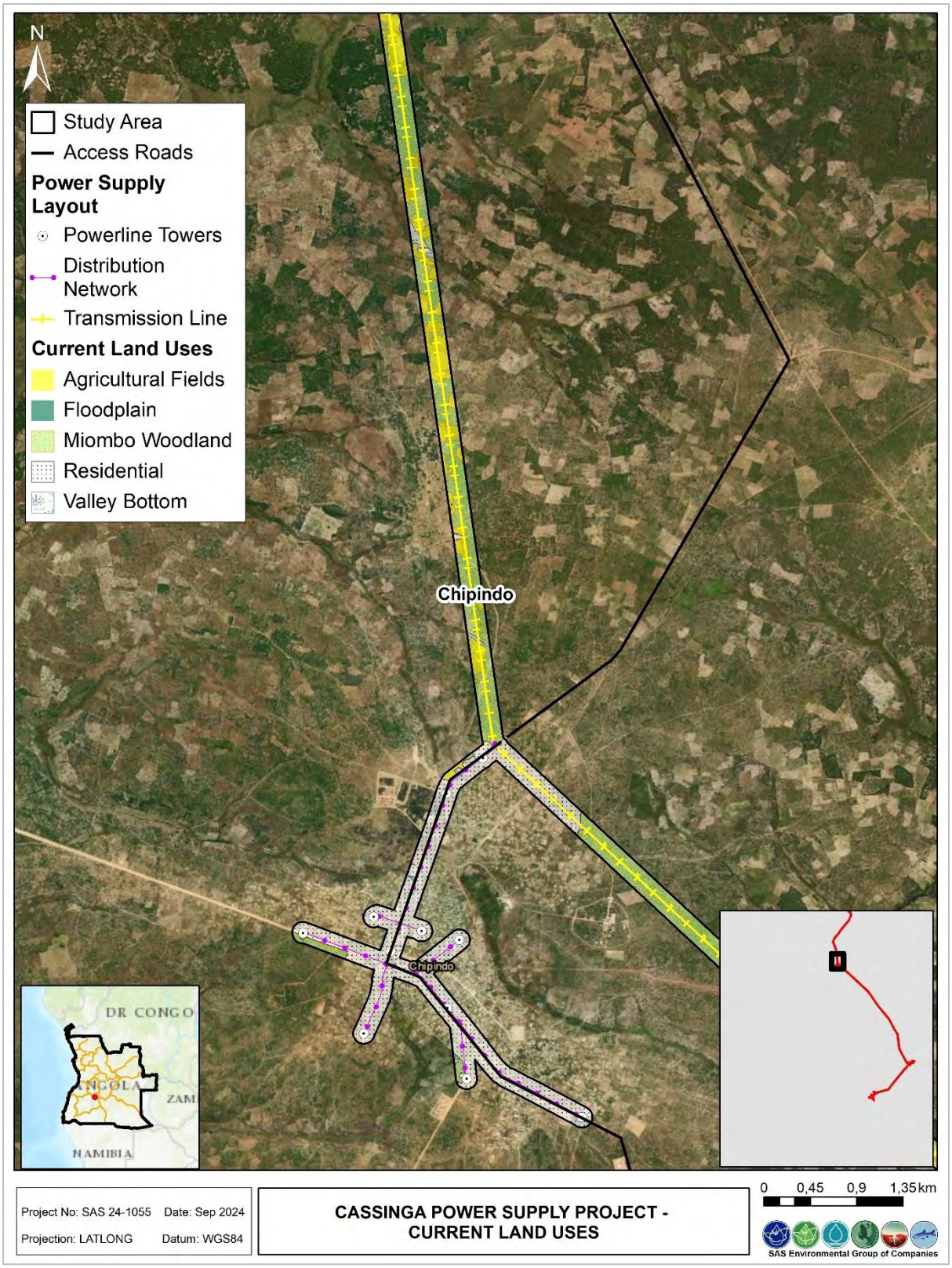


Figure 16: Land uses associated with northern section of the study area.

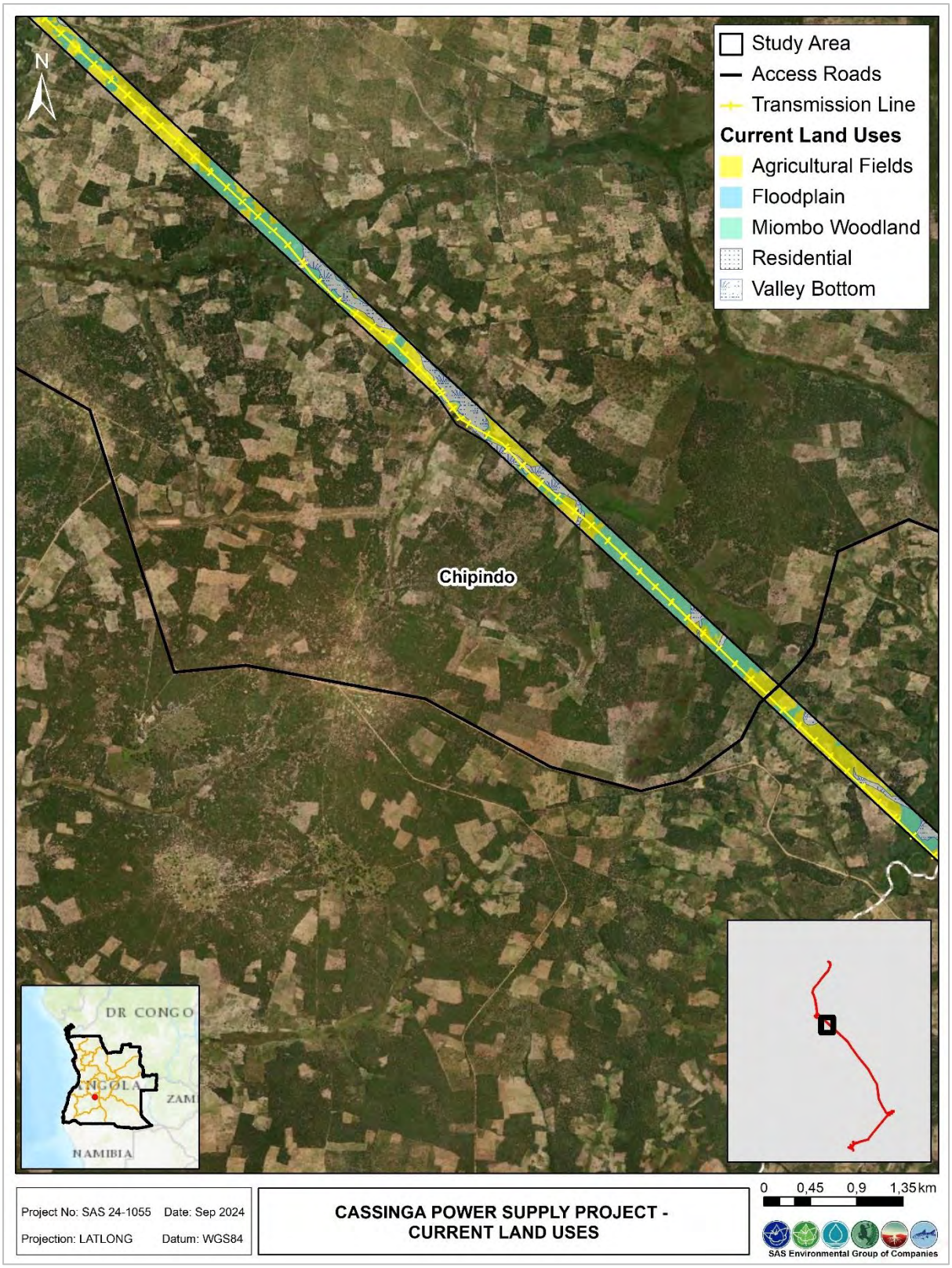


Figure 17: Land uses associated with northern central section of the study area.

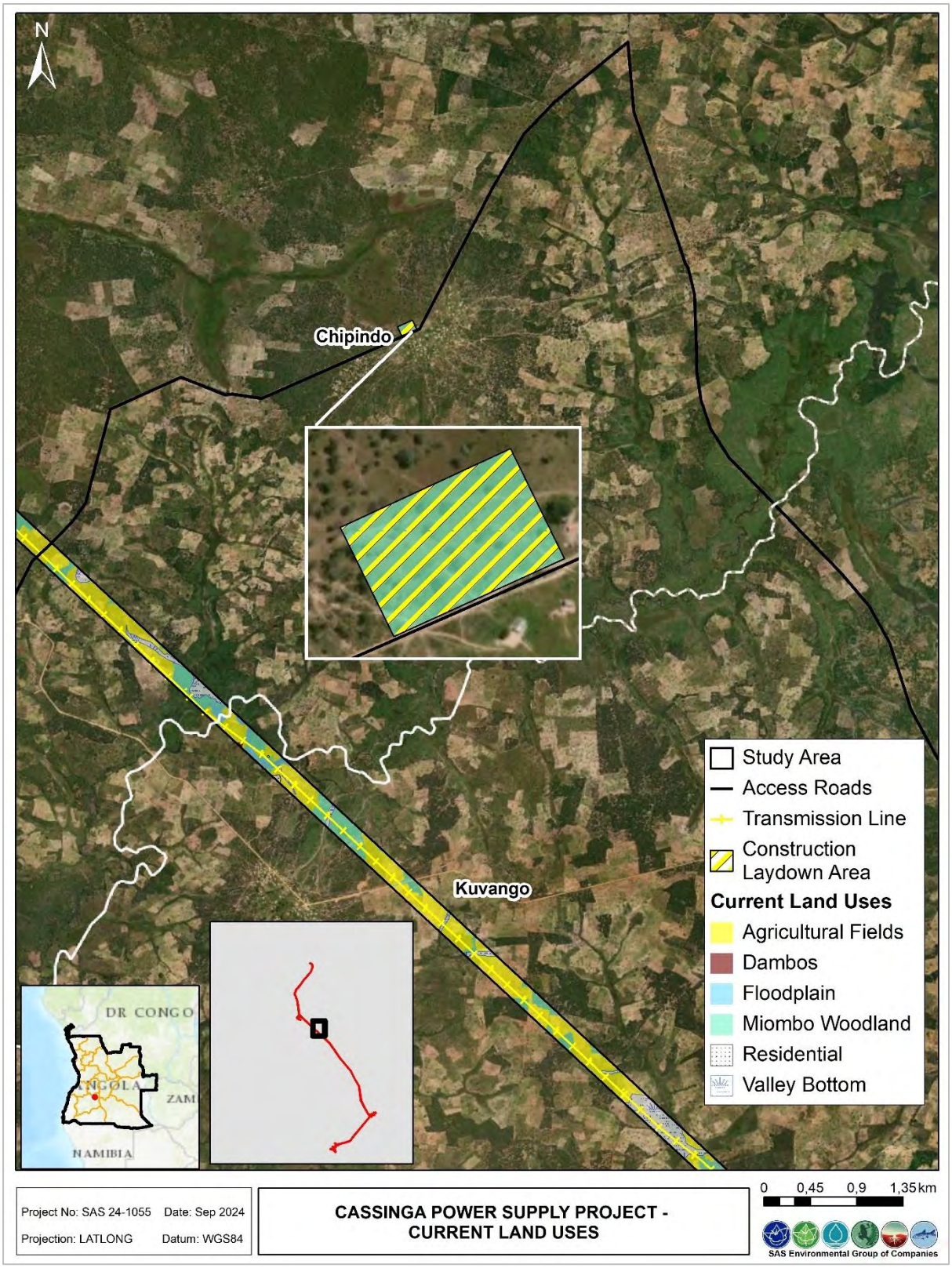


Figure 18: Land uses associated with northern central section of the study area.

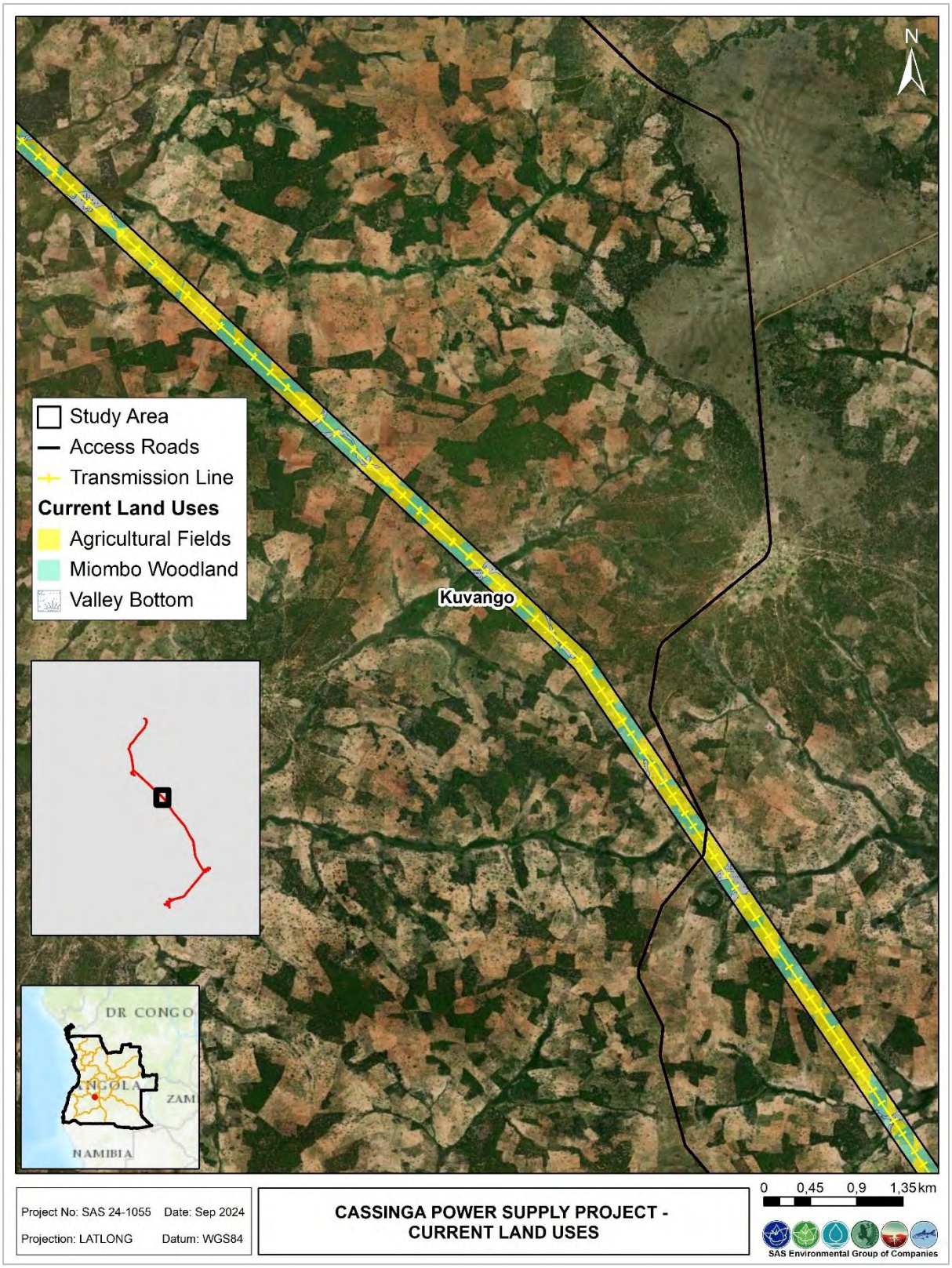


Figure 19: Land uses associated with central section of the study area.

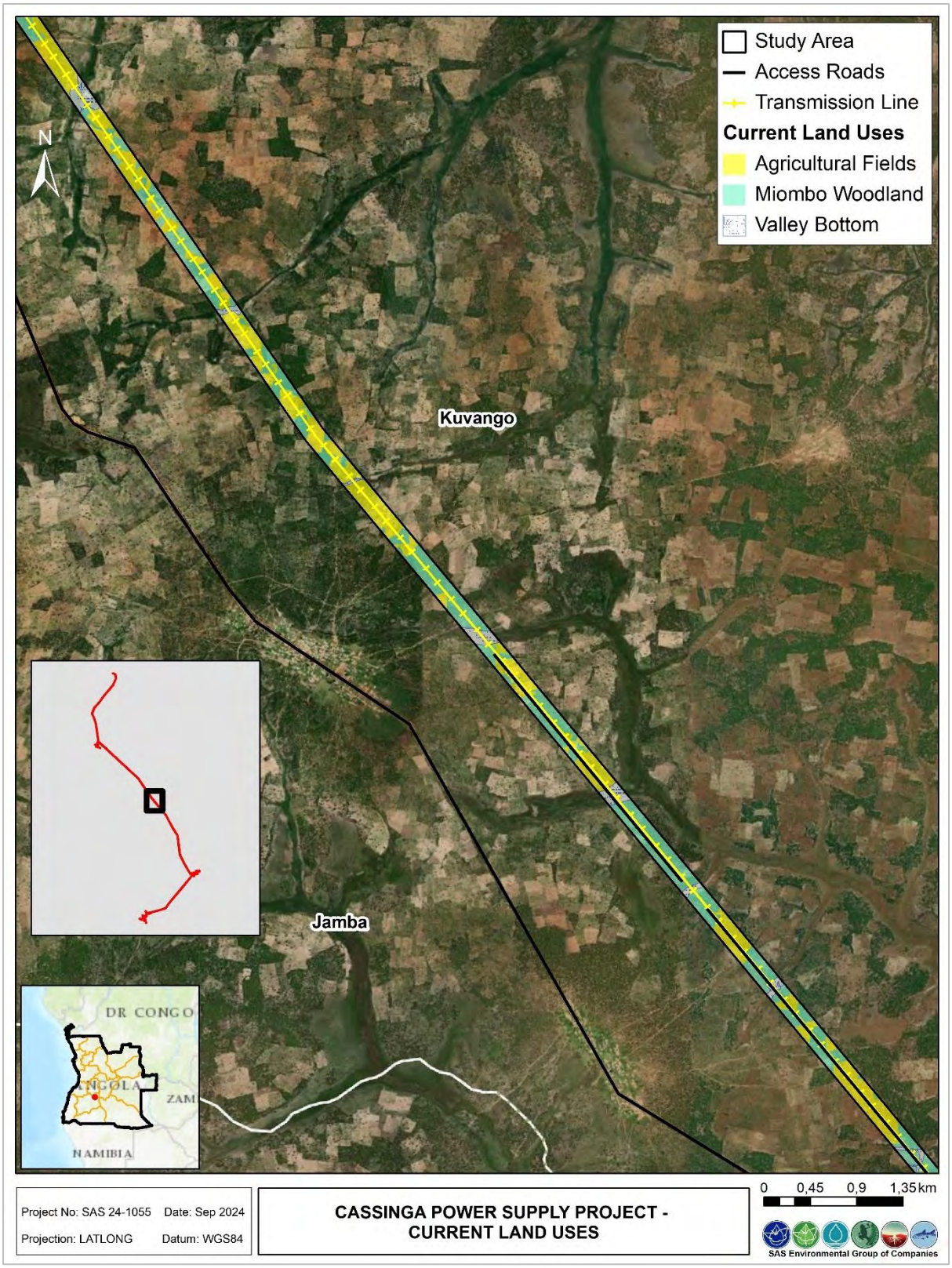


Figure 20: Land uses associated with central section of the study area.

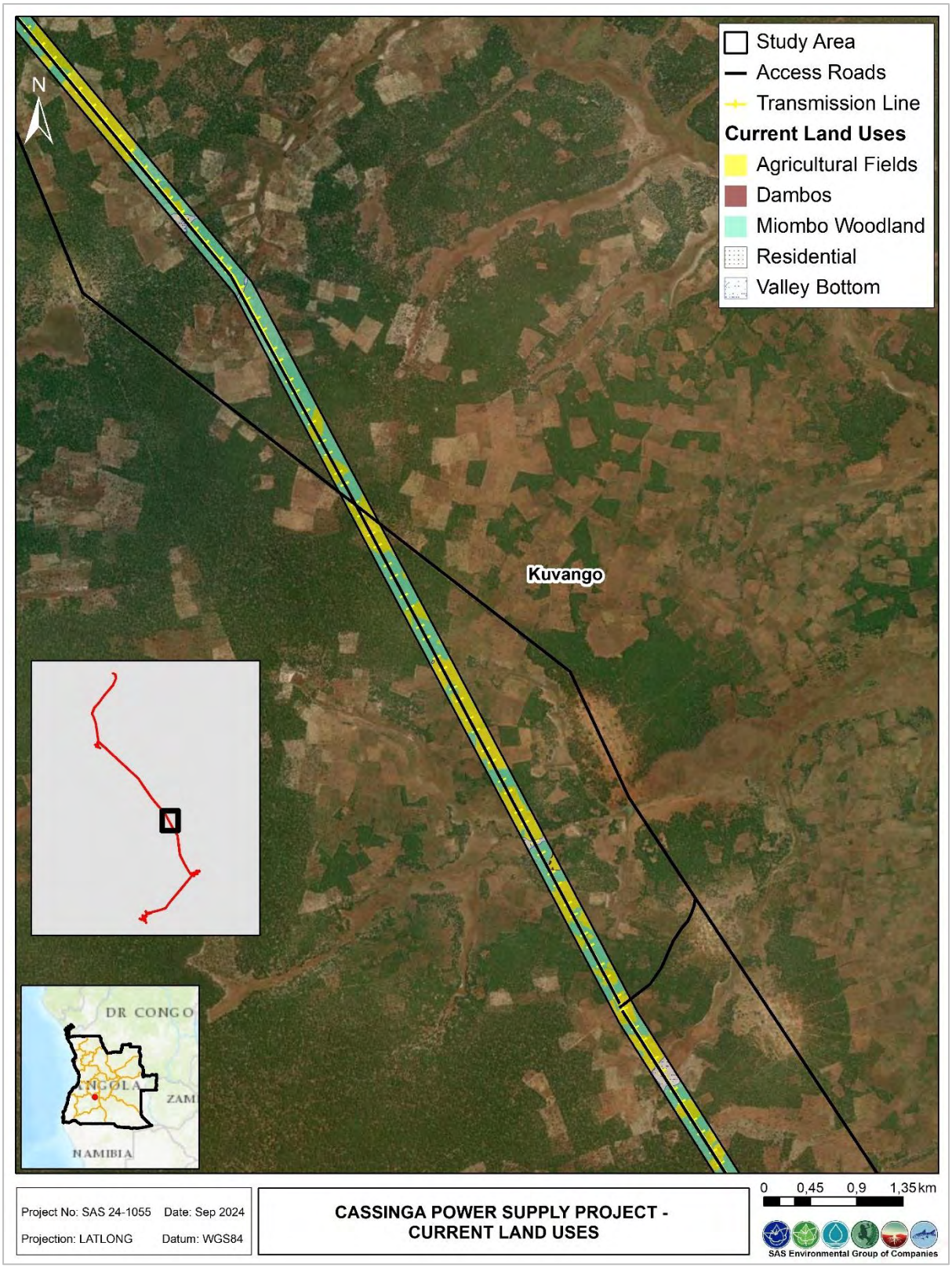


Figure 21: Land uses associated with southern central section of the study area.

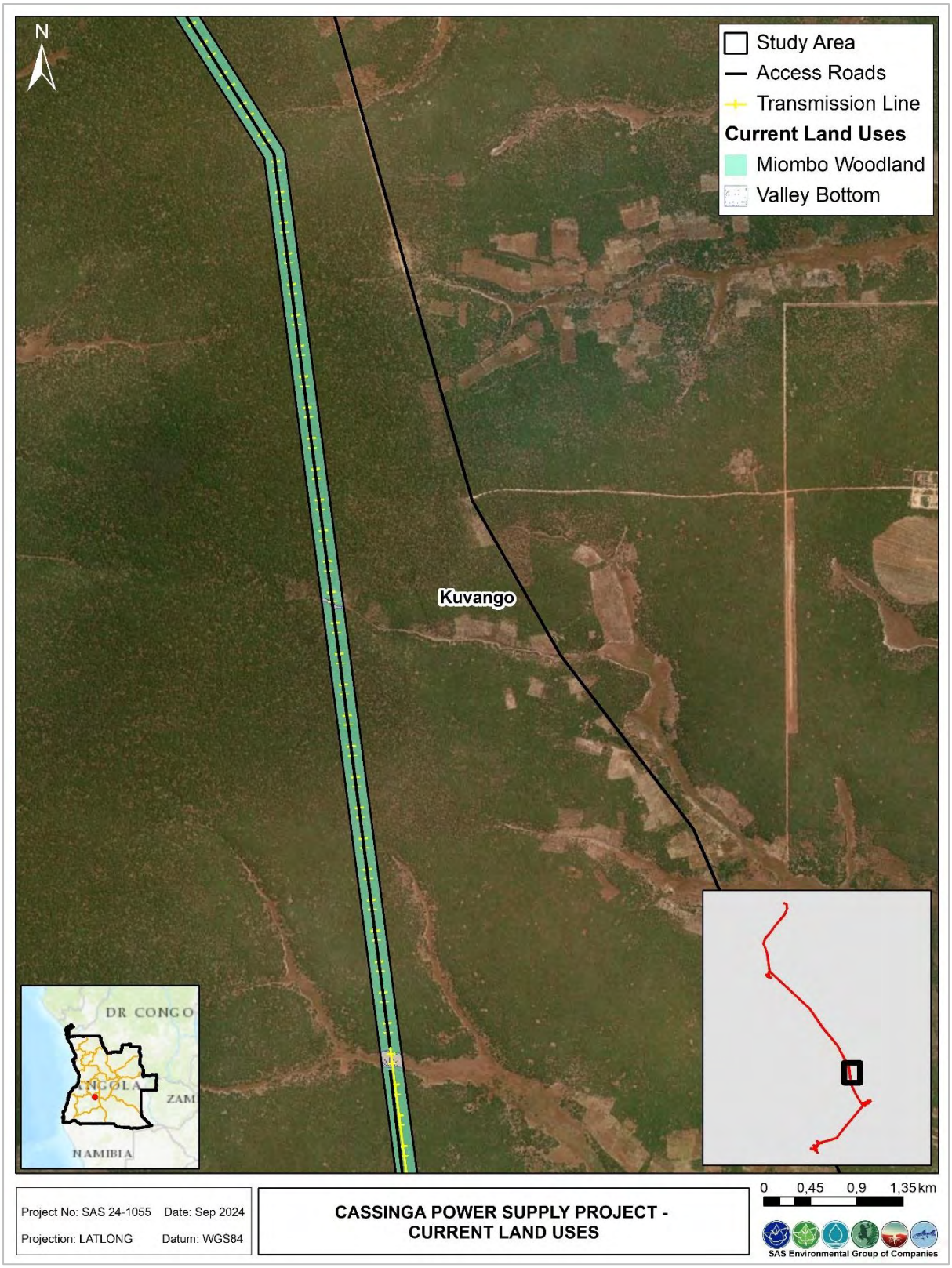


Figure 22: Land uses associated with southern central section of the study area.

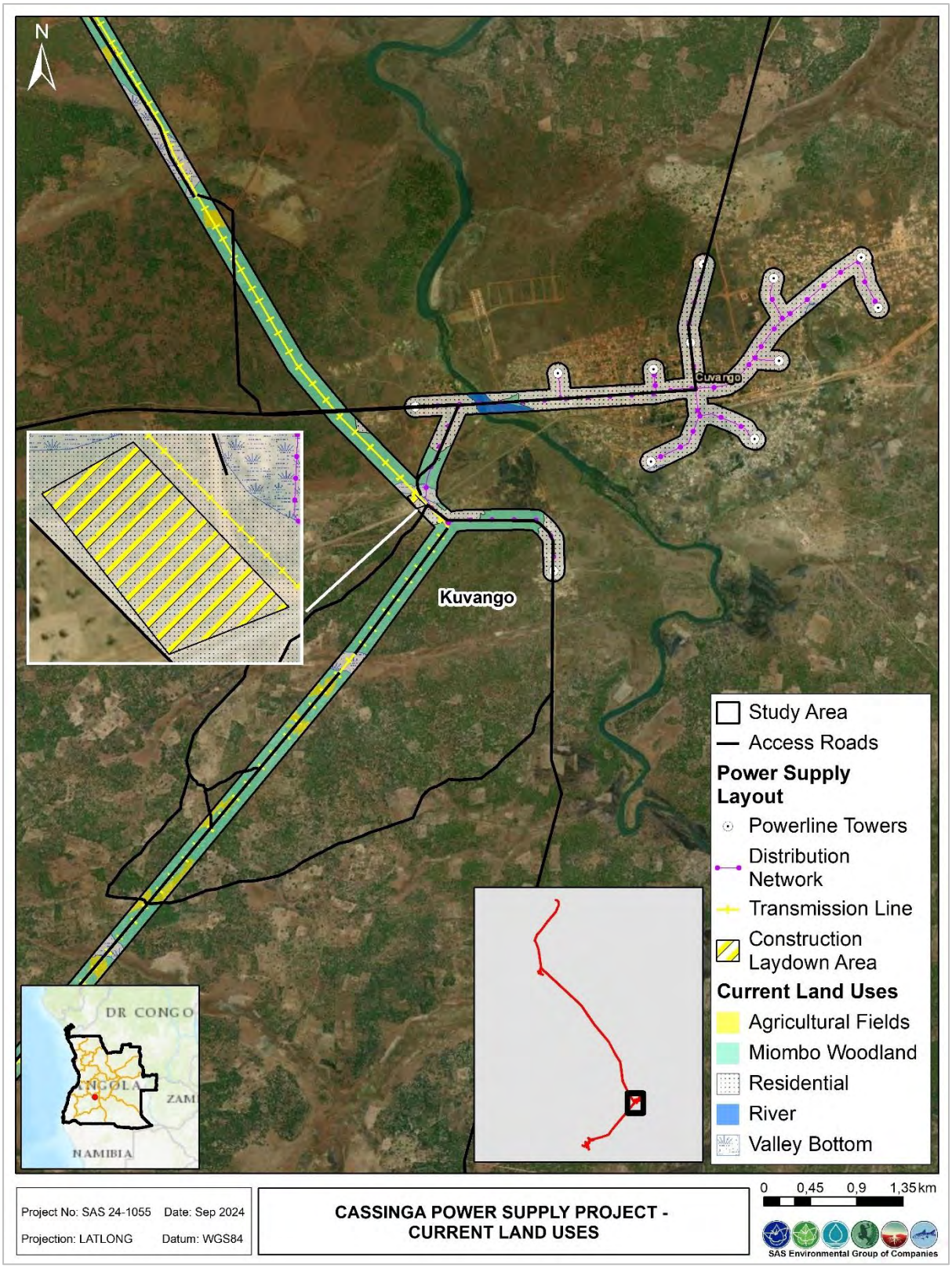


Figure 23: Land uses associated with southern section of the study area.

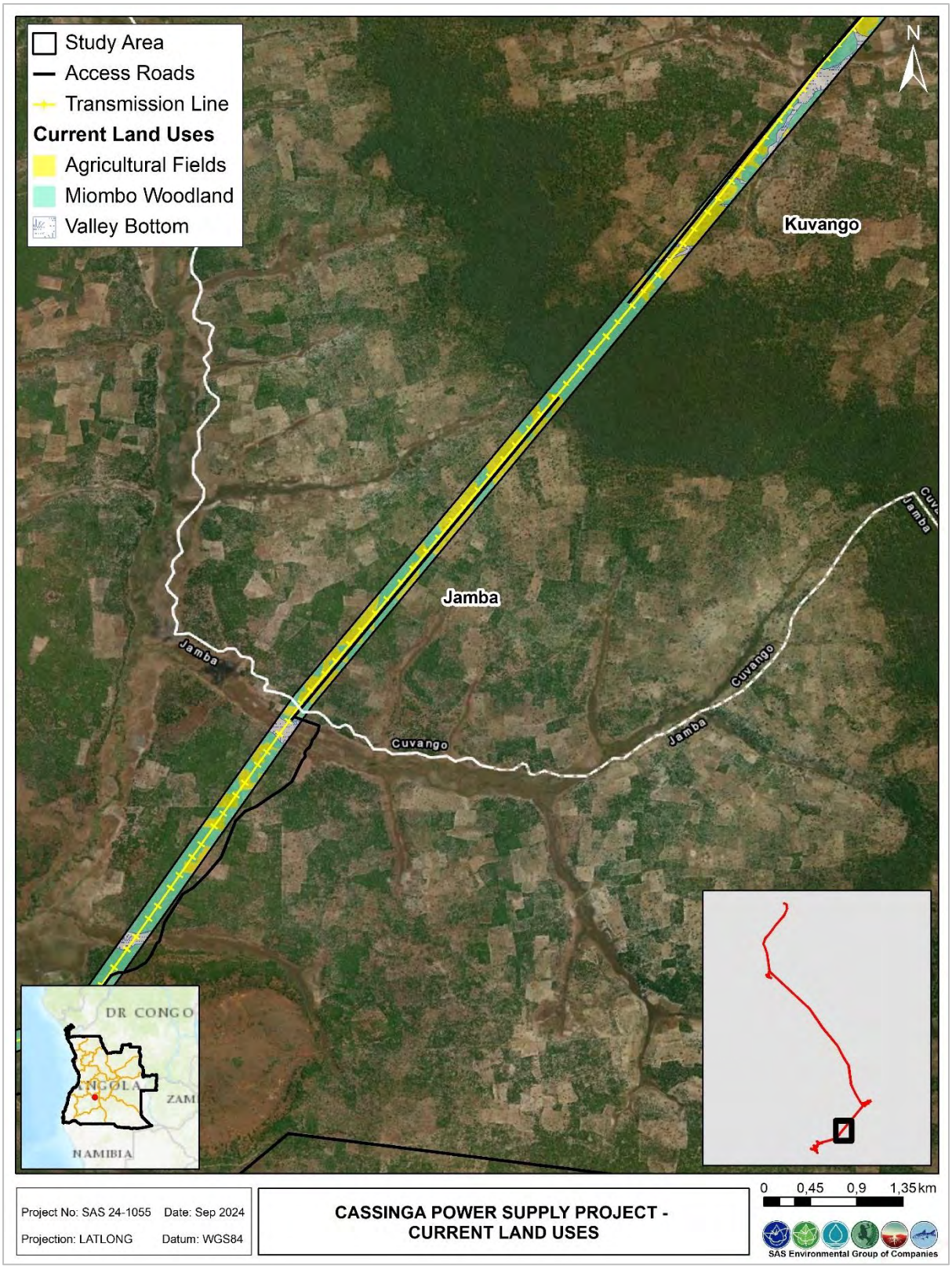


Figure 24: Land uses associated with southern section of the study area.

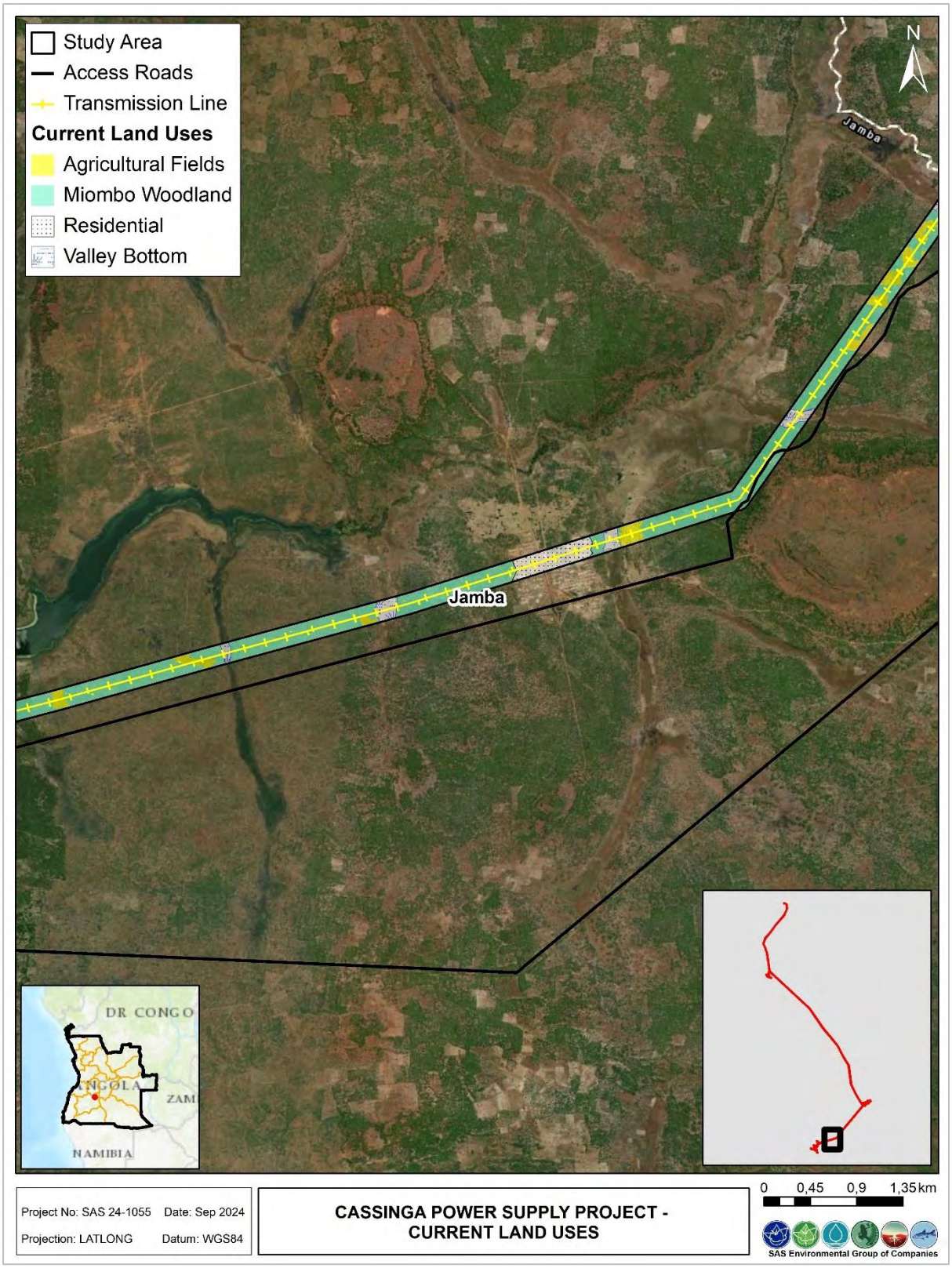


Figure 25: Land uses associated with southern section of the study area.

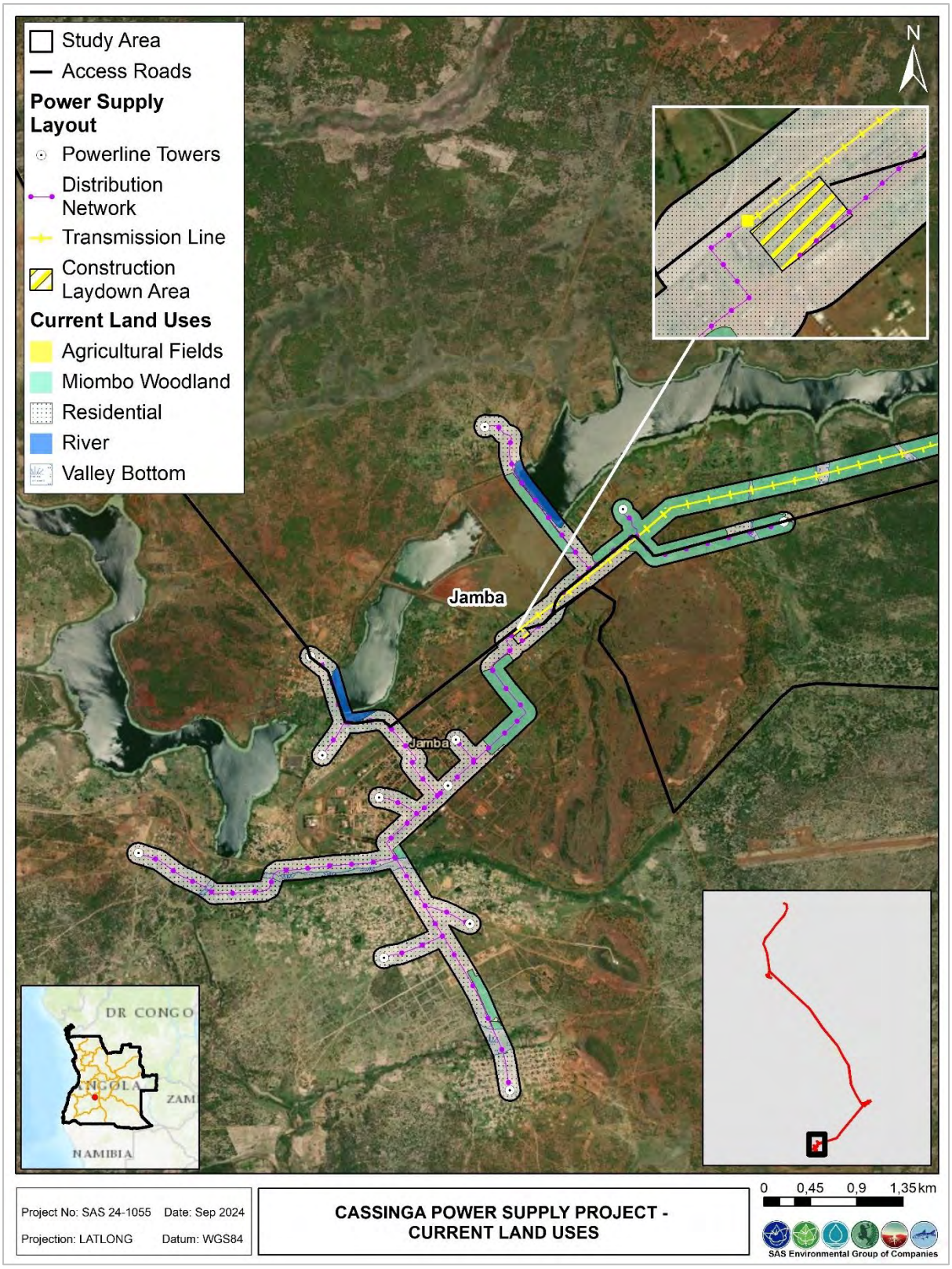


Figure 26: Land uses associated with southern section of the study area.

6.1.2 Dominant Soil Types

The project footprint areas are dominated by Ferralsols, Acrisols, Plinthosols, Leptosols and Anthrosols. These soils are largely range between moderately deep to very deep and are well drained, red and yellow soils. The topsoil is of most soils is of 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.

Leptosols soils are typically shallow in nature. The shallow depth can be attributed to limited rock weathering and convex topographical conditions at the crest or scarp of a hillslope resulting in removal of soil and in some instance leaving rocky outcrops behind. Based on the degree of weathering some lithic material of varying sizes can be mixed intimately with soil material. These types of soils are usually avoided for intensive use and thus left for grazing, forestry, and wildlife land uses.

Ferralsols soil types are characterised by development in well-drained oxidising environmental conditions (warm and moist) which allow for iron oxide coating on soil particles thus resulting in the dominant red colours of the soils. In some instances, the red colour can be as a result of the iron-rich parent material. Besides depth limitations in some instances these soils can be considered suitable for cultivation due to their well-drained conditions, good aeration and sandy to loam textural class.

Acrisols are characterised by their reddish coloration and high clay content, typically formed in weathered tropical environments. Acrisols exhibit good drainage properties and moderate fertility, making them suitable for a wide range of cultivated crops, including maize and cassava. However, their susceptibility to erosion, coupled with factors such as deforestation and improper land management, poses challenges to their long-term sustainability. Sustainable agricultural practices, including soil conservation measures and agroforestry, are essential for preserving the fertility and productivity of Acrisols in the region.

Plinthosols are iron-rich soils characterised by the presence of plinthite, petroplinthite or pisoliths in the subsoil horizons. These soils have the potential to support agriculture and contribute to food security, but their sustainable management requires careful consideration such as crop selection practices tailored to the local environmental conditions.

Gleysols formations are characterised by long periods of saturation leading to formation of gleyic and albic (loss of colloidal matter or bleaching) properties in the subsoil. These soils

may have high clay content which can be a limiting factor for root growth and high moisture content leading to anaerobic conditions not suitable for most cultivated crops.

Fluvisols are soils formed from sediments deposited by rivers or streams and are typically found in floodplains and river valleys. Generally, Fluvisols have the potential to be highly productive for agriculture due to their relatively high fertility and the presence of nutrient-rich alluvial deposits. However, these soils are susceptible to erosion and have low water holding capacity and thus are not utilised for intense agriculture, unless intensive management practices are implemented.

Anthrosols formation are soils which have been subjected to physical disturbance due to human activities, in this case unpaved roads and railway line. In this context, Technosols soils include unpaved road areas as well transported soil material which has been significantly impacted such that the diagnostic horizons could not be identified, as is the case with the railway line footprint areas. As a result, these soils are not ideal for agricultural cultivation.

The spatial distribution of all identified soil types within the study area is presented in a soil map from Figure 26 to 38. Table 7 below presents the dominant soil types and their respective diagnostic horizon sequence.

Table 7: 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

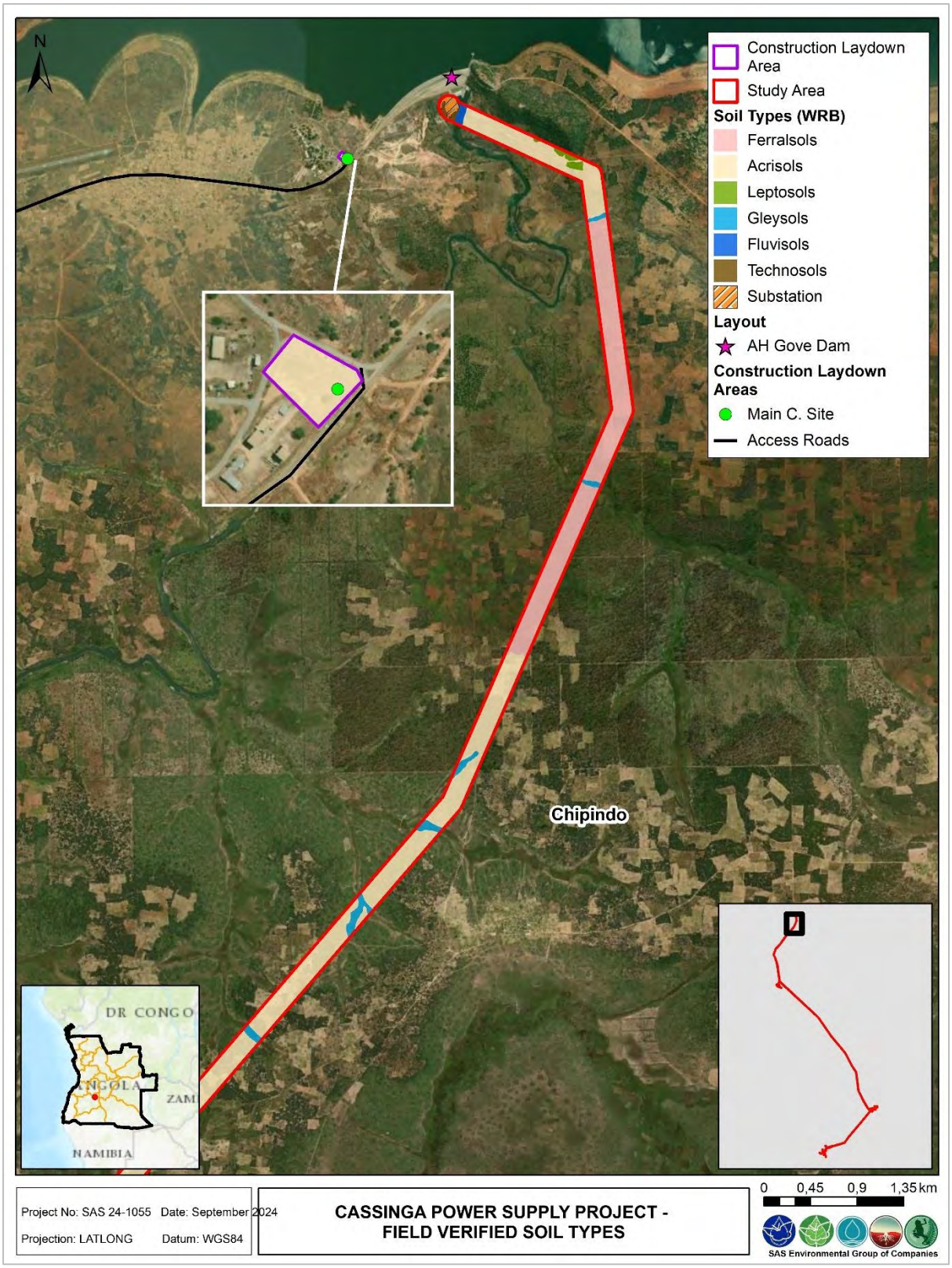


Figure 27: Dominant soil types associated with the study area.

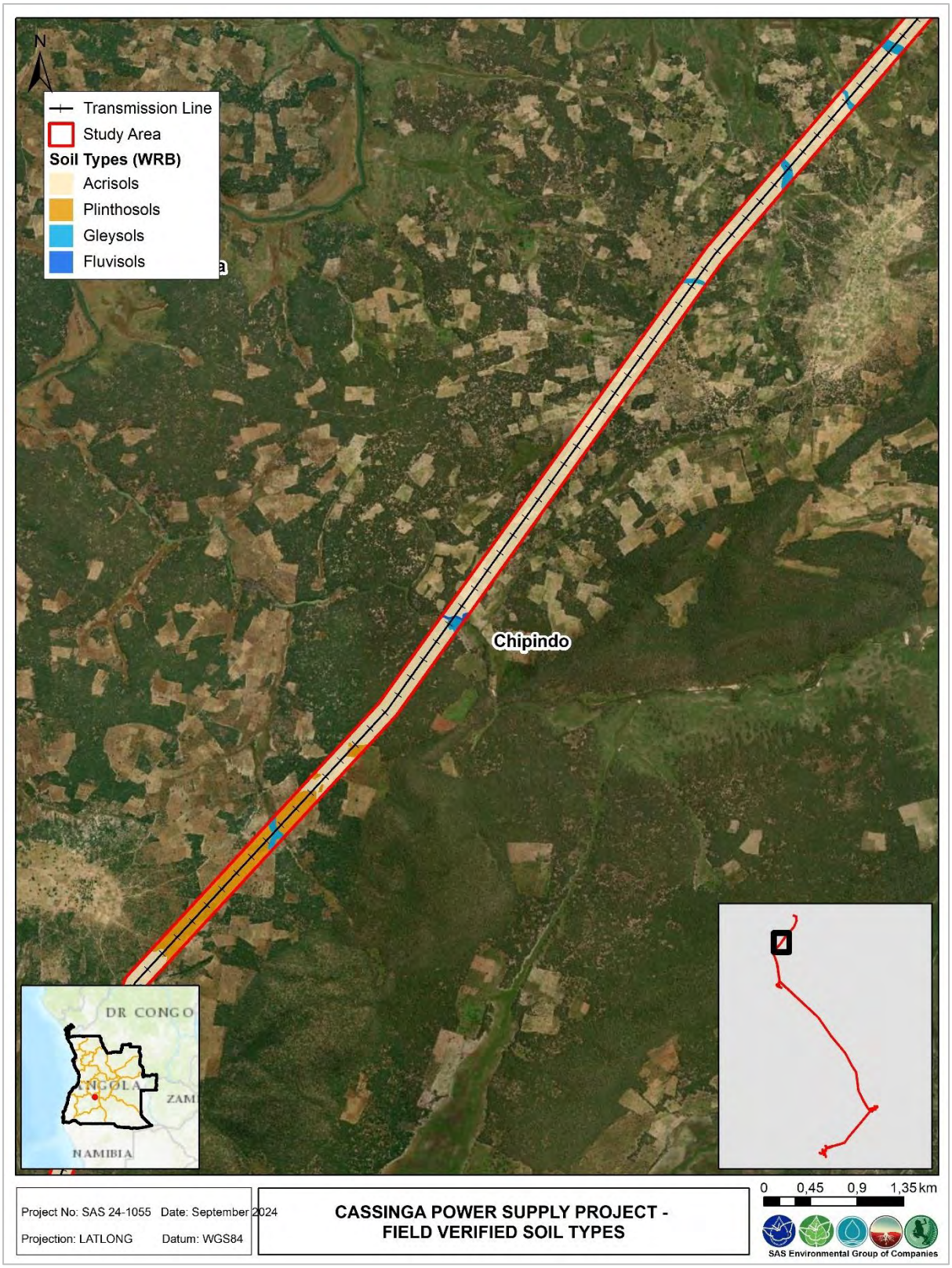


Figure 28: Dominant soil types associated with the study area.

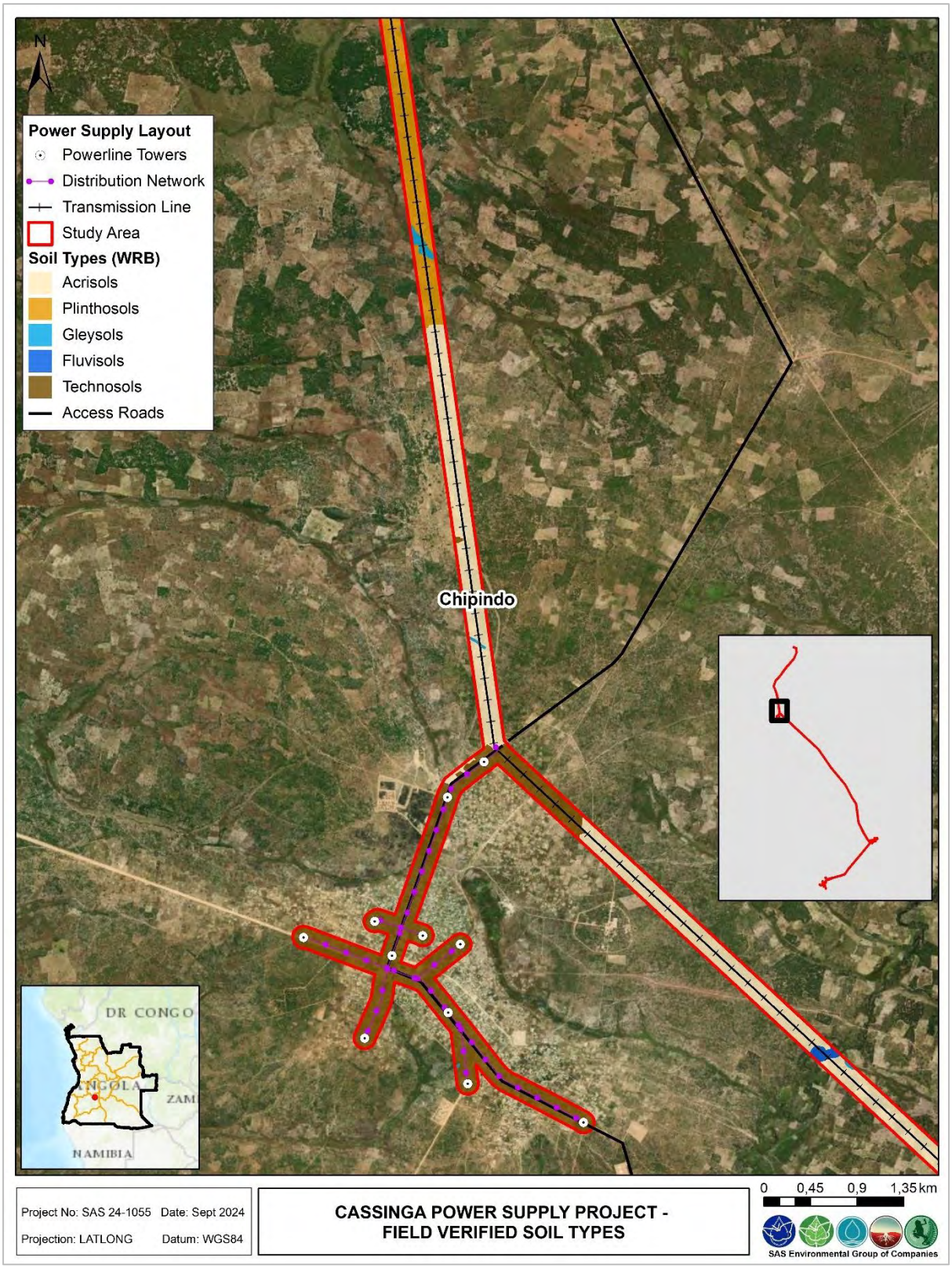


Figure 29: Land uses associated with northern section of the study area.

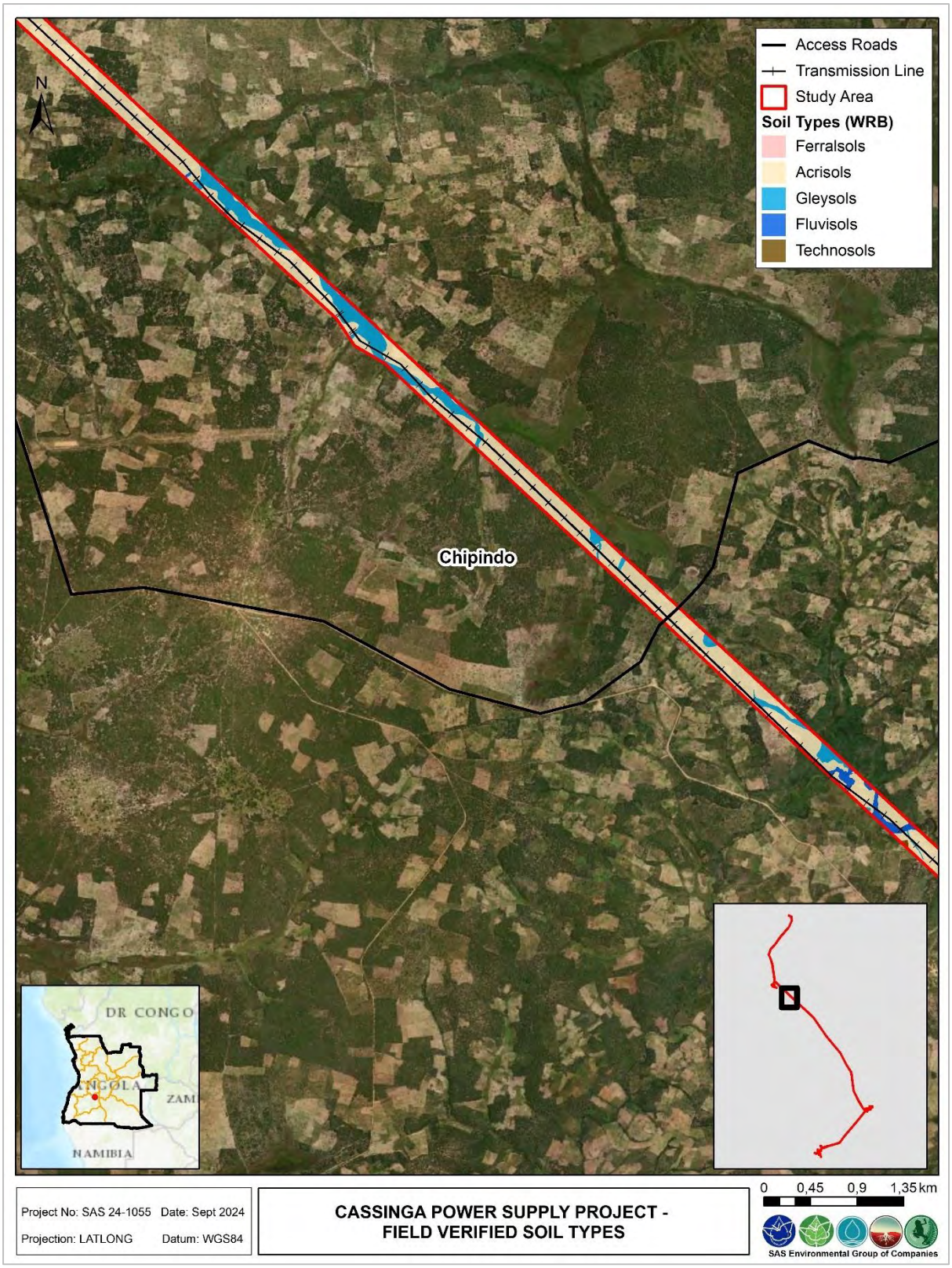


Figure 30: Soil types associated with northern section of the study area.

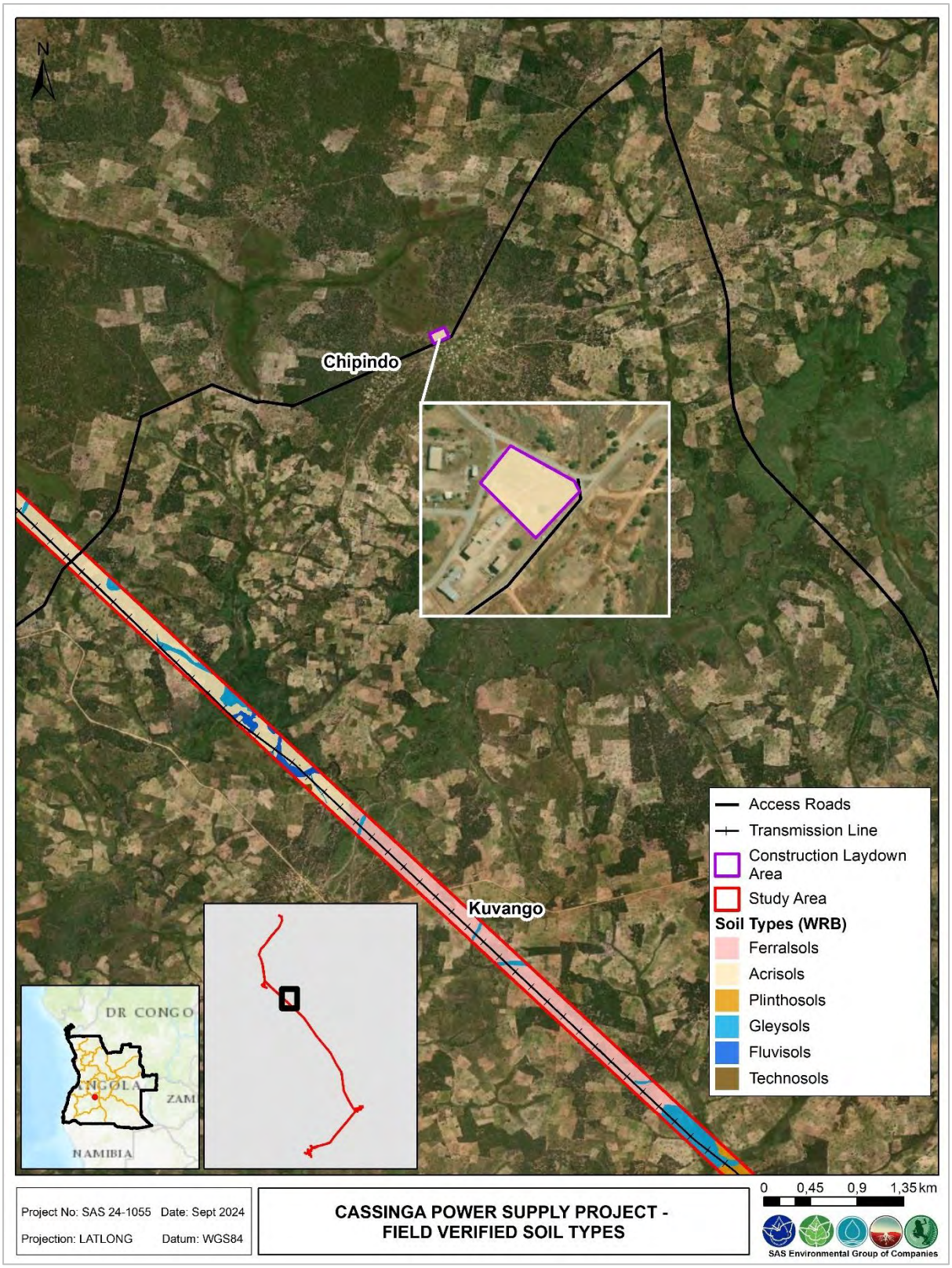


Figure 31: Soil types associated with northern central section of the study area.

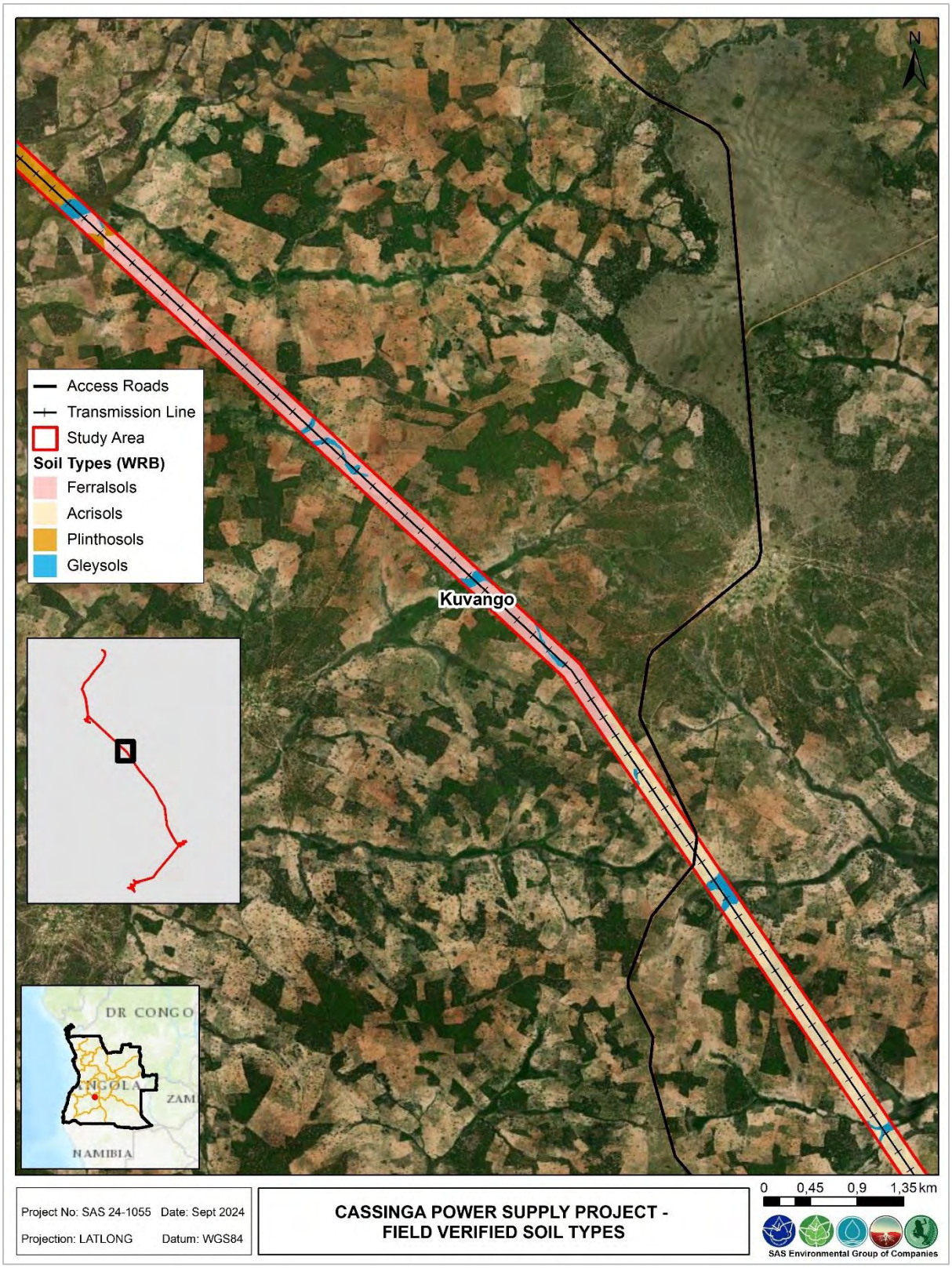


Figure 32: Soil types associated with northern central section of the study area.

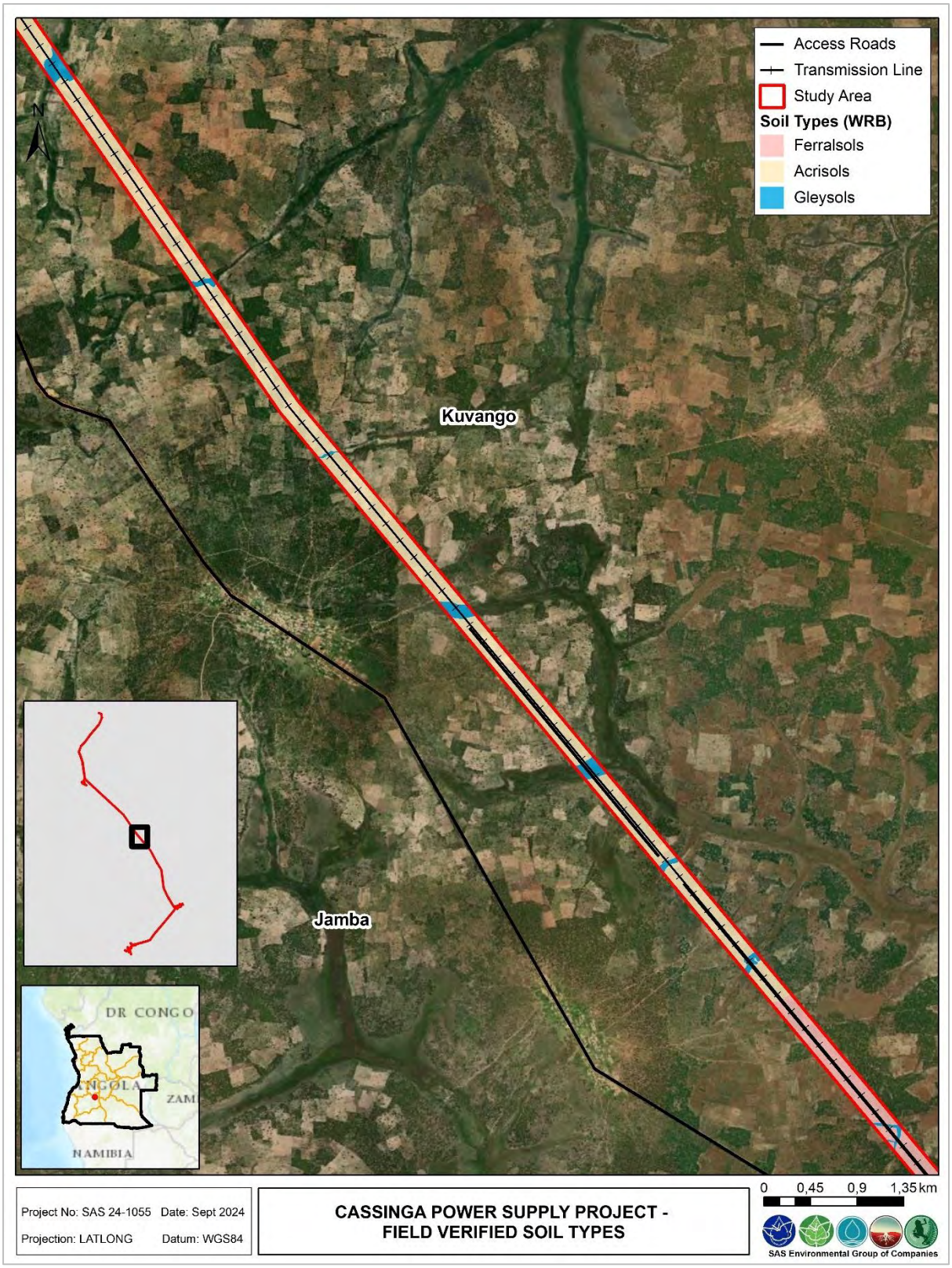


Figure 33: Soil types associated with central section of the study area.

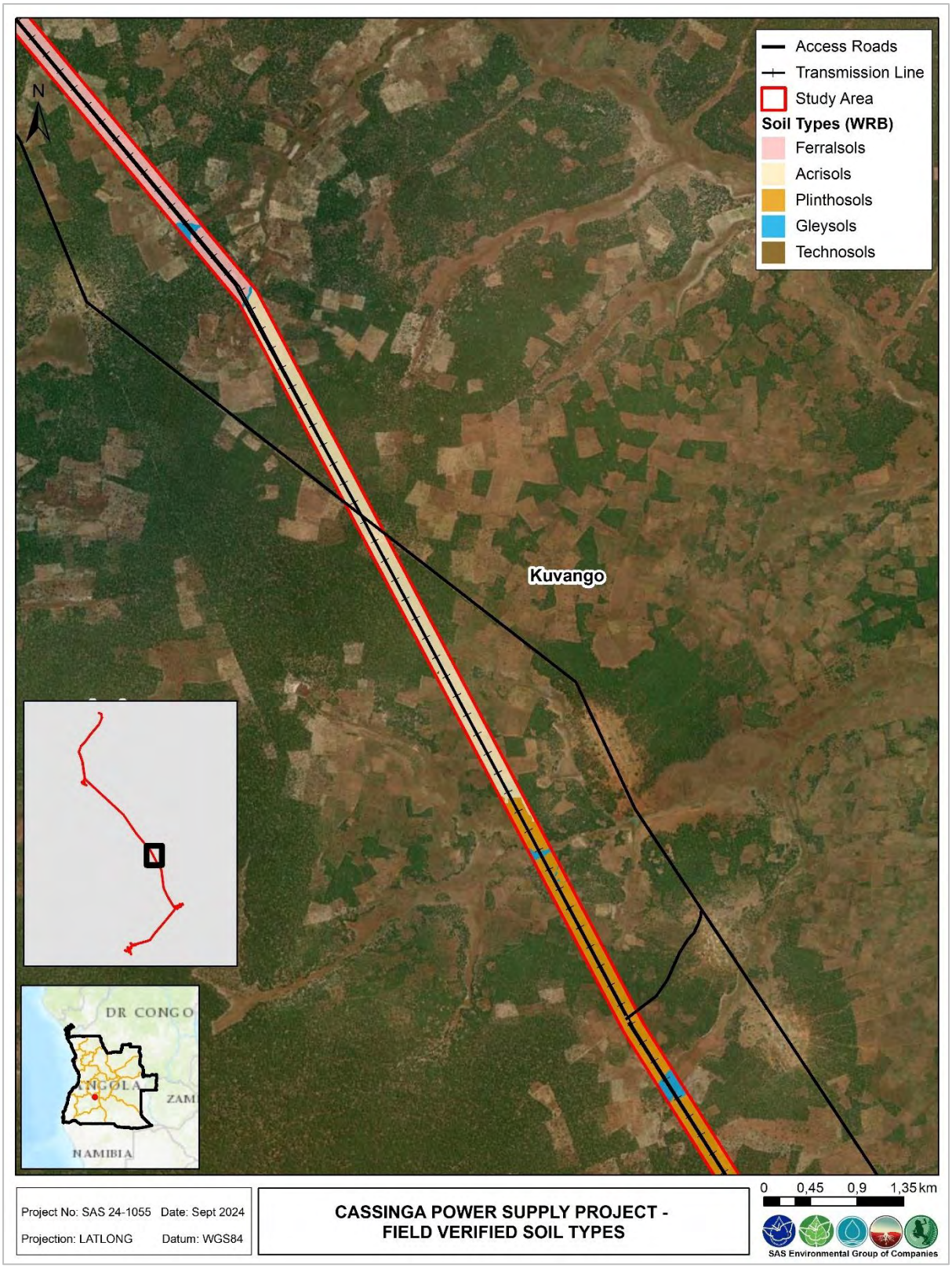


Figure 34: Soil types associated with central section of the study area.

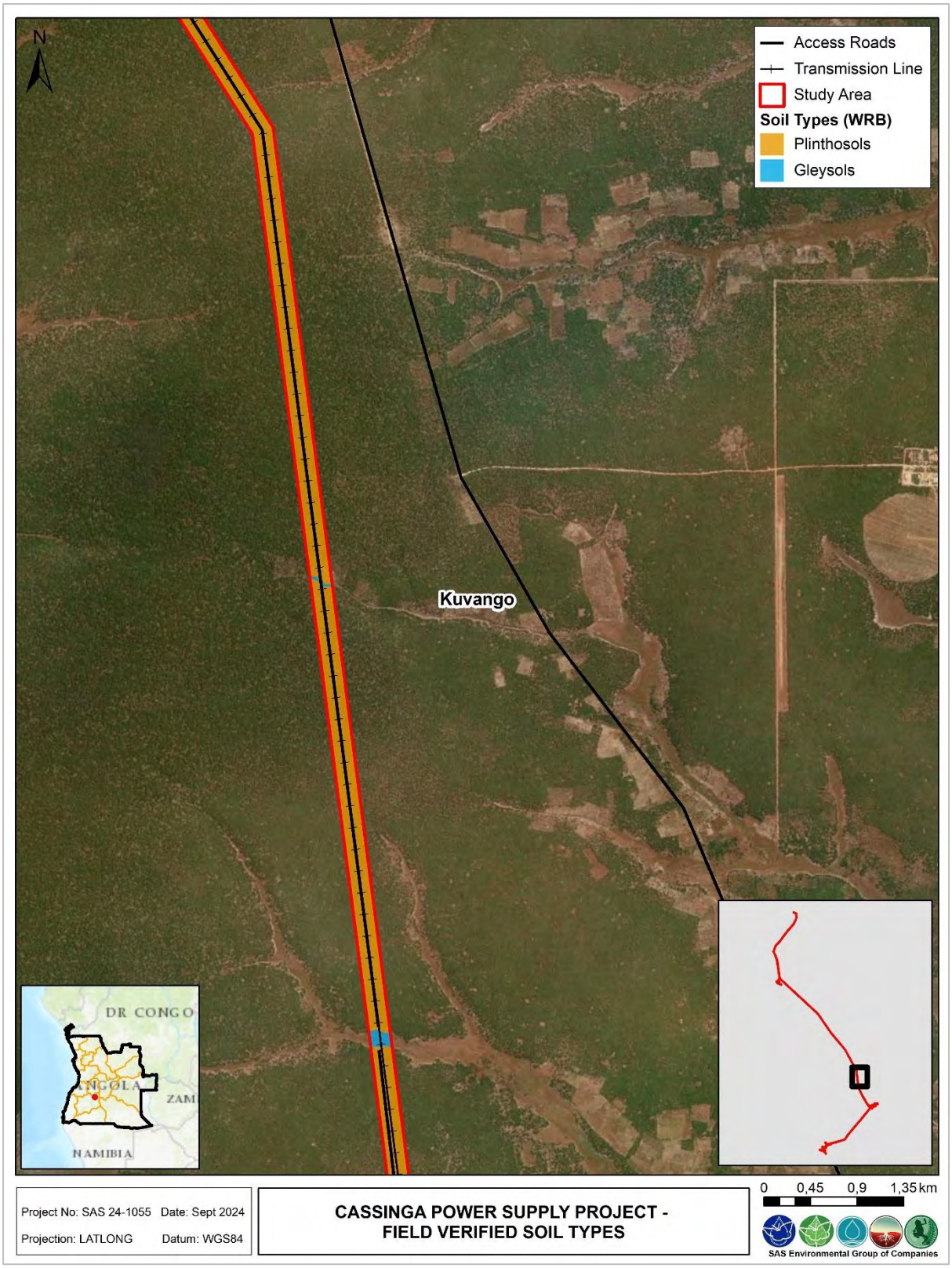


Figure 35: Soil types associated with central section of the study area.

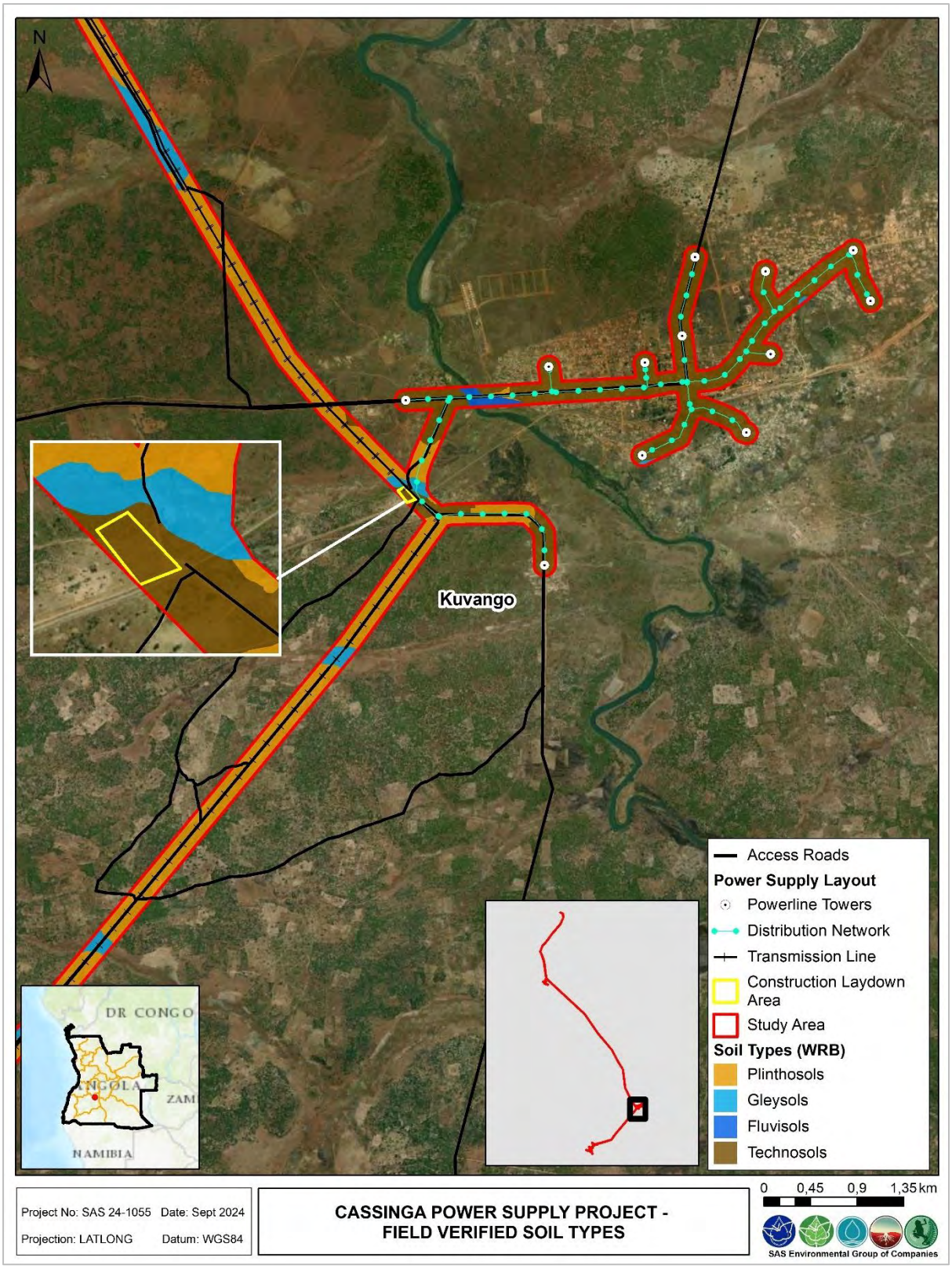


Figure 36: Soil types associated with southern central section of the study area.

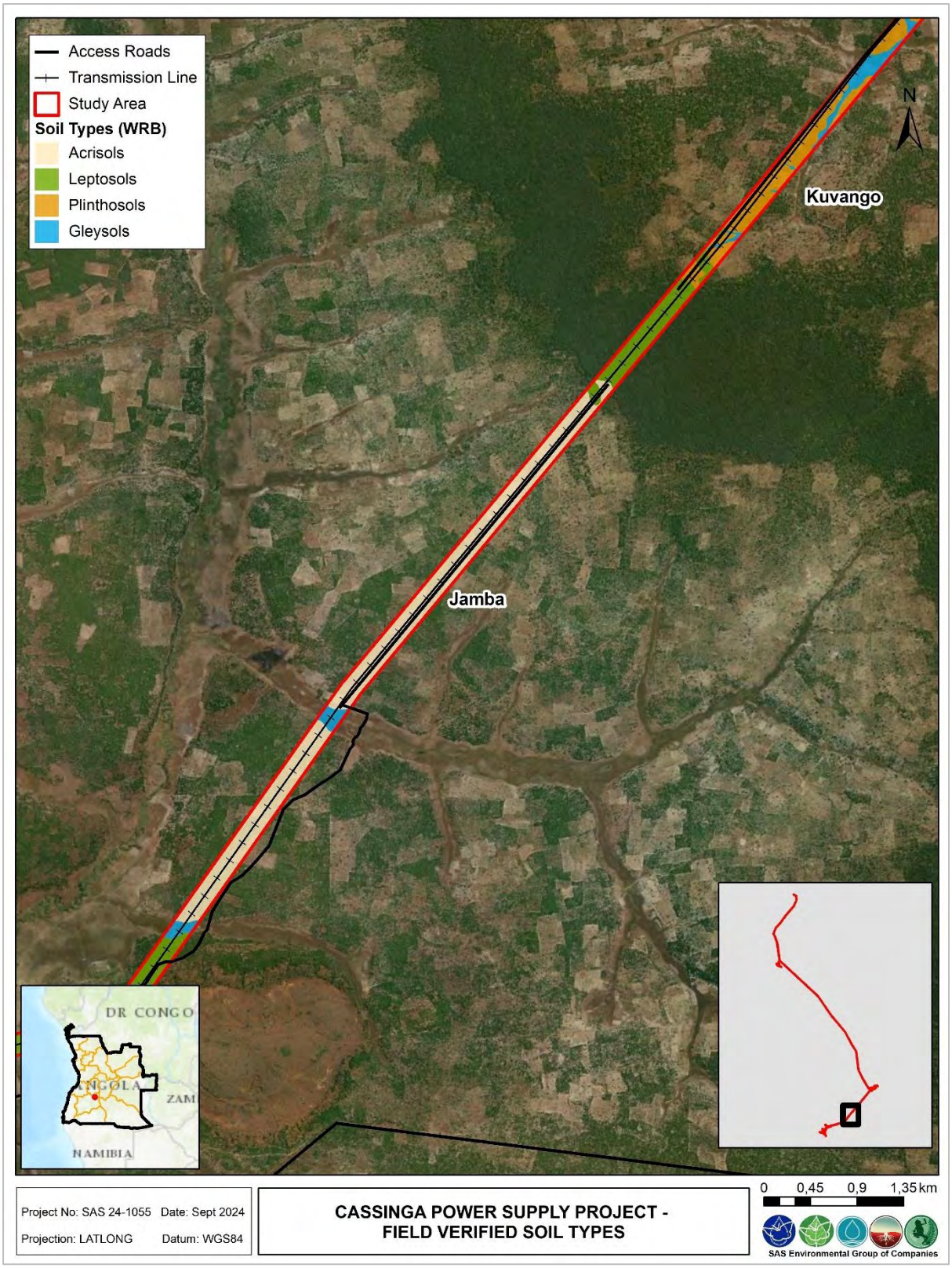


Figure 37: Soil types associated with southern section of the study area.

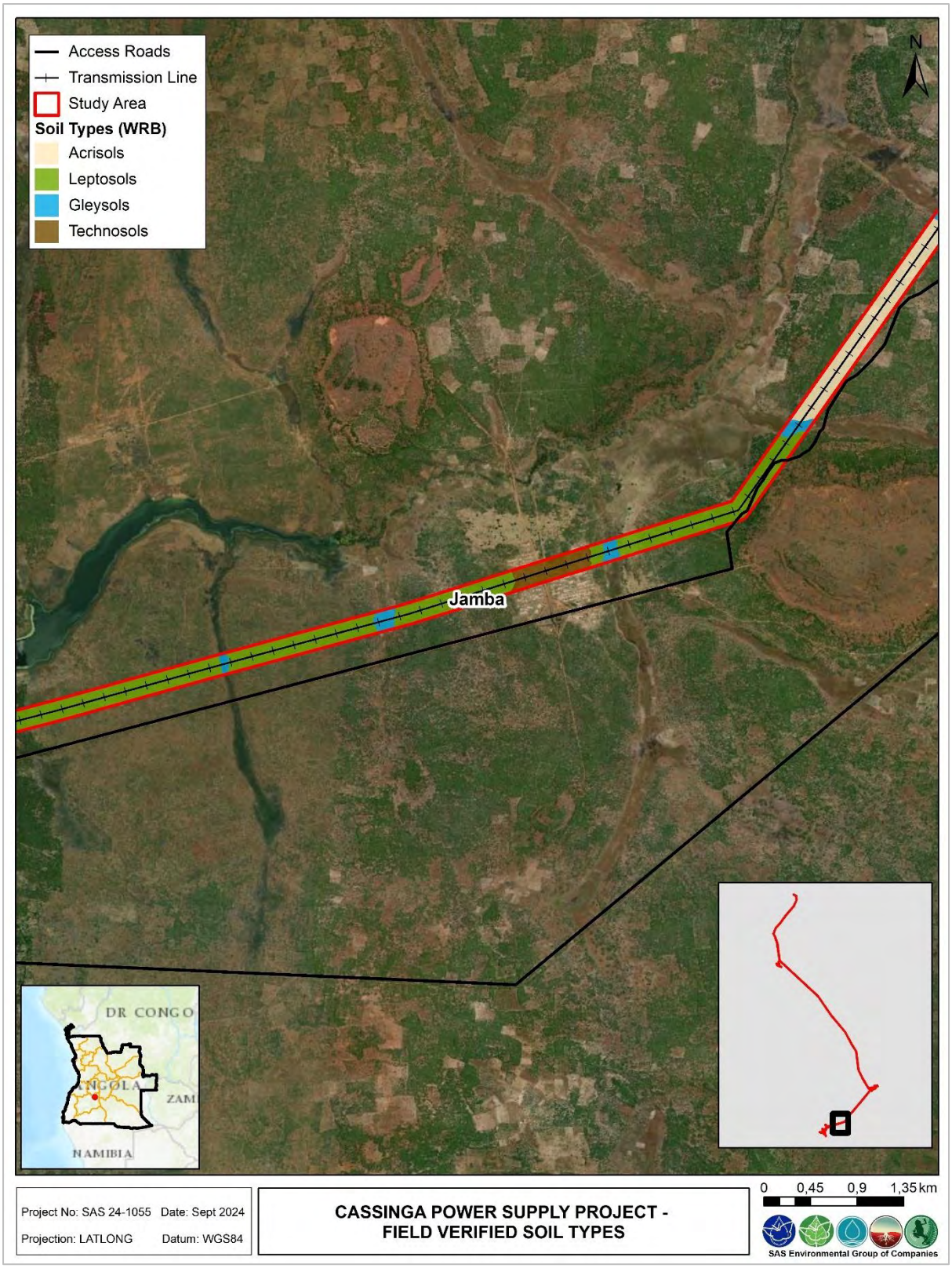


Figure 38: Soil types associated with southern section of the study area.

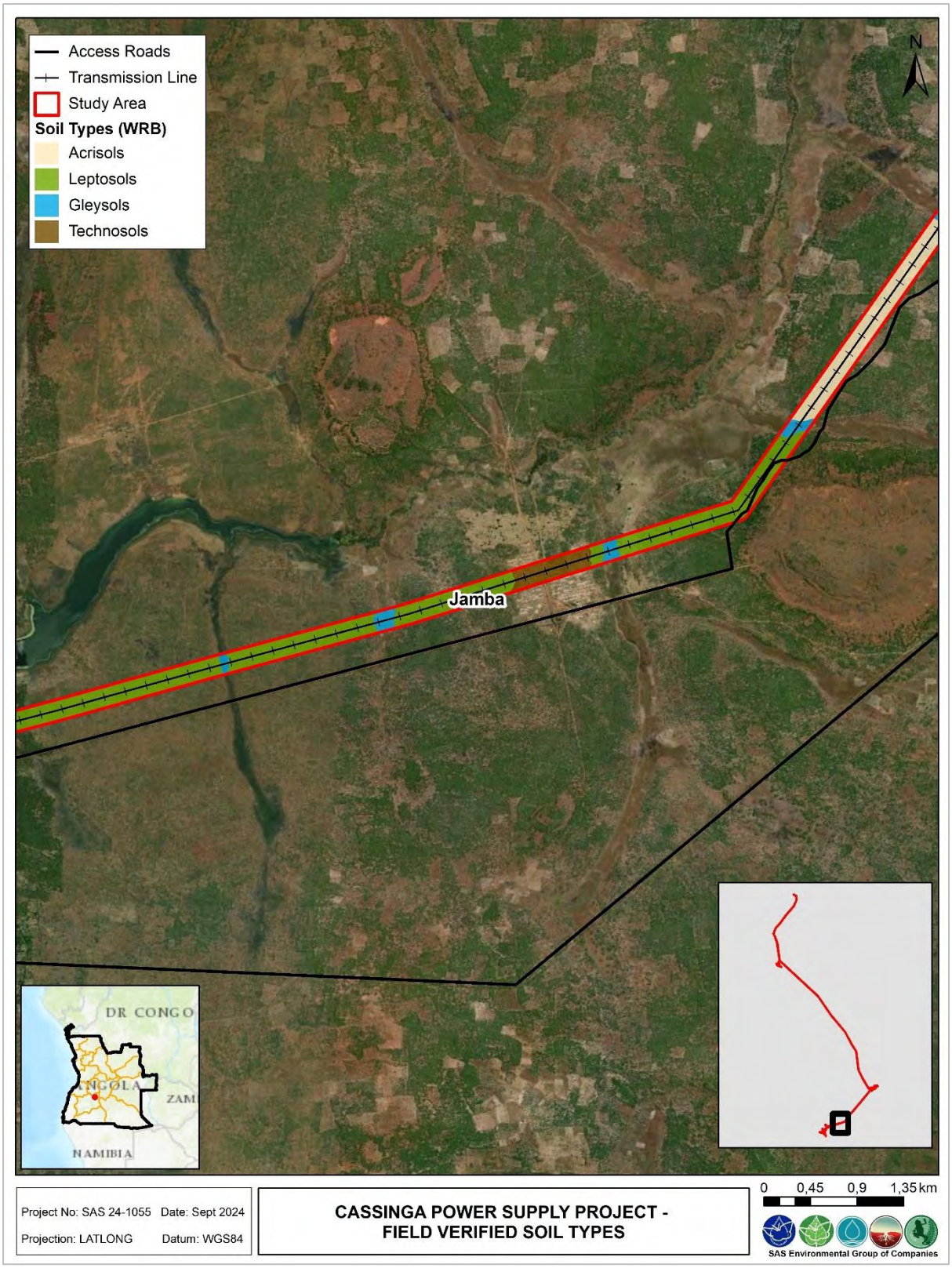


Figure 39: Soil Types associated with southern section of the study area.

6.1.3 Land Capability Classification

Agricultural land capability is generally restricted by climatic conditions, particularly water availability (moisture retention/rainfall) and temperature. However, even within similar climatic zones, different soil types typically have different land use capabilities attributed to their inherent characteristics.

For the purpose of this assessment, land capability was inferred in consideration of observed limitations to land use due to physical soil properties and prevailing climatic conditions. Climate Capability (measured on a scale of 1 to 8) was therefore considered in the agricultural potential classification. The study area falls into Climate Capability Class 1 (none to slight limitations) since the local climate is favourable for good yield for a wide range of adapted crops throughout the year.

The identified soils were classified into land capability and land potential classes using the Camp *et. al*, and Guy and Smith Classification system (Camp *et al.,* 1987; Guy and Smith, 1998), as presented from Figure **39 to 51** below. The identified land capability limitations for the identified soils are discussed in comprehensive “dashboard style” summary tables presented from Table **9 to 13**. The dashboard reports aim to present all the pertinent information in a concise and visually appealing fashion.

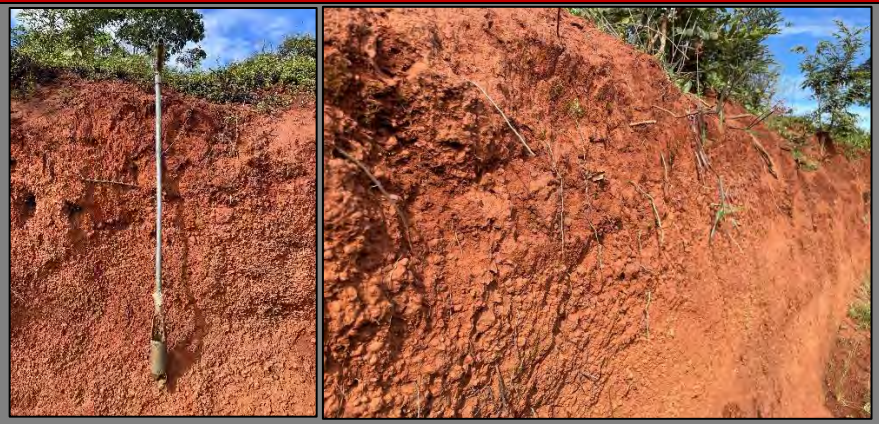
Table 8 presents the dominant soil types and their respective land capability as well as areal extent expressed as hectares as well as percentages.

Table 8: Land capability associated with the 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		2 456,70	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 VI	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 ha**	**100.00**			

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

Table 9: Summary discussion of the Arable (Class II) land capability class.

<table>
<tr><th colspan="5">Land Capability: Arable (Class II) and High potential land potential</th></tr>
<tr><td colspan="5">  </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">1.4% Relatively flat slope to moderately sloping</td><td>Photograph notes</td><td>View of the red apedal, yellow brown apedal and soft plinthic horizons associated with the Ferralsols occurring within the study area</td></tr>
<tr><td>soil type (s)</td><td colspan="2">Ferralsols</td><td>Area Extent</td><td>455,50 ha (10,94 %)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">None. These soils have enough depth (greater than 60cm) for most cultivated crops and good drainage characteristics.</td><td colspan="2" rowspan="2">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.</td></tr>
<tr><td>Land Potential</td><td colspan="2">Very high potential: No limitations. Appropriate contour protection must be implemented and inspected.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact of the proposed open cast pits and related infrastructure development on land capability and land potential is anticipated to be Medium (M prior to mitigation measures and Low (L) post mitigation, due to the inherently high land capability of the identified dominant soil types.</td><td colspan="2" rowspan="2">Consideration of Integrated Environmental Management and Sustainable Development Principles:

These soils are under rainfed subsistence agriculture, utilising irrigation systems in some instances to maximise the yield from the available land. It is the opinion of the specialist that the OHL development should avoid placement of infrastructure within the actively cultivated soils to minimise the impact on the agricultural resources.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 10: Summary discussion of the Arable (Class III) land capability class associated with the Acrisols soils.

<table>
<tr><th colspan="5">Land Capability: Arable (Class III)</th></tr>
<tr><td colspan="5">  </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Gently sloping landscapes of < 0.5% slope gradient.</td><td>Photograph notes</td><td>View of the red apedal underlain by lithic horizons as associated with the Nkonkoni soils occurring within the study area.</td></tr>
<tr><td>soil type (s)</td><td colspan="2">Acrisols and Plnthosols</td><td>Area Extent</td><td>2 456,70 ha (58,99 %)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">The occurrence of plinthite material and high clay content at moderate depth as well risk of water logging are the primary land capability limitation of these soils.</td><td colspan="2" rowspan="2">Land Capability
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.</td></tr>
<tr><td>Land Potential</td><td colspan="2">High potential: Very infrequent and/or minor limitations due to soil, slope, temperatures. Appropriate contour protection must be implemented and inspected.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact on land capability is anticipated to be medium (M) without mitigation and can be reduced to low level (L) with effective application of soil conservation mitigation measures such as avoiding placement of any infrastructure on these good agricultural potential soils where feasible.</td><td colspan="2" rowspan="2">Consideration of Integrated Environmental Management and Sustainable Development Principles:
The identified soils are generally considered significant in terms of agricultural productivity within the study area. Protection of these soils (if feasible) is highly recommended particularly where these soils are currently under active cultivation to ensure agricultural production occurs during all phases of development.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 11: Summary discussion of the Grazing (Class V) land capability class (Watercourses/Dambos).

<table>
<tr><th colspan="5">Land Capability: Grazing (Class V)</th></tr>
<tr><td colspan="5">    </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Relatively flat to moderately sloping land of <1.5% slope</td><td>Photograph notes</td><td>View of the watercourses (including drainage lines) associated with the study area</td></tr>
<tr><td>soil type (s)</td><td colspan="2">Fluvisols and Gleysols</td><td rowspan="2">Areal Extent</td><td rowspan="2">298,54 ha (0,06 %)</td></tr>
<tr><td>Average Depth (cm)</td><td colspan="2">35cm</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">Wetness</td><td colspan="2" rowspan="2">Land Capability
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.</td></tr>
<tr><td>Land Potential</td><td colspan="2">L5 – Restricted Potential - Due to the signs of wetness (Watercourse)</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact of the proposed developments on land capability and land potential is anticipated to be Low with mitigation measures in place, due to the inherently poor land capability of the identified dominant soil types associated with watercourses.</td><td colspan="2" rowspan="2">Consideration of Integrated Environmental Management and Sustainable Development Principles:
While these soils are not considered prime agricultural production soils because periodic water saturation and alluvial soil material associated with the watercourses, preservation of these soils for conservation purposes takes precedence, according to the Angolan Water Law. Thus, protection of these soils is deemed essential particularly because watercourses are used by livestock for drinking and for irrigation purposes.</td></tr>
<tr><td>Overall impact significance post to mitigation</td><td>L</td></tr>
</table>

Table 12: Summary discussion of the Grazing (Class VI) land capability class associated with the Leptosols.

<table>
<tr><th colspan="5">Land Capability: Grazing (Class VII)</th></tr>
<tr><td colspan="5">  </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Gradually sloping land of >1% slope</td><td>Photograph notes</td><td>View of the identified orthic horizon directly underlain by lithic/hard rock material associated with the Leptosols.</td></tr>
<tr><td>soil type (s)</td><td colspan="2">Leptosols</td><td>Areal Extent</td><td>298,42 ha (7,17 %)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">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.</td><td colspan="2" rowspan="2">Land Capability
The identified Leptosols are of poor (Class VII) land capability and are not suitable for arable agricultural land use. Theses 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.</td></tr>
<tr><td>Land Potential</td><td colspan="2">Moderate potential: Moderately regular and/or severe to moderate limitations due to soil, slope, temperature.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact of the proposed development is anticipated to be Medium (M) without mitigations and Low (L) with mitigation measures in place. This is due to the inherently poor land capability of the identified dominant soil types.</td><td colspan="2" rowspan="2">Consideration of Integrated Environmental Management and Sustainable Development Principles:

The identified soil types are, at best, suited for grazing and/or wilderness practices. These soils are generally not considered to be of significant agricultural. Therefore, mitigation measures should this put in place to minimise vegetation clearance on these soils as far as practically possible. Some of these soils were under cultivation during the site assessment and therefore areas under natural grassland should be targeted to ensure that the proposed development co exists with cultivated agriculture.</td></tr>
<tr><td>Overall impact significance post to mitigation</td><td>L</td></tr>
</table>

Table 13: Summary discussion of the Wildlife/Wilderness (including developed areas) (Class VIII) land capability class associated with the Technosols.

<table>
<tr><th colspan="5">Land Capability: Wildlife/Wilderness (Class VIII)</th></tr>
<tr><td colspan="5">   </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Not applicable; highly disturbed areas.</td><td>Photograph notes</td><td>View of the identified Technosols formation.</td></tr>
<tr><td>soil type (s)</td><td colspan="2">Technosols</td><td>Area Extent</td><td>652,81 ha (7,17%)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">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.</td><td colspan="2" rowspan="2">Land Capability
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.</td></tr>
<tr><td>Land Potential</td><td colspan="2">Very Low Potential (L8): Severe limitations due to soil, slope, temperature, or rainfall. Non-arable.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>L</td><td rowspan="2">The overall impact of the proposed development on the land capability of these soils is anticipated to be low (L) due to the already existing poor land capability.</td><td colspan="2" rowspan="2">Consideration of Integrated Environmental Management and Sustainable Development Principles:
The current state of these soils requires significant rehabilitation already. The proposed development is not anticipated to cause a loss of agricultural resources since these soils have been disturbed and therefore are not ideal for cultivation.</td></tr>
<tr><td>Overall impact significance post to mitigation</td><td>L</td></tr>
</table>

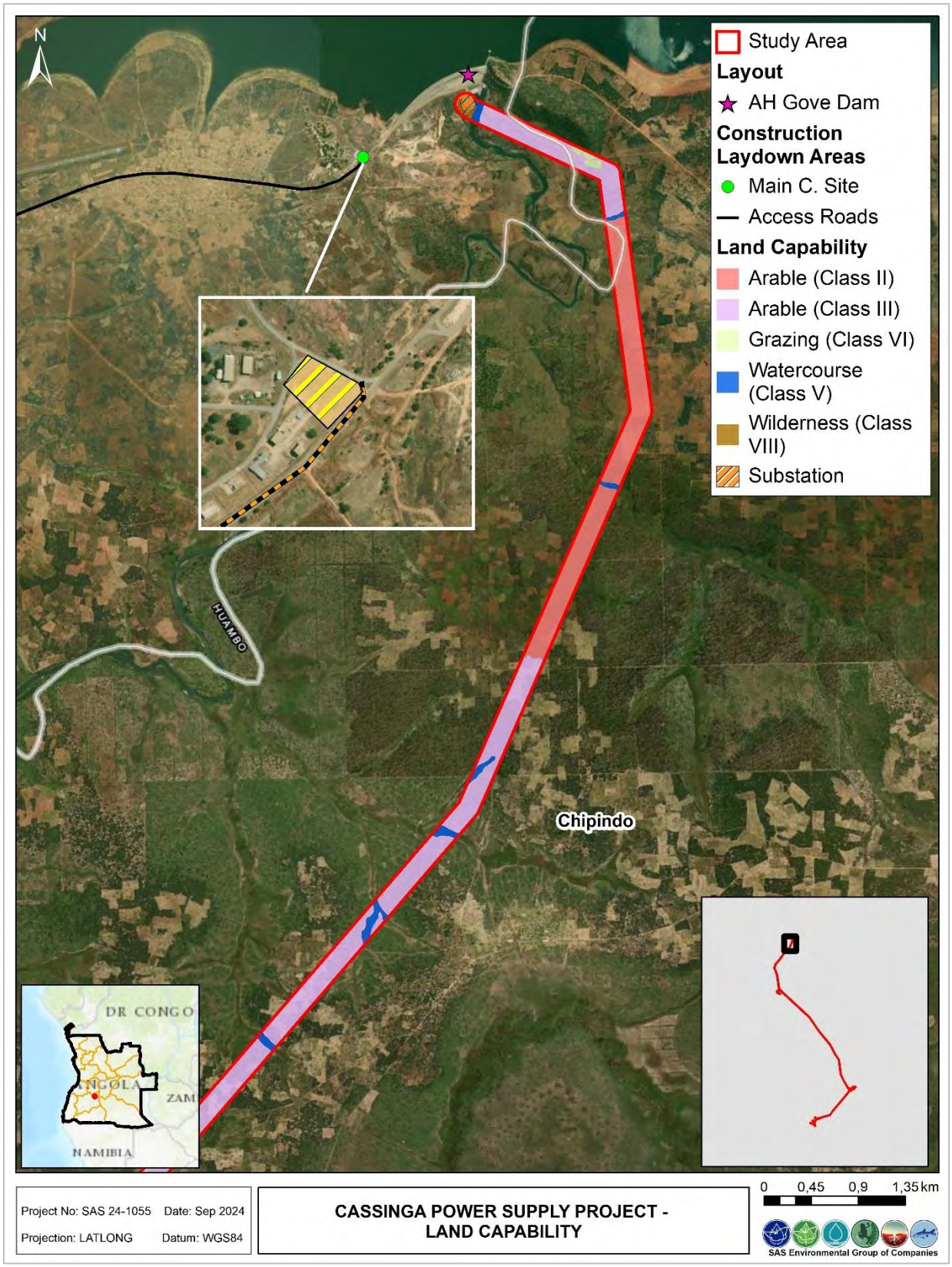


Figure 40: Land capability associated with the soils in northern section of the study area.

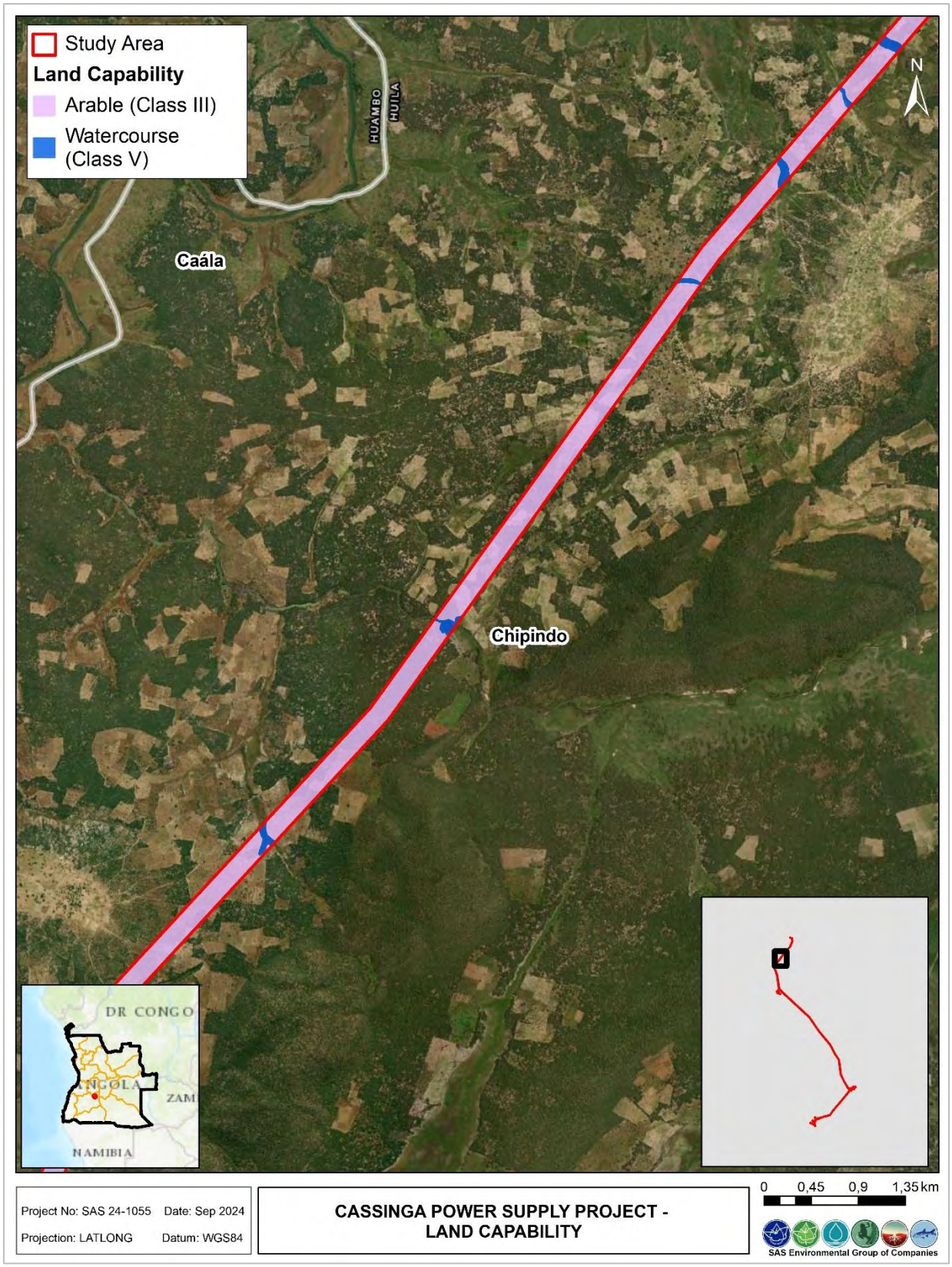


Figure 41: Land capability associated with the soils in northern section of the study area.

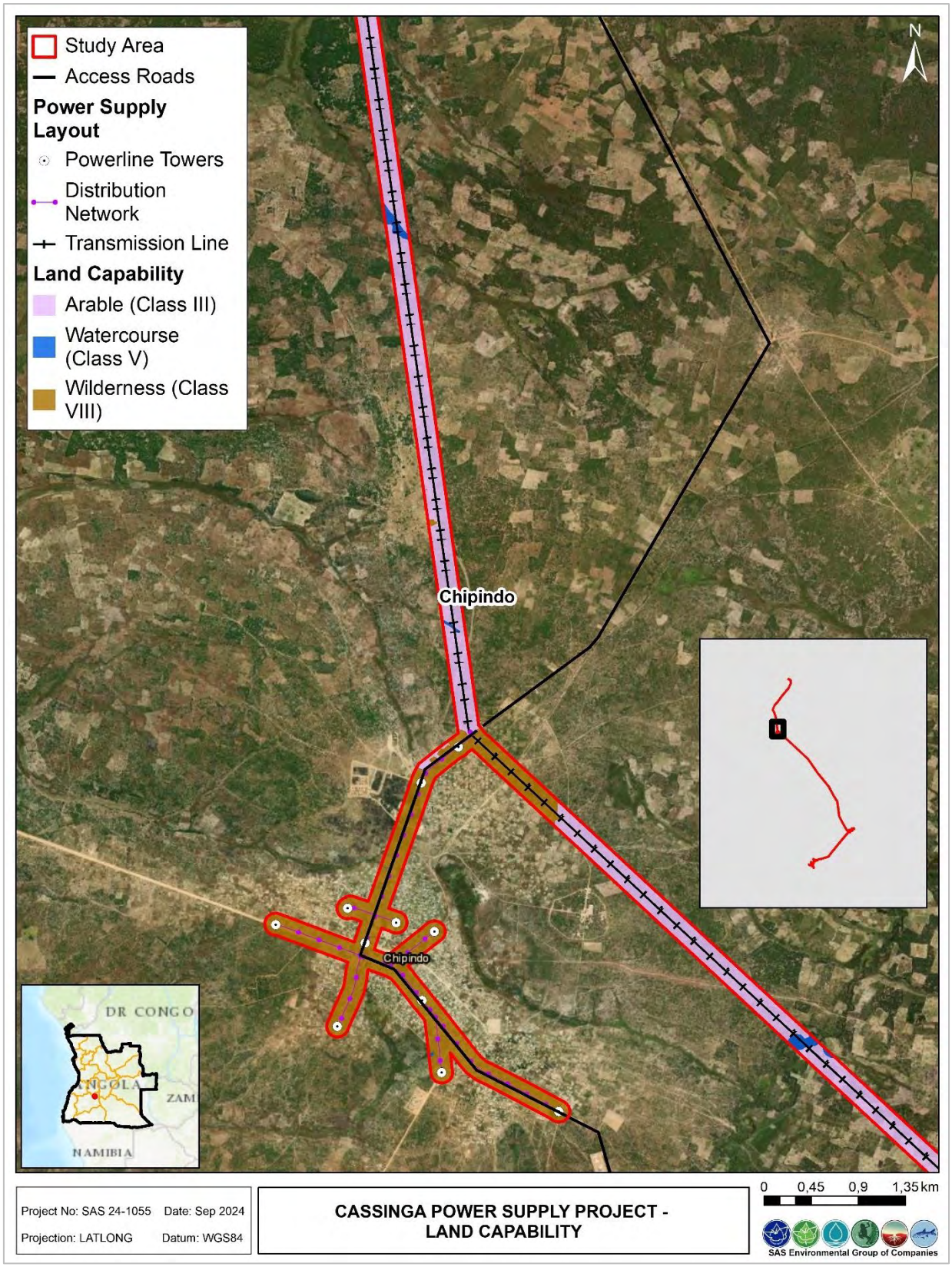


Figure 42: Land capability associated with the soils in northern section of the study area.

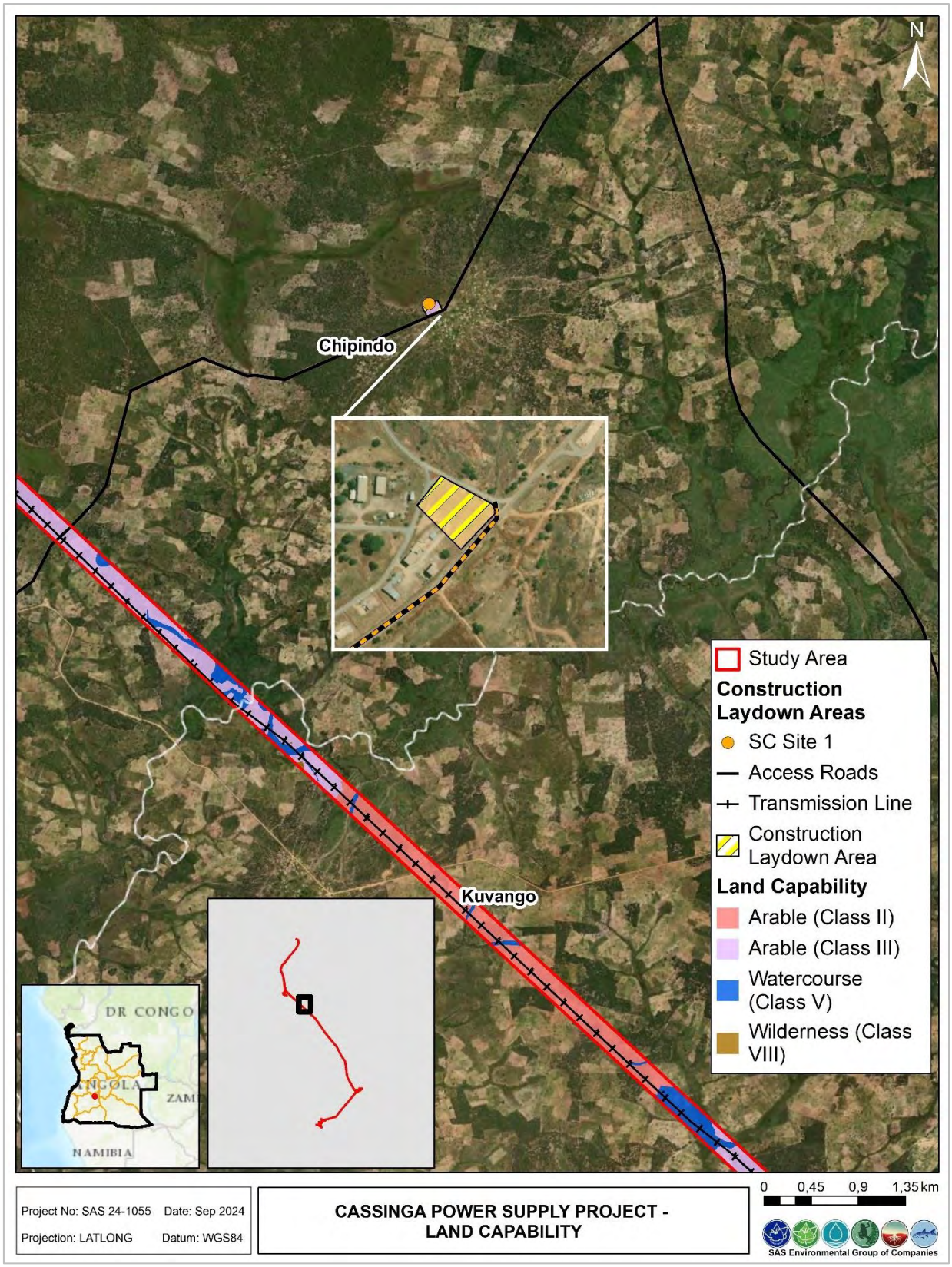


Figure 43: Land capability associated with the soils in northern central section of the study area.

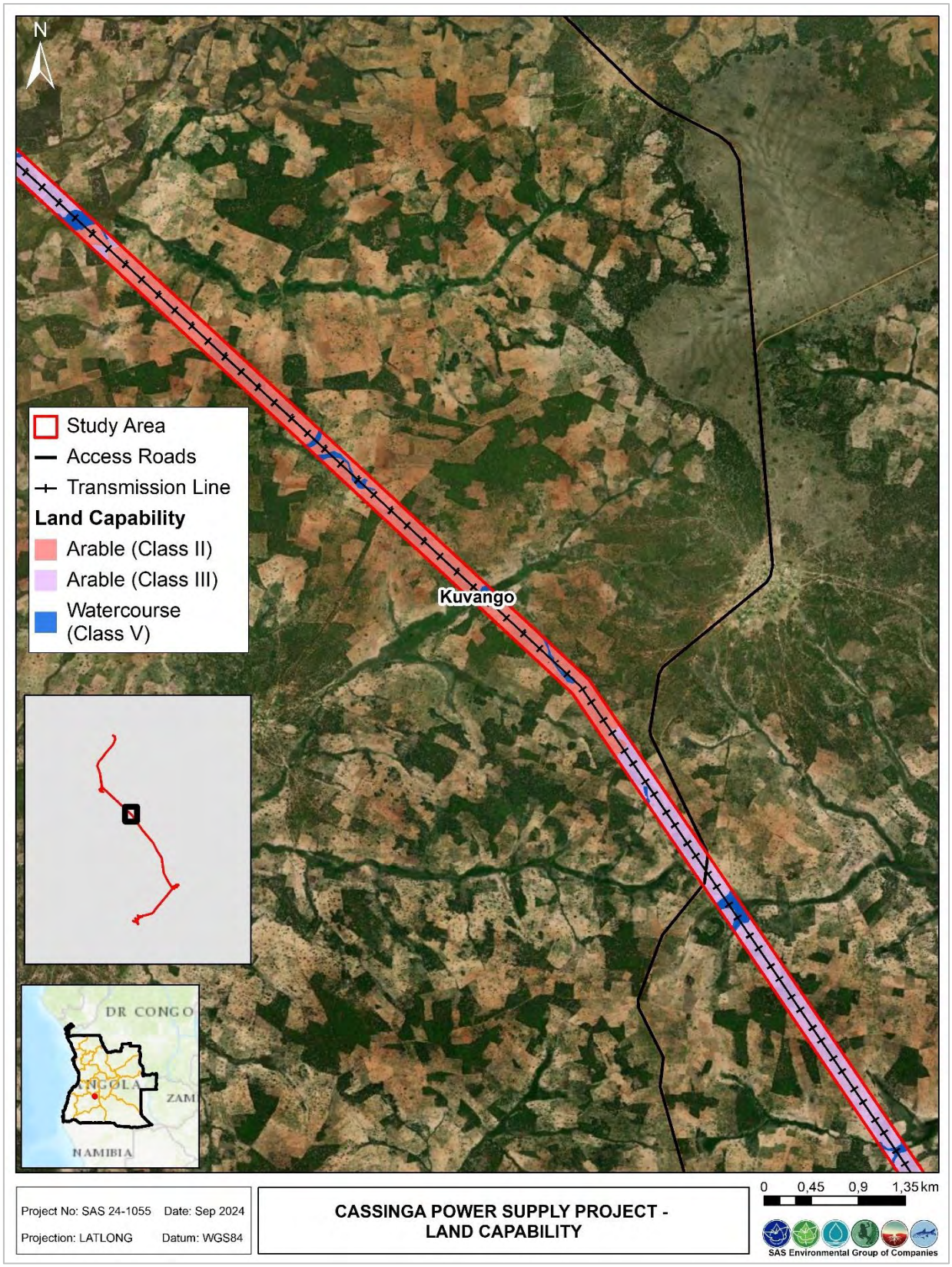


Figure 44: Land capability associated with the soils in northern central section of the study area.

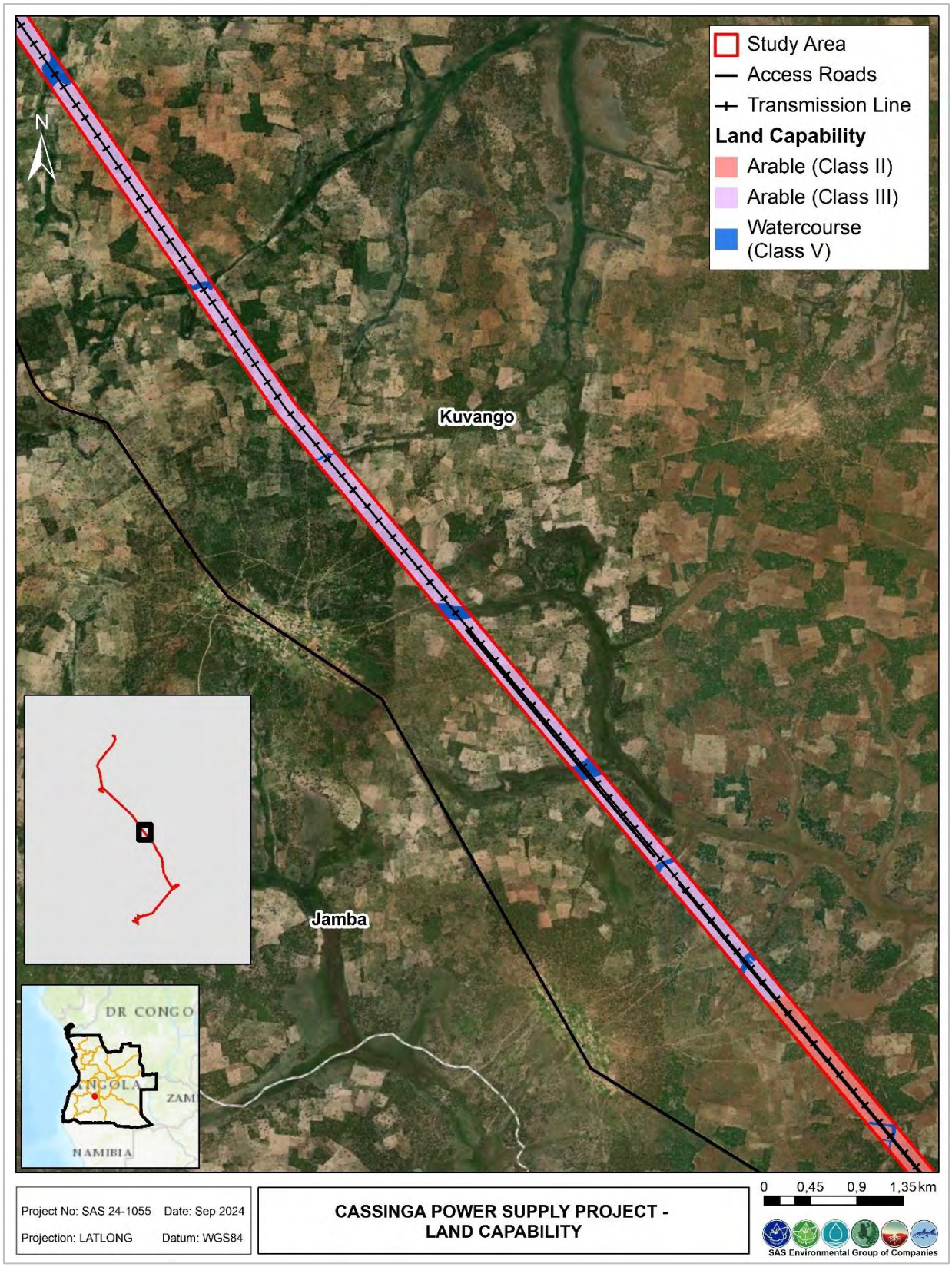


Figure 45: Land capability associated with the soils in central section of the study area.

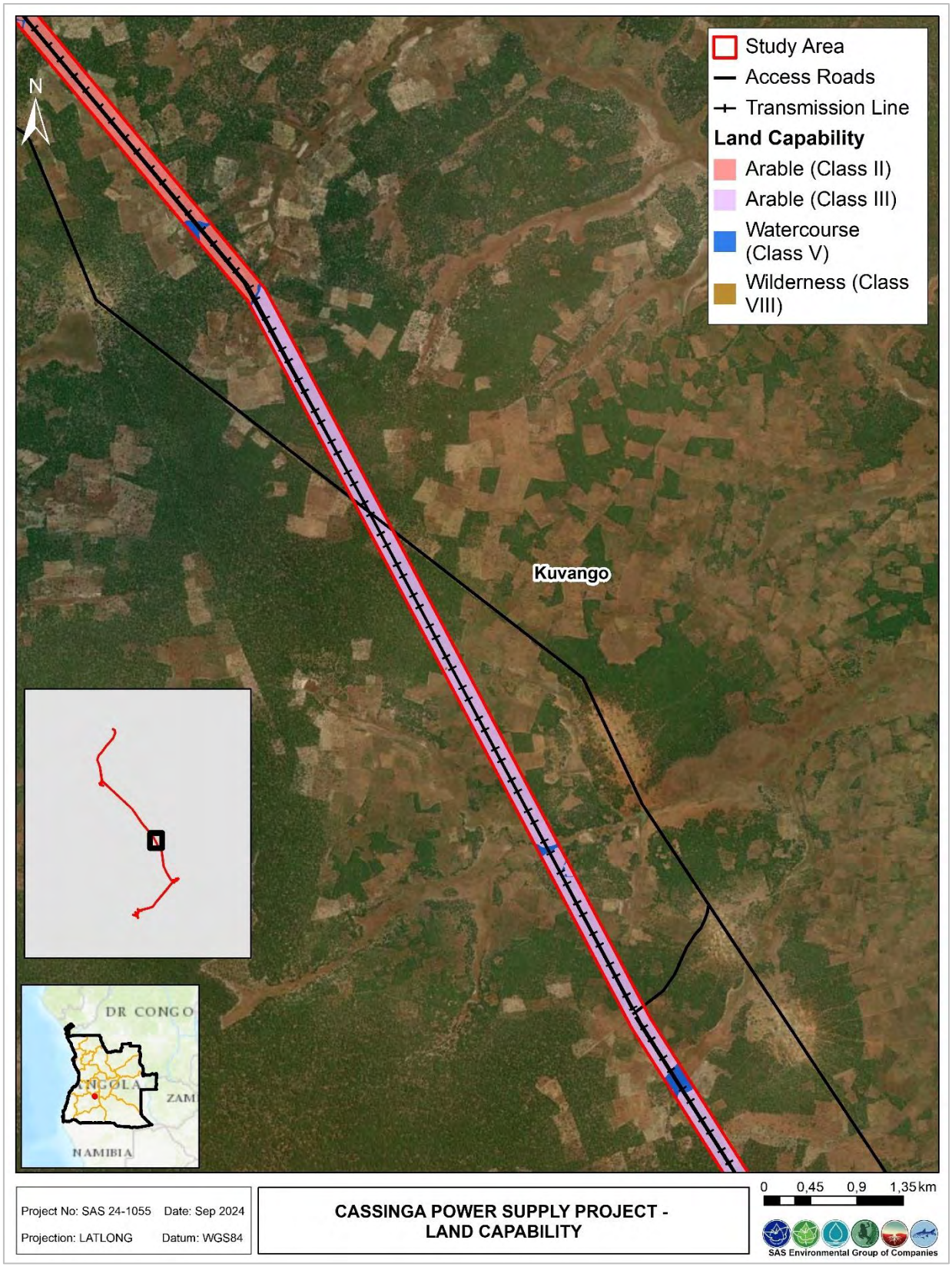


Figure 46: Land capability associated with the soils in southern central section of the study area.

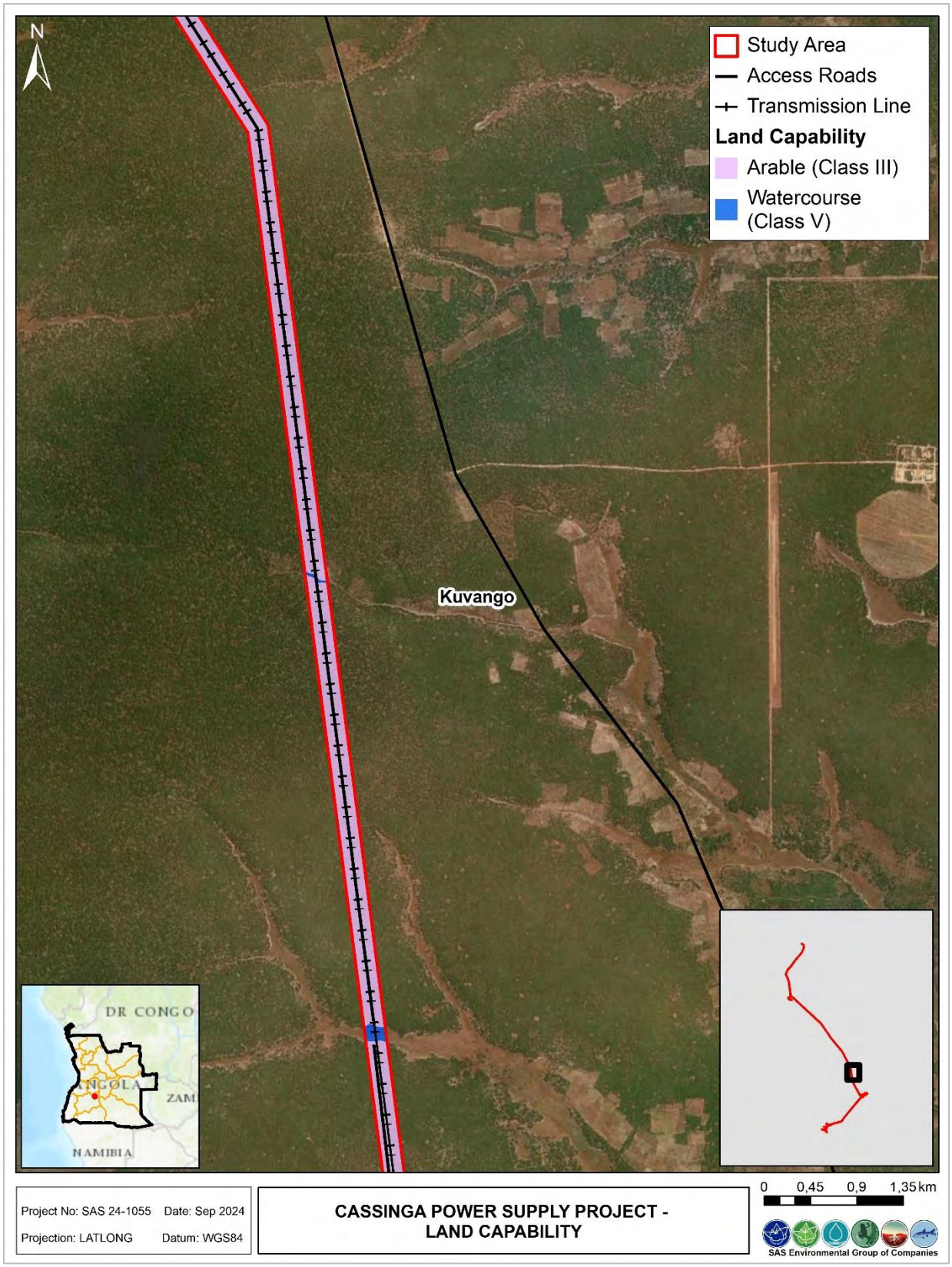


Figure 47: Land capability associated with the soils in southern central section of the study area.

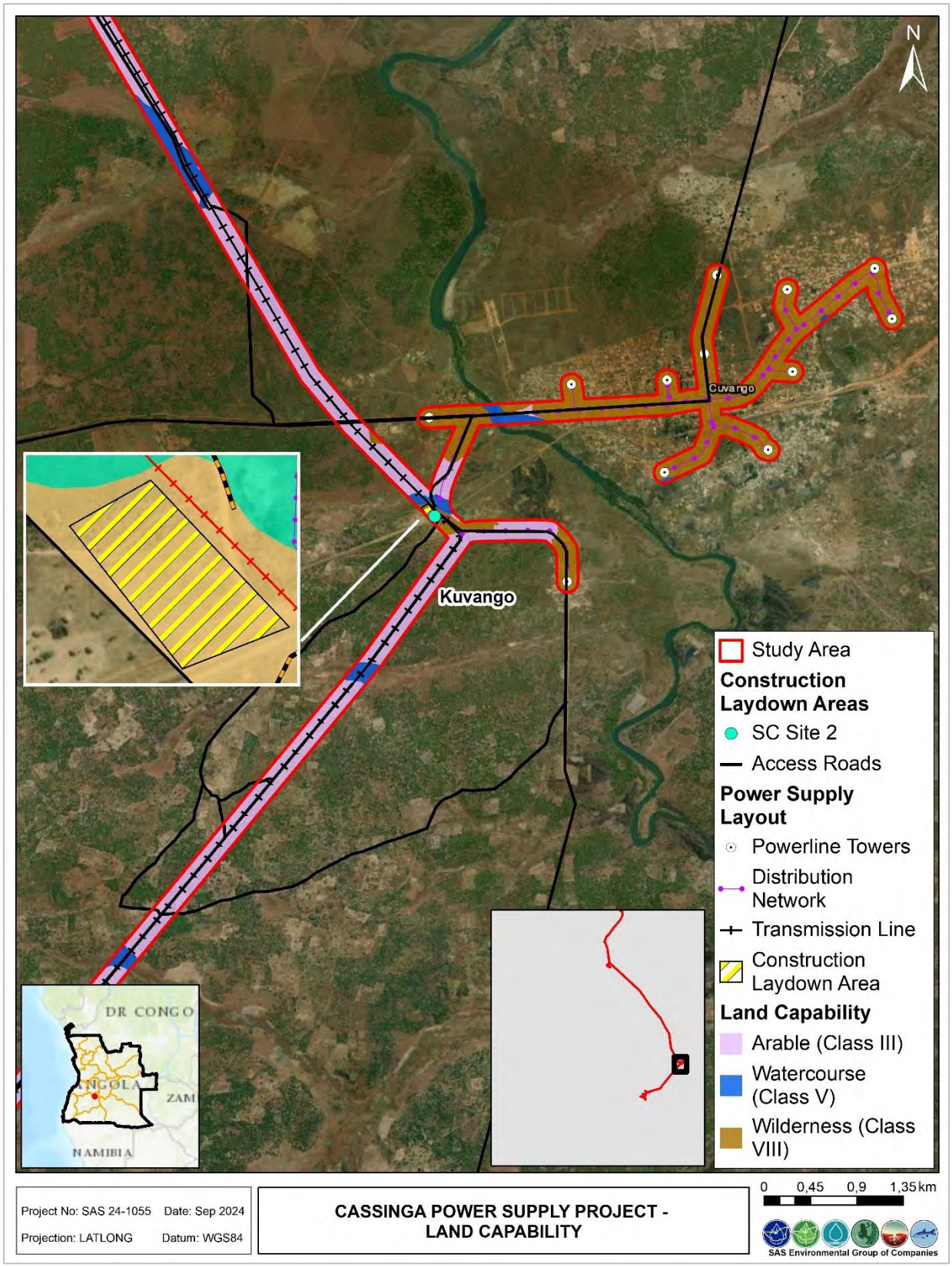


Figure 48: Land capability associated with the soils in southern section of the study area.

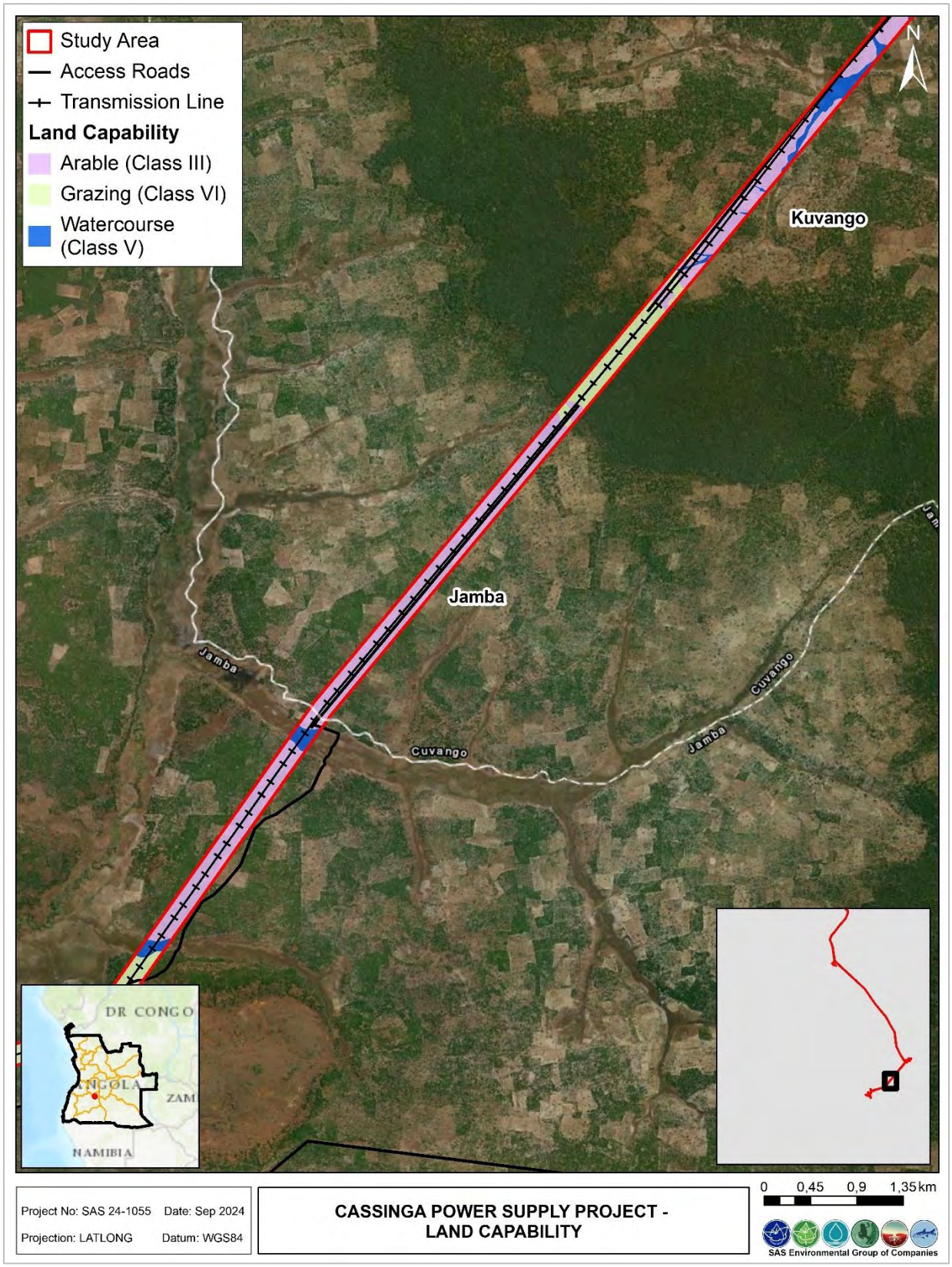


Figure 49: Land capability associated with the soils in southern section of the study area.

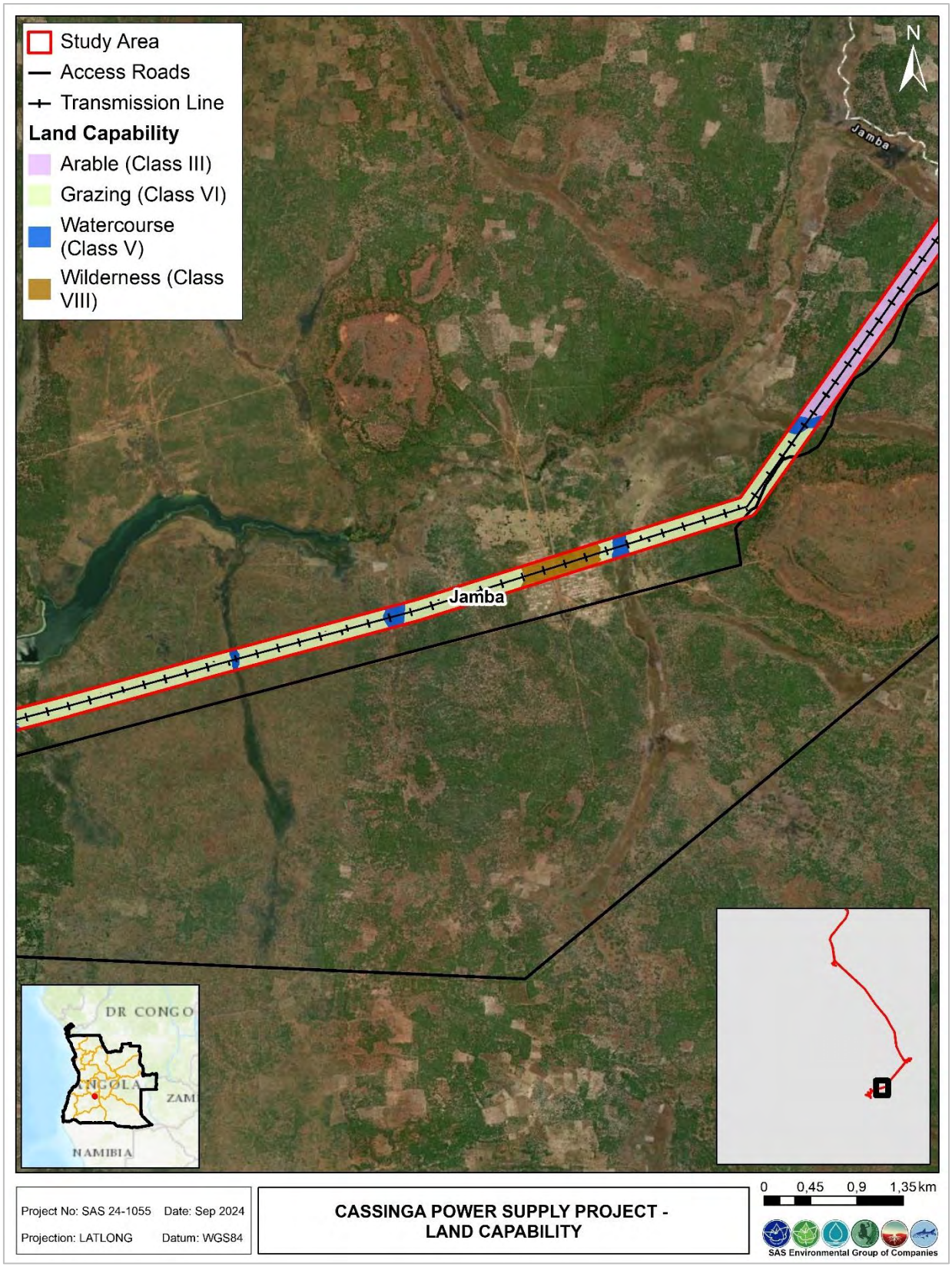


Figure 50: Land capability associated with the soils in southern section of the study area.

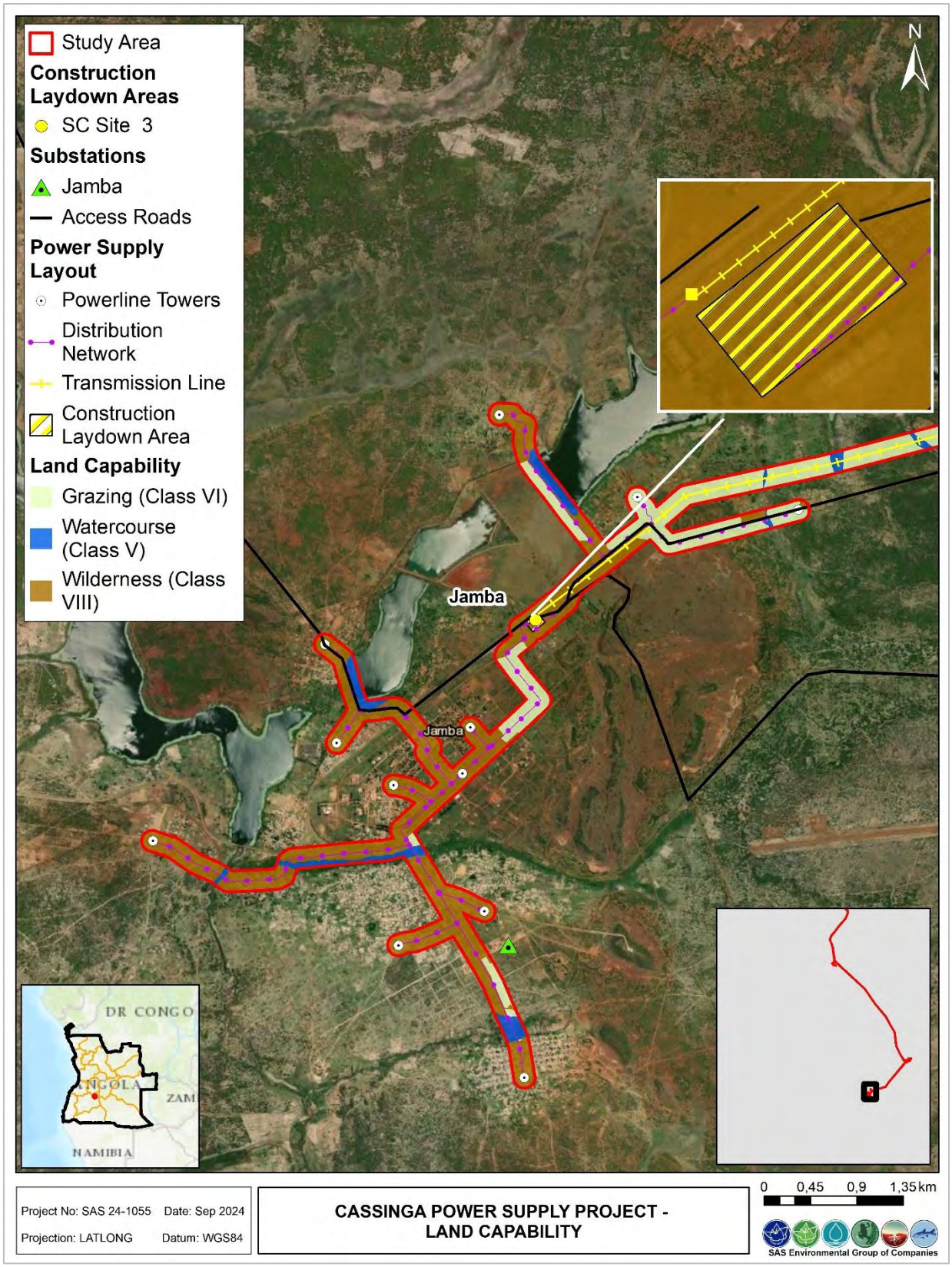


Figure 51: Land capability associated with the soils in southern section of the study area.

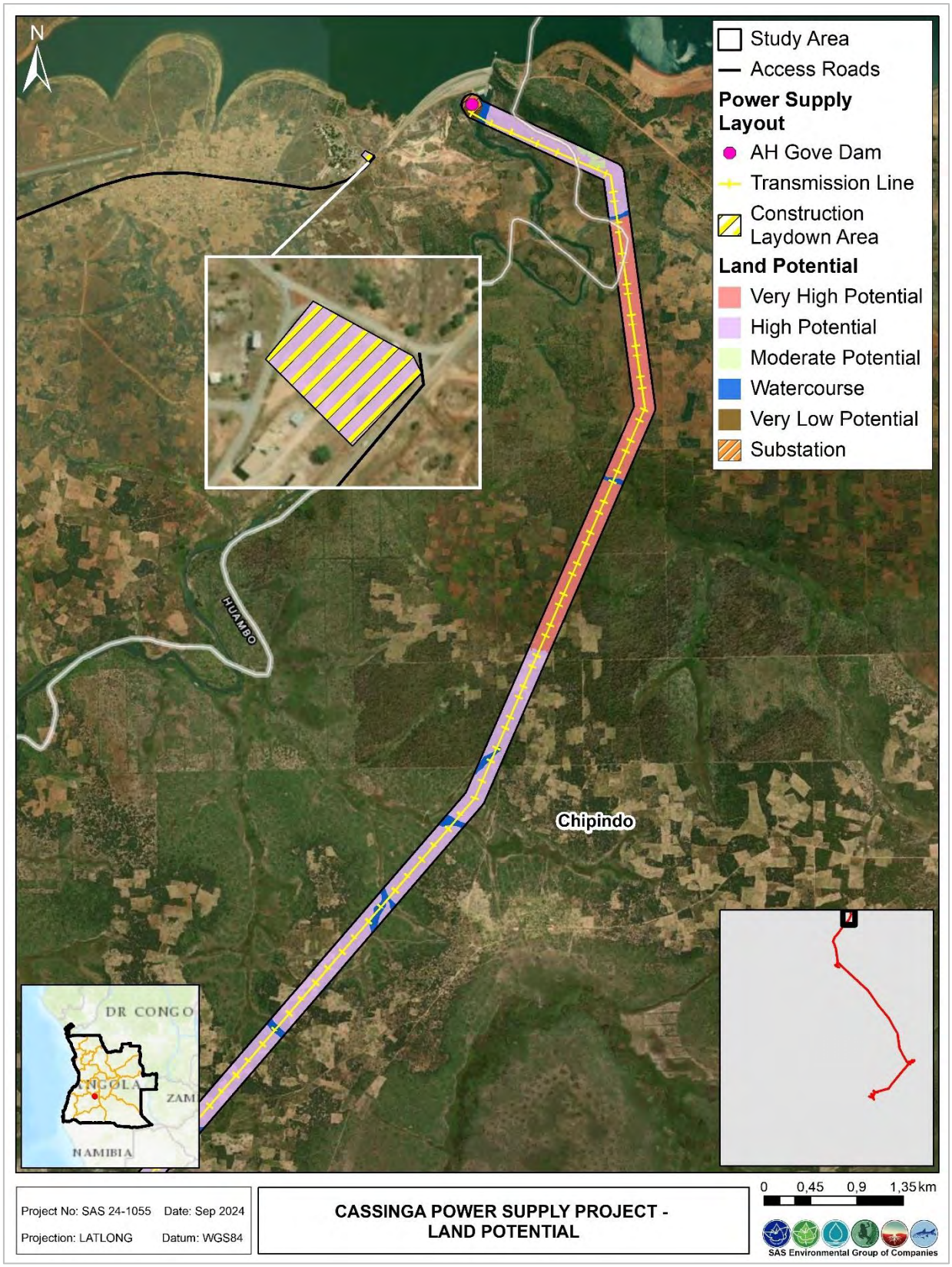


Figure 52: Land potential associated with the soils in northern section of the study area.

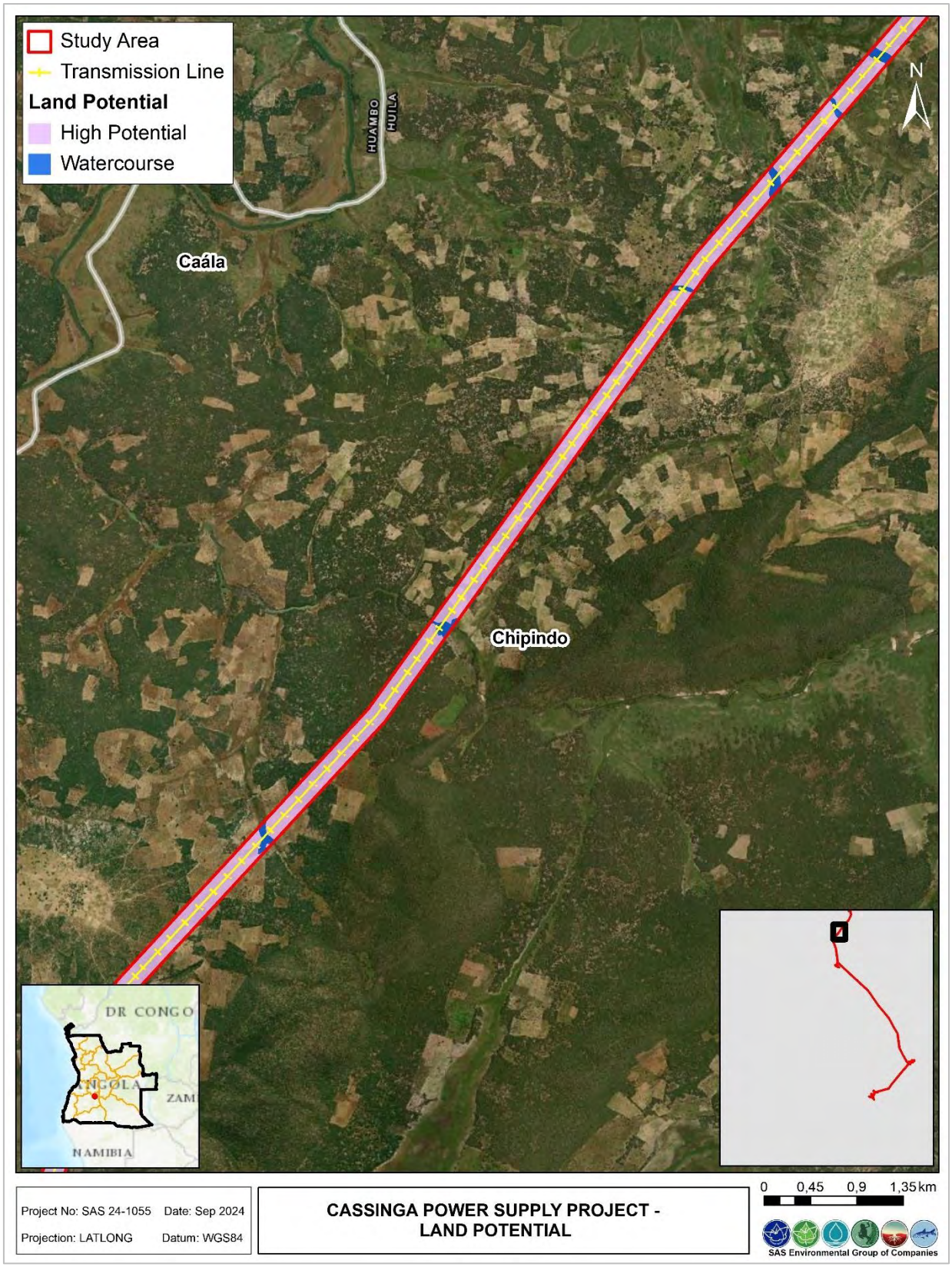


Figure 53: Land potential associated with the soils in northern section of the study area.

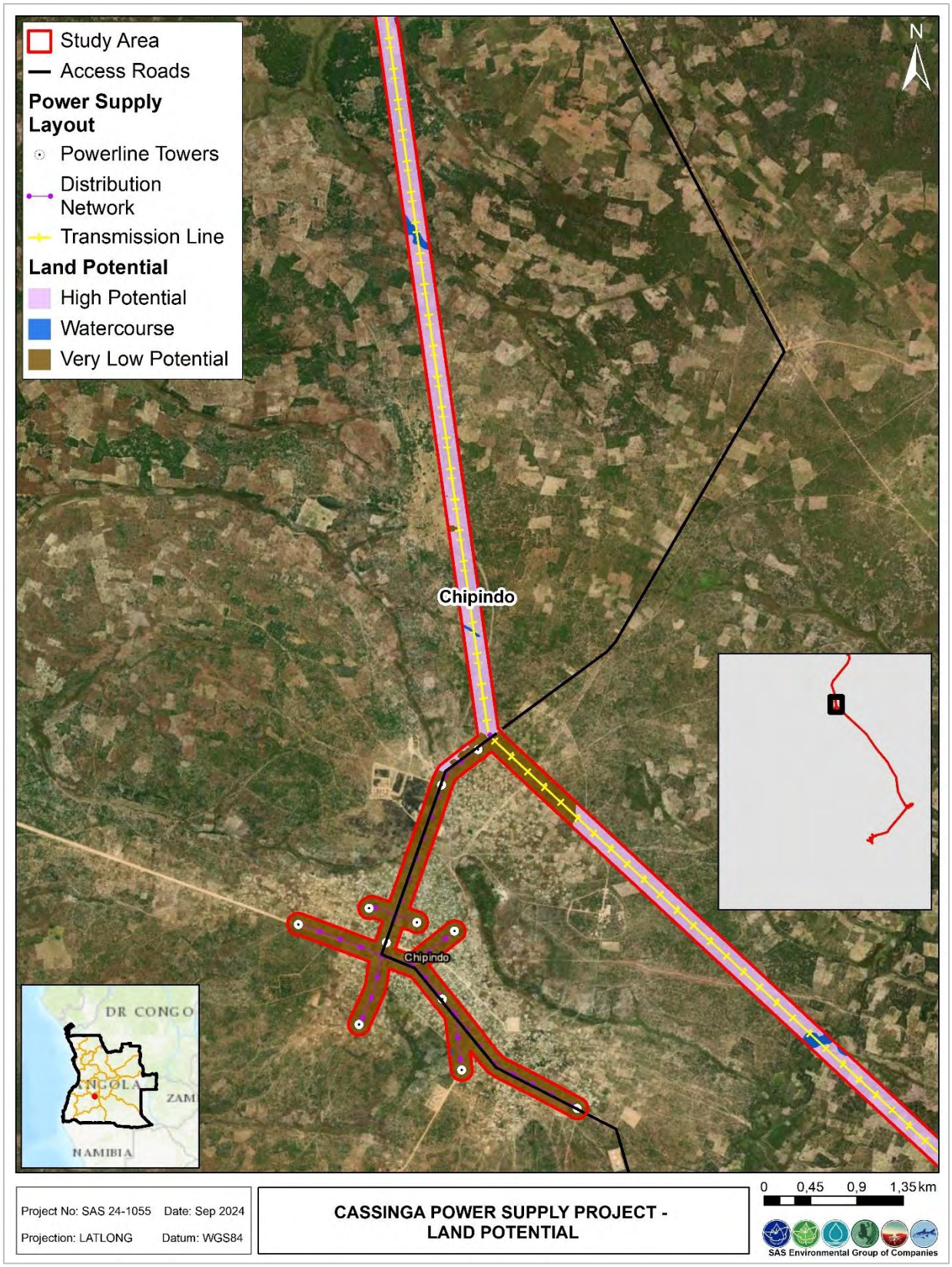


Figure 54: Land potential associated with the soils in northern section of the study area.

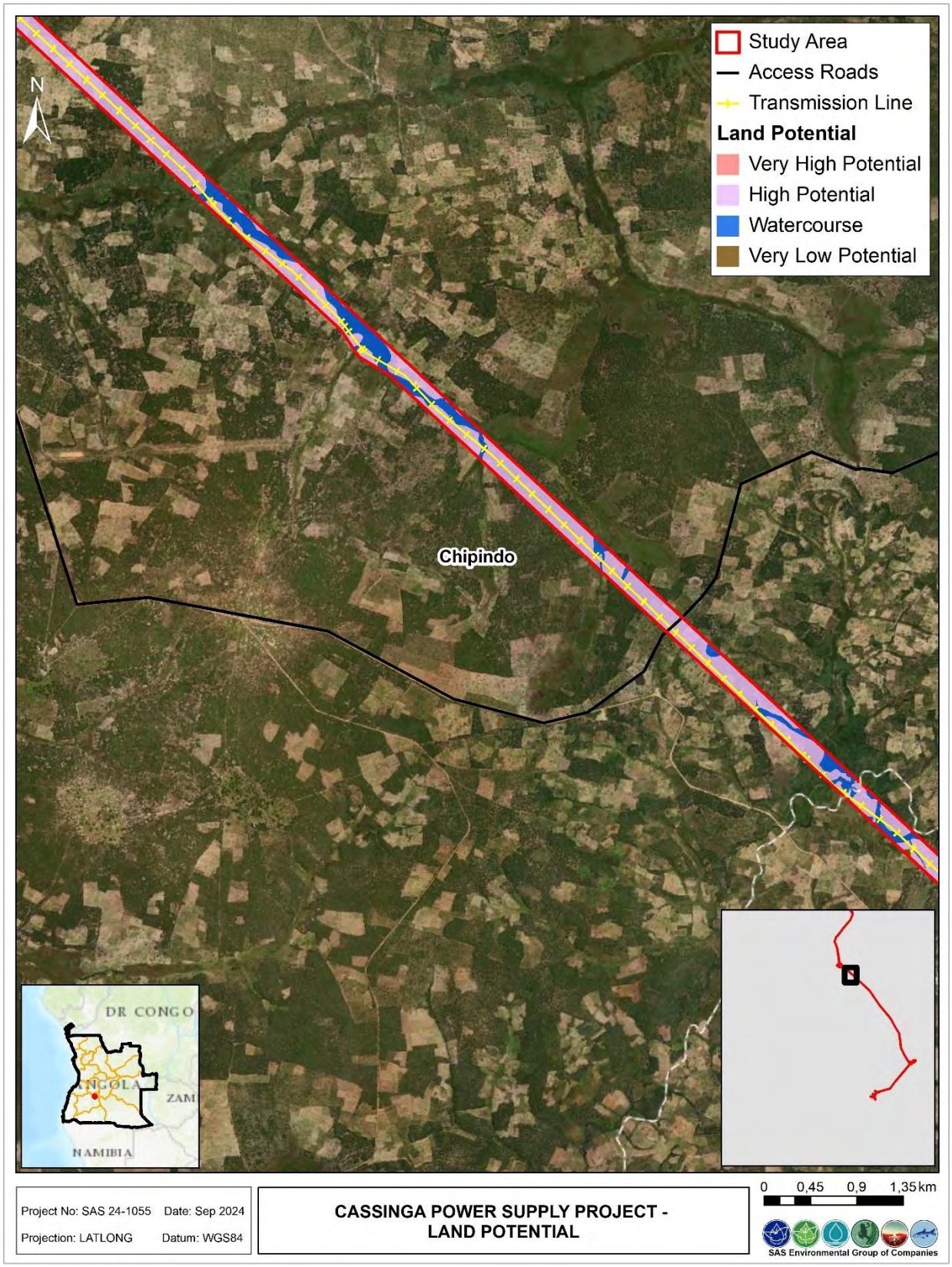


Figure 55: Land potential associated with the soils in northern central section of the study area.

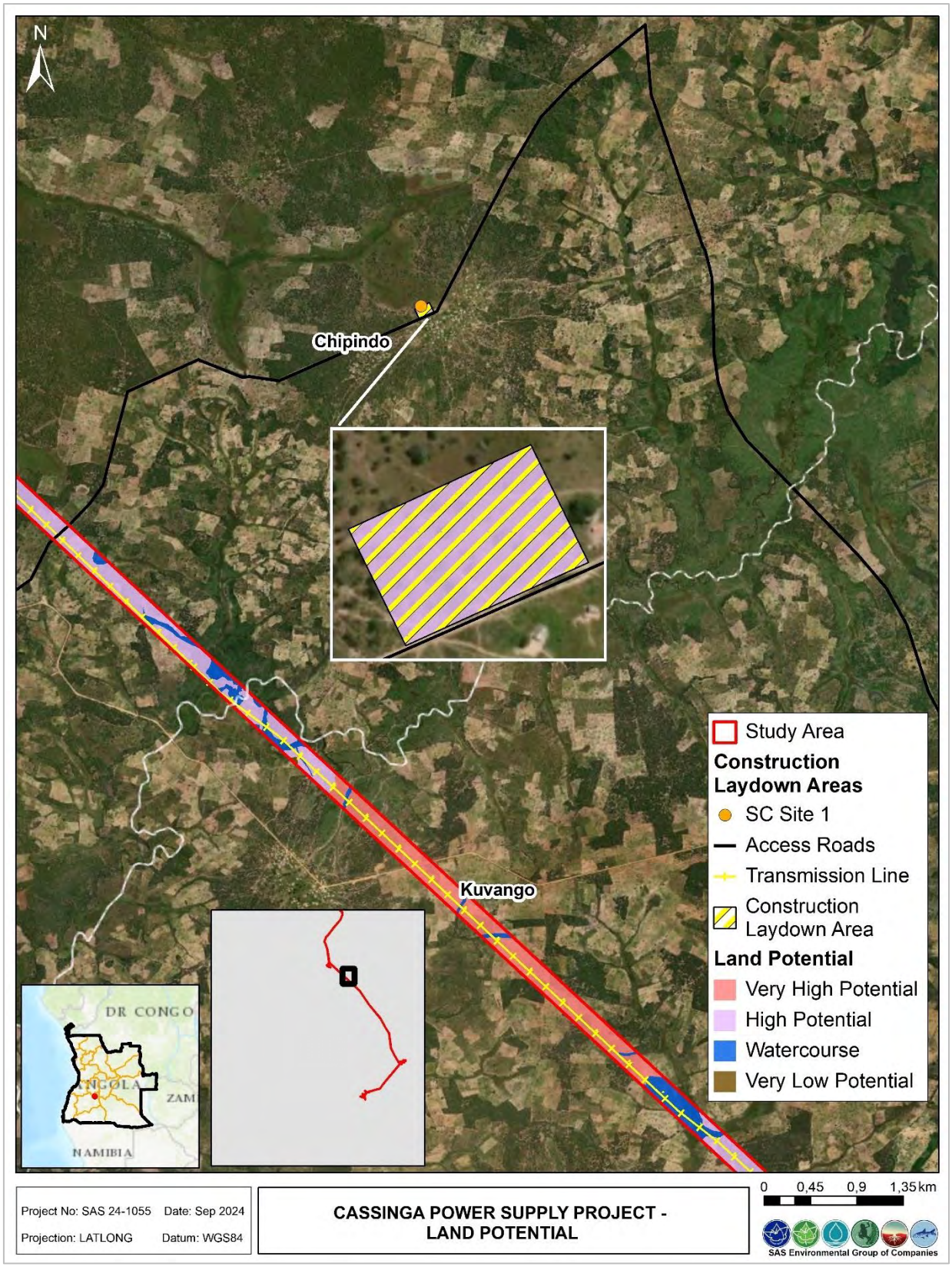


Figure 56: Land potential associated with the soils in central section of the study area.

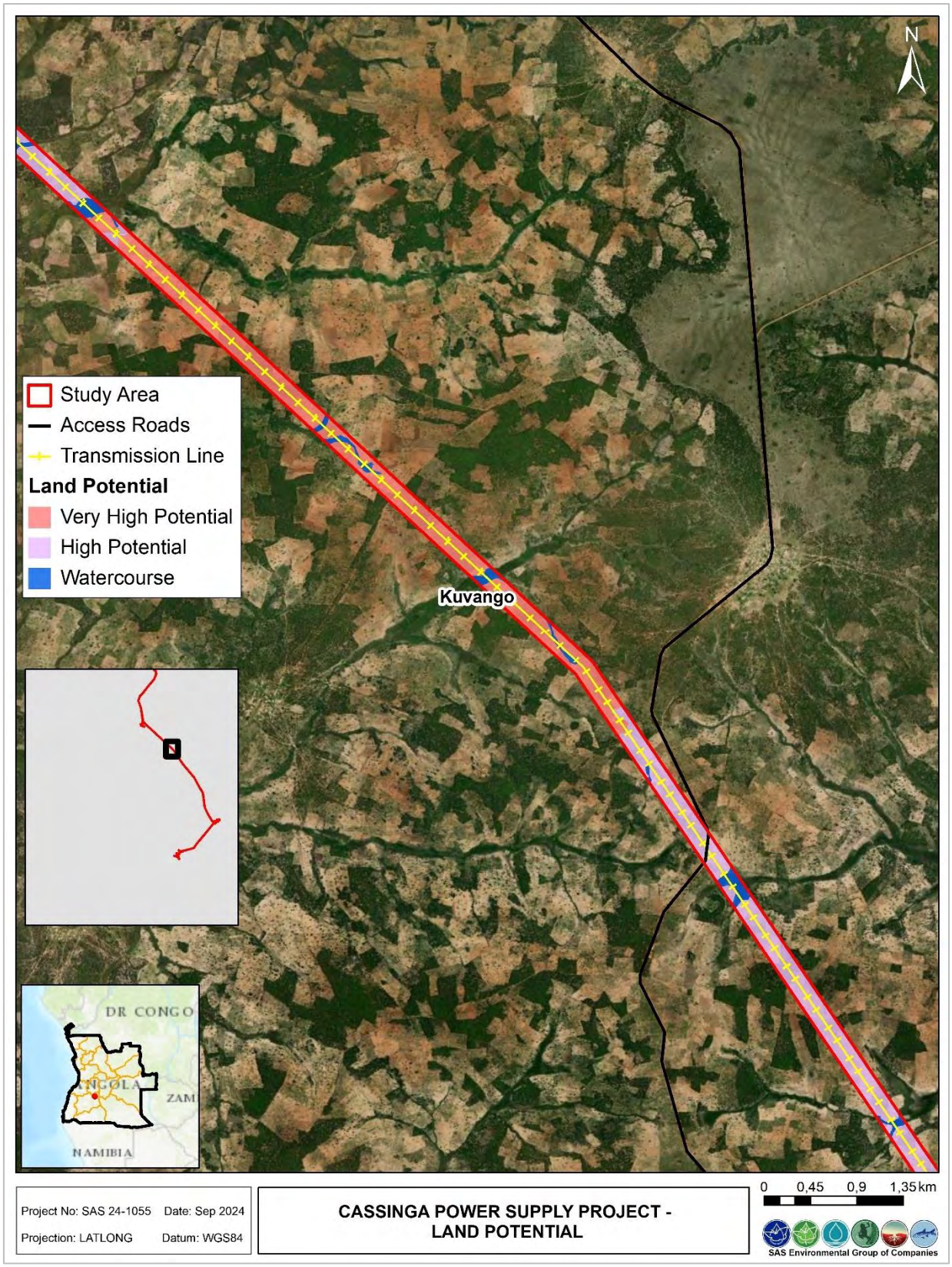


Figure 57: Land potential associated with the soils in central section of the study area.

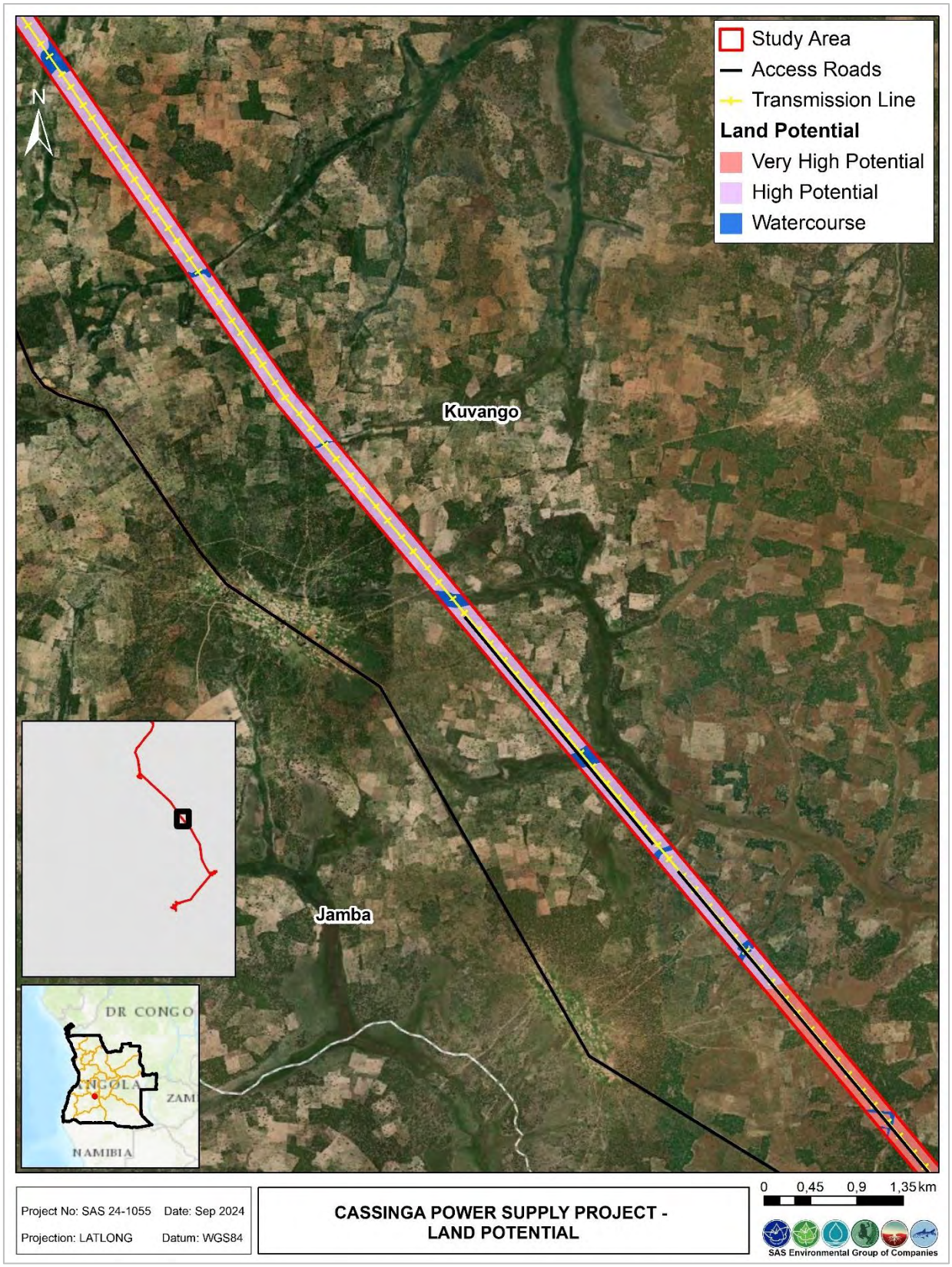


Figure 58: Land potential associated with the soils in central section of the study area.

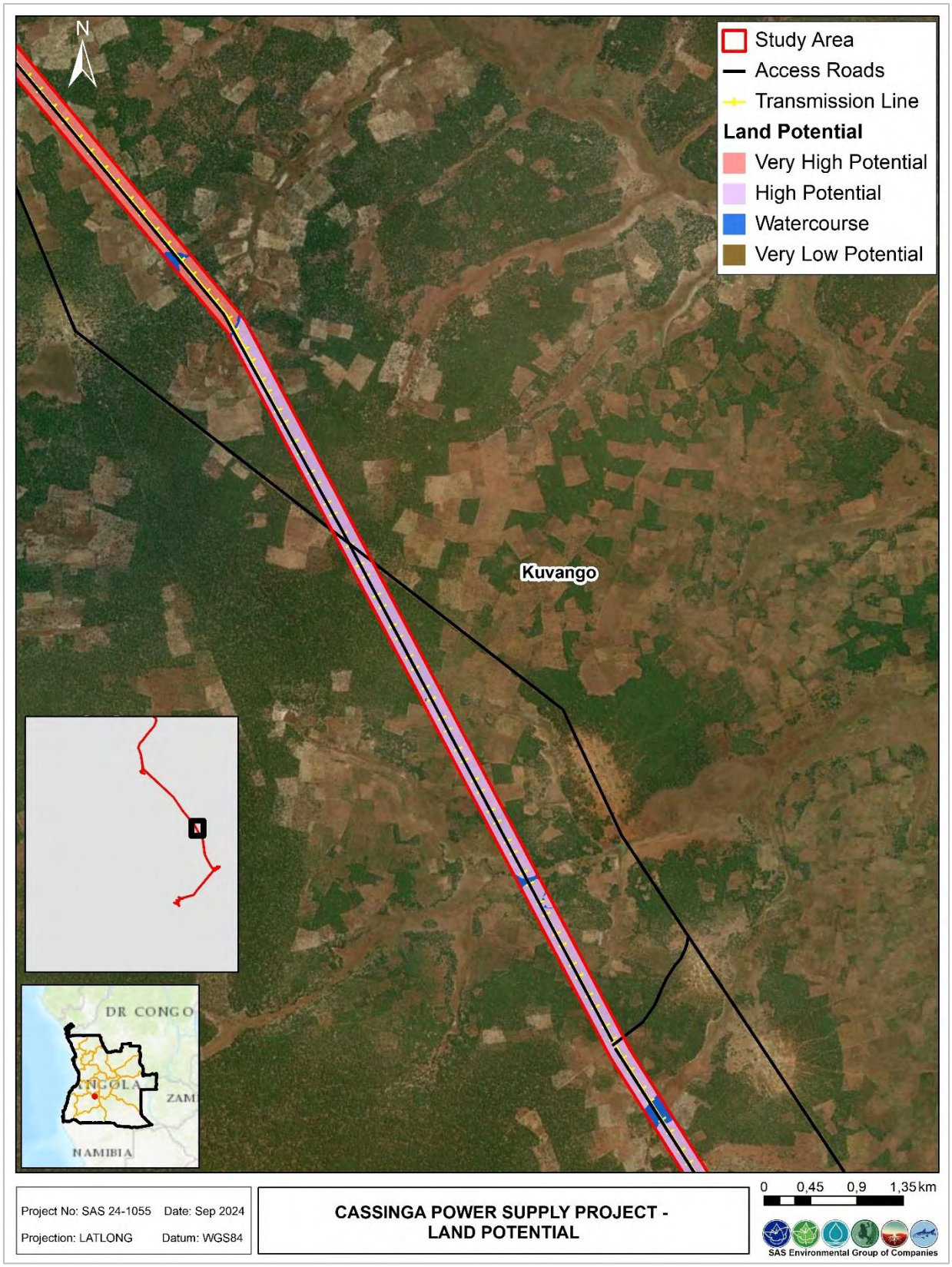


Figure 59: Land potential associated with the soils in southern central section of the study area.

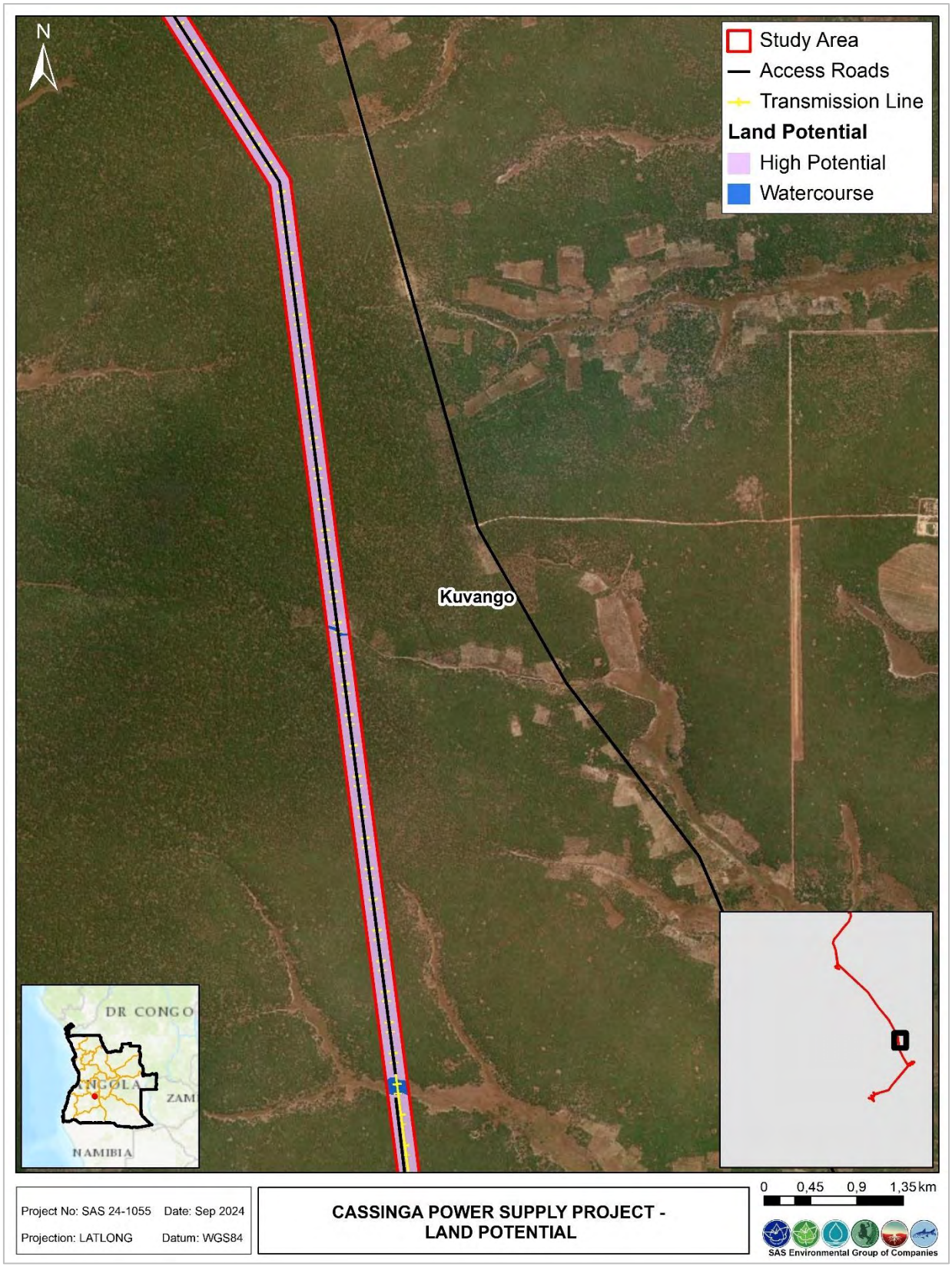


Figure 60: Land potential associated with the soils in southern section of the study area.

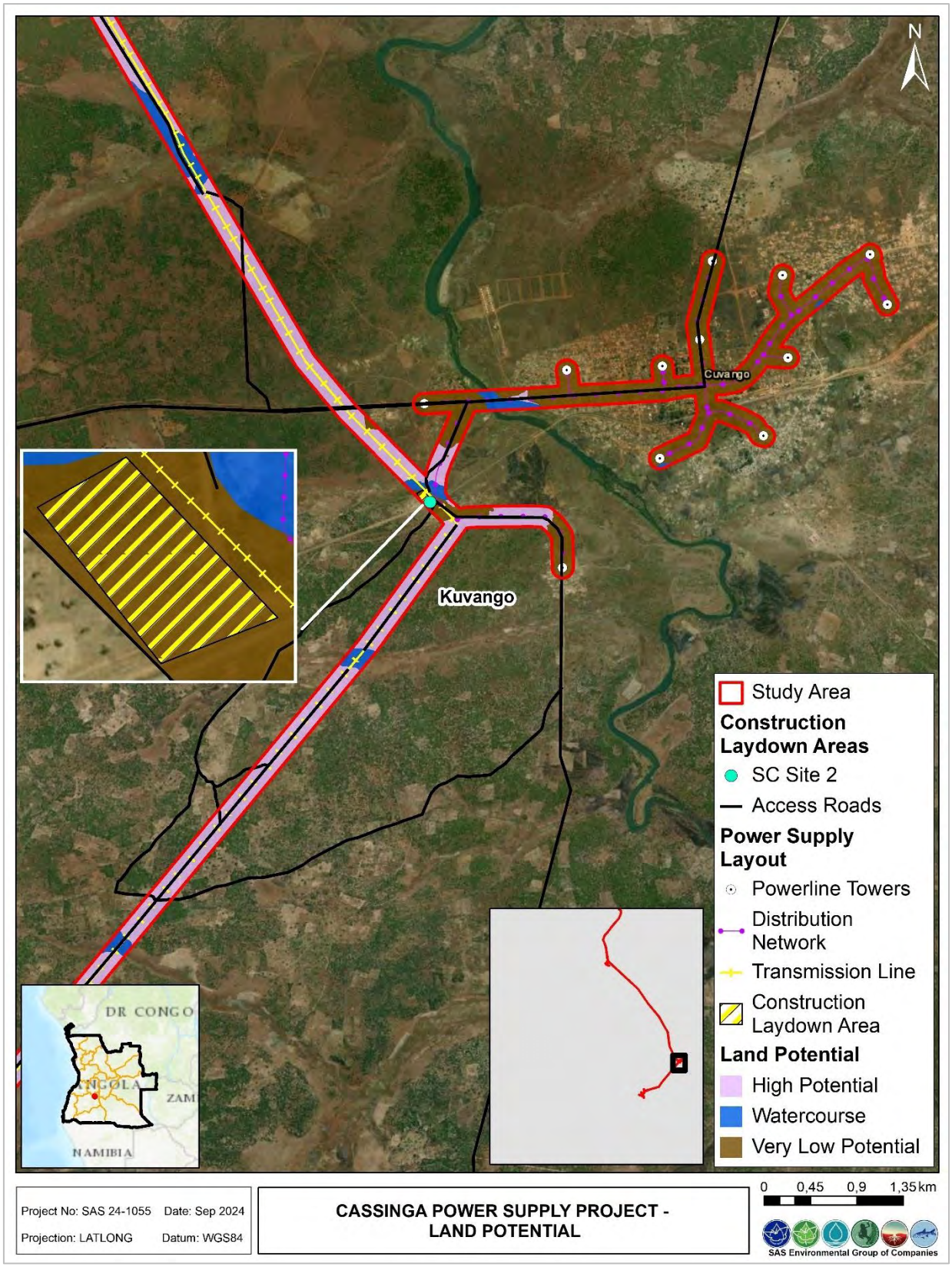


Figure 61: Land potential associated with the soils in southern section of the study area.

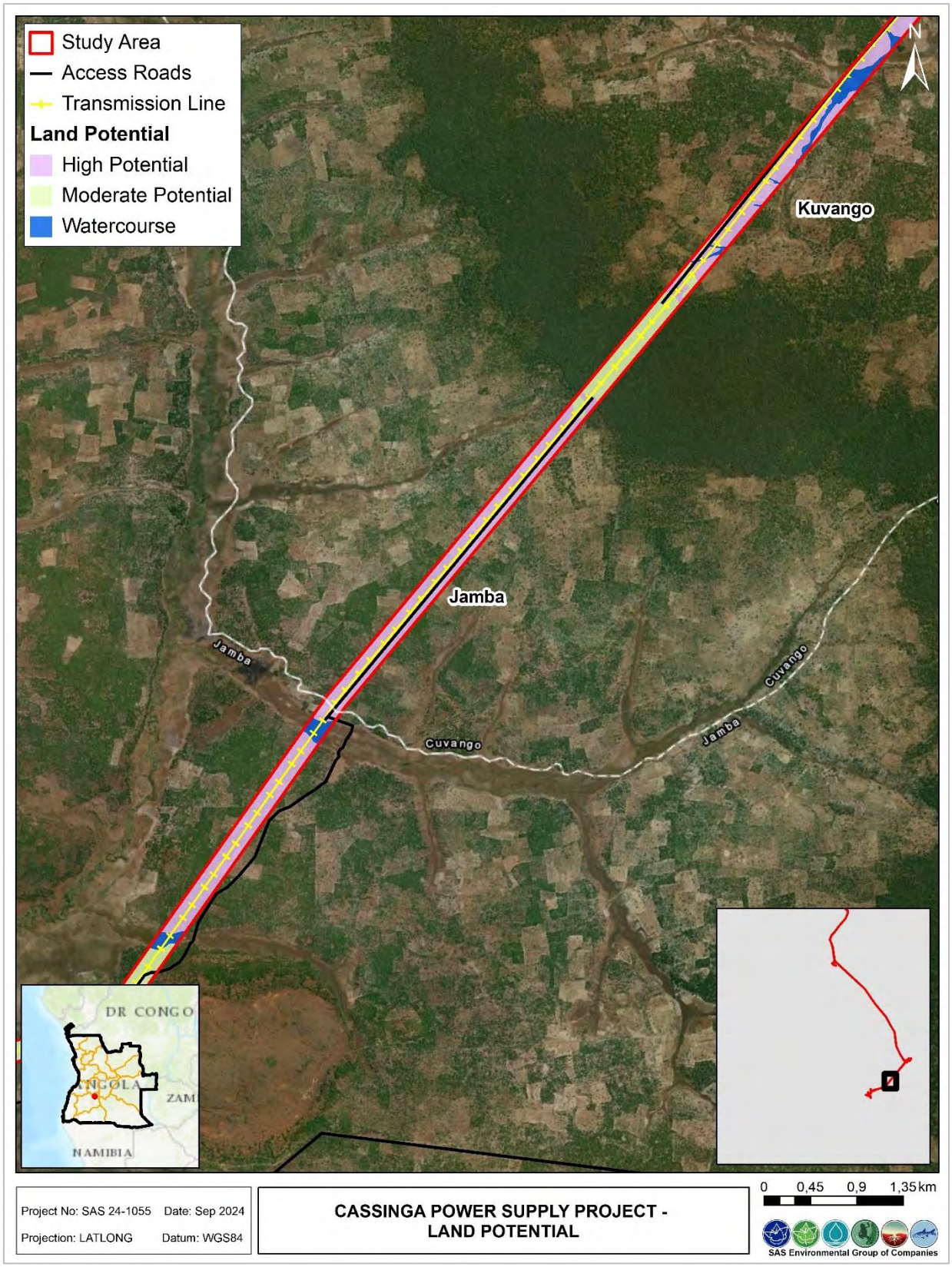


Figure 62: Land potential associated with the soils in southern section of the study area.

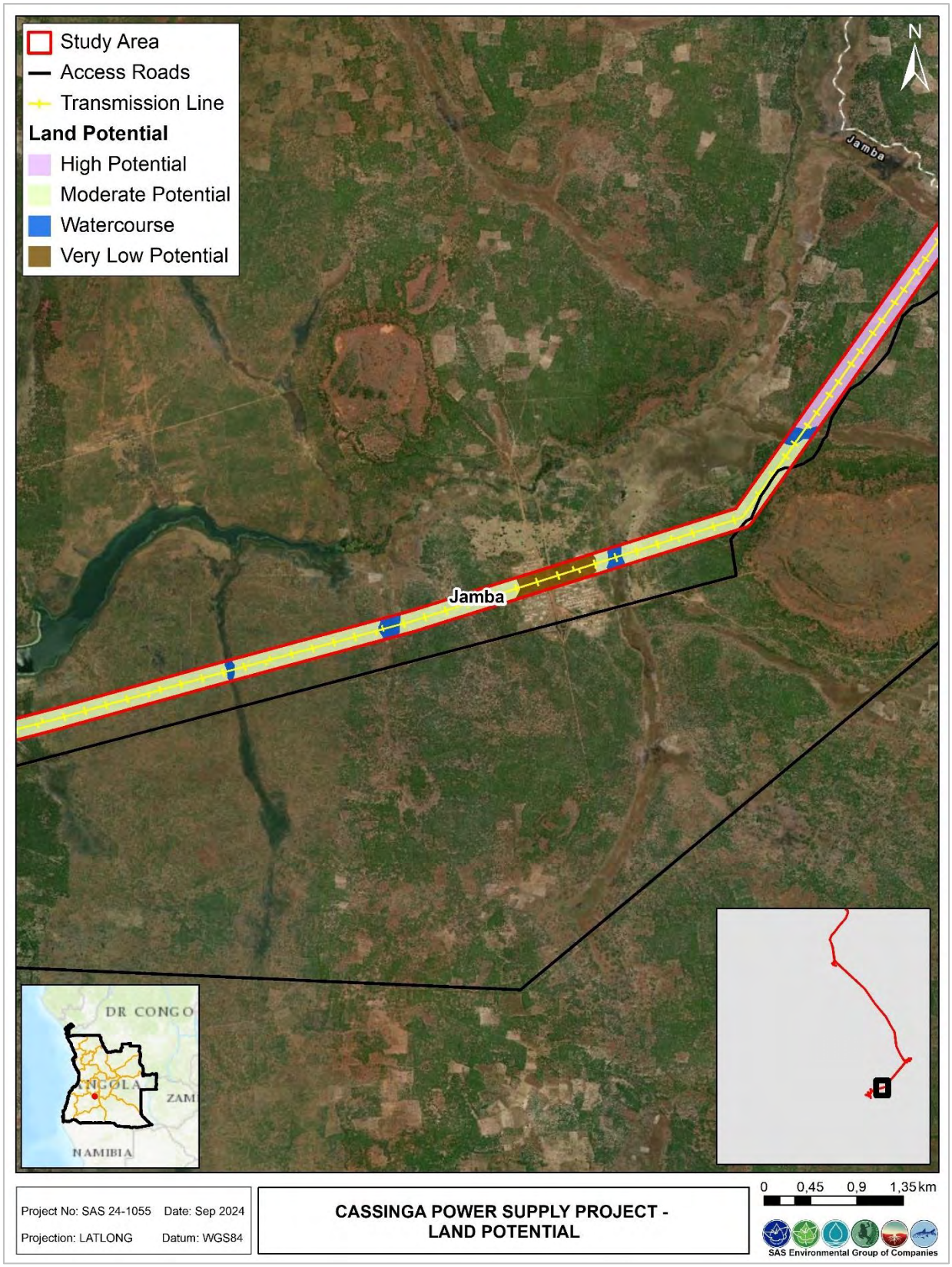


Figure 63: Land potential associated with the soils in southern section of the study area.

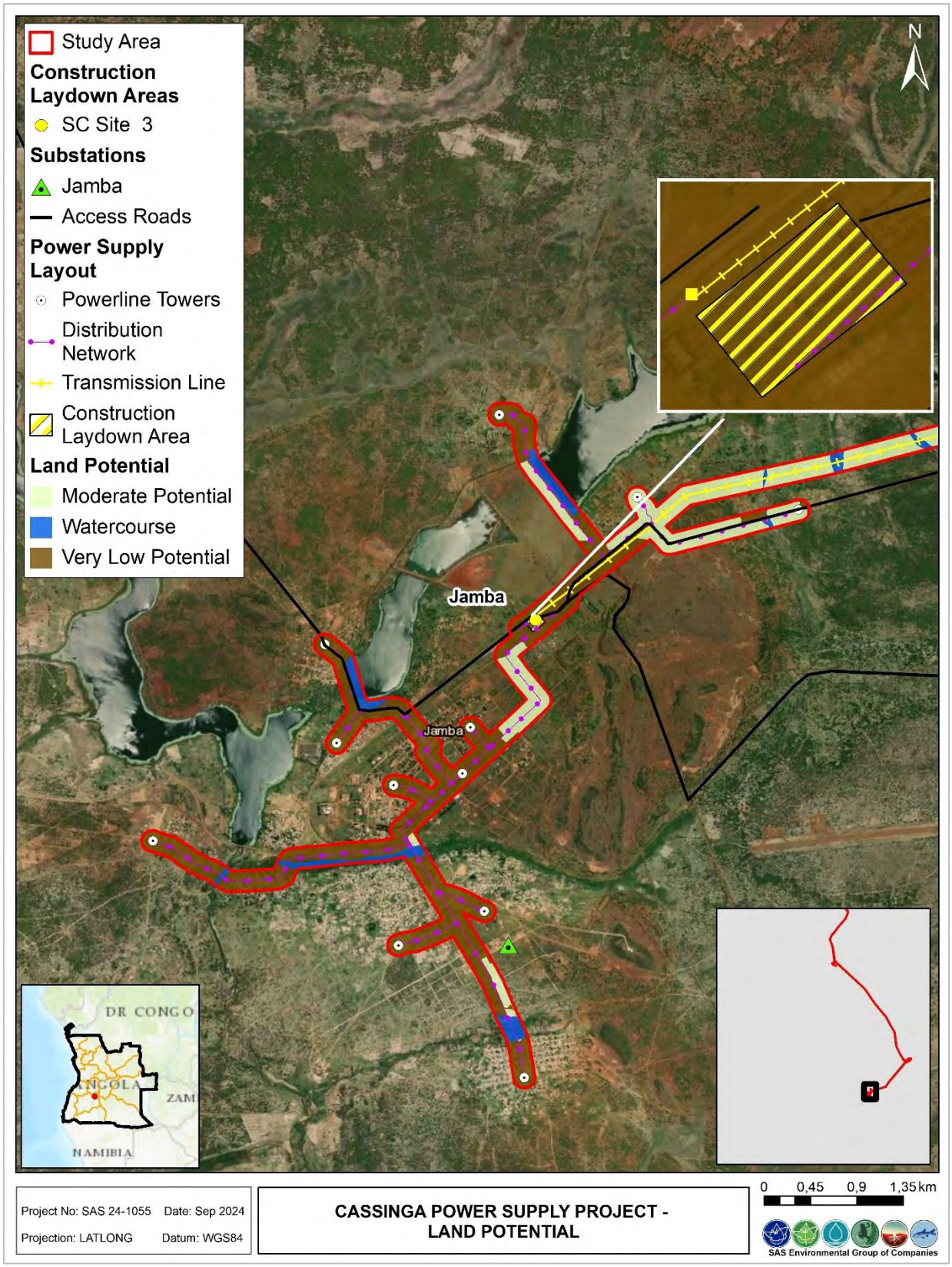


Figure 64: Land potential associated with the soils in southern section of the study area.

7 IDENTIFICATION OF POTENTIAL IMPACTS

The purpose of this section is to Identify potential impacts (direct, indirect and cumulative) for the construction, operation and decommissioning phases of the project.

Table 14: Description of project activities posing a potential impact on the soil and land capability.

Potential Impacts	Description of Impact
Construction, Operational, Decommission and Closure Phase	
Soil Erosion	*Site clearing, removal of vegetation, and associated disturbances to soils, leading to increased runoff, erosion, and consequent loss of land capability in cleared areas and subsequent loss of soils utilised for grazing. *Potential frequent movement of earth moving machinery within lose and exposed soils, leading to excessive erosion.
Soil Compaction	*Site clearing, removal of vegetation, and associated disturbances to soils, leading to, increased runoff, soil compaction and consequent loss of land capability in cleared areas.
Soil Contamination	*Spillage of petroleum hydrocarbons during construction of the proposed overhead line and substation and the associated access road. *Potential disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.
Loss of land capability and agricultural potential	*Soil stripping/excavation and removal of soil as a growth medium and loss of grazing land.
Consideration of Cumulative Impacts	
Land Fragmentation	This activity includes the operation and maintenance of the powerline infrastructure including powerline servitude. Other general activities include clearing of vegetation within the servitude during routine maintenance or during operational failure.
Rehabilitation within disturbance areas associated with the proposed powerline.	This activity includes the rehabilitation of areas that were disturbed during the construction phase of the powerline and associated infrastructure. This includes levelling, revegetation of cleared areas and removal of any rubble within construction footprint following construction activities.

i. Loss of Agricultural Land Capability

The Cassinga OHL Interconnection 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.

ii. 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, thus less prone to erosion in comparison to sandy textured soils, which in contrast are more susceptible to erosion.

The proposed development footprint is located on a gradually sloping terrain. Soils which were vegetated prior to the proposed activities will be more susceptible to erosion during the construction phase if left bare or if not vegetated before the rainy season; thus, exposed to wind and storm water. The severity of this impact is anticipated to be medium and with the appropriate mitigation measures the significance of this impact may be further reduced to low.

iii. Soil compaction

Heavy equipment traffic during the powerline and substation 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 vehicle and heavy machinery during the construction phase and if work is done when the soil is wet this may increase the soils susceptibility to compaction. However, the significance of the impact is perceived to be medium low if unmanaged and low with mitigation measures, given that the effect will be localised and restricted to access roads, vehicle hardstand areas and equipment and machinery laydown areas.

iv. Potential Soil Contamination

Contamination sources are mostly unpredictable and often occur as incidental spills or leaks during both the construction and operational phase. 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 mitigations. 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 reducing the yield potential of soils.
- Potential reduction of water quality used as a source of drinking for livestock.

The significance of the overall potential impacts on the soil, land use and land capability are summarised on Tables presented below for the proposed development.



8 PERMIT REQUIREMENTS

Decree No.117/20 on General Regulation for Environmental Impact Assessment and Environmental Licensing Procedure.

This decree establishes the standards and procedures that regulate the environmental impact assessment of public and private projects and the environmental licensing procedure for activities that, due to their nature, location, or dimension, may cause significant environmental and social impact (Article 1). Applies to all public or private activities that may directly or indirectly influence environmental components (Article 2).

9 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS FOR THE CONSTRUCTION, OPERATION, DECOMMISSION AND CLOSURE

The proposed development will entail construction of surface infrastructure components as part of the Cassinga OHL Interconnection establishment which will entail excavation as part of surface infrastructure preparations. These activities are anticipated to expose the occurring soils within the study area to erosion, dust emission, compaction, and potential soil contamination impacts during the construction phase of the proposed development; and these impacts may persist for the duration of the operational, decommission and closure phases if not mitigated adequately. The tables below present the impact assessment matrix in efforts to quantify the impact significance of the proposed development at various phases.

Table 15: Summary of the impact assessment for the construction phase of the OHL, new substations and associated supporting infrastructure.

Activity 1: Site preparation, excavation and removal of soils as part of infrastructure establishment.								
Project phase: Construction								
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
After Management	Minor	Short term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Soil Erosion resulting from footprint clearing and excavation activities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Soil Compaction due to movement of construction vehicles of good potential agricultural soils								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Soil Contamination because of spillage of hydrocarbons								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**High**	Possible	**High**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Management Measures: ➢ 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; ➢ Infrastructure footprint areas should be clearly demarcated to avoid unnecessary disturbance of adjacent soils; ➢ The pylons should be located outside of the actively cultivated plots, wherever possible to ensure that the agricultural activities remain uninterrupted during all phases of development. ➢ 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; ➢ Uncontrolled construction vehicle and heavy machinery/equipment movement should be limited to within the project perimeters to avoid unnecessary compaction of adjacent soils; ➢ Revegetate adjacent areas with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions; ➢ Bare soils within the access roads can be regularly dampened with water to suppress dust during the construction phase, especially when strong wind conditions are predicted according to the local weather forecast; ➢ Contamination prevention measures should be addressed in the Environmental Management Programme (EMP) for the proposed development, and this should be implemented, always made available and accessible to the contractors and construction crew conducting the works on site for reference; ➢ 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; ➢ 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 preventative measures to prevent contamination; ➢ All disturbed areas adjacent to the proposed development areas should be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, to minimise soil erosion and dust emission; ➢ Temporary erosion control measures should be used to protect the disturbed soils during the construction phase until adequate vegetation has established.								

Table 16: Summary of the impact assessment for the construction phase of the Camps and laydown areas.

Activity 1: Site preparation prior to commencement of construction of the new substations.								
Project phase: Construction								
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**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Erosion resulting from footprint clearing and excavation activities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Compaction due to movement of construction vehicles of good potential agricultural soils								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Contamination because of spillage of hydrocarbons								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**High**	Possible	**High**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Management Measures: ➢ 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; ➢ Infrastructure footprint areas should be clearly demarcated to avoid unnecessary disturbance of adjacent soils; ➢ 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; ➢ Uncontrolled construction vehicle and heavy machinery/equipment movement should be limited to within the project perimeters to avoid unnecessary compaction of adjacent soils; ➢ Revegetate adjacent areas with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions; ➢ Contamination prevention measures should be addressed in the Environmental Management Programme (EMP) for the proposed development, and this should be implemented, always made available and accessible to the contractors and construction crew conducting the works on site for reference; ➢ 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; ➢ 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 preventative measures to prevent contamination; ➢ All disturbed areas adjacent to the proposed development areas should be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, to minimise soil erosion and dust emission; ➢ Temporary erosion control measures should be used to protect the disturbed soils during the construction phase until adequate vegetation has established.								

Table 17: Summary of the impact assessment for the construction phase of the access roads.

Activity 1: Site preparation prior to commencement of construction.								
Project phase: Construction								
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**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Erosion resulting from footprint clearing and excavation activities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Compaction due to movement of construction vehicles of good potential agricultural soils								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Contamination because of spillage of hydrocarbons								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Management Measures: ➢ The footprint of the proposed camps and laydown areas should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible; ➢ Infrastructure footprint areas should be clearly demarcated to avoid unnecessary disturbance of adjacent soils								

Table 18: Summary of the impact assessment for the operational phase of the OHL, new substations and associated supporting infrastructure.

Activity 1: Operation, Servicing, and maintenance infrastructure.								
Project phase: Operational								
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**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Erosion resulting from footprint clearing and excavation activities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Compaction due to movement of construction vehicles of good potential agricultural soils								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Contamination because of spillage of hydrocarbons								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Management Measures: ➢ Maintenance vehicles should be checked for leakages of hydrocarbons prior to commencement of maintenance activities; ➢ Monitoring of erosion should occur after every major rainstorm until such a time where the vegetation has fully established. Any erosion should be captured and recorded and reported during the ECO site visit; ➢ Maintenance vehicles should stick to demarcated road as far as practically possible to minimise soil compaction on adjacent soils; and ➢ Disturbed areas adjacent to the footprint area should be revegetated with indigenous grass mix to limit potential soil erosion.								

Table 19: Summary of the impact assessment for the operational phase of the Camps and Laydown areas.

Activity 1: Operation of the OHL								
Project phase: Operational								
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	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Erosion resulting from footprint clearing and excavation activities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Compaction due to movement of construction vehicles of good potential agricultural soils								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Contamination because of spillage of hydrocarbons								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Management Measures: ➢ Maintenance vehicles should be checked for leakages of hydrocarbons prior to commencement of maintenance activities; ➢ Maintenance vehicles should stick to demarcated road as far as practically possible to minimise soil compaction on adjacent soils; and ➢ Disturbed areas adjacent to the footprint area should be revegetated with indigenous grass mix to limit potential soil erosion.								

Table 20: Summary of the impact assessment for the operational phase of the access roads.

Activity 1: Operation, Servicing, and maintenance infrastructure.								
Project phase: Operational								
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**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Erosion resulting from footprint clearing and excavation activities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium

Impact Summary: Soil Compaction due to movement of construction vehicles of good potential agricultural soils								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Contamination because of spillage of hydrocarbons								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Management Measures: ➢ Maintenance vehicles should be checked for leakages of hydrocarbons prior to commencement of maintenance activities; ➢ Monitoring of erosion should occur after every major rainstorm until such a time where the vegetation has fully established. Any erosion should be captured and recorded and reported during the ECO site visit; ➢ Maintenance vehicles should stick to demarcated road as far as practically possible to minimise soil compaction on adjacent soils; and ➢ Disturbed areas adjacent to the footprint area should be revegetated with indigenous grass mix to limit potential soil erosion.								

Based on the project description as compiled by proponent, 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 (Cassinga Powerline ESIA Project description Draft 20240040).

The impact significance for the decommission and closure presented in Table 17 was done considering the statement presented above.

Table 21: Summary of the impact assessment for the decommission and closure phase for the proposed development.

Activity 1: Maintenance, removal of surface infrastructure and rehabilitation of the landscape.								
Project phase: Decommission and Closure								
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	Minor	Long term	Site	**Medium**	Possible	**Low**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Erosion resulting from footprint clearing and excavation activities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Compaction due to movement of construction vehicles of good potential agricultural soils								

	Magnitude	Duration	Scale	Consequence	Probability	SIGNIFICANCE	+ /-	Confidence
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Contamination because of spillage of hydrocarbons								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Management Measures: ➢ The post development landscape should mimic the predevelopment scenario to ensure that predevelopment land uses can commence post closure; ➢ All surfaces should be thoroughly cleaned and tested for contamination to ensure that land uses such as agriculture are not impacted by possible contamination; ➢ Decommissioning vehicles should be checked for leakages of hydrocarbons prior to commencement of decommissioning and closure activities; ➢ Decommissioning vehicles and equipment should stick to demarcated roads and disturbed areas as far as practically possible to minimise soil compaction on adjacent soils; ➢ Disturbed areas adjacent to the footprint area should be revegetated with indigenous grass mix to limit potential soil erosion; and ➢ Monitoring of rehabilitated landscapes particularly where disturbance of soil has occurred should be undertaken to ensure that no loss of soil resources post closure occurs.								

Table 22: Summary of the impact assessment for the operational phase of the Camps and Laydown areas.

Activity 1: Operation, Servicing, and maintenance of the substations								
Project phase: Operational								
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	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Erosion resulting from footprint clearing and excavation activities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Compaction due to movement of construction vehicles of good potential agricultural soils								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Contamination because of spillage of hydrocarbons								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium

Management Measures:

- Camps and laydown areas should be thoroughly cleaned once construction has been competed;
- All structures should be removed and return the camps and laydown areas to predevelopment land uses.

Table 23: Summary of the impact assessment for the decommission and closure phase for the proposed access roads.

Activity 1: Maintenance, removal of surface infrastructure and rehabilitation of the landscape.								
Project phase: Decommission and Closure								
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	Minor	Long term	Site	**Medium**	Possible	**Low**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Erosion resulting from footprint clearing and excavation activities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Compaction due to movement of construction vehicles of good potential agricultural soils								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Impact Summary: Soil Contamination because of spillage of hydrocarbons								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Site	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Short term	Site	**Low**	Unlikely	**Low**	-	Medium
Management Measures: ➢ The post development landscape should mimic the predevelopment scenario to ensure that predevelopment land uses can commence post closure; ➢ All surfaces should be thoroughly cleaned and tested for contamination to ensure that land uses such as agriculture are not impacted by possible contamination; ➢ Decommissioning vehicles should be checked for leakages of hydrocarbons prior to commencement of decommissioning and closure activities; ➢ Decommissioning vehicles and equipment should stick to demarcated roads and disturbed areas as far as practically possible to minimise soil compaction on adjacent soils; ➢ Disturbed areas adjacent to the footprint area should be revegetated with indigenous grass mix to limit potential soil erosion; and ➢ Monitoring of rehabilitated landscapes particularly where disturbance of soil has occurred should be undertaken to ensure that no loss of soil resources post closure occurs.								

9.1 Cumulative Impacts

The development footprint presents areas of active cultivation where maize and soybeans are dominantly cultivated, with few patches of cassava. The cultivated areas are therefore regarded as productive and economically viable from an agricultural point of view and as such development in these lands will impact on food production from the land parcel and contribute to losses of food production on a broader scale if not properly mitigation.

The most significant impact foreseen for the project is the ground clearing associated with the powerline servitude which will cause loss of agricultural land for cultivation as well as potential land fragmentation, thus leading to permanent change in land use. The cumulative loss of agricultural resources locally and regionally is medium without mitigation and low with mitigation measures. The establishment of the servitude of the powerline should therefore be carefully considered to ensure that the agricultural activities can continue unhindered during all phases of development.

If the mitigation measures presented in this document are adequately adhered to during all phases of development, the scale of impact on the Valued Environmental and Social Components (VECs) in the context of agricultural resources and livelihoods will be reduced to acceptable. Therefore, this project meets all required applicable IFC standards, and it not perceived to cause significant loss of agricultural recourses after mitigations have be implemented. The monitoring plan to management cumulative impact is presented in Section 8 below.

9.2 Consideration of Ecosystem Services

The impact of an overhead powerline traversing cultivated agricultural fields can affect ecosystem services in several ways, both for Type I and Type II services. Here's a breakdown of potential impacts:

Type I Ecosystem Services

Type I ecosystem services are those that have direct economic value and can often be measured in economic terms. These include provisioning services like crops, livestock, and raw materials.

- **Crop Yield and Quality**: The presence of powerlines 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**: Powerlines 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.
- **Soil Health**: Construction and maintenance activities associated with powerlines could lead to soil compaction, erosion, or contamination, which could directly affect soil quality and, subsequently, crop yields.

Type II Ecosystem Services

Type II ecosystem services are indirect and often less immediately quantifiable but crucial for long-term ecosystem health. These include regulating services like climate regulation, water purification, and supporting services like soil formation and nutrient cycling.

- **Biodiversity and Habitat Fragmentation**: The installation of powerlines 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.
- **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.
- **Water Regulation and Quality**: The construction of powerlines might alter local water flow patterns and affect water quality. For instance, runoff from maintenance areas might carry pollutants into nearby water bodies, impacting water resources used for irrigation.
- **Microclimate Effects**: Large structures like powerlines might influence local microclimates. For instance, they could create shade or alter wind patterns, which might affect local temperature and humidity levels, indirectly impacting crop growth.

10 PROJECT MONITORING PROGRAMME

It is deemed imperative that monitoring is done in the areas impacted by the construction activities associated with the proposed Cassinga powerline project. The rehabilitation and monitoring of disturbed areas must be done progressively in-line with the phase approach of the project given that this is a linear infrastructure project with spans over a distance of 170 km.

The monitoring programme will ensure that allow all parties involved to accurately assess and manage the progress of the rehabilitation interventions and any arising issues particularly for the monitoring of soil erosion, soil contamination and loss of land use. In addition, the information presented here should also be used for adaptive management to ensure that the issues adequately addressed. Table 19 presents guidelines which can be implemented to ensure that monitoring programme is effective.

Table 24: Monitoring recommendations for the impacted areas.

Aspect	Monitoring Location	Frequency of sampling	Frequency of Reporting	Report Content	Equipment
Erosion	Within cleared, excavated, and backfilled areas	Monitoring of erosion should occur on a weekly basis during construction by the contractor, and after every major rainstorm until such a time when the vegetation has fully established. Any erosion should be captured and recorded and reported during the ECO site visit	1. After every major rainstorm and/or flood. 2. Monthly monitoring report compiled by the appointed ECO during the construction phase.	1. Brief indication of the method of assessment; 2. Assumptions and Limitations must be listed. 3. Photos and GPS point locations areas of erosion. 4. Any erosion observed must be discussed in detail and management recommendations made; and 5. Map indicating where erosion is present. 6. Recommended and undertaken control measures.	1.GPS 2. Camera 3. Notepad 4. Measuring Tape
Soil Compaction	Within cleared, excavated, and backfilled areas as well as areas in the immediate vicinity such as temporary access routes, laydown areas and camp sites.	Once after the construction phase has been completed.	Once after the construction phase has been completed	1. Brief indication of the method of assessment; 2. Assumptions and Limitations must be listed. 3. Photos and GPS point locations areas of compaction. 4. Report on penetration resistance which can be used as a measure of compaction, and this should be discussed in detail and management recommendations made; and 6. Recommended and undertaken control measures.	1.GPS 2. Camera 3. Notepad 4. Penetrometer to measure resistance to penetration
Soil Contamination	Areas within the 50m radius of the bulk infrastructure sites such as substations.	Once after the construction phase has been completed.	Once after the construction phase has been completed	1. Brief indication of the method of assessment. 2. Assumptions and Limitations must be listed. 3. Photos and GPS point locations areas of contamination. This includes sources of pollution as well as areas of pollution migration. 4. Any erosion observed must be discussed in detail and management recommendations made; and 5. Map indicating where contamination has occurred. 6. Recommended and undertaken control measures.	1. GPS 2. Camera 3. Soil sampling bag 4. Spade or soil auger to recover samples



11 CONCLUSION AND IMPACT STATEMENT

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Authorisation (EA) process for the proposed construction of a new overhead line (OHL) 220 kV between Gove and Cuvango, through Chipindo, Angola. The proposed OHL has an associated 200 metre (m) assessment corridor (i.e., 100 m on either side of the overhead line), the assessment corridor will hereafter be referred to as the "study area".

The objective of this study was to determine the impact of the proposed OHL grid connection on the soil, land use, land capability and agricultural potential. The proposed project traverses soils which support agricultural practice and food production. Thus, it is crucial to consider the surrounding soils, land uses, and land potential to make sure that the proposed project takes into account high-potential agricultural land in accordance with the applicable Angolan Law.

During the site assessment, it was noted that the study area largely consists of agricultural fields as part of subsistence farming, grazing, Miombo woodland, plantations, wildlife/wilderness, residential areas as well as waterbodies. Crops observed within cultivated areas largely includes maize and beans with a small section comprising Cassava, while livestock such as cattle, goats, and chickens are also observed during the site visit. Wood harvesting activities were also noted in some portion of the study area although these activities did not seem to be practices on a large scale within the field verified areas. Fishing activities in areas near rivers was also observed and this is deemed to be an important economic activity, providing food and income for rural communities.

The project footprint areas are dominated by Ferralsols, Acrisols, Plinthosols, Leptosols and Anthrosols. These soils are largely range between moderately deep to very deep and are well drained, red and yellow soils. The topsoil is of most soils is of 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. Table A presents summarised findings of the soil investigation.

Table 25: Identified soil types within the study area and their respective land capability, land potential and areal extent expressed in hectares and percentages.

WRB Classification	Soil Depth (mm)	Land Capability Class	Areal Extent (ha)	Extent Percentage (%)	Land Potential
Ferralsols (Well drained)	<1200	Class II	455,50	10,94	Very High potential
Acrisols	800 - 1000	Class III	2 456,70	58,99	High potential
Plinthosols	700 - 900				
Leptosols	<400	Class VI	298,42	7,17	Moderate Potential
Fluvisols (Rivers and DLs)	400 -500	Class V	298,54	7,17	Watercourse
Gleysols (Valley Bottoms)					
Anthrosols	N/A	Class VIII	652,81	15,68	Very Low Potential
Total Enclosed Area			**= 4 164,37***		

***Substation = 2.4ha (0.06%)**

Following the assessment of the study area and the identified potential impacts as the result of the proposed development, the proposed OHL project and associated surface infrastructure development is deemed acceptable from a soil, land use and land capability point of view since the impact will largely be medium without mitigation and low with mitigatory measures adequately implemented during all phases of the development. Additionally, the proposed overhead line has the potential to co-exist concurrently with agricultural activities both cultivated and livestock grazing activities. The integrated mitigation measures provided must be implemented accordingly, with the aim of minimising potential impacts on the agricultural resources while considering the need for sustainable development.

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APPENDIX A - Terms of Use and Indemnity

INDEMNITY AND TERMS OF USE OF THIS REPORT

The findings, results, observations, conclusions, and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and ZRC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field or pertaining to this investigation.

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APPENDIX B – Legislation

LEGISLATIVE REQUIREMENTS

Ministry of Environment (MINAMB)	The Ministry of Environment (MINAMB) is the Ministerial Department responsible to formulate, conduct, supervise, evaluate, and execute the Executive's policy in the field of protection, preservation and conservation of environmental quality, pollution control, areas of conservation and enhancement of natural heritage, as well as the preservation and rational use of mineral resources. MINAMB comprises a set of agencies and services, in particular, the National Directorate for the Prevention and Assessment of Environmental Impacts (Direcção Nacional de Prevenção e Avaliação de Impactes Ambientais (DNPAIA)), which is the service responsible for the conception and implementation of policies and strategies to prevent the incidences of environmental impacts. Depending on the type of project being developed, the EIA report must also be approved by the line ministry. This ensures that the EIA not only addresses the requirements of the Environmental Baseline Law and the Presidential Decree on Environmental Impact Assessment and Environmental Licensing, but also the relevant sectoral legislation. MINAMB also includes a set of bodies and services, in particular the National Directorate for the Prevention and Evaluation of Environmental Impacts (DNPAIA), which is the service responsible for designing and implementing policies and strategies to prevent environmental impact incidences. MINAMB is responsible for the implementation of the Environment Framework Law 5/98, the approval of EIAs under the Presidential Decree 117/20 on Environmental Impact Assessment and Environmental Licensing Procedure, and all associated Regulations
The General Environmental Law No. 5/98	The General Environmental Law (Lei de Bases do Ambiente, LBA) was promulgated in accordance with the Constitutional Law of the Republic of Angola. The purpose of the law is to provide the framework for environmental legislation and regulations; more specifically to define the basic concepts and principles for the protection, preservation and conservation of the Environment, promotion of quality of life and the rational use of natural resources (Article 1). The LBA incorporates international declarations which Angola has ratified and defines citizens' rights and responsibilities. Further, the LBA introduces the concept of legal penalties for illegal activities that have caused damage to the environment. Article 4 includes a number of principles guiding LBA, including a principle in respect of liability: all persons or organisations which through their actions cause harm to the environment, or the degradation, destruction or depletion of national resources, shall be held liable for the same, and shall be required to repair such damage and/or pay compensation for the damage caused. Article 16(1) of LBA stipulates that an Environmental Impact Assessment (EIA), including public consultation (Articles 10 and 32), is mandatory for all undertakings which have an impact on the balance and wellbeing of the environment and society. Article 16(2) states that more specific legislation on EIAs will be developed by the government. An Environmental License is issued on the basis of an EIA/EIS and a license is required before any other license required by law will be granted (Article 17(2)). According to the LBA, MINAMB is responsible for issuing environmental licenses
Decree No.117/20 on General Regulation for Environmental Impact Assessment and Environmental Licensing Procedure.	This decree establishes the standards and procedures that regulate the environmental impact assessment of public and private projects and the environmental licensing procedure for activities that, due to their nature, location or dimension, may cause significant environmental and social impact (Article 1). Applies to all public or private activities that may directly or indirectly influence environmental components (Article 2). This decree revokes the regulations previously in force on these matters (Decree No. 51/04, of 23 July 2004, on EIA, and Decree No. 59/07, of 13 July, on Environmental Licensing), as well as all legislation that contradicts its wording. Chapter II of the decree focuses on EIA, and Chapter III establishes the provisions applicable to Environmental Licensing. Chapter IV sets out the requirements for monitoring the provisions of the decree, the fees to be paid and the fines and accessory penalties applicable to infractions. Article 7 refers to the categorization of the activities and therefore Annexes I to V list the activities that are classified under Category A, B, C, D and E, respectively, and specifies the requirements for each one of those categories. For activities under category A, an EIA is required as well as Terms of Reference (TOR) and an Environmental Pre-Feasibility Study and Scoping (EPDA) (Article 7 and 12); Category B requires an EIA and the preparation of TOR for its elaboration; and Category C will require a Simplified Environmental Study and TOR. At the beginning of an Environmental Impact Assessment procedure, the project owner (in this instance, Soul Rock) must register the proposed activity, under the terms of the applicable legislation in force, in the Integrated Environmental

	System (SIA). The Ministerial Department that oversees the proposed activity must, within 5 (five) days, after receiving the Environmental Impact Study, issue an opinion on the project to be licensed (Article 6 (3)). Within a maximum period of 30 (thirty) days from the date of receipt of the documentation, the Ministerial Department responsible for the Environment Sector sends the respective opinion to the competent authority to license or authorize the project (Article 17). Therefore, the project that has received a negative opinion from the Minister responsible for the Environment cannot be given authorization or license (Article 18 (1)). Furthermore, the decision taken by MINAMB can be appealed under the general terms of administrative procedures and litigation (Article 18 (2)). This decree adopts provisions concerning requirements, criteria and administrative procedures related to Environmental Licenses. In terms of Article 26, any activity requiring an EIA must apply for an Environmental License, which the MINAMB issues.
Law No. 9/04, Land Law	The present law establishes the general bases of the legal regime of the lands integrated in the original property of the State, the land rights and the general regime of transmission, constitution, exercise and extinction of these rights (Article 2). This law shall apply to rural and urban land over which the State constitutes any of the land rights provided for the benefit of natural persons or legal persons governed by public or private law, in particular with a view to pursuing agricultural purposes, livestock, forestry, mining, industrial, commercial, housing, urban or rural building, land use planning, environmental protection and anti-erosion (Article 3(1)). The State respects and protects the land rights held by rural communities, including those based on custom or custom (Article 9(1)). Number 2 of the same Article establishes that land in rural communities may be expropriated for the purpose of public utility and to be an object of requisition, with fair compensation. According to Article 16(1), "The occupation, the use, and usufruct of the land is subject to the rules on environmental protection, in particular those related to the protection of the landscape, and the species of flora and fauna, preservation of the ecological balance, and the citizens' rights to a healthy, and unpolluted environment". Article 19(3) states that grantable land[2] is classified into urban and rural land. Rural land is considered to be the rustic building situated outside the area bounded by a charter or the area of an urban agglomeration and intended to be used for agricultural, livestock, forestry and mining purposes (Article 19(5)). According to Article 22(1), rural land is classified according to the purpose for which it is intended and the legal regime to which it is subject, in rural community land, to agricultural land, forest land, installation land and road land. Rural community land is land occupied by families of local rural communities for their dwelling, practice of their activity or for other purposes recognized by custom or this law and its regulations (Article 22(2)). Number 5 of the same article defines that the installation land is the land provided for the implementation of mining, industrial or agro-industrial installations, under the terms of the present law and the respective legislation applicable to mining and oil activities and industrial parks. Community rural land are considered, according to the Article 23(1), as land used by a rural community in accordance with customary land use, including, as appropriate, complementary areas for shifting agriculture, transhumance corridors for access by livestock to water sources and pastures and crossings, whether or not subject to the easement regime, used to access water or roads or access roads to urban areas. It is competent, for the classification of a land as land of mining and oil installation, the body that oversees the planning of the territory and the environment, upon proposal or prior opinion of the entities that oversee the respective area (Article 25(2)).
Presidential Decree No. 194/11 on Liability on Environmental Damage	This decree establishes strict liability for degradation of the environment. Aimed at preventing and repairing environmental damage, the decree establishes that all activities capable of causing damage to the environment (Article 3(1)) are considered liabilities and are subject to regulation under the "polluter pays" principle. According to the decree, any entity responsible for pollution (by act of wilful misconduct or negligence) will be held responsible for cleaning up and restoring the environmental damage. Responsibility will be held for losses and damages caused to the environment by way of compensation for damages and environmental recovery measures. Article 18º informs the right of the public to request intervention when there is concern that environmental damage has taken place. In Article 21º, the Decree also states that any individuals or legal entities which carry out activities that impose environmental risks shall have civil liability insurance
Presidential Decree No. 261/11 on Water Quality	This decree serves as an addition to the national Water Law No. 6/02, dealing specifically with water quality. It establishes the roles within the Angolan governmental administration for overseeing water quality issues and addressing the water quality standards relating to human consumption and wastewater. The decree also lists the role of water quality monitoring and the standard parameters for drinking water, surface water and emissions limits for wastewater discharge (in Annex VI). According to item 3 of Article 1, this law also regulates the control standards of wastewater discharge in water bodies and soil to preserve the quality of the aquatic environment and protect public health. Article 13 of Chapter III (Protection of Waters Against Pollution of Discharged Wastewater) defines that the discharge of wastewater from a treatment facility into water and soil requires a license issued by the Ministry of Environment, in which discharge standards for mitigation or prevention of damage are set.

International Finance Corporation (IFC) Environmental Health and Safety Guidelines and Performance Standards (2007)	**IFC Performance Standards considered** ➢ **Performance Standard 1**: Assessment and Management of Environmental and Social Risks and Impacts - Underscores the importance of managing environmental and social performance throughout the life of a project. ➢ **Performance Standard 3**: Resource Efficiency and Pollution Prevention - Recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.1 ➢ **Performance Standard 4**: Community Health, Safety, and Security - Recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. ➢ **Performance Standard 5**: Land Acquisition and Involuntary Resettlement - Recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. ➢ **Performance Standard 6**: Biodiversity Conservation and Sustainable Management of Living Natural Resources - Recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development.
Food and Agricultural Organisation of the United Nations	The World Reference Base (WRB) is the international standard for soil classification system endorsed by the International Union of Soil Sciences. It was developed by an international collaboration coordinated by the IUSS Working Group. It replaced the FAO/UNESCO Legend for the Soil Map of the World as international standard. The WRB borrows heavily from modern soil classification concepts, including Soil Taxonomy, the legend for the FAO Soil Map of the World 1988, the Référentiel Pédologique and Russian concepts. As far as possible, diagnostic criteria match those of existing systems, so that correlation with national and previous international systems are accurate.

APPENDIX C - Assessment Methodology

Desktop Screening

As part of the desktop assessment, a background information relating to the study area and literature reviews were sourced from various databases such as the World Reference Base for Soil Resources (WRB, 2014), World Soil and Terrain database (SOTER, 2013) and Food and Agriculture Organization of the United Nations (FAO, 2022).) as well as other sources as listed under references were utilised to fulfil the objectives for the assessment.

Soil Classification and Sampling

A soil survey was conducted from between the 6th - 10th of September 2024 at which time the identified soils within the study area were classified into soil types according to the World Reference Base for Soil Resources (WRB, 2014). The soil survey was restricted to the study area. Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which will entail evaluation of physical soil properties and prevailing limitations to various land uses.

Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII, as presented in Table 2 below; with Classes I to III classified as prime agricultural land that is well suited for annual cultivated crops, whereas Class IV soils may be cultivated under certain circumstances and specific or intensive management practices, and Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of C1 to C8, as illustrated in Table 1. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating. The anticipated impacts of the proposed land use on soil and land capability were assessed in order to inform the necessary mitigation measures.

Slope percentage plays a vital role in land capability calculations. This therefore necessitates the need to group the relevant slope classes. The slope percentages (that contribute to land capability calculations) have been divided into five slope classes as per the methodology described in by Smith (2006) in the farming handbook as follows:

- Slope Class 1 (0-3%);
- Slope Class 2 (3-8%);
- Slope Class 3 (8-15%);
- Slope Class 4 (15-25%); and
- Slope Class 5 (>25%).

Table A1: South Africa's agricultural land capability (Smith 2006).

Land Capability Class	Increased Intensity of Use									Land Capability Groups	Limitations
I	W	F	LG	MG	IG	LC	MC	IC	VIC	Arable land	No or few limitations
II	W	F	LG	MG	IG	LC	MC	IC			Slight limitations
III	W	F	LG	MG	IG	LC	MC	IC			Moderate limitations
IV	W	F	LG	MG	IG	LC					Severe limitations
V	W	F	LG	MG						Grazing land	Water course and land with wetness limitations
VI	W	F	LG	MG							Limitations preclude cultivation. Suitable for perennial vegetation
VII	W	F	LG								Very severe limitations. Suitable only for natural vegetation

VIII	W									**Wildlife**	Extremely severe limitations. Not suitable for grazing or afforestation.
W- Wildlife					MG- Moderate grazing					MC- Moderate cultivation	
F- Forestry					IG- Intensive grazing					IC- Intensive cultivation	
LG- Light grazing					LC- Light cultivation					VIC- Very intensive cultivation	

Table A2: 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.

The land potential assessment entails the combination of climatic, slope and soil condition characteristics to determine the agricultural land potential of the investigated area. The classification of land potential and knowledge of the geographical distribution within an area of interest. This is of importance for making an informed decision about land use. **Table A3** below presents the land potential classes, whilst Table 4 presents description thereof, according to Guy and Smith (1998).

Table A3: Land Potential Classes (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 A4: 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.

APPENDIX D – Impact Table Methodology

Impact assessment methodology

Potential impacts (direct, indirect, cumulative) will be assessed using information gathered during the baseline assessment in combination with previously collected desktop data and compared with the detailed project description.

Impact significance rating

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 D1 and involves the following 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.
- 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 D1: Impact significance rating system.

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 favorable 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, .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	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					
Impact characteristics	**Definition**		**Criteria**		
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

After determining the significance rating, practicable management measures are suggested for each specific impact. The impact description should indicate the significance rating prior to and following mitigation/optimisation. As explained above:

"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 is then re-assessed with assumed management measures in place ("after management"). Specialists also recommend and describe 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 in the table D2 below.

Table D2: 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:								

APPENDIX E - DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

Lourens Tshabalala BSc (Agric.) (Soil Science) (University of Free State)

Braveman Mzila BSc (Hons) Environmental Hydrology (University of KwaZulu-Natal)

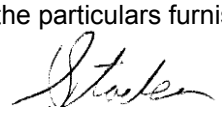
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Zimpande Research Collaborative		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1. (a) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



Signature of the Specialist

1.(b) A declaration that the specialist is independent in a form as may be specified by the competent authority

I, Braveman Mzila, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.

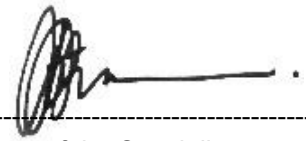


Signature of the Specialist

1. (c) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Lourens Tshabalala, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource discipline lead, Managing member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for wetland assessment short course Rhodes University	2016
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2013

Short Courses

Certificate – Department of Environmental Science in Legal context of Environmental Management, Compliance and Enforcement (UNISA)	2009
Introduction to Project Management - Online course by the University of Adelaide	2016
Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – Democratic Republic of the Congo

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant species and Landscape Plan
- Freshwater Offset Plan
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Soil Monitoring
- Soil Mapping

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments
- View Shed Analyses
- Visual Modelling

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

SAS ENVIRONMENTAL GROUP OF COMPANIES (SEGC) –
SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF LOURENS TSHABALALA

PERSONAL DETAILS

Position in Company	Soil Scientist/Hydropedologist
Joined SAS Environmental Group of Companies	2023

MEMBERSHIP IN PROFESSIONAL SOCIETIES

South African Council for Natural Scientist Professions (SACNASP) – Reg. No: 144043

Member of the South African Soil Surveyors Organization (SASSO)

EDUCATION

Qualifications

B.Sc. (Agric) Honours Soil Science	(University of the Free State)	2020

COUNTRIES OF WORK EXPERIENCE

South Africa – Kwa-Zulu Natal, Mpumalanga, Limpopo, Western Cape, Gauteng North West, Eastern Cape and Free State

KEY SPECIALIST DISCIPLINES

Hydropedological Assessments:

- Soil Survey & Profile Description
- Soil Delineation
- Hydrological hillslope classification

Soil, Land use, Land Capability and Agricultural Potential Studies

- Soil Desktop assessment
- Soil classification
- Agricultural Soil Potential
- Agricultural Impact Assessments

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF BRAVEMAN MZILA

PERSONAL DETAILS

Position in Company	Wetland Ecologist and Soil Scientist
Joined SAS Environmental Group of Companies	2017

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Soil Science Society (SASSO)

Member of the Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

BSc (Hons) Environmental Hydrology (University of Kwazulu-Natal)	2013
BSc Hydrology and Soil Science (University of Kwazulu-Natal)	2012

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Free State, North West, Limpopo, Northern Cape, Eastern Cape, KwaZulu-Natal

KEY SPECIALIST DISCIPLINES

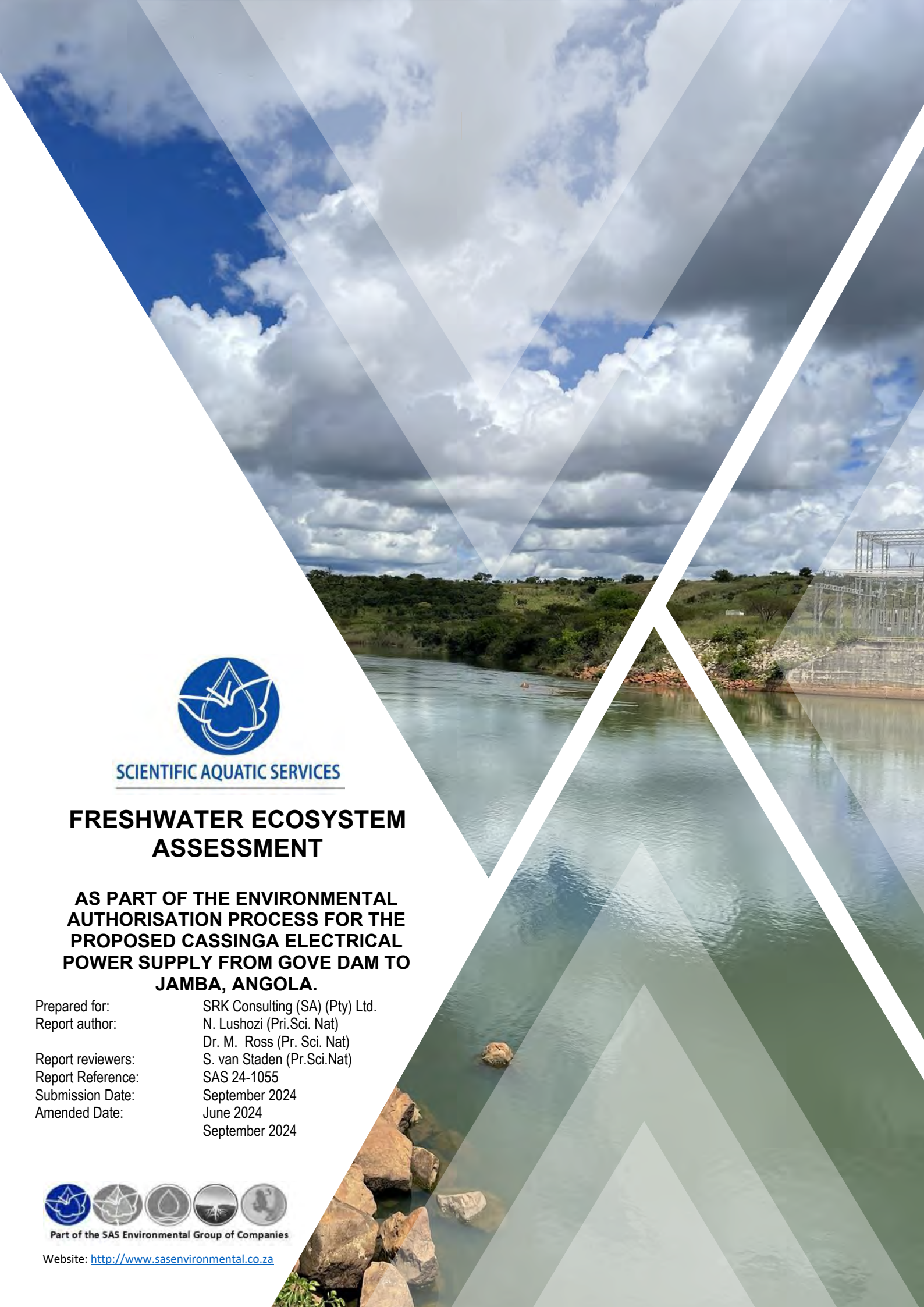
Hydropedological Assessments:

- Soil Survey
- Soil Delineation
- Hydrological hillslope classification
- Hydropedological loss Quantification
- Hydropedological impact assessment
- Scientific buffer determination

Soil, Land use, Land Capability and Agricultural Potential Studies

- Soil Desktop assessment
- Soil classification
- Agricultural potential
- Agricultural Impact Assessments

Appendix F: Freshwater ecosystems



SCIENTIFIC AQUATIC SERVICES

FRESHWATER ECOSYSTEM ASSESSMENT

AS PART OF THE ENVIRONMENTAL AUTHORISATION PROCESS FOR THE PROPOSED CASSINGA ELECTRICAL POWER SUPPLY FROM GOVE DAM TO JAMBA, ANGOLA.

Prepared for:	SRK Consulting (SA) (Pty) Ltd.
Report author:	N. Lushozi (Pri.Sci. Nat) Dr. M. Ross (Pr. Sci. Nat)
Report reviewers:	S. van Staden (Pr.Sci.Nat)
Report Reference:	SAS 24-1055
Submission Date:	September 2024
Amended Date:	June 2024 September 2024

Part of the SAS Environmental Group of Companies

Website: http://www.sasenvironmental.co.za

EXECUTIVE SUMMARY

Scientific Aquatic Services (Pty) Ltd. (SAS) was appointed by SRK Consulting (South Africa) to conduct a freshwater ecosystem assessment as part of the environmental authorisation (EA) process for the Cassinga Electrical Power Supply Project ESIA, this is referred to throughout the report as the proposed Cassinga powerline project. The proposed Cassinga powerline project is located South of the centre of Angola, namely, in the provinces of Huila and Huambo. The proposed Cassinga powerline extends for about 170 km, crossing six municipalities which include Jamba, Kuvango, Dongo, Galangue, Chipindo and Kalima.

During the assessment conducted over a period of five (5) days in April 2024, identified drainage systems comprised four primary hydrogeomorphic (HGM) types: 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 the freshwater ecosystems was largely intact due to the remote geographic location of the proposed powerline infrastructure. Ecological modifiers include freshwater crossings, subsistence cultivation activities, impoundments including large dams such as the Gove dam and Cuandeja Dam and impacts associated with use of some of the freshwater ecosystems for domestic needs. Despite these impacts, in terms of ecological services, the freshwater ecosystems are considered important for local communities in terms of provision of water for domestic use, these systems are also a drinking source for cattle and are able to provide good habitat essential for biodiversity maintenance. In addition, the valley bottom wetland systems were utilised for subsistence farming.

A dry season survey was undertaken during July 2024, where all the watercourses and freshwater ecosystem resources identified during the wet season survey were re-assessed to evaluate the influence of seasonality on the systems. It was noted that the surface water ecosystems are generally strongly influenced by seasonality, with many of the minor watercourses, valley bottom wetland units and other isolated wetland features no longer supported persistent surface waters. Seasonal variability is a natural process of the habitat units. None of the wetlands and watercourses were shown to suffer a decline in ecological integrity.

The proposed powerline will cross the freshwater systems, however, given the spatial footprint of the infrastructure such as the powerline supporting pylons and proposed substations, the extent of modification is anticipated to be low. During the planning phase, it must be ensured that the powerline support pylons are spanned appropriately to avoid direct encroachment within the freshwater ecosystems. This is critical for maintenance of ecological functionality as well as for the longevity and protection of the proposed infrastructure.

In terms of the proposed access roads, the layout indicates that some proposed new roads will traverse the delineated freshwater ecosystems, 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 to limit. The medium impact significance is particularly likely to occur during the construction phase of the project where increased vehicle movement will be taking place, resulting in increased dust generation, smothering of freshwater habitat and potential proliferation of alien and invasive species. Beyond the construction phase, the proposed freshwater crossings will also result in a cumulative loss of freshwater habitat and therefore it is important that suitable mitigation measures are implemented to manage significant loss of freshwater habitat during construction of the proposed new access roads and associated crossings.

In conclusion, given that the project has the potential to limit direct impacts on the freshwater ecosystems which reduces the overall impact significance of the project and that the project is considered essential for human livelihoods including socio-economic development and more broadly, for sustainable development for local communities in the areas which form part of the project, it is the opinion of the specialist that the project be considered in a positively for authorisation.

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animans and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the outer boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Endorheic	As it relates to a depression wetland: inward-draining with no transport of water into downstream systems via subsurface or surface flow. Water leaves via evapotranspiration and infiltration only.
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas.
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurrences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Wetland:	The Ramsar Convention, formally known as the Convention on Wetlands of International Importance, defines wetlands as follows: • Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

°C	Degrees Celsius.
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
EWR	Ecological Water Requirements
ESIA	Environmental and Social Impact Assessment
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GPS	Global Positioning System
HGM	Hydrogeomorphic
IFC	International Finance Corporation
kV	kilovolt
m	Metre
MAP	Mean Annual Precipitation
NIMEA	Ministry of Energy and Water
OHL	Overhead Line
PES	Present Ecological State
MVAs	Megavolt-amperes
RMO	Resource Management Objective
SACNASP	South African Council for Natural Scientific Professions
SAS	Scientific Aquatic Services
SQR	Sub quaternary catchment reach
WMS	Water Management System

1 INTRODUCTION

1.1 Background and Project Description

Scientific Aquatic Services (Pty) Ltd. (SAS) was appointed by SRK Consulting (South Africa) to conduct a freshwater ecosystem assessment as part of the environmental authorisation (EA) process for the Cassinga Electrical Power Supply (220 kV overhead powerline) Project Environmental and Social Impact Assessment (ESIA), this is referred to throughout the report as the proposed Cassinga powerline project. The proposed Cassinga powerline project is located South of the centre of Angola, in the provinces of Huila and Huambo. The proposed Cassinga powerline extends for approximately 170 km, crossing six municipalities which include Jamba, Kuvango, Dongo, Galangue, Chipindo and Kalima. The detailed project description is provided the section below.

1.1.1 Project description[1]

The main works will be carried out largely in Huila Province near the Gove Hydro Dam (Huambo) 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 associated with the electrification of villages at Chipindo, Cuvango and Jamba will be constructed.

The Republic of Angola, through its Ministry of Energy and Water (MINEA), is embarking on a significant enhancement of its electrical infrastructure with the Cassinga Project, aiming to boost electric power supply across various communities within the Province of Huíla. The Project is structured around the establishment of a new 220 kV Overhead Line (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. Furthermore, the Project includes the laying down of medium voltage overhead lines for distribution, along with the necessary low voltage 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

[1] Obtained from memorandum document provided by the EAP titled: Memo: Cassinga Electrical Power Supply Project ESIA: Project Description. Dated: 5th April 2024.

caters to the current demands but is also scalable to accommodate future expansions, including the prospective OHL 220 kV interconnection to Cuchi/Menongue.

An estimated power demand of 80 MW has been calculated for the Cassinga 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.

Transmission lines and towers

Transmission line conductors are strung on in-line suspension towers and bend (strain) towers. The structures proposed to be used for the majority of the 220 kV Transmission line are metallic towers type Y, adequate to the angle of the OHL. These towers are approximately 50 m in height and a total footprint area of 80 m x 50 m is required for each tower. The average span between two towers is 400 m.

The cross-rope suspension tower is typically used along the straight section of the servitude, while the self-supporting angle towers and inline strain towers are used where there is a bend in the powerline alignment. Angle towers are cumbersome and more steel-intensive than suspension towers, making them more visually intrusive and costly to construct. Therefore, transmission line routes are planned with as few bends as possible.

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 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.

Overhead powerline 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

The Gove – Chipindo – Cuvango section of the OHL will comprise the following components:

- High Voltage Transmission Line, 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 mm^2 (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 will comprise the following components:

- High Voltage Transmission Line, 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.

Electrification of community homes and public lighting

The electrification of Chipindo, Cuvango and Jamba requires several infrastructure components. The installation of these components within each community will establish a medium and low voltage network to supply grid electricity to approximately 1 000 homes in each community, including public lighting.

1.1.2 Purpose of the report

The purpose of this report is to define the ecology of the area in terms of freshwater ecosystems characteristics, including mapping of the freshwater ecosystems, discuss key ecological drivers and to define the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS), as well as the socio-cultural and ecological service provision of the freshwater ecosystems utilising current industry "best practice" assessment methods in order to ascertain what, if any, impact the activities will have on the freshwater ecosystems associated with the proposed Cassinga powerline project.

The objective of the study is to provide detailed information when considering the existing activities in the vicinity of the freshwater ecosystems, to ensure the ongoing functioning of the ecosystem such that local and regional conservation requirements and the provision of

ecological services in the local area are supported while considering the need for sustainable economic development.

An impact assessment provided by the Environmental Assessment Practitioner (EAP) was applied to determine the significance of the perceived impacts associated with the proposed Cassinga powerline project on the receiving environment. In addition, mitigatory measures were developed, which aim to minimise the perceived impacts associated with the proposed activities, followed by an assessment of the significance of the impacts post-mitigation. This report, after consideration and a description of the ecological integrity of proposed Cassinga powerline project, must guide the EAP and relevant authorities, by means of a reasoned opinion and recommendations, as to the viability of the proposed infrastructure from a freshwater ecosystem management point of view.

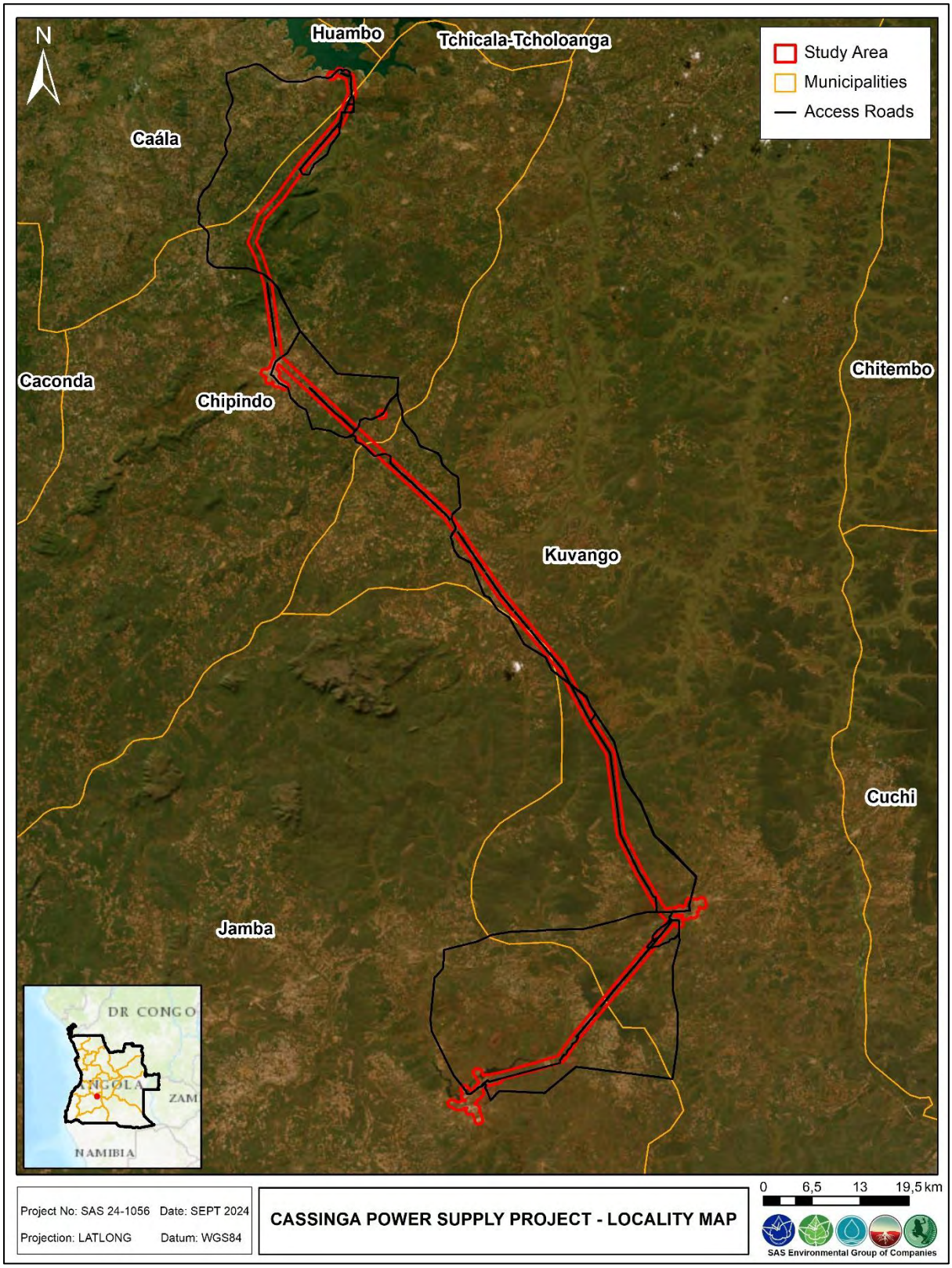


Figure 1: Digital satellite image depicting the location of the study and investigation areas associated with the proposed Cassinga powerline project in relation to the surrounding environment.

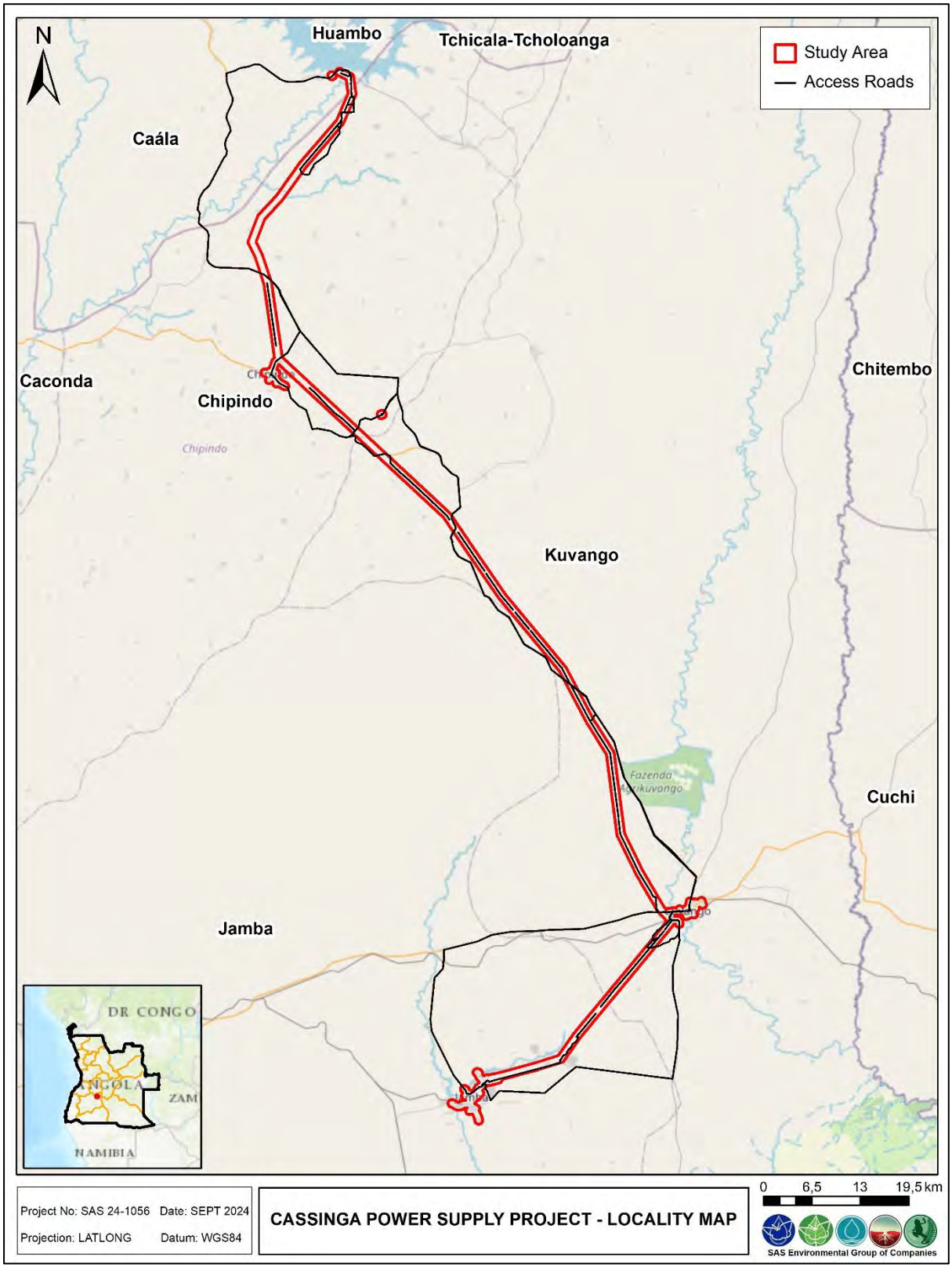


Figure 2: The study and investigation areas associated with the proposed Cassinga powerline project depicted on a topographical map in relation to the surrounding area.

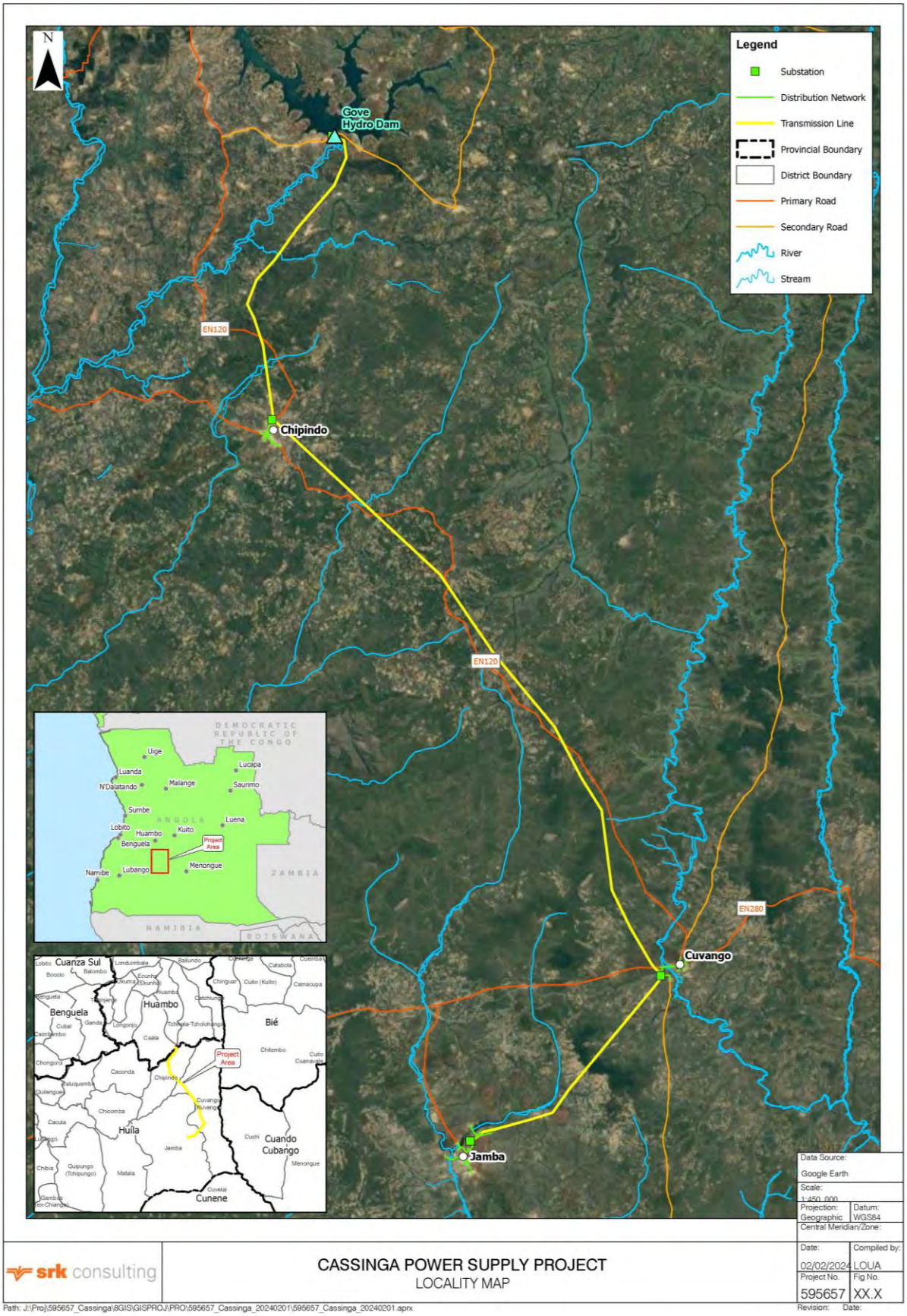


Figure 3: Location of the proposed 220 kV OHL and the towns it will supply with electricity.

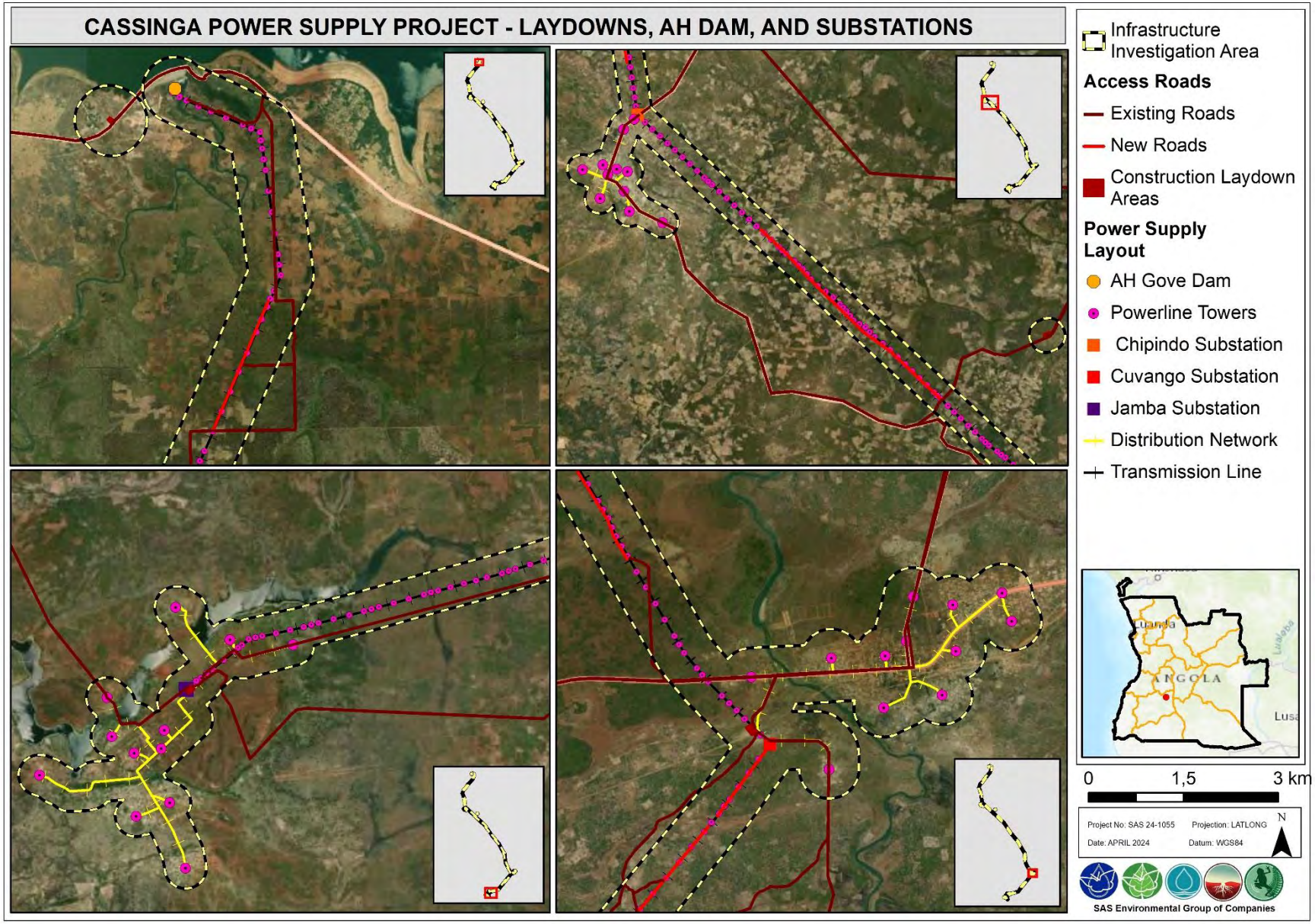


Figure 4: Digital satellite image depicting the location of the substation infrastructure associated with the proposed Cassinga powerline project in relation to the surrounding environment.

1.2 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The delineation and mapping of freshwater features as presented in this report are regarded as a best estimate of the outer boundaries based on the site conditions present at the time of assessment;
- Due to access constraints pertaining to access roads and terrain, some freshwater ecosystems could not be accessed at the proposed crossing points associated with the proposed Cassinga powerline. Therefore, verification points for some freshwater ecosystems were located at points as close to the freshwater ecosystem crossing as possible to be verified and, where necessary, the conditions at the exact point required were inferred or extrapolated. The observations made are deemed sufficient to ensure that informed decision making can be undertaken;
- 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;
- Given the extensive agricultural activities as well as other anthropogenic disturbances within the assessment 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 in this report 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 DWAF (2008) method followed is considered sufficient to provide similar results;
- It is important to note that although all data sources used to provide background information on the sensitivity of the assessed areas provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely

accurate indication of the focus area's actual site characteristics at the scale required to inform the environmental authorisation processes. Field assessments are conducted in order verify these findings and provide more accurate information about on-site conditions;

- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. A more reliable assessment of the biota would require seasonal sampling, with sampling being undertaken under both low flow and high flow conditions. However, it is expected that the existing activities have been accurately assessed and considered, based on the field observations and the consideration of existing studies and monitoring data in terms of aquatic, riparian and wetland ecology.

1.3 Structure of this Report

This report forms part of a suite of reports produced for the purposes of providing freshwater and aquatic ecological investigation of the study area as provided by the proponent. This report specifically deals with the freshwater and aquatic ecological components of the study. The following structure is applicable to this report:

Section 1: Introduction

Provides an introduction, purpose of the study, and assumptions and limitations.

Section 2: Key legislative frameworks and lender requirements

Provides key legislative requirements including national legislative frameworks and the general approach to the ESIA considering both nationally and relevant international standards.

Section 3: Assessment Approach

Provides scope of work, summaries of the relevant methodology and definitions applicable to this report, a description of the sensitivity mapping and the risk assessment approach.

Section 4: Project activities posing potential impacts

Provides description of the project aspects that are likely to result in impacts on freshwater ecosystems within the development footprint.

Section 5: Results of the background assessment and baseline results from the field investigation

This section reports the following:

a) A background study of relevant international and national datasets (such as the Freshwater Ecoregions of the World and the World Database on Protected Areas); and

b) A description and delineation of all freshwater ecosystems associated with the proposed Cassinga powerline project according to the Department of Water Affairs and Forestry (DWAF)[2] (2008) "A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". All features are mapped according to their ecological sensitivity;

- The classification of the freshwater ecosystems according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- A high-level discussion of the Ecostatus of the freshwater ecosystems, encompassing aspects such as impacts on the hydraulic regimes, geomorphological processes, water quality and habitat and biota of the freshwater ecosystems; and
- A high-level summary of the goods and services provision of the freshwater ecosystems to the surrounding communities.

Section 6: Identification of key issues

Provides a brief description of potential impacts (direct, indirect and cumulative) for the construction, operation and decommissioning phases of the project.

Section 7: Permit requirements/ as well as regulated areas for development in terms of guidelines or protocols under national or international legislation

Provides information on any licenses required under Angolan Legislation, as well as applicable guidelines or protocols under national or international legislation.

Section 8: Impact Statement and Proposed Management Measures

Provides a brief impact statement of the anticipated impacts associated with the proposed project, and guidelines for managing such impacts. The impact assessment provided by the EAP (SRK) is used to quantitatively assess potential impacts on freshwater ecosystems. In addition, the IFC Good Practice Handbook on Cumulative Impact Assessments (2013) is used as a high-level guide to determine cumulative impacts.

[2] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA). At present, the Department is known as the Department of Water and Sanitation (DWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.

Section 9: Recommendations for Environmental and Social Management Plan (ESMP)

Provides monitoring recommendations for each of the management actions presented in assessment of impacts.

Section 10: Conclusion and impact statement

Summarises key impact assessment findings and recommendations based on the risk assessment outcomes. In addition, this provides an impact statement based on freshwater specialist findings.

2 KEY LEGISLATIVE REQUIREMENTS, NATIONAL AND INTERNATIONAL GUIDELINES

The following legislation was taken into consideration during the assessment. The following section has been compiled from the online data resources and previous studies conducted in Angola:

- The Constitution of the Republic of Angola (2010);
- The General Environmental Law No. 5/98;
- Decree No.117/20 on General Regulation for Environmental Impact Assessment and Environmental Licensing Procedure;
- Water Law No. 6/02;
- Presidential Decree No. 26/20 (National Biodiversity Strategy and Action Plan 2019-2025);
- Presidential Decree No. 194/11 on Liability on Environmental Damage;
- Presidential Decree No. 261/11 on Water Quality;
- Presidential Decree No. 190/12 on Waste Management;
- Presidential Decree No. 82/14, approves the Regulation on the General Use of Water Resources,

The following subsection focuses on the Good International Industry Practice (GIIP) standards:

- International Finance Corporation (IFC) Environmental Health and Safety Guidelines and Performance Standards (2007).
    - **Performance Standard 1**: Assessment and Management of Environmental and Social Risks and Impacts - Underscores the importance of managing environmental and social performance throughout the life of a project.
    - **Performance Standard 3**: Resource Efficiency and Pollution Prevention - Recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.
    - **Performance Standard 4**: Community Health, Safety, and Security - Recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.
    - **Performance Standard 5**: Land Acquisition and Involuntary Resettlement - Recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land.

- **Performance Standard 6**: Biodiversity Conservation and Sustainable Management of Living Natural Resources - Recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development.

- Equator Principles (The Equator Principles Association, 2011):
  - The Equator Principles aim to ensure that all companies that apply to the Equator Principles Financial Institution (EPFI) for capital are utilising natural resources responsibly and with focus on sustainability of their operations. The Equator Principles further aim to ensure that any development projects in foreign countries are managed to the same level as they would be in a more developed country, or the country of origin in which the development corporation is based.

3 ASSESSMENT APPROACH AND METHODOLOGY

3.1 Scope of Work

Specific outcomes in terms of this report are outlined below:

- A background study of relevant international and national datasets (such as the Freshwater Ecoregions of the World and the World Database on Protected Areas) was undertaken to aid in defining the PES and EIS of the freshwater ecosystems;
- A description and delineation of all freshwater ecosystems associated with the MR201 according to the Department of Water Affairs and Forestry (DWAF)[3] (2008) "A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". All features are mapped according to their ecological sensitivity;
- The classification of the freshwater ecosystems according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- A high-level discussion of the ecological integrity of the freshwater ecosystems, encompassing aspects such as impacts on the hydraulic regimes, geomorphological processes, water quality and habitat and biota of the freshwater ecosystem;
- A high-level summary of the goods and services provision of the watercourses to the surrounding communities;

[3] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA). At present, the Department is known as the Department of Water and Sanitation (DWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.

- The Ecoservices of the freshwater ecosystems were assessed according to "A technique for rapidly assessing ecosystem services supplied by wetlands" (Kotze *et al*., 2020);
- The SRK impact assessment methodology was applied to identify potential impacts that may affect the identified freshwater ecosystems as a result of the activities associated with the proposed Cassinga powerline project and aim to quantify the significance thereof; and
- To present management and mitigation measures which should be implemented going forward to assist in minimising the impact on the receiving environment.

3.2 Freshwater Ecosystem Definition

Wetlands are defined by the Ramsar Commission as "*areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres*". As per this definition, a wetland also contains "*riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands*" (Article 2.1, Ramsar Commission). These "riparian zones of habitats" includes vegetation, known as "riparian vegetation", occurring within the area between the water body and the surrounding higher lying areas.

Wetlands of Angola, according to the Food and Agriculture Organization of the United Nations (FAO) are divided into marine, estuarine, riverine, lacustrine, and palustrine systems. These wetlands are found in five hydrographic zones of the Zaire, Cuanza, Zambezi, Cunene, and Cubango basins. According to FAO, of the total land area of the country of 1 246 700 km^2, wetlands occupy approximately 5 750 km^2 of the land area (4.6%), however no systematic inventory of wetlands has been carried out in Angola. These wetlands occur in the form of sponges, dambos, floodplains, and various types of coastal wetlands, defined as follows:

- Swamps – these are vast, usually inundated, depressions that consist essentially of floating vegetation and wet peaty land;
- Floodplains – these are zones along major river systems that are low-lying and are seasonally flooded; and
- Dambos – these are 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; and

- Valley bottoms – these are characterised by their location on valley floors and the absence of characteristic floodplain features. Dominant water inputs to these wetlands are from the river channel flowing through the wetland, either as surface flow resulting from flooding or as sub surface flow, and/or from adjacent valley-side slopes (as overland flow or interflow). In Angola, valley bottom wetlands have always supported small-scale (largely subsistence) agriculture. Flood recession agriculture on riverside fields called "Nakas" is practised (locally used term). Most of the soils found in these valley bottoms are hydromorphic.

According to RAMSAR, wetlands as defined above are areas which support vegetation, known as “riparian vegetation”, occurring within the area between the water body and the surrounding higher lying areas. These “riparian zones of habitats” include vegetation, known as “riparian vegetation”, occurring within the area between the water body and the surrounding higher lying areas. Ramsar does not provide a definition of riparian habitat, thus, since riparian habitat is sometimes associated with watercourses and is considered an integral part of a watercourse, the extent of riparian vegetation was included in the delineations presented in this report.

In order to further refine the definition of wetland and riparian habitat, the definitions as provided in neighbouring countries’ legislation were also consulted. In this regard, South Africa’s National Water Act, 1998 (Act 36 of 1998) provides a detailed definition of both wetland and riparian habitat, as follows:

Wetland means-
“Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

Riparian habitat includes-
“The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas”.

For the purposes of this report, the terms “watercourse” and “drainage systems” comprise both wetlands (including swamps, sponges, floodplains, and dambos as defined above) as well as

rivers with an associated riparian zone. Where it is necessary to distinguish between such features, the specific term is utilized.

3.3 Delineation of Freshwater Ecosystems

Taking the definitions above (Section 2.2) for wetland and riparian habitat into consideration, the delineation of the various watercourses (which includes dambos/wetlands and rivers) were initially undertaken using desktop methods, making use of historical and current digital satellite imagery, and was based on identifying features displaying a diversity of digital signatures. In this regard, specific mention is made of the following:

- Vegetation associated with wetlands and riparian zones: a distinct increase in density as well as shrub size near flow paths;
- Hue: with water flow paths often showing as white/grey or black and outcrops or bare soils displaying varying chroma created by varying vegetation cover, geology and soil conditions; and
- Texture: with areas displaying various textures, created by varying vegetation cover and soil conditions.

These delineations were subsequently verified and, where necessary, refined, during the site assessment undertaken in April 2024.

3.4 Characterisation of Freshwater Ecosystems

Factors influencing the habitat integrity of the freshwater ecosystems identified during the field surveys were noted, and the functioning, ecological and socio-cultural goods and services (Ecoservices) provided by the various features was assessed. 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 to ensure the most appropriate and accurate characterisation of the resources. Whilst detailed assessments of the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and goods and services provision were not undertaken, the methods referred to above were utilised as a guideline to gauge the ecostatus of the drainage systems.

In addition to the delineation of the freshwater ecosystems, field observation of the systems was undertaken at as many points of interest as possible, to define the following important aspects of the wetland ecology:

- Wetland characterisation and classification was undertaken according to the method of Ollis *et al.,* (2013);

- The ecostatus of the freshwater ecosystems, encompassing aspects such as hydraulic connectivity and regimes, geomorphological processes, water quality, habitat and biota. In assessing the ecostatus, impacts to the aforementioned aspects are taken into consideration; and
- Provision of goods and services of the freshwater ecosystems to the surrounding communities, including ecological service provision which may not necessarily be of direct benefit to humans but is crucial to the ongoing ecological functioning of the environment as a whole.

3.5 Sensitivity Mapping

All freshwater ecosystems associated with the proposed Cassinga powerline were delineated using desk based methods, the delineations were ground-truthed in the field at certain pre-selected points, where possible, with the use of a Global Positioning System (GPS). Geographic Information System (GIS) software was used to project these features onto digital satellite imagery and topographic maps. Where necessary ground truthing of digital satellite imagery was used to refine the delineations developed using desk-based methods.

The sensitivity (setback) maps in Section 7 should be used to guide the design and layout of the proposed Cassinga powerline project, particularly the placement of laydown areas, powerline towers and any access roads to construction sites. Due to the extent and complex hydraulic connectivity of these drainage systems, the extent of the study area, and nature of the terrain preventing access to much of the study area, it was not feasible to access nor assess each system individually. Therefore, extrapolation of the extent of the features was undertaken by comparing data verified *in-situ* to high resolution digital satellite imagery to map features across the study area. Despite this, the observations made are deemed sufficient to ensure that informed decision making can be undertaken.

3.6 Impact Assessment and Recommendations

Following the completion of the assessment, an impact assessment as provided by the EAP was applied (please refer to Appendix D for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed Cassinga powerline project. These recommendations also include general ‘best practice’ management measures, which apply to proposed Cassinga powerline project as a whole, and which are presented in Appendix F. Mitigation measures have been developed to address issues in all phases throughout the life of the proposed Cassinga powerline project including construction, operation and rehabilitation. The detailed site-specific mitigation measures are outlined in Section 6 of this report.



3.7 Assessment of 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 categorized into provisioning, regulating, supporting, and cultural services.

Regarding Type I and Type II ecosystem services, the IFC categorizes 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.

4 PROPOSED ACTIVITIES POSING POTENTIAL IMPACTS TO FRESHWATER ECOSYSTEMS

The below table presents activities associated with the proposed Cassinga powerline project that will potentially pose impacts to the freshwater ecosystems within the development footprint during the construction and operation phases of the project. In addition to the activities, the following considerations were made:

- The activities relating to the proposed Cassinga powerline project are all highly site specific, although activities such as clearing of vegetation along the powerline corridor route may result in a cumulative impacts;
- While the operation of the powerline and associated infrastructure will be a permanent activity, the construction thereof is envisioned to take approximately two (2) years to complete; and
- It is highly recommended that the proponent make provision for small-scale rehabilitation of the areas of the freshwater ecosystems which may be directly impacted upon by construction activities. The area must preferably be rehabilitated to

conditions as close as possible to the “preconstruction” state, and where feasible, these rehabilitation efforts must seek to improve site conditions.

Table 1: List of activities associated with the proposed Cassinga powerline project.

Proposed Activity	Activity Description
Construction Phase	
Site preparation prior to construction activities including clearing of vegetation within the development footprint.	The site preparation will take place prior to any construction activities associated with the project. This phase generally includes planning for infrastructure, access and site camps layouts. In addition, site preparation includes clearing vegetation for servitudes and substation platforms, access paths construction and the establishment of temporary construction camps and laydown areas for materials and equipment.
Groundbreaking activities for construction of the support structures and spanning of the proposed powerline.	This phase includes earthworks such as digging the ground/excavating for the construction of structural foundations, particularly for powerline support structures including levelling the site to the required elevation. Spanning/stringing of the powerline involves hanging conductors (wires) between transmission towers or utility poles to create an electrical pathway for transmitting power.
Construction activities associated with the erection of new substations	This activity includes earthworks and excavations associated with the construction of new substations for power distribution and the construction of foundations including construction for management of stormwater infrastructure within the footprint of the substation.
Transportation of infrastructure and storage of equipment.	This activity generally involves the movement of vehicles and personnel throughout the construction areas associated with the powerline project. In addition, it includes the stockpiling of powerline/substation material within the development footprint.
Operation Phase	
Operation and maintenance of the powerline infrastructure including substations and access route.	This activity includes the operation and maintenance of the powerline infrastructure including powerline servitude. Other general activities include management of vegetation within the servitude during routine maintenance or during operational failure.
Rehabilitation within disturbance areas associated with the proposed powerline.	This activity includes the rehabilitation of areas that were disturbed during the construction phase of the powerline and associated infrastructure. This includes levelling, revegetation of cleared areas and removal of any rubble within construction footprint following construction activities.

5 FRESHWATER ECOSYSTEM ASSESSMENT

5.1 Results: Freshwater Desktop Analysis

The following section contains data accessed as part of the desktop assessment. It is important to note that although all data sources used provide useful and often verifiable high-quality data, the various databases do not always provide an entirely accurate indication of the site specific biodiversity characteristics.

5.1.1 World Database on protected areas

According to the World Database on Protected Areas (UNEP-WCMC, 2024), the proposed Cassinga powerline and investigation area are not associated with a protected area.

5.1.2 Aquatic Ecoregion

According to the WWF FEOW (Freshwater Ecoregions of the World, http://www.feow.org/ecoregions/) classification, the entire extent of the proposed Cassinga powerline and associated investigation area is located within the Zambezian Headwaters Ecoregion (reference number 555).

5.1.3 Zambezian Headwaters

The major Upper Zambezi tributaries in the ecoregion are the Lungwebungu, the Luanginga, the Cuando, the Luena, the Dongwe, and the Kabompo Rivers (Bell-Cross 1972). The major tributary of the Kafue is the Lunga River. The Okavango tributaries: the Cubango and the Cuito, arise on the plateau of central Angola, and the Cunene River (1200 km long) arises in west-central Angola. The Cunene's flow is disrupted by a series of rapids and by the 122 m high Ruacana Falls, located at the divide between the rim of the continental plateau and the Atlantic coastal slope (Roberts, 1975).

5.1.4 Boundaries

The fast-flowing Zambezian headwater streams contribute to two major sub-Saharan rivers: the Zambezi and the Okavango. The ecoregion extends from the Okavango catchment in the west to the headwaters of the Kafue River in the east and includes the headwaters of the Upper Zambezi River. The majority of the rivers drain the interior of Angola, but parts of the upper Zambezi and the upper Kafue flow through northern Zambia. The headwaters of the Zambezi share a common watershed divide with the Congo River Basin to the northeast, and with the headwaters of the Cuanza and other westward draining rivers of Angola to the northwest.



5.1.5 Freshwater Habitats

The rivers of this ecoregion are permanent and characterized by steep gradients in places. However, these rivers are unlike many mountain headwaters in that high gradient zones are discontinuous (Allanson *et al.,* 1990).

5.1.6 Endangered and vulnerable fish species

The tables below list fish species are considered at risk of becoming extinct in the absence of conservation efforts and species considered vulnerable (Ministry of the Environment, 2018). Although the database lists a number of other fish species considered vulnerable or at risk of extinction, these fish species were mostly marine rather than freshwater species.

Table A: List of species that are considered vulnerable.

Species	Common name	Family	Status	Habitat
Ethmalosa fimbriata	*Bonga Shad*	Dorosomatidae	VU	Marine, brackish
Arnoglossus capensis	Cape Scaldfish	Bothidae	VU	Marine

Neither of these species are relevant to the proposed development due to geographical distributions that do not coincide with the study area and habitat limitations.

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, 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.

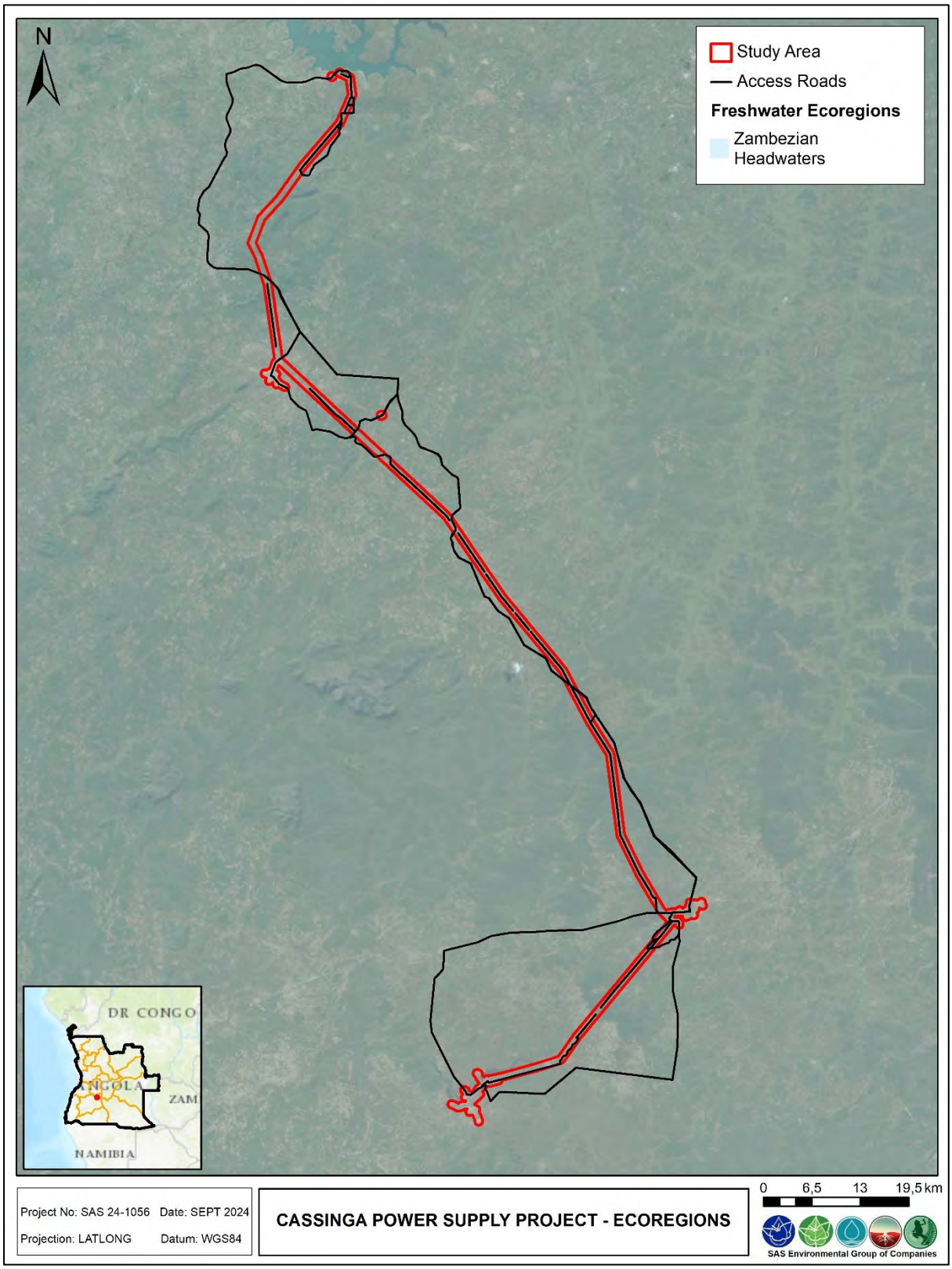


Figure 5: Aquatic Ecoregion associated with the proposed Cassinga powerline investigation area (INHR, 2016).

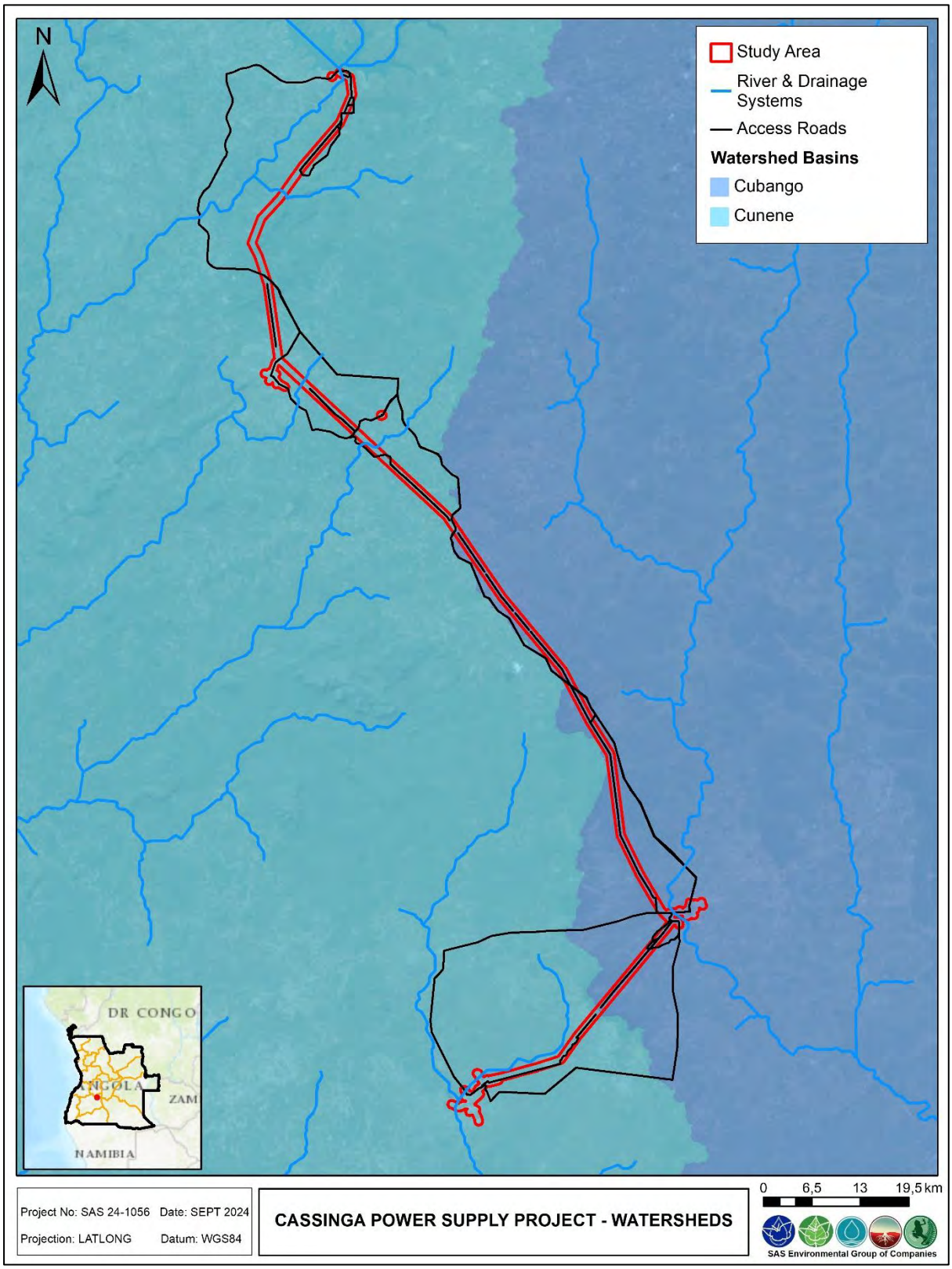


Figure 6: Basins, rivers and drainage systems associated with the proposed Cassinga powerline and investigation areas

5.2 Results: Freshwater Ecosystem Assessment

5.2.1 Delineation of freshwater ecosystems

Figures 8 to 13 below depict the position of the various wetland systems within the study area 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 7) 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;



Figure 7: 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.

- 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. Despite this, in some of the dambo systems, various sedge species, orchids, and graminoid species adapted to moist conditions were identified.

5.2.2 Freshwater ecosystem definition and characterisation

In preparation for the field assessment, aerial photographs, digital satellite imagery and available wetland databases were used to identify areas of interest at a desktop level. All possible measures were undertaken to ensure all freshwater ecosystems which may be affected by the proposed Cassinga powerline were identified, delineated and assessed. During the site assessment conducted over five days April 2024, numerous extensive drainage systems were identified within the study area, many of which are interlinked and extend far beyond the boundaries of the study area.

The identified freshwater ecosystems were classified using the guidelines provided by Ollis *et al*., (2013) (please refer to Appendix A) but taking into consideration the descriptions of wetlands commonly used in Angola as outlined in Section 3.1 of this report. At a high level, these watercourses were classified as Inland Systems falling within the Zambezian Headwaters Aquatic Ecoregions. The identified drainage systems comprised four primary hydrogeomorphic (HGM) types: 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.

Table 2: 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 Zambezian 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.
		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.
	Plain: an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land	**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.

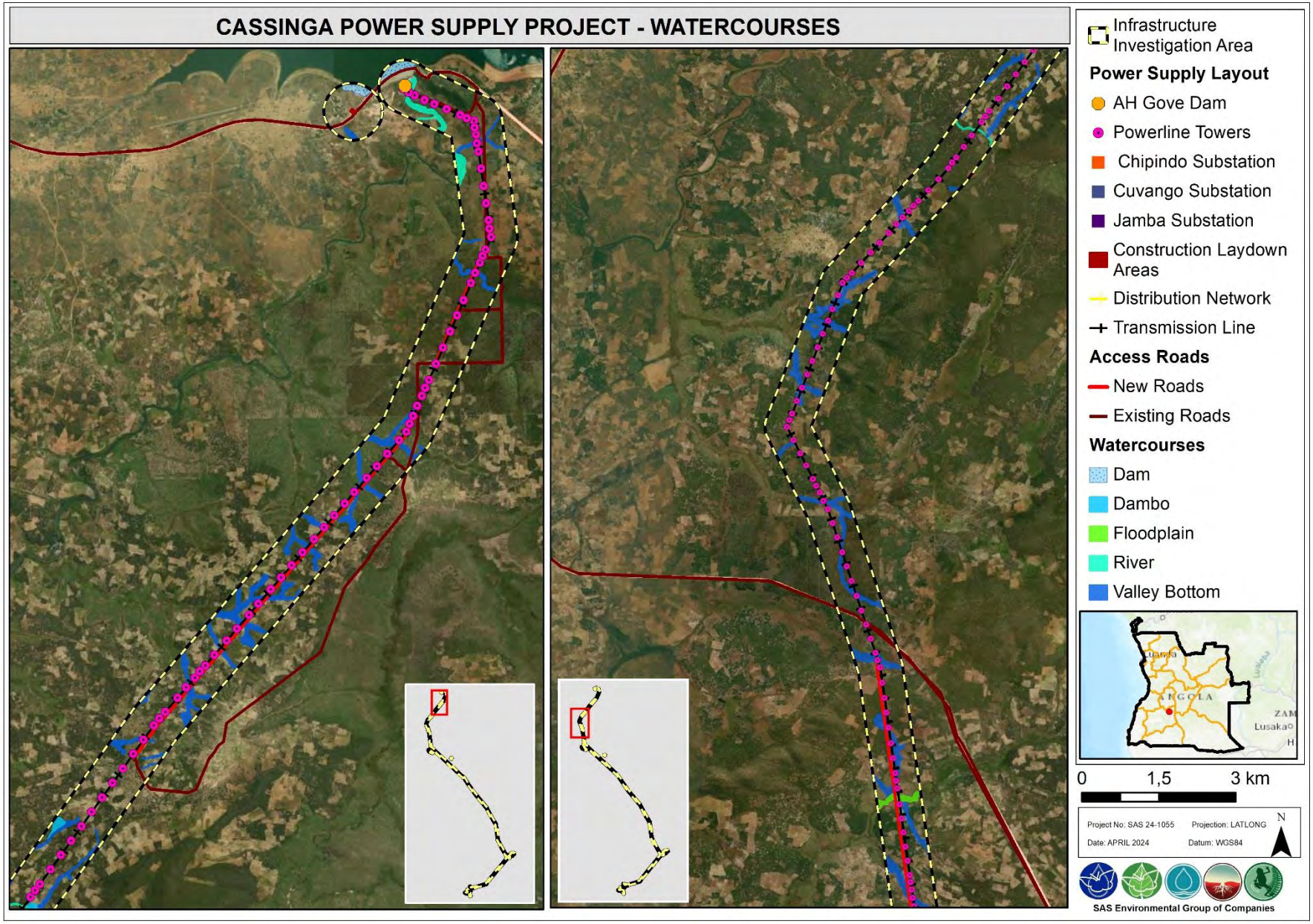


Figure 8: The location of the delineated freshwater ecosystems (northern) associated with the proposed Cassinga powerline project.

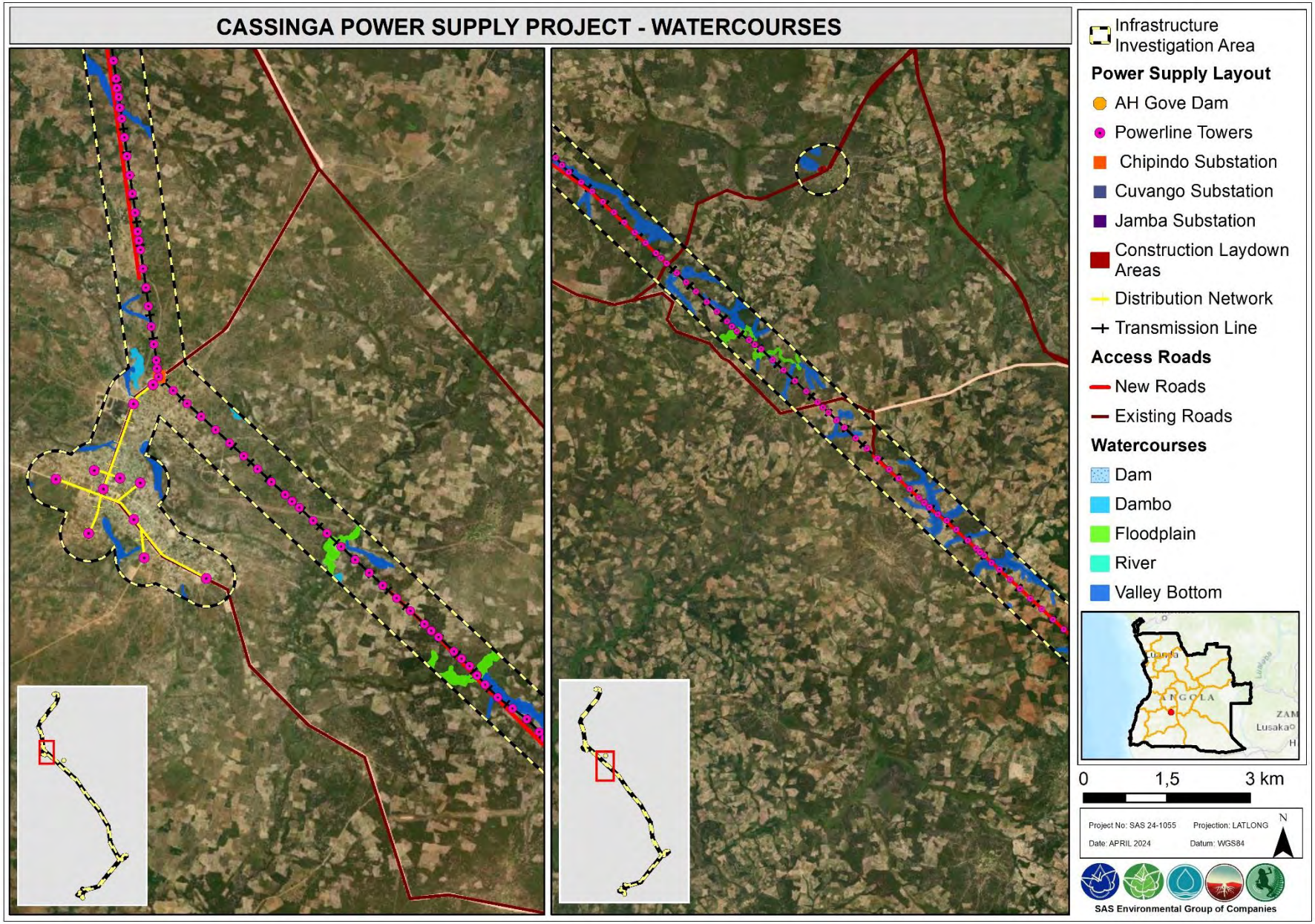


Figure 9: The location of the delineated freshwater ecosystems (northern to central) associated with the proposed Cassinga powerline project.

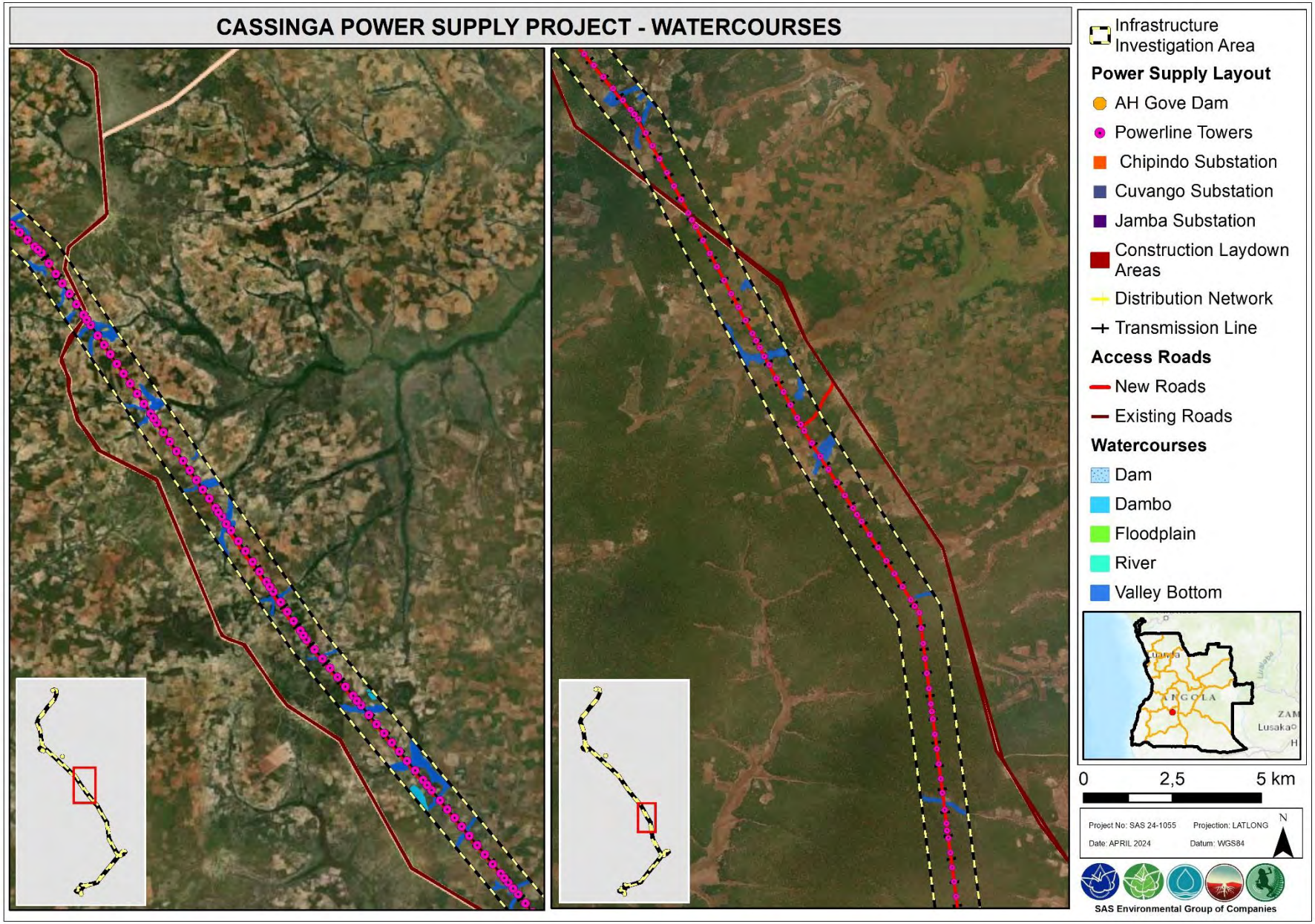


Figure 10: The location of the delineated freshwater ecosystems (central to southern) associated with the proposed Cassinga powerline project.

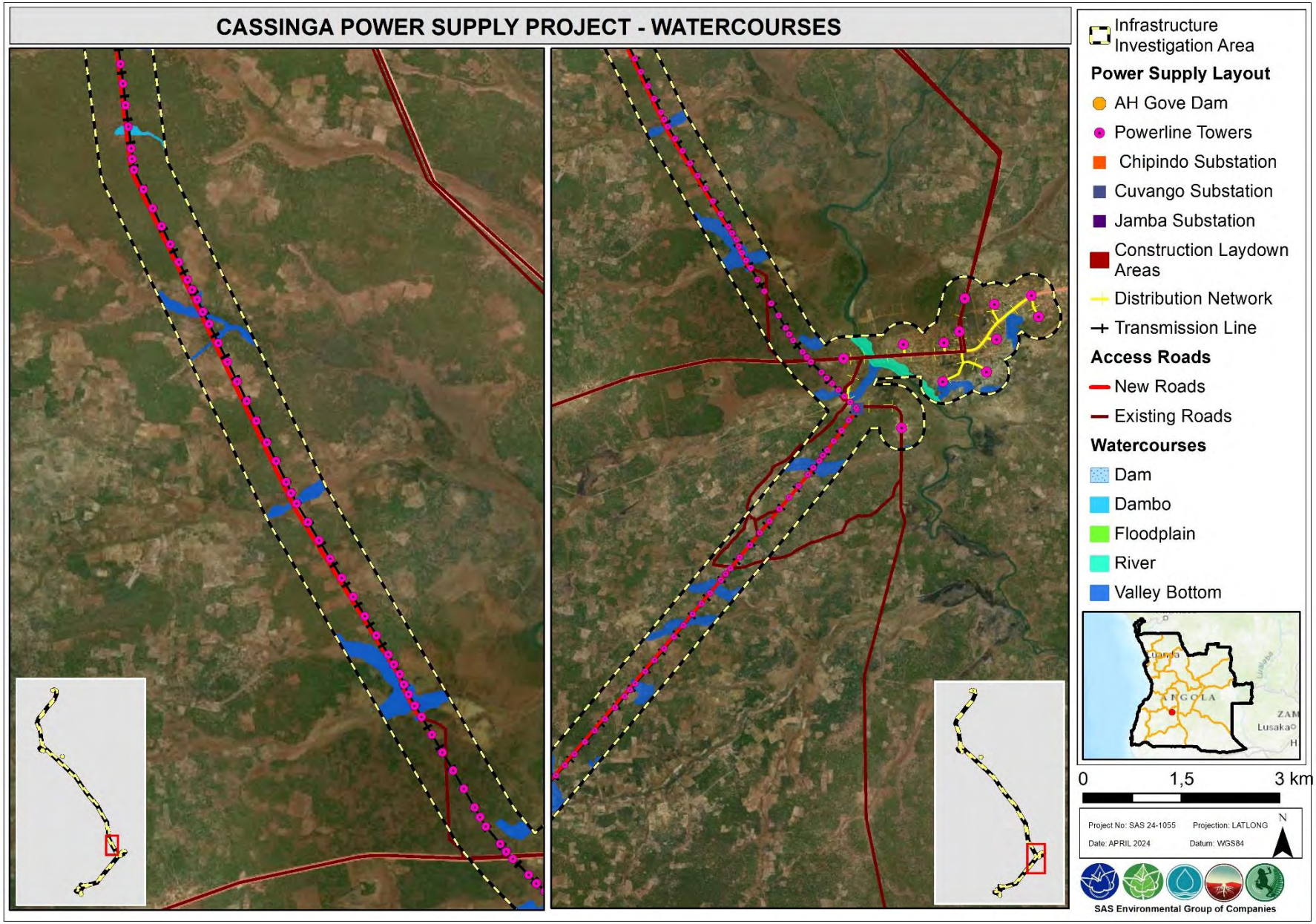


Figure 11: The location of the delineated freshwater ecosystems (southern) associated with the proposed Cassinga powerline project.

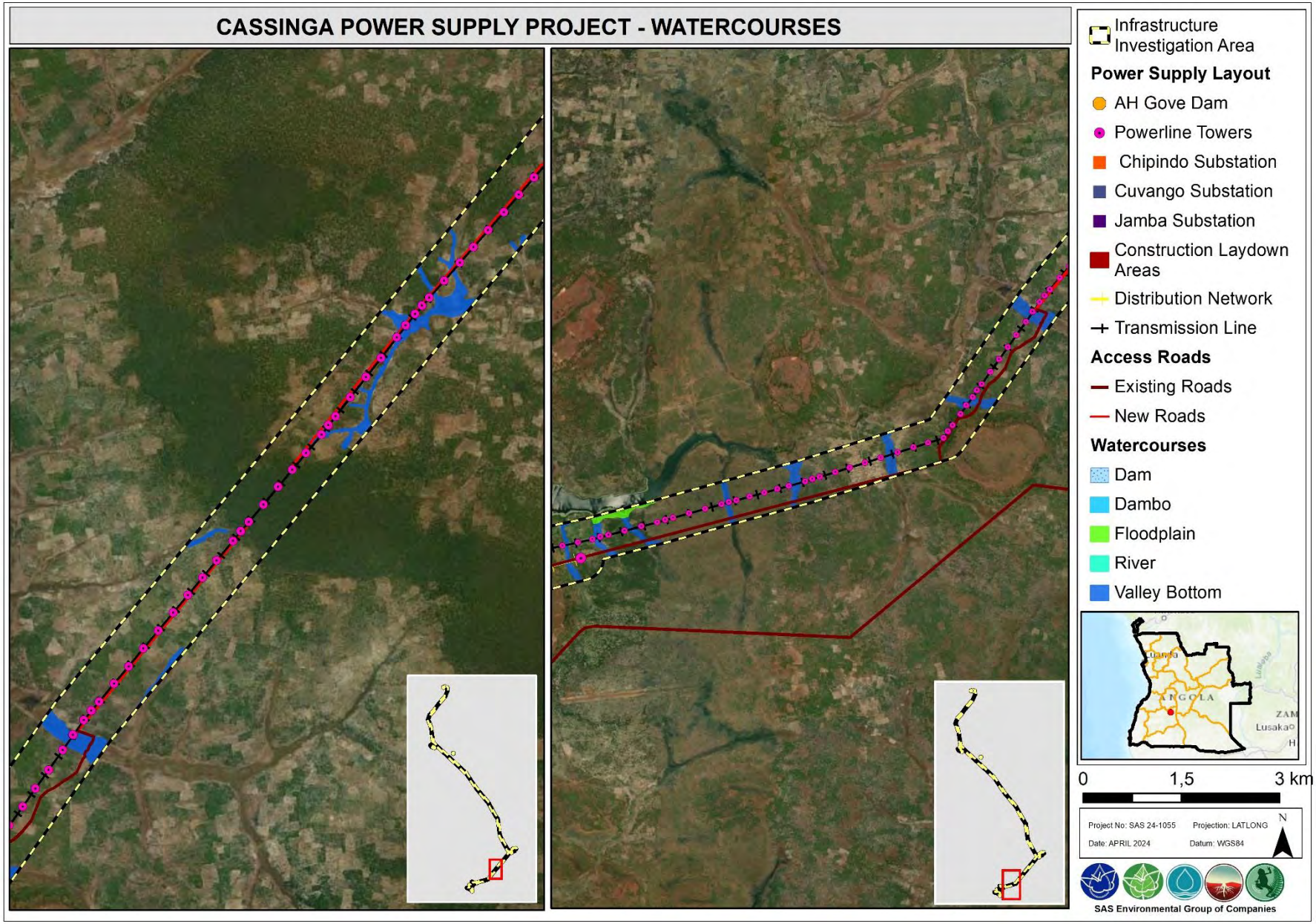


Figure 12: The location of the delineated freshwater ecosystems (southern) associated with the proposed Cassinga powerline project.

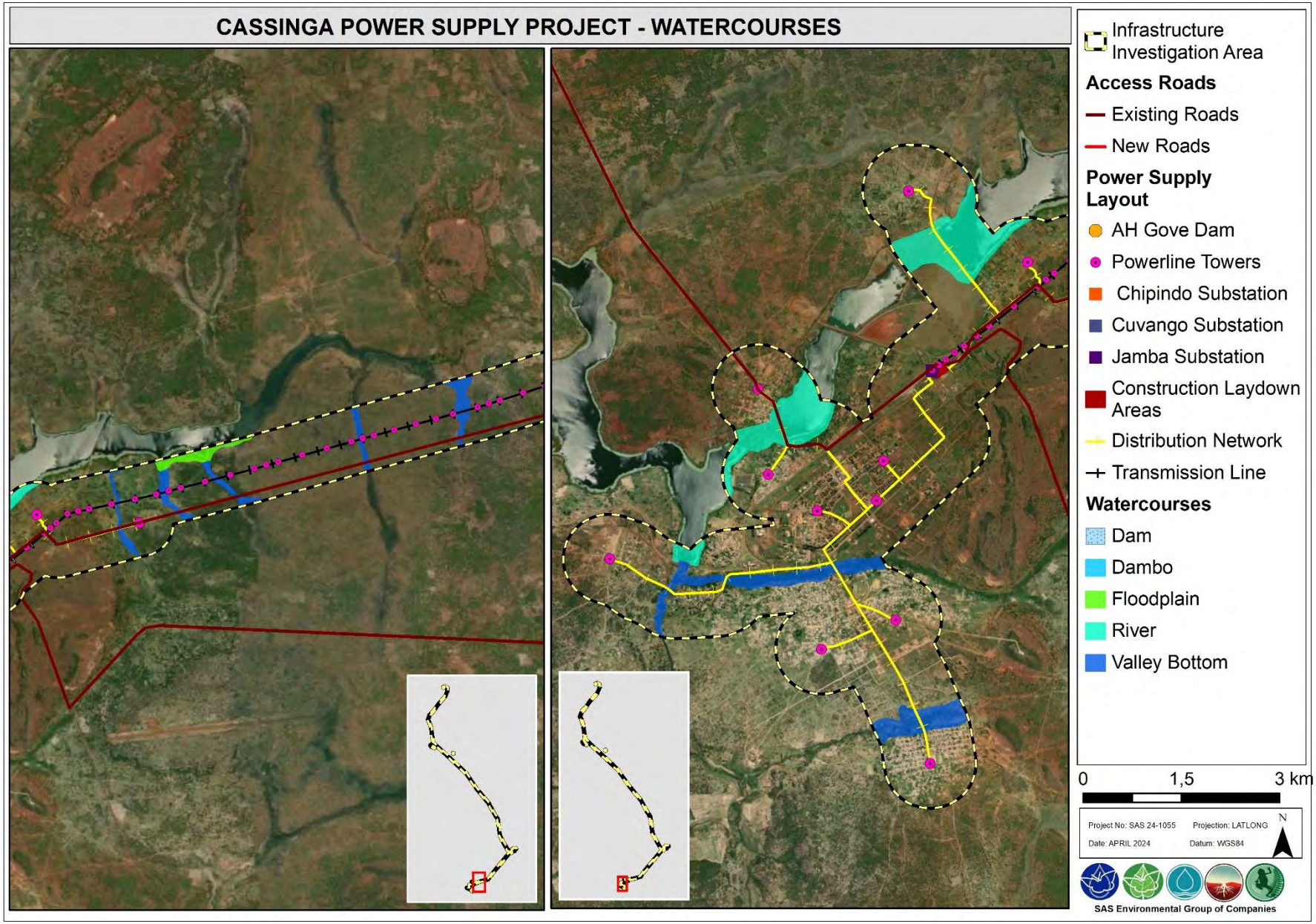


Figure 13: The location of the delineated freshwater ecosystems (southern) associated with the proposed Cassinga powerline project.

5.2.3 Freshwater Ecosystem Analysis and Discussion

Whilst there were distinct differences between the different HGM types (e.g. between the rivers with associated riparian zones and rivers with an associated floodplain), it was noted during the site assessment that conditions were largely homogenous within each group of the various drainage systems. Therefore, having been subjected to similar anthropogenic impacts (cultivation, cattle trampling and instream crossings), the ecoservice provision, hydrological regime, geomorphological characteristics, water quality and habitat of these systems were assessed in a combined fashion.

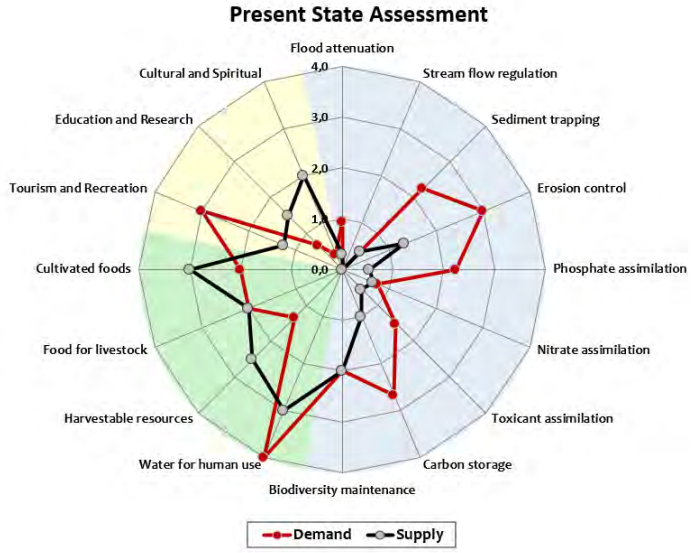
For the purposes of this report, the freshwater ecosystems were discussed in terms of system type (e.g. river, channelled valley bottom, dambo), key characteristics, ecostatus including ecological integrity, sensitivity and importance, and in terms of goods and services provision. The latter is considered of particular importance in the context of the rural setting of the study area.

The dashboard style reports below summarise the findings of the field verification in terms of relevant aspects (hydrology, geomorphology and vegetation components) of wetland and riparian ecology. These dashboard reports aim to present all the pertinent facts pertaining to each system in as concise and visually appealing a manner as possible and in as limited a space as possible and preferably on one page.

Table 3: Summary of the assessment of the rivers identified during the field assessment. The rivers include the Cunene River (associated with Gove dam), Cubango River (located in Cuvango) and Cuandeja River (located in Jamba) associated with the proposed Cassinga powerline project.



Photograph notes: Representative photographs of the, A - Cunene River (associated with Gove dam), B - Cubango River (located in Cuvango) and C - Cuandeja 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".



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 Cuandeja 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.

<table>
<tr><td>Goods and Services Provision</td><td>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.</td><td colspan="2">pH: 6.53
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.</td></tr>
<tr><td>Ecostatus discussion</td><td>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.</td><td>Extent of modification anticipated</td><td>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.</td></tr>
<tr><td colspan="4">Consideration of Integrated Environmental Management and Sustainable Development principles:</td></tr>
<tr><td colspan="4">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.</td></tr>
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Table 4: Summary of the assessment of the valley bottom systems associated with the proposed Cassinga powerline project.







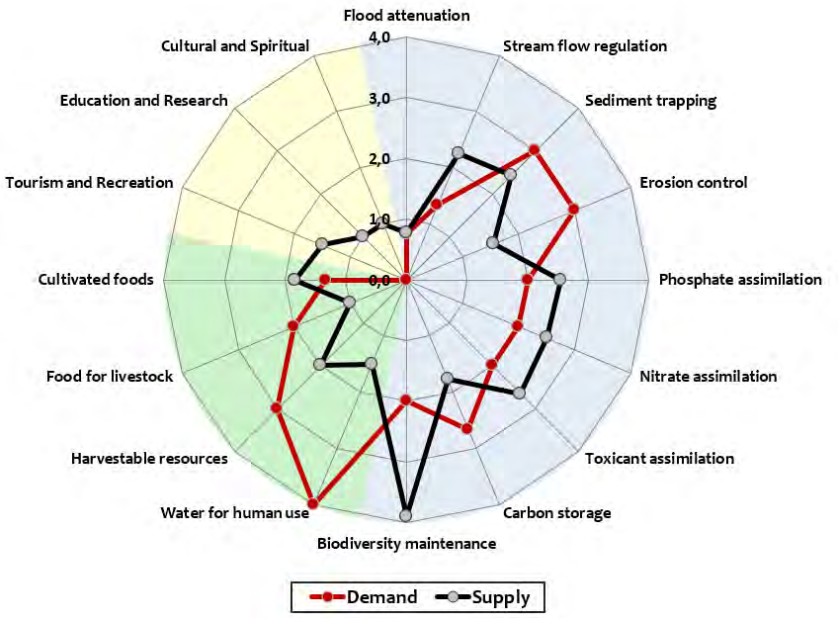
Photograph notes: Various channelled and unchannelled valley bottom wetland systems noted during the site assessment. Significant rainfall was received during the week of the field work resulting in standing ponds observed at the time.







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.



Goods and Services Provision

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.

Watercourse characteristics relating to ecostatus discussion:

a) Hydraulic regime

Few informal road crossings impeding flow and resulting in the accumulation of snagged debris (e.g. branches, grass stalks etc.) within the valley bottom system are considered the modifier of the ecological integrity of these systems. Despite the observed woody vegetation that has encroached some portions of these systems, impacts from water reductions were considered low. Similarly, there were limited water reduction activities observed within the assessed reaches, and therefore the hydraulic regime is deemed to be in a largely natural state.

b) Geomorphology and sediment balance

The sediment balance within the valley bottom systems has been impacted by presence of informal road crossings that 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 conducive for the establishment of species that are favour growth in sedimented environments. In addition, disturbance associated with agricultural activities and vegetation removal have also contributed to increased sediment inputs and altered distribution of sediment within the wetland.

c) Water quality

Water quality parameters, where measured, indicated that aside from turbidity observed within some of the valley bottom systems, water quality is relatively unimpaired. This is as anticipated due to the remote geographic setting and the fact that the rivers are more regularly utilised for domestic purposes. Increased nutrients are expected due to increased faecal matter from domestic livestock. Water quality parameters were measured during the high flow survey as follows:
EC – 12.5 mS/m; pH – 7.44 and temperature – 22.1˚C; based on this single assessment, this indicated no limitations for supporting aquatic biota in terms of the measured *in-situ* parameters.

Low flow survey results:
EC: 3.8 mS/m
TDS: 19 ppm
pH: 6.77
Temperature: 12.84° C
Oxygen content: 7.78 mg/ℓ
Oxygen saturation: 88.4%

The measured in situ water quality from the low flow survey indicate that the surface waters remain low in dissolved salts (salinity levels), indicating good water quality. The remaining parameters fall within guideline water quality ranges and are therefore not a limiting factor to supporting aquatic/wetland biota.

d) Habitat and biota

The vegetation within the valley bottom systems was considered to be 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. Species indicative of disturbance or alien and invasives species were predominantly observed along the side of the road/within the road reserve.	
Ecostatus 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.		

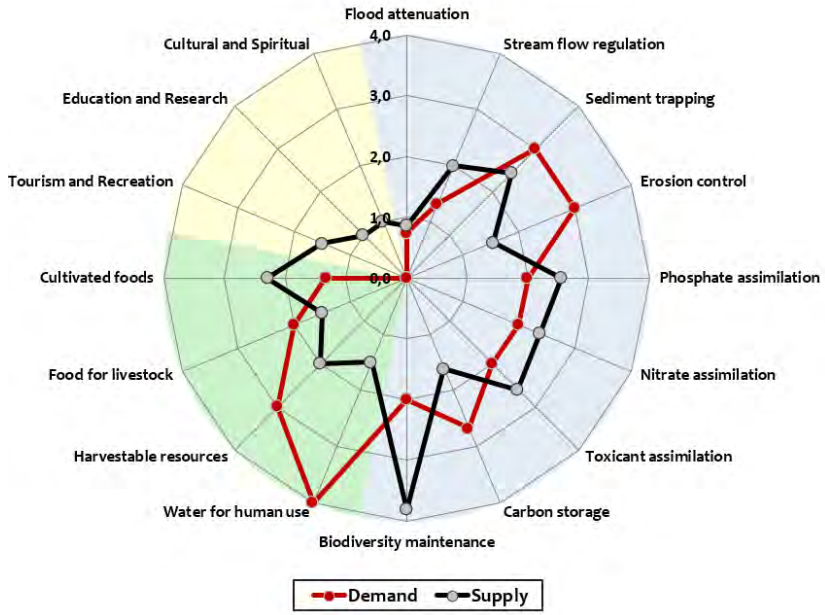
Table 5: Summary of the assessment of the dambos and floodplain wetland systems associated with the proposed Cassinga powerline project.







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:

a) 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.

b) 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.

c) Water quality

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

<table>
<tr><td>Ecostatus discussion</td><td>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.</td><td colspan="2">d) 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 Bidens pilosa and Tagetes minuta.</td></tr>
<tr><td>Goods and Services Provision</td><td>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.</td><td>Extent of modification anticipated</td><td>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.</td></tr>
<tr><td colspan="4">Consideration of Integrated Environmental Management and Sustainable Development principles:</td></tr>
<tr><td colspan="4">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.</td></tr>
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6 IDENTIFICATION OF POTENTIAL IMPACTS

The below table (Table 6) presents potential impacts on freshwater ecosystems associated with the construction and operation phases of the proposed Cassinga powerline project. There are four key ecological impacts on freshwater ecosystems that are anticipated:

- 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.

Table 6: List of the anticipated potential impacts on freshwater ecosystems associated with the construction and operation phases of the proposed Cassinga powerline project.

Construction and Operation Phase	
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 pre-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 discussed above (Section 4), particularly during pre-construction and construction phases, 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.
Consideration of Cumulative Impacts	
Impacts to downstream water users	The runoff generated from construction sites can contain sediment, chemical contaminants, and other pollutants such as oil and diesel, which has the potential to impact on water quality in nearby rivers and wetlands, and affect the use of the water for downstream users. However, given the nature of the proposed development, this impact is not considered severe, particularly in terms of risk of chemical contamination.
Habitat Fragmentation	The construction of powerline infrastructure includes the clearing of vegetation within the powerline servitude. These activities have the potential to result in the loss of freshwater habitat where crossings are required and fragmentation of freshwater habitat.

7 LEGISLATIVE REQUIREMENTS AND BUFFER ZONE RECOMMENDATIONS

7.1 Consideration of Buffer Zones

Presidential Decree No. 82/14, approves the Regulation on the General Use of Water Resources:

This decree applies to surface water and groundwater, namely watercourses, lakes, lagoons, swamps, springs, reservoirs, estuarine areas and other water bodies, without prejudice to the respective watercourse bed, riverbanks and surroundings.

Article 109(2) establishes that holders of rights to use water resources shall in general be prohibited from:

(e) Carry out any activities in the water protection zones."

Article 110 establishes that proponents shall consider a 200 m buffer zone as follows: "areas of protection of water resources, the water course beds, riverbanks and water courses adjacent zones of up to a distance of 200 metres".

In addition to the above recommended buffer zone, based on the specialist's prior experience in neighbouring SADC countries consideration was given to regional guidelines. A 30 m buffer is often stipulated by the Zimbabwean Environmental Management Agency, while in South Africa, legislation stipulates a 32 m development setback around wetlands and rivers.

Therefore, the precautionary principle, which is considered an important component in Integrated Environmental Management, was applied and a 32 m buffer is therefore recommended as a setback for the non-linear components of the proposed projects (e.g., support pylons positions) and for any linear developments running parallel to the freshwater systems. This may not always be practical to implement however, in which case the Preliminary Guidelines for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries (Macfarlane *et al.*, 2015) was applied. Although developed primarily with the South African context in mind, the tool focuses on ecological processes and is flexible enough to allow for regional adaptation and application. On that basis, a 10 m buffer is considered the minimum for all non-permanent infrastructure during the construction phase where a wider buffer cannot be implemented. The recommended buffer areas are depicted in Figure 14 - 19 in relation to the proposed infrastructure footprint. These should be taken into consideration during future planning to ensure that no infrastructure is unnecessarily placed within watercourses or proximity thereof.

7.2 IFC Performance Standards on Environmental and Social Sustainability

The International Finance Corporations (IFC) Sustainability Framework articulates the Corporation's strategic commitment to sustainable development and is an integral part of IFC's approach to risk management. The sustainability framework comprises IFC's Policy and Performance standards on Environmental and Social Sustainability, and IFC's Access to Information Policy. The IFC Performance Standards (PS) are designed to assist the proponent in designing and implementing a project in a manner where risks and impacts associated with the project are identified and mitigated to ensure the project is completed sustainably. The applicant deemed it necessary that the environmental assessment had to consider, were applicable and/or include the Equator Principles as well as Performance Standards 1,3,4,6 and 8. For a detailed description of the Performance Standards please see Appendix B.

In the context of the freshwater assessment the following IFC Performance Standards are applicable:

- Performance Standard 1 (IFC PS1) – Assessment and Management of Environmental and Social Risks and Impacts; and
- Performance Standard 6 (IFC PS6) – Biodiversity Conservation and Sustainable Management of Living Natural Resources.

IFC PS1 is applicable to all projects which pose potential risk and may have an impact on the receiving environment. IFC PS1 (2012) states that should the host country have legislative control for the management of the environment that overlaps with the guidelines of the IFC standards, the more stringent measure should be implemented for the project. The objectives of IFC PS1 (2012), where applicable to the freshwater assessment, are summarised as follows:

- The identification and quantification of environmental risks and impacts associated with the proposed powerline project, as well as the identification of -mitigation measures to be implemented at the site to minimise or avoid said risks and impacts (Please see Sections 4 and 6 for the risks and mitigation measures pertaining to the proposed Cassinga powerline project);
- To encourage and ensure that the proponent runs the project as sustainably as possible using efficient and effective environmental management plans; and
- To ensure that relevant stakeholders (e.g. local communities, government, etc.) are aware of the project and their respective communications and queries are responded to and managed effectively.

IFC PS6 recognises that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The objectives of IFC PS6 are:

- To protect and conserve biodiversity;
- To maintain the benefits from ecosystem services; and
- To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

In a development context, IFC PS 6 states that the proponent (a developer) must 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;
- Any conversion or degradation is mitigated according to the mitigation hierarchy; and
- The IFC PS 6 stipulates that in areas of natural habitat, mitigation measures will be designed to achieve no nett loss of biodiversity where feasible. No nett loss of biodiversity is defined in the PS as:
    - the point at which project-related impacts on biodiversity are balanced by measures taken to avoid and minimise the project's impacts, to undertake on-site restoration and finally to offset significant residual impacts, if any, on an appropriate geographic scale.

Appropriate actions to ensure no nett loss of biodiversity 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.

The proposed Cassinga powerline project has the potential to avoid direct impacts on the freshwater ecosystems by ensuring sufficient spanning of powerline support structures. This will ensure a no nett loss of freshwater biodiversity and largely avoiding potential impacts in line with the mitigation hierarchy. Given that the project is linear infrastructure, the crossing of the freshwater ecosystems will take place and development of access roads into the construction sites would result in a series of direct and indirect impacts on the freshwater ecosystems, especially considering that there is no road footprint at some of the crossing

locations. However, a series of mitigation measures to reduce or negate negative impacts have been stipulated (refer to Section 6) which will only result in impacts of low magnitude.

The freshwater ecosystems associated with the proposed Cassinga powerline project were also categorised according to the relevant IFC defined habitat categories. For a detailed discussion on the habitat categories please see Appendix J.

The freshwater ecosystems fall within the **natural habitat category** as the freshwater ecosystems are "*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 the natural habitats as the direct impacts on the freshwater ecosystems have the potential to be largely been avoided, as per the mitigation hierarchy, and effective mitigation measures to prevent direct or indirect impacts have been stipulated (Section 8 and Appendix F) to ensure no nett loss of aquatic biodiversity occurs.

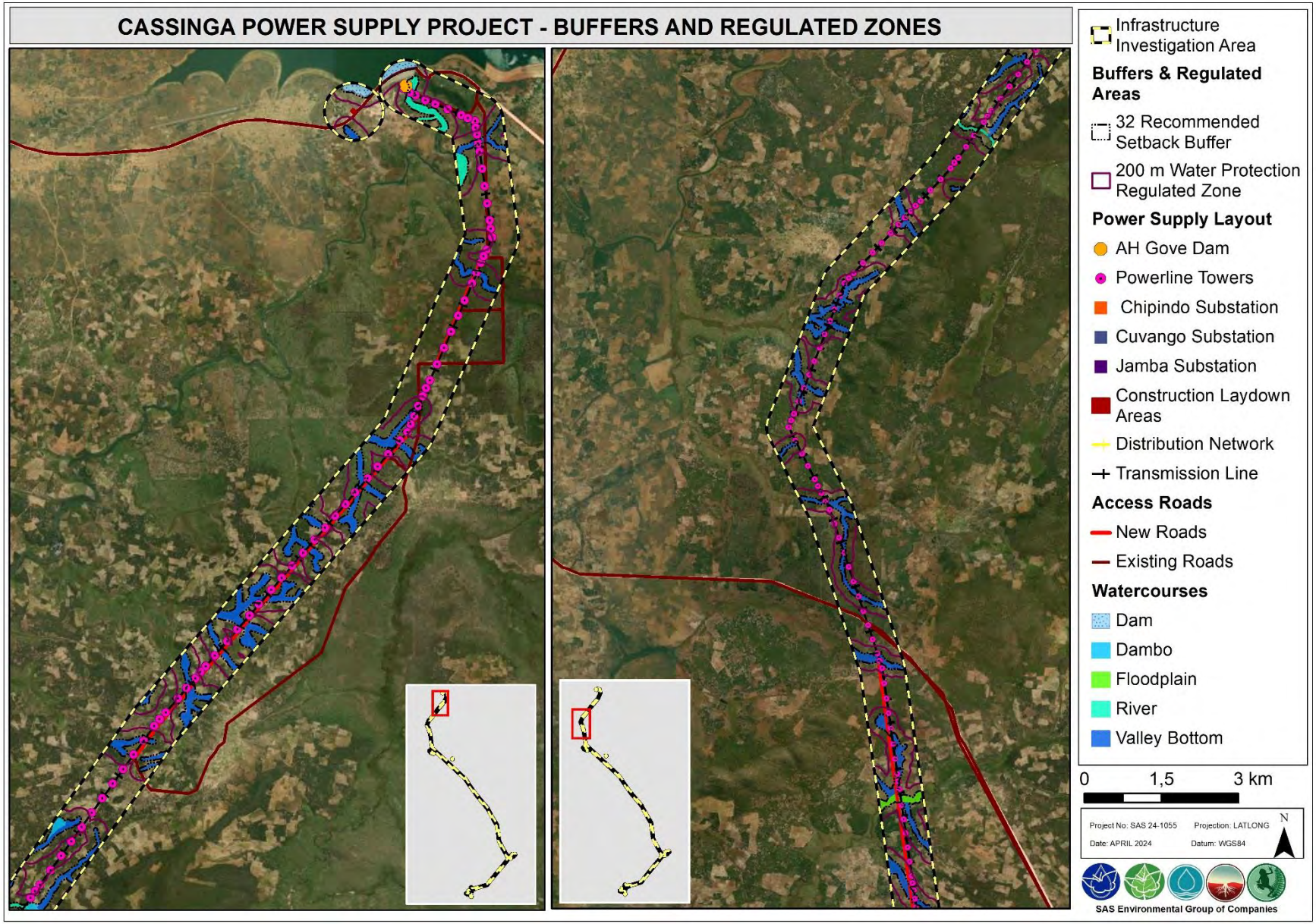


Figure 14: The location of the delineated freshwater systems including buffer zones associated with the proposed Cassinga powerline project.

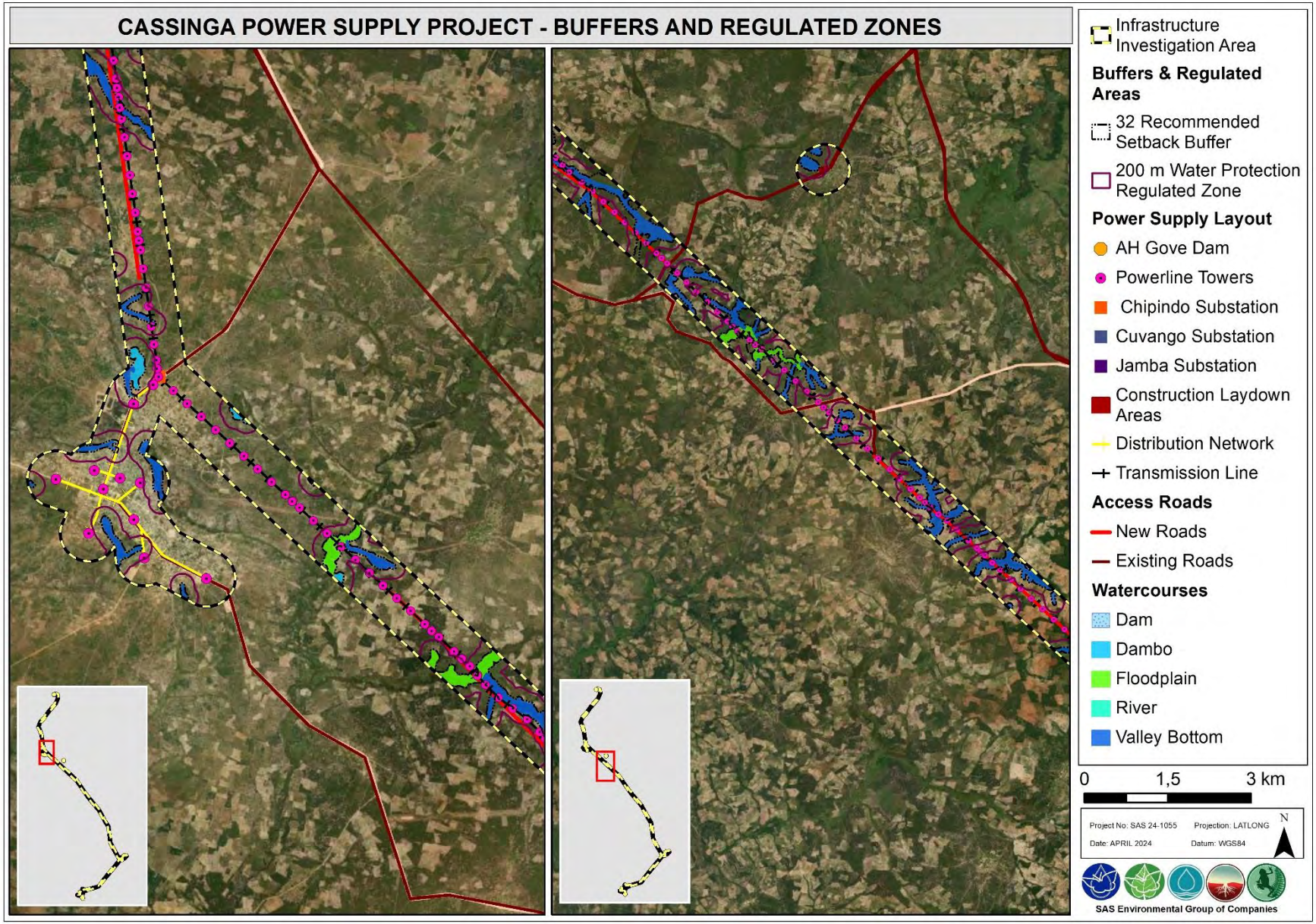


Figure 15: The location of the delineated freshwater systems including buffer zones associated with the proposed Cassinga powerline project.

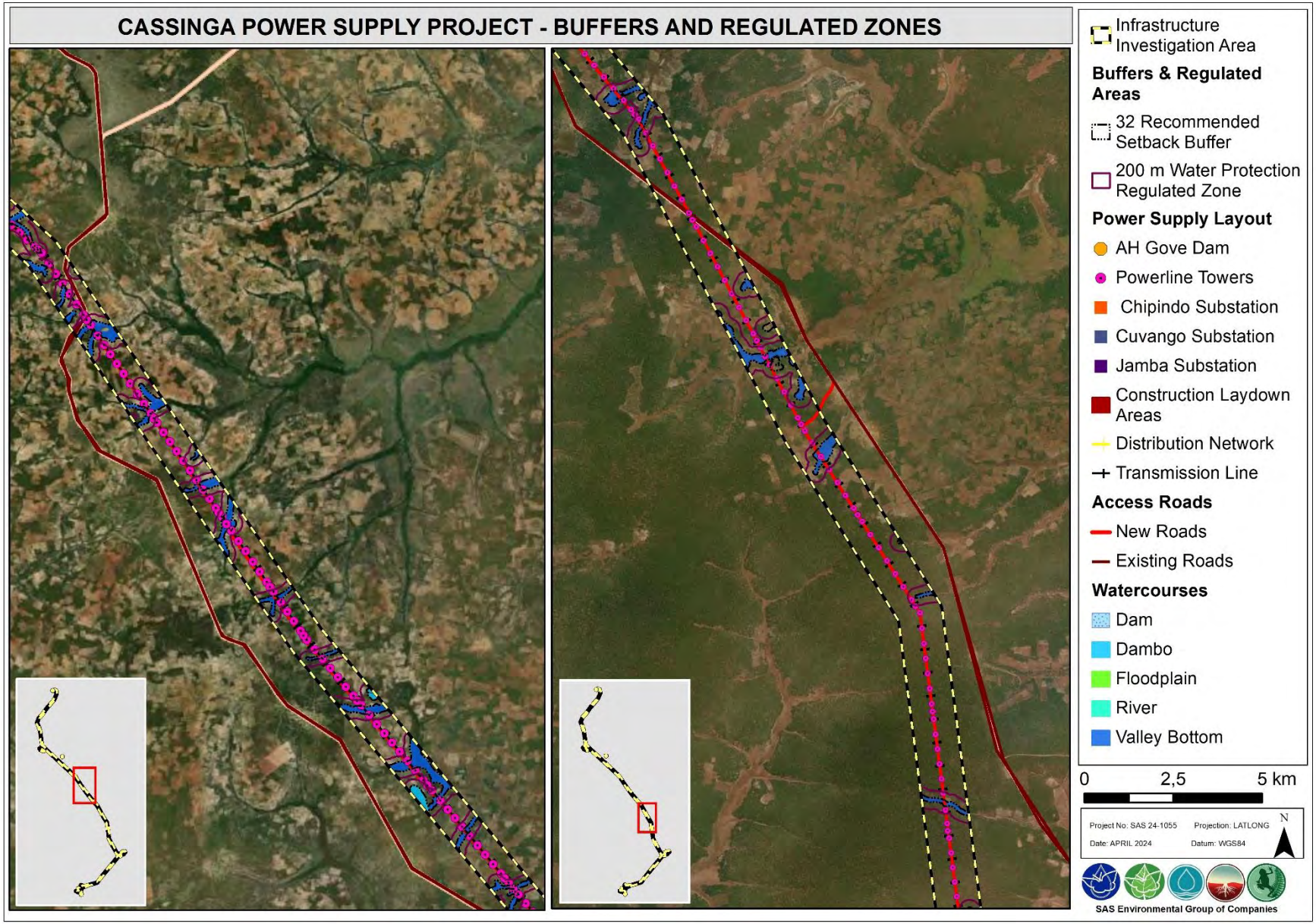


Figure 16: The location of the delineated freshwater systems including buffer zones associated with the proposed Cassinga powerline project.

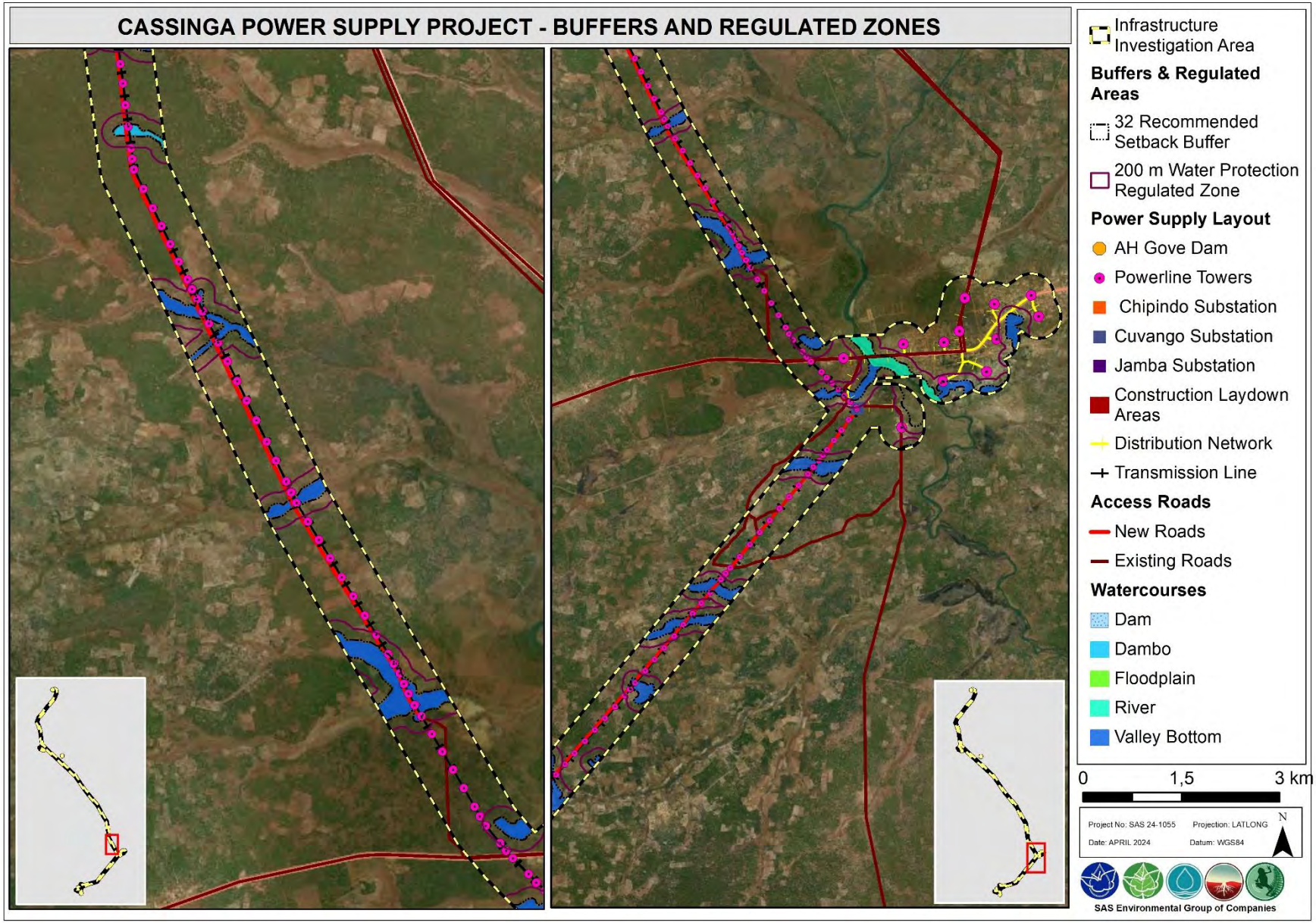


Figure 17: The location of the delineated freshwater systems including buffer zones associated with the proposed Cassinga powerline project.

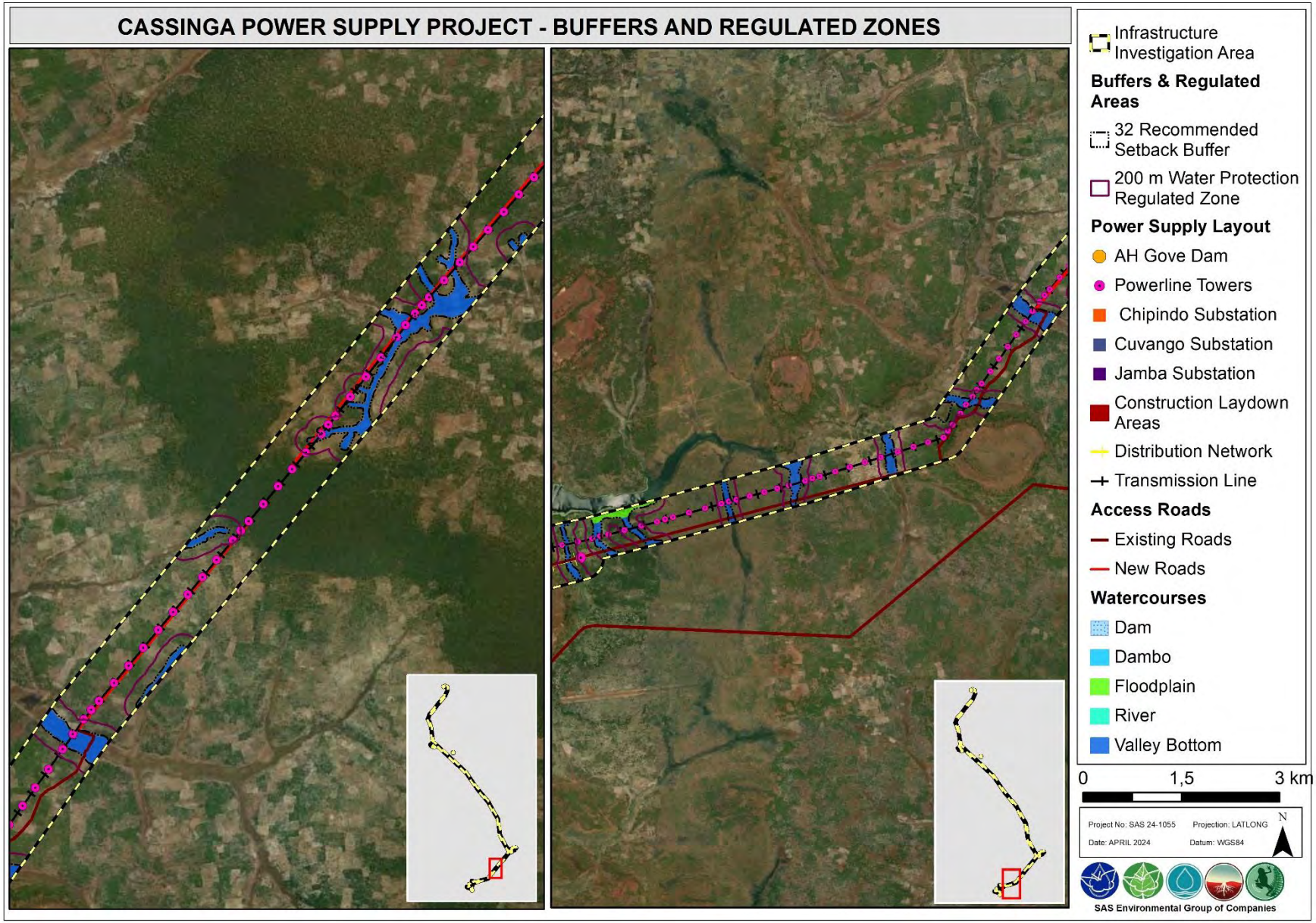


Figure 18: The location of the delineated freshwater systems including buffer zones associated with the proposed Cassinga powerline project.

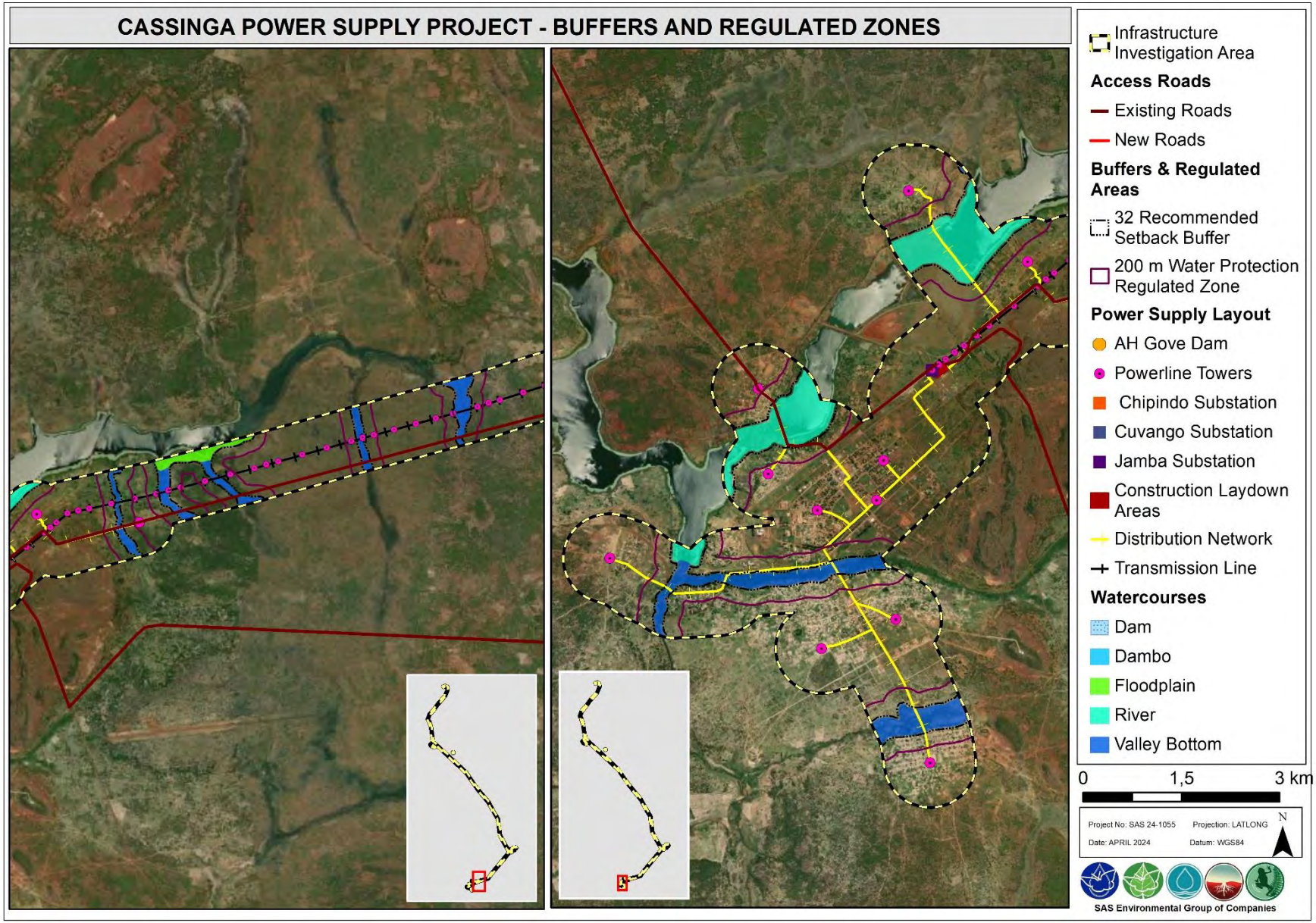


Figure 19: The location of the delineated freshwater systems including buffer zones associated with the proposed Cassinga powerline project.

8 IMPACT ASSESSMENT

This section presents the impact assessment conducted for the proposed activities associated with the construction of the proposed powerline and associated infrastructure.

8.1 Assessment of impacts using the assessment methodology provided by the EAP

Identified impacts are described in terms of the nature of the impact, receptor sensitivity and the significance of the predicted environmental change (*with and without mitigation*). The assessment of the identified impacts is based on determining the following aspects: impact probability, duration, extent, consequence, and loss of the resource. The impact rating system considers the confidence level that can be placed on the successful implementation of mitigation.

Table 7: Summary of the impact assessment conducted for the proposed Cassinga powerline project activities for the pre-construction phase.

ACTIVITY 1: Site preparation prior to commencement of construction.								
Impact Summary: ➢ Removal of vegetation leading to increased bare areas and changes in runoff in the landscape; ➢ Smothering of freshwater habitat due to dust generated from cleared areas; and ➢ Miscellaneous activities by construction personnel.								
	Magnitude	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Before management	Major (-)	Medium term	Local	Medium	Definite	**Medium**	– ve	Medium
Essential management measures: ➢ All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; ➢ As far as possible, existing roads must be utilised to gain access to sites; ➢ 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, 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; ➢ 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. 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; ➢ Contractor laydown areas, and material storage facilities to remain within the designated contractor camp and batching plant footprint; and ➢ 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.							
After management	Minor	Short term	Site	Low	Possible	**Low**	– ve	Medium

Table 8: Construction activities associated with the development of construction camps/laydown areas.

ACTIVITY 2: Site preparation prior to commencement of construction.								
Impact Summary: ➢ Increased bare areas and changes in runoff in the landscape; ➢ Generation of dust in the cleared areas and smothering of freshwater habitat; and ➢ Miscellaneous activities by construction personnel.								
	Magnitude	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Before management	Major (-)	Medium term	Local	Medium	Definite	**Medium**	– ve	Medium
Essential management measures: ➢ All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; ➢ Suitable procedures for the disposal of construction waste and hazardous materials must be developed; ➢ Containment systems to prevent contamination of groundwater and surface water such as drip trays must be installed; ➢ 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								

➢ 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**	– ve	Medium

Table 9: Summary of the impact assessment conducted for the proposed Cassinga powerline project activities for construction phase.

ACTIVITY 3: 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).								
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***	***Status***	***Confidence***
Before Management	Major (-)	Medium term	Local	Medium	Definite	**Medium**	– ve	Medium
Essential management measures: ➢ Careful planning of pylons for the powerlines 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; ➢ Excavation of pits 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; ➢ 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; ➢ 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; ➢ Suitable drainage must be insured 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. Rehabilitation of the construction footprint areas: ➢ Rehabilitation measures around areas where construction 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; ➢ Ensure that soils are replaced in the correct layers, ripped and re-reprofiled, and that vegetation is restored to a point where succession will lead to the same conditions as the pre-mining 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**	– ve	Medium

Table 10: Construction activities associated with the development of infrastructure of new substations.

ACTIVITY 4: Construction activities associated with the development of infrastructure of new substations.								
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***	***Status***	***Confidence***
Before management	Moderate (-)	Medium term	Local	Medium	Definite	**Medium**	– ve	Medium
Essential management measures: ➢ Silt/sediment traps are to be used during the construction phase, to limit additional sediment associated with construction activities from reaching the freshwater habitat; ➢ Design of infrastructure should be environmentally and structurally sound and all possible precautions taken to prevent contamination of surface and resources present; ➢ 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 special mention is made of: o Sheet runoff from cleared areas, paved surfaces and/or access roads needs to be curtailed; o Runoff from paved surfaces should be slowed down by the strategic placement of berms; and o All overburden stockpiles and waste stockpiles must have berms and/catchment paddocks at their toe to contain runoff from the facilities. ➢ Erosion arising as a consequence of the development of surface infrastructure must be remedied immediately and included as part of an ongoing rehabilitation plan; ➢ 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 a suitable alien vegetation control plan; ➢ 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; **Control measures specific to concrete works:** ➢ 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; ➢ 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; ➢ 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; ➢ 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; and ➢ Spilled or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be provided. Rehabilitation measures of the construction footprint areas as outlined in Activity 2 must be implemented in a phased manner shortly after the construction activities.								
After management	Minor (-)	Short term	Site	Low	Possible	**Low**	– ve	Medium

Table 11: Construction activities associated with the development of access roads.

ACTIVITY 5: Construction activities associated with the development of access roads.								
➢ Impact Summary: ➢ 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 which may affect the freshwater ecosystem, leading to impaired water quality including an altered pH regime, salinisation of soils and increased contaminants in the freshwater ecosystems.								
	Magnitude	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Before management	Major (-)	Medium term	Local	Medium	Definite	**Medium**	– ve	Medium
Essential management measures: ➢ 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; ➢ **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;** ➢ Implementation of erosion and sediment control measures must be implemented to prevent excessive sedimentation during construction; ➢ 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; ➢ Any diversion for construction activities must mimic natural flow patterns and maintain sediment transport; and ➢ All alien and invasive vegetation species, debris and litter removed from the road reserve must be removed from site.								
After management	Moderate (-)	Short term	Local	Medium	Possible	**Medium**	– ve	Medium

Table 12: Operation of the proposed surface infrastructure (OHPL and powerline servitudes).

ACTIVITY 6: Operation of the proposed linear infrastructure (OHPL and powerline corridors).								
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***	***Status***	***Confidence***
Before management	Minor (-)	Medium term	Site	Low	Definite	**Low**	– ve	Medium
Essential management measures: ➢ An emergency 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; ➢ The powerline servitude must be monitored for alien and invasive vegetation encroachment and all alien vegetation/weeds must be removed according to a suitable alien vegetation control plan. Annual follow up should be undertaken for at least 3 years post construction; and								

➢ 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**	– ve	Medium

Table 13: Operation of the proposed surface infrastructure (substations).

ACTIVITY 7: Operation of the proposed surface infrastructure (substations).								
Impact Summary: ➢ Increased impermeable surfaces due to the presence of surface infrastructure (substations); ➢ Potential indiscriminate movement of vehicles within the riverine systems for perimeter inspections/ maintenance.								
	Magnitude	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Before management	Minor (-)	Medium term	Site	Low	Definite	**Low**	– ve	Medium
Essential management measures: ➢ Rehabilitation measures around areas where construction 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; ➢ Ensure that soils are replaced in the correct layers, ripped and re-reprofiled, and that vegetation is restored to a point where succession will lead to the same conditions as the pre-mining state as a minimum; ➢ It must be ensured that regular inspections of all stormwater infrastructure are conducted. During the inspection data must be recorded and kept for the purposes of tracking and reporting; ➢ Bare areas should be revegetated within suitable indigenous vegetation species.								
After management	Minor (-)	Short term	Site	Low	Possible	**Low**	– ve	Medium

Table 14: Operation of the proposed new accessed roads.

ACTIVITY 8: Operation of the proposed new accessed roads.								
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***	***Status***	***Confidence***
Before management	Moderate (-)	Short term	Local	Medium	Possible	**Medium**	– ve	Medium
Essential management measures: ➢ Regular inspection of the access roads and associated culverts must be done in order to ensure structural stability during the operation of the road; ➢ 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; ➢ Any erosion or gully formation must be identified on an ongoing basis and re-profiled and revegetated accordingly; and ➢ 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**	– ve	Medium

Table 15: Decommissioning of infrastructure associated with the proposed powerline project.

ACTIVITY 9: Decommissioning of infrastructure associated with the proposed powerline project.								
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; ➢ Smothering of freshwater habitat due to dust generated from cleared areas; ➢ Proliferation of alien and invasive species within the freshwater habitat; and ➢ Disturbance to aquatic biota.								
	Magnitude	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Before management	Minor (-)	Medium term	Site	Low	Definite	**Low**	– ve	Medium
Essential management measures: ➢ Decommissioning vehicles should be checked for leakages of hydrocarbons prior to commencement of decommissioning and closure; ➢ Vehicles should utilise existing access roads and minimise compaction of adjacent areas; ➢ Disturbed areas adjacent to the decommissioning sites should be revegetated in order to limit potential soil erosion; ➢ 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; ➢ Ensure that soils are replaced in the correct layers where infrastructure has been removed/decommissioned, ripped and re-reprofiled, 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 ➢ Monitor spread of alien and invasive species during the decommissioning phase.								
After management	Minor (-)	Short term	Site	Low	Possible	**Low**	– ve	Medium

8.2 Cumulative Impacts

Cumulative impacts are activities and their associated impacts on the past, present and foreseeable future, both spatially and temporally, considered together with the impacts identified in Section 8 above.

Direct and indirect impacts identified within freshwater ecosystems include agricultural activities, various freshwater ecosystem crossings associated with informal roads impacting on the natural hydraulic regime, an increase in alien and invasive species entering the system due to regular disturbance of soil and removal of indigenous vegetation. The disturbances associated with creation of access roads and construction of surface infrastructure in the area will potentially further increase clearing of vegetation, changes to the natural pattern and timing of flows in the landscape and potential incision of freshwater areas, if suitable mitigatory measures are not put into place. Additionally, the fragmentation of habitats and disturbance to freshwater ecosystems can lead to altered water quality, loss of biota, and alter the ecological functions provided by the freshwater ecosystems. Furthermore, the cumulative impacts associated with activities for the powerline construction and operation may exacerbate erosion and sedimentation, threatening the stability of riverbanks and exacerbating the loss of valuable wetland habitats.

Some of the proposed access roads will result in a cumulative loss of freshwater habitat and therefore it is important that suitable mitigation measures are implemented to manage significant loss of freshwater habitat during construction of access roads and associated crossings. Watercourse crossings for vehicular access must be done using formal structures that will not hinder the natural flow of surface waters such as suitably sized culverts. If the watercourse is relatively wide, such as for valley bottom wetland units, then multiple culverts should be used so that the flow of water can be spread across the width of the watercourse. This will promote the flow-through of silt from upstream sources and will also abate the effects of erosion at the downstream side of the culvert drains. Restriction of the flow to a single flow path (i.e., a single culvert) will promote erosion at the downstream side.

Rehabilitation efforts such as alien vegetation management, clearing of construction rubble, ensuring that the pre-construction landscape in terms of surface flows is re-instated and where possible improved must be done to ensure that the cumulative impacts on the system are reduced and the ecological functioning of the systems can be maintained. Additionally, ongoing monitoring and adaptive management strategies are important to address unforeseen impacts and ensure the long-term integrity and resilience of wetlands and rivers which are to be potentially impacted by the proposed powerline development. The table below (Table 16)



summarises the impact significance of the cumulative impacts associated with the proposed powerline development.

Table 16: Summary of impact assessment for cumulative impacts associated with the proposed powerline project.

Cumulative impacts associated with the proposed powerline infrastructure.								
Impact Summary: ➢ Smothering of freshwater habitat and impacts to downgradient freshwater systems; ➢ Proliferation of alien and invasive species and change in freshwater habitat; ➢ Runoff of contaminated water from construction areas to downstream freshwater ecosystems; ➢ Vegetation disturbance along powerline corridor due to maintenance activities; and ➢ Potential indiscriminate movement of vehicles within the riverine systems for perimeter inspections/ maintenance.								
	Magnitude	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Before management	Major (-)	Medium term	Local	Medium	Definite	**Medium**	– ve	Medium
Essential management measures: ➢ Rehabilitation measures around areas where construction 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.								
After management	Minor (-)	Short term	Site	Low	Possible	**Low**	– ve	Medium

If the mitigation measures presented in this document (Section 6) are adequately adhered to during all phases of proposed powerline project, the scale of impact on the Valued Environmental and Social Components (VECs) in the context of freshwater ecosystems will be reduced to acceptable. The monitoring plan to manage cumulative impacts is presented in Section 9 below.

8.3 Impacts on Type I and Type II Ecosystem Services

Ecosystem services regarded as Type I ecosystem include services that directly benefit human well-being, through the provision of tangible goods or services. These may include water quality regulation, flood regulation and maintenance of biodiversity through provision of habitat. Ecosystem services regarded as type II typically are those that support the functioning of the ecosystems and the provision of Type I services. In the context of the proposed powerline and associated infrastructure, the proposed construction activities will result in clearing of vegetation, ground-breaking activities and increase in bare areas, this may result in the increase in erosion rates and impact soil stability within the freshwater ecosystems, therefore impacting on Type II ecosystem services such as erosion control, assimilation of nutrients and toxicants. Potential impacts on the freshwater ecosystems due to construction have the potential to impact on the hydraulic regime of the freshwater ecosystems thereby altering the natural pattern and timing of flows within the systems, this will result in also result

in impacts on Type II ecosystem services such as streamflow regulation, and flood attenuation which is essential for hydrologically connected freshwater ecosystems.

Construction and operation of the powerline infrastructure has the potential to impact on Type I ecosystem services, an example of this is through the cumulative loss of freshwater habitat due to construction particularly of the access roads. This has the potential to result in habitat fragmentation impacting on the wetlands ability to provide habitat and therefore maintain biodiversity. The cumulative loss of freshwater habitat also has the potential to result in decrease in provision of Type I ecosystem services such as opportunities for tourism and recreation due to loss of aesthetic value of the freshwater ecosystems although this is not considered the most significant ecosystem service within the assessed areas. Freshwater ecosystems provide direct services such as provision of water for human use, and for cattle and livestock, impacts associated with groundbreaking activities and increased vehicle movement resulting in dust generation have the potential to result in changes in the water quality regime of the freshwater ecosystems and therefore impacting on the provision of these direct services.

9 PROPOSED MONITORING PROGRAMME

Prudent monitoring must be done in the areas impacted by the construction activities associated with the proposed Cassinga powerline project. Given that this is a linear infrastructure project, the rehabilitation and monitoring of disturbed areas must be done progressively in-line with the phase approach of the project. This will ensure a continual flow of data, enabling all parties involved to accurately assess and manage the progress of the rehabilitation interventions and any arising issues particularly for the monitoring of biota specific water quality on aquatic resources in the vicinity of the construction activities, monitoring of alien and invasive species, water retention and distribution patterns in the landscape. To ensure the accurate gathering of data, the following techniques and guidelines should be followed (Table 17):

Table 17: Monitoring recommendations for the impacted areas.

Aspect	Monitoring Location	Frequency of sampling	Frequency of Reporting	Report Content	Equipment
Water quality	Immediately upstream and downstream of the freshwater crossings.	Monitoring must take place prior to construction activities along freshwater crossings and after construction is completed.	Water monitoring must be assessed on a two-weekly basis along crossing points that are in an active phase of development during the construction phase and during maintenance in the event of infrastructure failure.	Report must be compiled on a monthly basis for all data collected and include mitigation and management actions that are recommended and that are undertaken.	1. GPS 2. Camera 3. Field Form 4. Handheld multi parameter water quality meter
Freshwater resource (riparian) ecological monitoring	Immediately upstream and downstream of the freshwater crossings. This must also include culverts associated with the proposed crossings.	Monitoring should take place bi-annually during the construction phase along crossing points that are in an active phase of development.	Bi-annual status quo reporting.	Results of the must be compared to the baseline results and any changes in ecological integrity/ecostatus or ecoservice provision must be documented. This can be done by assessing ecological drivers and receptors of the freshwater system. Important aspects include hydrological changes, water quality, soil erosion, and changes in the vegetation composition. In terms of ecoservices, important aspects include use of freshwater ecosystems by locals as source for water, cattle for drinking and various biodiversity for habitat.	1. GPS 2. Camera 3. Field Form
Erosion	Immediately upstream and downstream of the freshwater crossings.	Monitoring of erosion should occur on a weekly basis during construction by the contractor or ECO, and after every major rainstorm. Any erosion should be captured and recorded and reported during the ECO site visit	1. After every major rainstorm and/or flood. 2. Monthly monitoring report compiled by the appointed ECO during the construction phase.	1. Brief indication of the method of assessment; 2. Assumptions and Limitations must be listed; 3. Photos and GPS point locations taken of existing erosion in the freshwater features and adjacent banks must be incorporated into the report. 4. Any erosion observed must be discussed in detail and management recommendations made; and 5. Map indicating where erosion is present. 6. Recommended and undertaken control measures.	1.GPS 2. Camera 3. Field Form 4. Measuring Tape
Alien vegetation control	Immediately upstream and downstream of the freshwater crossings.	Regrowth of alien vegetation should be monitored monthly during the first growing season.	At the end of the first growing season following the completion of construction, and on an on-going monthly basis during operations.	1. Provide a list of species occurring within the study area; 2. Discuss the density of species; 3. Freshwater feature integrity and risk to be discussed; 4. Fixed point photograph (Taking photograph at specific point within priority area to show effect of alien vegetation control); 5. Control measures undertaken to be recorded, and; 6. Assess the necessity of further alien and invasive vegetation control.	1. GPS; 2. Field Form; and 3. Camera

10 IMPACT STATEMENT AND CONCLUSION

Scientific Aquatic Services (Pty) Ltd. (SAS) was appointed by SRK Consulting (South Africa) to conduct a freshwater ecosystem assessment as part of the environmental authorisation (EA) process for the Cassinga Electrical Power Supply Project, this is referred to throughout the report as the proposed Cassinga powerline project. During the wet season assessment conducted over a period of five (5) days in April 2024, identified drainage systems comprised four primary hydrogeomorphic (HGM) types: 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 the freshwater ecosystems was largely intact due to the remote geographic location of the proposed powerline infrastructure. Ecological modifiers include freshwater crossings, subsistence cultivation activities, impoundments including large dams such as the Gove dam and Cuandeja Dam and impacts associated with use of some of the freshwater ecosystems for domestic needs. The dry season survey undertaken during July 2024 reiterated the strong seasonal variability of the surface water resource units, especially the valley bottom and dambo wetland units. This does not impact on the overall PES nor ecoservice provision of the units, however.

Despite these impacts, in terms of ecological services, the freshwater ecosystems are considered important for local communities in terms of provision of water for domestic use, these systems are also a drinking source for cattle and are able to provide good habitat essential for biodiversity maintenance. In addition, the valley bottom wetland systems were utilised for subsistence farming.

10.1 Impact Statement

The proposed powerline will cross the freshwater systems, however, given the spatial footprint of the infrastructure such as the powerline supporting pylons and proposed substations, the extent of modification is anticipated to be low. During the planning phase, it must be ensured that the powerline support pylons are spanned appropriately to avoid direct encroachment within the freshwater ecosystems. This is critical for maintenance of ecological functionality as well the longevity and protection of the proposed infrastructure.

In terms of the proposed access roads, the layout indicates that some proposed new roads will traverse the delineated freshwater ecosystems, 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 to limit. The medium impact significance is particularly likely to occur during the construction phase of the project where increased vehicle movement will be taking place, resulting in increased dust generation, smothering of freshwater habitat and potential proliferation of alien and invasive species. Beyond the construction phase, the proposed freshwater crossings will also result in a cumulative loss of freshwater habitat and therefore it is important that suitable mitigation measures are implemented to manage significant loss of freshwater habitat during construction of the proposed new access roads and associated crossings.

10.2 Conclusion and Specialist Opinion

In conclusion, given that the project has the potential to limit direct impacts on the freshwater ecosystems which reduces the overall impact significance of the project and that the project is considered essential for human livelihoods including socio-economic development and more broadly, for sustainable development for local communities in the areas which form part of the project, it is the opinion of the specialist that the project be considered in a positively for authorisation.

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APPENDIX A – Terms of Use and Indemnity

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APPENDIX B – Legislation

LEGISLATIVE REQUIREMENTS

Ministry of Environment (MINAMB)	The Ministry of Environment (MINAMB) is the Ministerial Department responsible to formulate, conduct, supervise, evaluate, and execute the Executive's policy in the field of protection, preservation and conservation of environmental quality, pollution control, areas of conservation and enhancement of natural heritage, as well as the preservation and rational use of mineral resources. MINAMB comprises a set of agencies and services, in particular, the National Directorate for the Prevention and Assessment of Environmental Impacts (Direcção Nacional de Prevenção e Avaliação de Impactes Ambientais (DNPAIA)), which is the service responsible for the conception and implementation of policies and strategies to prevent the incidences of environmental impacts. Depending on the type of project being developed, the EIA report must also be approved by the line ministry. This ensures that the EIA not only addresses the requirements of the Environmental Baseline Law and the Presidential Decree on Environmental Impact Assessment and Environmental Licensing, but also the relevant sectoral legislation. MINAMB also includes a set of bodies and services, in particular the National Directorate for the Prevention and Evaluation of Environmental Impacts (DNPAIA), which is the service responsible for designing and implementing policies and strategies to prevent environmental impact incidences. MINAMB is responsible for the implementation of the Environment Framework Law 5/98, the approval of EIAs under the Presidential Decree 117/20 on Environmental Impact Assessment and Environmental Licensing Procedure, and all associated Regulations
The General Environmental Law No. 5/98	The General Environmental Law (Lei de Bases do Ambiente, LBA) was promulgated in accordance with the Constitutional Law of the Republic of Angola. The purpose of the law is to provide the framework for environmental legislation and regulations; more specifically to define the basic concepts and principles for the protection, preservation and conservation of the Environment, promotion of quality of life and the rational use of natural resources (Article 1). The LBA incorporates international declarations which Angola has ratified and defines citizens' rights and responsibilities. Further, the LBA introduces the concept of legal penalties for illegal activities that have caused damage to the environment. Article 4 includes a number of principles guiding LBA, including a principle in respect of liability: all persons or organisations which through their actions cause harm to the environment, or the degradation, destruction or depletion of national resources, shall be held liable for the same, and shall be required to repair such damage and/or pay compensation for the damage caused. Article 16(1) of LBA stipulates that an Environmental Impact Assessment (EIA), including public consultation (Articles 10 and 32), is mandatory for all undertakings which have an impact on the balance and wellbeing of the environment and society. Article 16(2) states that more specific legislation on EIAs will be developed by the government. An Environmental License is issued on the basis of an EIA/EIS and a license is required before any other license required by law will be granted (Article 17(2)). According to the LBA, MINAMB is responsible for issuing environmental licenses
Decree No.117/20 on General Regulation for Environmental Impact Assessment and Environmental Licensing Procedure.	This decree establishes the standards and procedures that regulate the environmental impact assessment of public and private projects and the environmental licensing procedure for activities that, due to their nature, location or dimension, may cause significant environmental and social impact (Article 1). Applies to all public or private activities that may directly or indirectly influence environmental components (Article 2). This decree revokes the regulations previously in force on these matters (Decree No. 51/04, of 23 July 2004, on EIA, and Decree No. 59/07, of 13 July, on Environmental Licensing), as well as all legislation that contradicts its wording. Chapter II of the decree focuses on EIA, and Chapter III establishes the provisions applicable to Environmental Licensing. Chapter IV sets out the requirements for monitoring the provisions of the decree, the fees to be paid and the fines and accessory penalties applicable to infractions. Article 7 refers to the categorization of the activities and therefore Annexes I to V list the activities that are classified under Category A, B, C, D and E, respectively, and specifies the requirements for each one of those categories. For activities under category A, an EIA is required as well as Terms of Reference (TOR) and an Environmental Pre-Feasibility Study and Scoping (EPDA) (Article 7 and 12); Category B requires an EIA and the preparation of TOR for its elaboration; and Category C will require a Simplified Environmental Study and TOR. At the beginning of an Environmental Impact Assessment procedure, the project owner (in this instance, Soul Rock) must register the proposed activity, under the terms of the applicable legislation in force, in the Integrated Environmental System (SIA). The Ministerial Department that oversees the proposed activity must, within 5 (five) days, after receiving the Environmental Impact Study, issue an opinion on the project to be licensed (Article 6 (3)).

	Within a maximum period of 30 (thirty) days from the date of receipt of the documentation, the Ministerial Department responsible for the Environment Sector sends the respective opinion to the competent authority to license or authorize the project (Article 17). Therefore, the project that has received a negative opinion from the Minister responsible for the Environment cannot be given authorization or license (Article 18 (1)). Furthermore, the decision taken by MINAMB can be appealed under the general terms of administrative procedures and litigation (Article 18 (2)). This decree adopts provisions concerning requirements, criteria and administrative procedures related to Environmental Licenses. In terms of Article 26, any activity requiring an EIA must apply for an Environmental License, which the MINAMB issues.
Water Law No. 6/02	Article 10 states that the objective of the State is "to ensure the use of available water for all purposes through its rational and planned use for the sustained development of the national economy" and also to "promote, frame and regulate the use of water for agricultural, livestock, industrial and hydroelectric purposes". The law states that private use of water cannot come before public use: "Common uses, as described in articles 21 and 22, have priority over any private use, so that private use cannot be granted or maintained to the detriment of those". Pursuant to Articles 22 and 24, water uses are classified as (1) common (public) use, which refers to water taken from natural sources without any administrative approval, and (2) private water use, which requires a license. Common (public) water uses have priority over private water uses. Articles 24 and 26 of the Act further clarify private uses that require and do not require a license or concession. The supply of water to the population for human consumption and health needs has priority over other private uses (Article 33(2)). Article 41 (1) establish that private use of water depends on licensing, in which its use does not significantly change the quality and quantity of the water and the environmental balance, in accordance with the Regulation. n.º2 of the same Article states that the following also depends on licensing: a) prospecting, pumping water and use of groundwater, except the activities described line c) of n.º1 of article 26 of this law[1]; b) deposits installation, the crops implantation or plantations and the cut down of trees on the beds and banks of the continuous or discontinuous natural currents and lakes, lagoons and marshes; and c) the extraction of inert materials, such as sand and gravel, from the beds and margins of continuous or discontinuous natural currents and from lakes, lagoons and marshes. In terms of Article 68, Section 1 of the law, "the discharge of wastewater, wastes or other substances, and any activities that cause pollution or degradation of public water, is dependent on authorisation granted by the institution responsible for managing water resources".
Presidential Decree No. 26/20 (National Biodiversity Strategy and Action Plan 2019-2025)	To implement the recommendations from the United Nations Convention on Biological Diversity (UNCBD, ratified by Resolution No. 23/97), the Government approved through Resolution No. 42/06 of 26 July 2006, the National Biodiversity Strategy and Action Plan (NBSAP). However, this Resolution was revoked by Presidential Decree No. 26/20 that approves the National Biodiversity Strategy and Action Plan 2019-2025, an annex of this Presidential Decree. This strategy aims to incorporate measures for the conservation and sustainable use of biological diversity and the fair and equitable distribution of biological resources favouring all Angolans into policies and development programmes. The National Strategy and Action Plan for Biodiversity (NBSAP) of the Republic of Angola was developed to serve as an integrated strategic framework. the conservation and sustainable use of biodiversity can be organized and coordinated to fulfil an Action Plan over seven years (2019-2025).
Presidential Decree No. 194/11 on Liability on Environmental Damage	This decree establishes strict liability for degradation of the environment. Aimed at preventing and repairing environmental damage, the decree establishes that all activities capable of causing damage to the environment (Article 3(1)) are considered liabilities and are subject to regulation under the "polluter pays" principle. According to the decree, any entity responsible for pollution (by act of wilful misconduct or negligence) will be held responsible for cleaning up and restoring the environmental damage. Responsibility will be held for losses and damages caused to the environment by way of compensation for damages and environmental recovery measures. Article 18º informs the right of the public to request intervention when there is concern that environmental damage has taken place. In Article 21º, the Decree also states that any individuals or legal entities which carry out activities that impose environmental risks shall have civil liability insurance
Presidential Decree No. 261/11 on Water Quality	This decree serves as an addition to the national Water Law No. 6/02, dealing specifically with water quality. It establishes the roles within the Angolan governmental administration for overseeing water quality issues and addressing the water quality standards relating to human consumption and waste water. The decree also lists the role of water quality monitoring and the standard parameters for drinking water, surface water and emissions limits for wastewater discharge (in Annex VI). According to item 3 of Article 1, this law also regulates the control standards of wastewater discharge in water bodies and soil to preserve the quality of the aquatic environment and protect public health. Article 13 of Chapter III (Protection of Waters Against Pollution of Discharged Wastewater) defines that the discharge of wastewater from a treatment facility into water and soil requires a license issued by the Ministry of Environment, in which discharge standards for mitigation or prevention of damage are set.

Presidential Decree No. 82/14, approves the Regulation on the General Use of Water Resources	This decree applies to surface water and groundwater, namely watercourses, lakes, lagoons, swamps, springs, reservoirs, estuarine areas and other water bodies, without prejudice to the respective watercourse bed, river banks and surroundings. Article 17 states that the use of water resources for private use need a specific title of use (concession or license). Article 109(2) establishes that holders of rights to use water resources shall in general be prohibited from: "b) Accumulate solid wastes, liquids or any substances in places and conditions that may contaminate or create danger of water resources contamination; c) Carry out any activities that imply or may imply the degradation or pollution of the water resources; d) Make any changes to the regime, flow, quality and use of water resources that may affect the public health, natural resources, the general environment, security and national sovereignty; e) Carry out any activities in the water protection zones." Article 110 establishes that proponents shall consider a 200m buffer zone as follows: "areas of protection of water resources, the water course beds, river banks and water courses adjacent zones of up to a distance of 200 metres". Article 111 defines, as it is forbidden, in the protection zones of the water resources, in terms of the present Diploma and other applicable laws: "d) Install dumps or heaps resulting from mining activity; f) Install pipelines and reservoirs of hydrocarbons or wastewater." Article 119 states that: "without prejudice the provisions of this legal document, the assignment of any permits for the use of water resources, independently of its end, is subject to prior approval by the corresponding environmental impact studies, provided that that the legislation in force to require, by virtue of its nature, size or location, which may have significant environmental and social impacts." Sections I and II from Chapter VIII (Fees) presents the calculations related with the fees to be paid for water abstraction and wastewater discharge. Executive Decree No. 469/15 on the slaughter prohibition in the national territory of protected species of the fauna and wild flora This executive decree establishes a ban on the slaughtering of wild fauna and flora (protected species) on national territory, in order to avoid the illegal hunting and trafficking of valuable objects, activities which, in recent years have assumed high levels, endangering the biodiversity, under the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES), assigning to the Ministry of Environment inspectors the responsibility for overseeing and define the regime of sanctions.
International Finance Corporation (IFC) Environmental Health and Safety Guidelines and Performance Standards (2007)	The IFC is a financial services provider which has set out to ensure that their clients act responsibly toward the environment by providing environmental, health and safety guidelines which their clients must follow and apply before lending of finance may take place. ○ **Performance Standard 1**: Assessment and Management of Environmental and Social Risks and Impacts - Underscores the importance of managing environmental and social performance throughout the life of a project. ○ **Performance Standard 3**: Resource Efficiency and Pollution Prevention - Recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. ○ **Performance Standard 4**: Community Health, Safety, and Security - Recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. ○ **Performance Standard 5**: Land Acquisition and Involuntary Resettlement - Recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. ○ **Performance Standard 6**: Biodiversity Conservation and Sustainable Management of Living Natural Resources - Recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The IFC habitat categories are defined as follows: ***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 Performance Standard 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 proponent 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 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 nett 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 are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered 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 nett reduction in the global and/or national/regional population of any Critically Endangered or Endangered species over a reasonable period of time; and ➢ A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the proponent's management program.

APPENDIX C – Method of Assessment

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the watercourses present or in close proximity of the study area are located. Aspects considered as part of the literature review are discussed in the sections that follow.

2. Wetland Classification System

All areas containing wetland or riparian characteristics that were encountered within the study area were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the "Classification System" (Ollis *et. al*., 2013). This method encompasses the broad suite of "wetlands" as defined by the Ramsar Convention and includes all ecosystems that the Ramsar Convention is concerned with.

A summary on Levels 1 to 4 of the classification system are presented in the tables below.

Table B1: Classification System for Inland Systems, up to Level 3.

<table>
<tr><th colspan="3">WETLAND / AQUATIC ECOSYSTEM CONTEXT</th></tr>
<tr><td>LEVEL 1:
SYSTEM</td><td>LEVEL 2:
REGIONAL SETTING</td><td>LEVEL 3:
LANDSCAPE UNIT</td></tr>
<tr><td rowspan="4">Inland Systems</td><td rowspan="4">DWA Level 1 Ecoregions
OR
NFEPA WetVeg Groups
OR
Other special framework</td><td>Valley Floor</td></tr>
<tr><td>Slope</td></tr>
<tr><td>Plain</td></tr>
<tr><td>Bench
(Hilltop / Saddle / Shelf)</td></tr>
</table>

Level 1: Inland systems

From the classification system, Inland Systems (Table B1) are defined as **aquatic ecosystems that have no existing connection to the ocean**[4] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but **which are inundated or saturated with water, either permanently or periodically.** It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included in Level 2 of the classification system is that of the aquatic ecoregion (Table B1). Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

[4] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

Table B2: Hydrogeomorphic (HGM) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 3: Landscape Setting

At Level 3 of the classification system for Inland Systems, a distinction is made between four Landscape Units (Table B1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et. al.,* 2013):

- **Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes;
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench (hilltop/saddle/shelf):** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the classification system (Table B2), on the basis of hydrology and geomorphology (Ollis *et. al*., 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **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;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

Taking into consideration the descriptions of wetlands commonly used in Angola. At a high level, the watercourses were classified as Inland Systems falling within the Zambezian Headwaters Aquatic Ecoregions. The identified drainage systems comprised four primary hydrogeomorphic (HGM) types: 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.

Wetland delineation

For the purposes of this investigation, wetland habitat was defined according to the factors associated with the Ramsar Commissions’ definition of a wetland. The extent of the wetland was determined by delineating the wetland based upon the Department of Water and Sanitation (DWS) (formerly DWA / DWAF) guidelines ‘A practical field procedure for the identification and delineation of wetlands and riparian areas’ (DWAF, 2008). This method is regarded as regional best practice adapted from the Ramsar Commissions guidelines and stipulates that consideration be given to four specific wetland indicators to determine the boundary of the wetland. Whilst not developed in the region in which the

investigation area is located, this method is regarded as applicable, relevant and provides an accurate rationale in watercourse mapping in support of the International Finance Corporation standards for rigorous characterisation of watercourses.

These indicators are:

- Densification of riparian vegetation;
- Changes in hue of vegetation;
- Linear connectivity of features to drainage systems;
- Position in the landscape, for example valley floors; and
- Presence of surface water showing up either as black areas or white areas reflecting cloud cover.

By observing the evidence of these features, in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF 2005).

The presence of hydric soils as a soil wetness indicator (i.e. examination of redoximorphic features within the soil) are one of the most important factors for identifying wetlands boundaries. The reason being that vegetation (considered to be the primary determining factor) can easily respond to changes in hydrology (e.g. the draining of a wetland), while the soil morphological signatures remain even if the wetland hydrology is altered.

A number of soil forms associated with the permanent zone of the wetland or the seasonal / temporary zones are provided in the guidelines of this method.

One of these are the redoximorphic features, which are the result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic. Only once soils within 500mm of the surface display these redoximorphic features can the soils be considered to be hydric (wetland) soils, and it can then be considered a wetland. Redoximorphic features typically occur in three types:

- A reduced matrix – i.e. an *in situ* low chroma (soil colour), resulting from the absence of Fe_3^+ ions which are characterised by “grey” colours of the soil matrix.
- Redox depletions - the “grey” (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur; and
- Redox concentrations - Accumulation of iron and manganese oxides (also called mottles).

Once the presence or absence of redoximorphic features within the upper 500mm of the soil profile is identified, that alone is sufficient to identify the soil as being hydric (a wetland soil) or non-hydric (non-wetland soil) (Collins, 2005; DWAF, 2005).

Riparian and wetland zones can be divided into three zones (DWAF 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant part of the rainy season and the temporary zone surrounds the seasonal zone and is only saturated for a short period of the year, but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation.

Since wetlands have a wetness gradient from the middle of the wetland to the adjacent terrestrial area, vegetation in an untransformed state can be used to support the delineation of a wetland due to plant community adapting to the moisture gradient. Plant communities are assessed, rather than individual indicator species, but the dominant species (hydrophytes or not) in the area are assessed to determine the presence of a wetland.

APPENDIX D – Impact Assessment Methodology

Impact assessment methodology

Potential impacts (direct, indirect, cumulative) will be assessed using information gathered during the baseline assessment in combination with previously collected desktop data and compared with the detailed project description.

Impact significance rating

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 D1 and involves the following 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.
- 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 D1: Impact significance rating system.

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 favorable 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, .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	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					
Impact characteristics	**Definition**		**Criteria**		
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

After determining the significance rating, practicable management measures are suggested for each specific impact. The impact description should indicate the significance rating prior to and following mitigation/optimisation. As explained above:

"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 is then re-assessed with assumed management measures in place ("after management"). Specialists also recommend and describe 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 in the table D2 below.

Table D2: 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:								

APPENDIX E – Results of Field Investigation

PRESENT ECOLOGICAL STATE (PES) AND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) RESULTS

Table E1: Presentation of the results of the Ecoservices for the riverine systems.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,3	0,9	0,0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!
	Sediment trapping	0,5	2,3	0,1	Very Low
	Erosion control	1,3	3,0	1,3	Moderately Low
	Phosphate assimilation	0,5	2,3	0,2	Very Low
	Nitrate assimilation	0,7	0,8	0,0	Very Low
	Toxicant assimilation	0,5	1,5	0,0	Very Low
	Carbon storage	1,0	2,7	0,8	Low
	Biodiversity maintenance	2,0	2,0	1,5	Moderately Low
PROVISIONING SERVICES	Water for human use	3,0	4,0	3,5	Very High
	Harvestable resources	2,5	1,3	1,7	Moderately Low
	Food for livestock	2,0	2,0	1,5	Moderately Low
	Cultivated foods	3,0	2,0	2,5	Moderately High
CULTURAL SERVICES	Tourism and Recreation	1,3	3,0	1,3	Low
	Education and Research	1,5	0,7	0,3	Very Low
	Cultural and Spiritual	2,0	0,3	0,7	Very Low

Table E2: Presentation of the results of the Ecoservices for the valley bottom wetland.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,8	0,0	0,0	Very Low
	Stream flow regulation	1,8	0,3	0,4	Very Low
	Sediment trapping	0,9	1,5	0,1	Very Low
	Erosion control	1,1	2,0	0,6	Very Low
	Phosphate assimilation	0,9	1,5	0,1	Very Low
	Nitrate assimilation	0,8	1,5	0,0	Very Low
	Toxicant assimilation	0,8	1,5	0,1	Very Low
	Carbon storage	1,4	2,7	1,3	Low
	Biodiversity maintenance	1,7	2,0	1,2	Low
PROVISIONING SERVICES	Water for human use	1,5	0,7	0,3	Very Low
	Harvestable resources	1,5	1,3	0,7	Very Low
	Food for livestock	2,0	2,7	1,8	Moderate
	Cultivated foods	2,5	2,0	2,0	Moderate
CULTURAL SERVICES	Tourism and Recreation	0,4	0,0	0,0	Very Low
	Education and Research	0,5	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

Table E3: Presentation of the results of the Ecoservices for the dambos.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,6	0,0	0,0	Very Low
	Stream flow regulation	2,0	0,0	0,5	Very Low
	Sediment trapping	1,6	3,0	1,6	Moderately Low
	Erosion control	1,5	1,3	0,7	Very Low
	Phosphate assimilation	1,7	2,0	1,2	Low
	Nitrate assimilation	1,6	2,0	1,1	Low
	Toxicant assimilation	1,7	2,0	1,2	Low
	Carbon storage	1,6	2,7	1,4	Moderately Low
	Biodiversity maintenance	1,6	1,0	0,6	Very Low
PROVISIONING SERVICES	Water for human use	1,5	0,3	0,2	Very Low
	Harvestable resources	0,5	0,3	0,0	Very Low
	Food for livestock	1,5	1,3	0,7	Very Low
	Cultivated foods	2,3	0,0	0,8	Very Low
CULTURAL SERVICES	Tourism and Recreation	0,3	0,0	0,0	Very Low
	Education and Research	0,5	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

APPENDIX F – Impact Analysis and Mitigation Measures

General construction management and good housekeeping practices

Latent and general impacts which may affect the freshwater ecosystem ecology and biodiversity, will include any activities which take place in close proximity to the proposed servitude that may impact on the receiving environment. Mitigation measures for these impacts are highlighted below and are relevant to the freshwater ecosystem identified in this report:

Development footprint

- All development footprint areas should remain as small as possible and should only encroach into the freshwater ecosystem considered absolutely essential;
- The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Planning of temporary roads and access routes should avoid freshwater ecosystem areas and be restricted to existing roads along the tarred access road which traverses the freshwater ecosystem;
- Appropriate sanitary facilities must be provided for the life of the repair and maintenance phase and all waste removed to an appropriate waste facility;
- All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant standards to prevent leakage;
- No fires should be permitted in or near the construction area; and
- Ensuring that an adequate number of waste and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills.

Vehicle access

- All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- All spills should they occur, should be immediately cleaned up and treated accordingly.

Vegetation

- Proliferation of alien and invasive species is expected within any disturbed areas. Whilst not considered severe at this time, the vegetation component within the freshwater ecosystem environment is already transformed. However, alien invasive species are opportunistic, and where disturbances do occur, they will promulgate; therefore, these species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;
- Removal of the alien and weed species encountered within the freshwater ecosystem must take place to comply with applicable legislation; and
- Species specific and area specific eradication recommendations:
    - Footprint areas should be kept as small as possible when removing alien plant species*;* and
    - No vehicles should be allowed to drive through designated sensitive freshwater ecosystems areas during the eradication of alien and weed species.

Soils

- Sheet runoff from compacted areas should be slowed down by the strategic placement of berms;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soils;
- Temporary stockpiling of excavated material from trenches can be retained alongside trenches, as required for backfilling. Any soil to be stockpiled for longer than a month should be moved to a designated stockpile area, as approved by the Environmental Control Officer (ECO);
- All soils compacted during the repair and maintenance phase should be ripped and profiled; and
- A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision.

Rehabilitation

- Construction rubble must be collected and disposed of at a suitable landfill site; and
- All alien vegetation in the footprint area as well as immediate vicinity of the proposed work area should be removed.

APPENDIX G – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Stephen van Staden	MSc (Environmental Management) (University of Johannesburg)
Dr. Matthew Ross	PhD Aquatic Health (University of Johannesburg)
Nqobile Lushozi	MSc (Geoinformatics) (Stellenbosch University)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Physical address:	29 Arterial Road West, Oriel		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	Stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Natural Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health Practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.



Signature of the Specialist

I, Mathew Ross, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.



Signature of the Specialist

I, Nqobile Lushozi, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health Practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)
5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF DR MATHEW JAMES ROSS

PERSONAL DETAILS

Position in Company	Discipline Lead, Principal Aquatic Ecologist, Ecologist
Joined SAS Environmental Group of Companies	2024

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist with the South African Council for Natural Scientific Professions (SACNASP): Reg no 005072 (Ecological Sciences & Aquatic Sciences)
Accredited River Health Practitioner by the South African River Health Program (RHP)
Member of the South African Wetland Society (SAWS)
Member of the South African Society for Aquatic Scientists (SASAqS)

EDUCATION

Qualifications

PhD Aquatic Health (University of Johannesburg)	2015
MSc Aquatic Health (University of Johannesburg)	2005
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc Biological Sciences (Zoology & Botany) (University of Johannesburg)	2000

Short Courses

Algal toxicity testing workshop – Environmentek, CSIR.	2003
Grass identification course – Witwatersrand Botanical Gardens	2003
Venomous snake handling and first aid	2003
First Aid – Level 3 – Netcare 911	2004
Advanced 4x4 driving	2001
Soil Classification course with emphasis on wetland delineations (TerraSoil Science)	2009
Advanced grass identification course (Africa Land Use Training)	2010
Qualified as an Advanced Scuba Diver.	2004
Internationally accredited protection dog trainer and trials assailant.	2005

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa –Botswana, Mozambique, Zimbabwe, Zambia, Namibia, Swaziland
Eastern Africa – Tanzania, Uganda, Malawi
West Africa – Ghana, Senegal, Angola, Cameroon, Mali, Burkina Fasso, Sierra Leone
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Renewable energy: Hydropower (run-of-river, pumped storage & dams), solar (floating PV, PV & CSP).
2. Fish migrations assessments and fishpass/fishway design & construction
3. Instream infrastructure: Gauging weirs, abstraction weirs.
4. Ecological Water requirements: DRIFT Modelling experience.

5. Linear developments (energy transmission, telecommunication, pipelines, roads)
6. Water resources sector (wastewater treatment works & water treatment works).
7. Mining sector (various).
8. Industrial, commercial & residential developments.

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans

Aquatic Ecological Assessment and Water Quality Studies

- Fish migrations analysis
- Fishpass/fishway design and development (2D and 3D design modelling)
- Fishway integration and hydraulic modelling
- Habitat Assessment Indices (IHAS, HCR, IHI & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Response Assessment Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological analysis
- Water quality monitoring
- Screening Test
- Riverine Rehabilitation Plans
- Floral Assessments

Biodiversity Assessments

- Floral Assessments
- Faunal Assessments
- Avifaunal Impact Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring

Modelling & Design

- Proficient in GIS modelling and analysis
- Proficient in AutoCAD design and modelling
- Proficient in hydraulic analysis of fishways and other instream infrastructure

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF NQOBILE LUSHOZI

PERSONAL DETAILS

Position in Company	Freshwater Ecologist Wetland and Aquatic Ecology
Joined SAS Environmental Group of Companies	April 2019

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the International Affiliation for Impact Assessments (IAIAsa) South Africa
Member of the South African Wetland Society (SAWS)
Member of the South African Council for Natural Scientific Professions (SACNASP Reg No - 124679)

EDUCATION

Qualifications

MSc Geoinformatics (Cum laude) (Stellenbosch University)	2019
BSc (Hons) Environmental Sciences (University of KwaZulu-Natal)	2015
BSc Environmental Sciences (University of KwaZulu-Natal)	2014

Short courses

Tools for Wetland Assessment (Rhodes University)	2020
Grass Identification Course (Africa Land-Use Training)	2021

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North-West, Limpopo, KwaZulu-Natal, Northern Cape, Free State
West Africa – Angola

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans

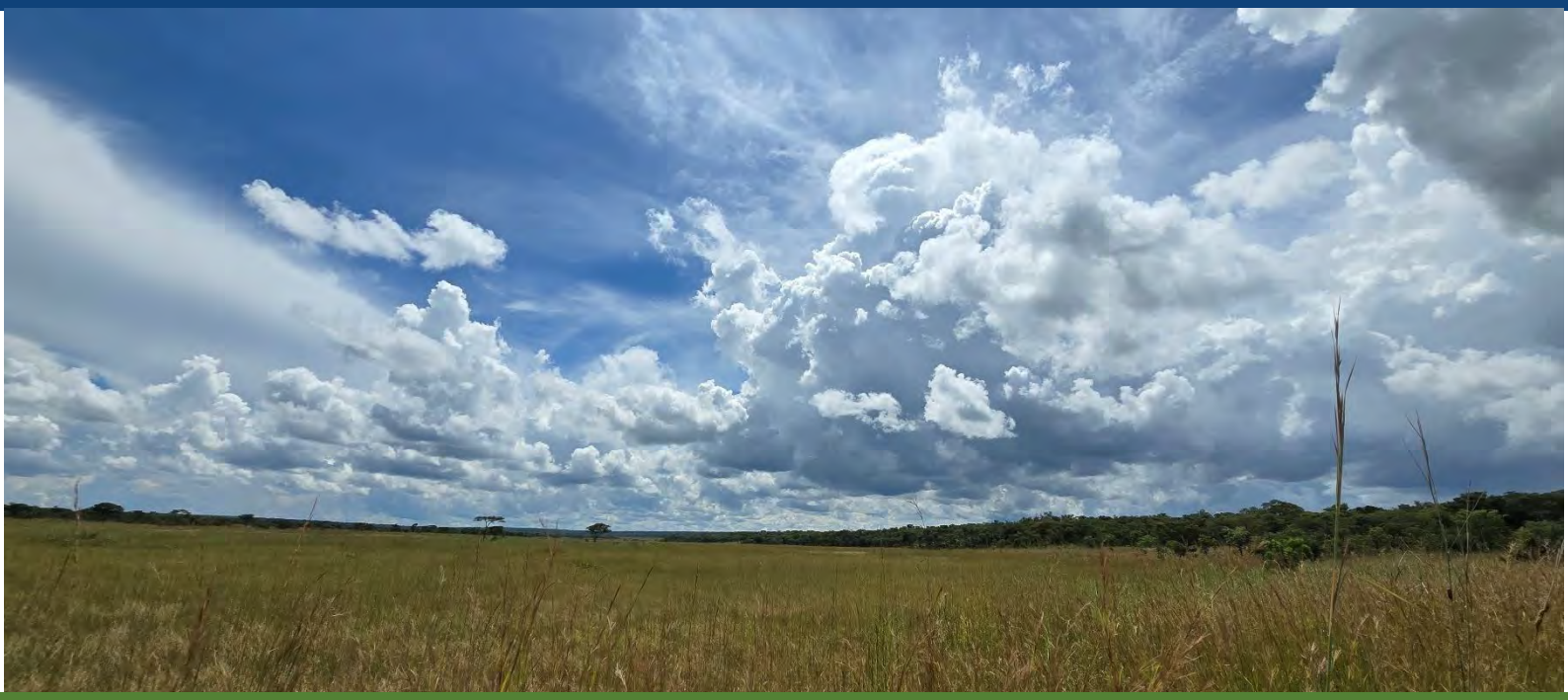
Aquatic Ecological Assessment and Water Quality Studies

- Toxicological Analysis
- Surface and groundwater quality Monitoring
- Screening Test
- Mass and salt balance determination

Appendix G: Hydrology

HCVAfrica

HIGH CONSERVATION VALUE



SPECIALIST STUDY: Hydrology Impact Assessment

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED CASSINGA ELECTRICAL SUPPLY PROJECT

September 2024

Disclaimer

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EXECUTIVE SUMMARY

This project requires an Environmental and Social Impact Assessment (ESIA) to be conducted in compliance with relevant Angolan legislation and regulations, and in conformance with international standards. HCV Africa was appointed (via Geolab) by SRK Consulting to conduct this ESIA. This report is the hydrology specialist study report for the ESIA.

The Project is located South of the centre of Angola, in the provinces of Huila and Huambo. The Project powerline extends for about 170 km, crossing three municipalities which include Jamba, Cuvango, Chipindo. The power line has 104 points where it crosses rivers or streams. Most of these streams are first order streams, being tributaries of larger river systems in the area. The main river systems that flow through the study area are:

- Cuandeja River (a tributary of the Cunene River)
- Cubango River
- Cunene River

The main works will be carried out largely in Huila Province near the Gove Hydro Dam (Huambo) 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 associated with the electrification of villages at Chipindo, Cuvango and Jamba will be constructed. The project will also include a 30 kV Medium Voltage OHL network to the new substations and a Low Voltage network to supply electricity to 1 000 homes in each of the three villages.

The area of influence (AoI) for this study considered the 220 kV overhead line, substations and smaller distribution lines within Jamba, Cuvango and Chipindo. During the construction, operations and closure periods, downstream impacts on all river systems that are crossed are expected. These impacts are expected to be mainly during the construction period. The impacts are likely to be small. Considering this, the AoI for the hydrology study was established to be the first and second order streams that the power lines cross or where substations are located. The impacts are likely to be insignificant due to dilution by the time streams reach their third order. Stream orders refer to the Strahler stream order system (top-down system). This AoI would account for buffers for the infrastructure – 100 m (50 either side) for HV line, 18 m either side for MV/LV lines and 3ha for substations.

Potential surface water impacts are:

- Siltation of receiving streams
- Hydrocarbon pollution in receiving streams
- High flow events may cause scouring around pylon foundations if they are constructed within flow zones
- Climate change may increase the flood peaks and therefore flood levels

These impacts will be limited to the wet season where normal surface runoff will wash the pollutants into the receiving streams and rivers.

Surface water impacts are expected to be small and limited to the first and second order streams (Strahler stream order system). The disturbed footprints are very small compared to the footprints disturbed by agriculture. The incremental surface water siltation impacts will be unnoticed third order streams in areas where agriculture is present and will be limited to river reaches near construction works. Impacts will occur during the wet season only.

If the construction and maintenance fleet are well-maintained, hydrocarbon pollution is expected to be negligible.

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

Acronym	Meaning
AoI	Area of Influence
CH	Critical Habitat
DEM	Digital Elevation Model
ESIA	Environmental and Social Impact Assessment
IDF	Intensity Duration Frequency
IFC	International Finance Corporation
km	Kilometre
kV	Kilo volt (1 000 volts)
m	Metre
mamsl	Meters above mean sea level
MAE	Mean annual evaporation
MAP	Mean annual precipitation
mm	Millimetre
MV	Medium voltage
MVA	Megavolt-amperes
OHL	Overhead line
SCS	United States Department of Agriculture *Soil Conservation Service*

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1 INTRODUCTION

The Republic of Angola, through its Ministry of Energy and Water (MINEA), is embarking on a significant enhancement of its electrical infrastructure with the Cassinga Project, aiming to boost electric power supply across various communities within the Province of Huíla. The Project is structured around the establishment of a new 220 kV Overhead Line (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. Furthermore, the Project includes the laying down of medium voltage overhead lines for distribution, along with the necessary low voltage 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 OHL 220 kV interconnection to Cuchi/Menongue.

An estimated power demand of 80 MW has been calculated for the Cassinga 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. A Technical Specification for Metallic Structures for Lines and Substations, adhering 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 Cassinga Electric Power Supply Initiative represents a significant leap forward in Angola's energy infrastructure development. The Project 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 Hydro Plant to the Cassinga Project and the future OHL 220 kV interconnection to Cuchi/Menongue.

1.1 Proposed Infrastructure

The Project involves the construction of three new substations and the establishment of a new 220 kV Overhead Line 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 medium voltage OHL network to the new substations and a Low Voltage network to supply electricity to 1 000 homes in each of the three villages.

1.1.1 Transmission lines and towers

Transmission line conductors are strung on in-line suspension towers and bend (strain) towers. The structures proposed to be used for the majority of the 220 kV transmission line are metallic towers type Y, adequate to the angle of the overhead line. These towers are approximately 50 m in height. A total footprint area of 80 m x 50 m is required for each tower. The average span between two towers is 400 m.

The cross-rope suspension tower is typically used along the straight section of the servitude, while the self-supporting angle towers and inline strain towers are used where there is a bend in the powerline alignment. Angle towers are cumbersome and more steel-intensive than suspension towers, making them more visually intrusive and expensive to construct. Therefore, transmission line routes are planned with as few bends as possible.

1.1.2 New substations

Three new substations will be constructed at Chipindo, Cuvango and Jamba.

1.1.3 Overhead line infrastructure

Overhead line infrastructure will be constructed in two stages:

- Stage 1: The Gove – Chipindo – Cuvango section of the overhead line.
- Stage 2: The section from Cuvango to Jamba.

1.1.4 Electrification of community homes and public lighting

The electrification of Chipindo, Cuvango and Jamba will consist of medium and low voltage network to supply grid electricity to approximately 1 000 homes in each village. The medium voltage 30 kV OHL (MV network) – yellow lines and transformation stations – red triangle in the villages is illustrated in ***Figure 1-1*** – Chipindo, ***Figure 1-2*** – Cuvango and ***Figure 1-3*** – Jamba.



Figure 1-1: MV network and transformation Station sites - Jamba



Figure 1-2: MV network and transformation Station sites - Cuvango

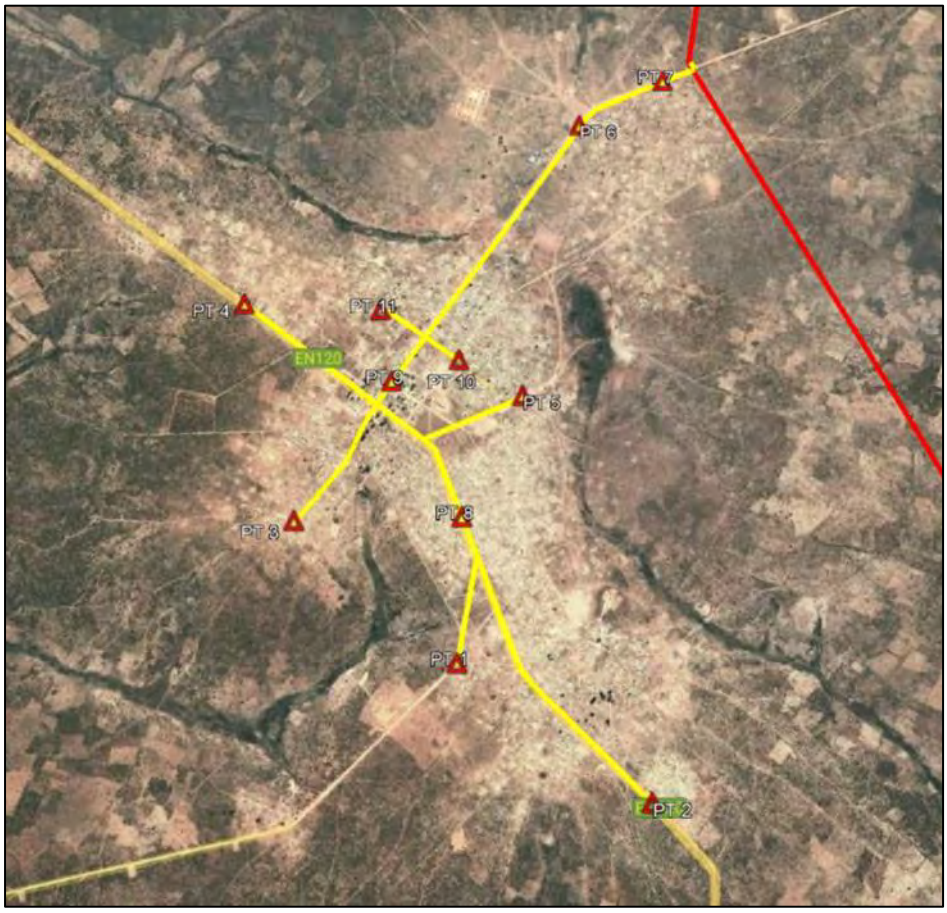


Figure 1-3: MV network and transformation Station sites - Chipindo

1.2 Purpose of Study

This project requires an Environmental and Social Impact Assessment (ESIA) to be conducted in compliance with relevant Angolan legislation and regulations, and in conformance with international standards. HCV Africa was appointed (via Geolab) by SRK Consulting to conduct this hydrology study to inform the ESIA.

Note that it is possible the layout (dimensions, quantities, and components) may change during detailed design phase.

1.3 Terms of Reference

The terms of reference for the hydrology specialist study are limited to baseline studies and impacts related to surface water flows and flow depths. Groundwater, wetlands, fauna and flora around surface water studies are detailed in separate specialist studies.

Baseline daily rainfall and monthly average evaporation data was supplied by SRK Consulting. This data is further processed for use in this study. The sources of this data, the description of this data and the results of the post processing are described in this report.

1.4 Assumptions, Exclusions and Limitations

The study includes hydrological and hydraulic calculations of 104 river crossings. A 100 m corridor of detailed LIDAR survey was available along the power line route. Survey outside of this corridor was sourced from the publicly available FABDEM DEM. The FABDEM DEM is calculated from satellite survey and has a 30 m resolution. This is a significant improvement on the publicly available SRTM DEM which has a 90 m resolution, but not as detailed as a LIDAR survey with ground control.

The FABDEM DEM was used for catchment delineation. This data is well suited to catchment delineation. The LIDAR survey was used to determine Normal flow depths at the river crossing sites. Accurate hydraulic flow depths are not required for impact prediction purposes but may be required for pylon placement.

Many of the river crossings are in remote areas that are inaccessible by vehicle. However, a site inspection of many of the river crossings that were accessible by vehicle or within practical walking distance of a road, showed that hydraulically unique river systems appear to be rare. A good indication of hydraulic characteristics can be estimated from available aerial photography, supplemented with field observations.

Floodlines for all 104 crossings are not included in the scope of work. However, accurate cross sections were taken at each river crossing location and Normal flow depths were calculated at each of these, based on assumed roughness inputs and measured channel slopes. The Normal flow depths and corresponding water surface elevations exceed the requirements for impact assessment purposes and provide adequate information for pylon placement. To alleviate the need for detailed floodlines of all 104 river crossings, conservative offsets from the stream centerline are provided in Appendix B.

Where pylons are required to be placed within these offsets, backwater analyses may be required to determine flow velocities at pylon plinths. This will account for backwater effects of any downstream controls in channels that have subcritical flow regimes.

Additionally, the following general assumptions and limitations are of relevance:

- The results of the assessment must be interpreted based on the knowledge that no medium – or long-term hydrological measurements are available. All data is based on singular collection efforts from a a single site visit;
- The results of the impact assessment must be interpreted with caution.

1.5 Information Sources

1.5.1 Topography

A 100 m corridor of detailed LIDAR survey was available along the power line route. Survey outside of this corridor was sourced from the publicly available FABDEM (30 Meter Resolution Bare Earth DEM from Fathom) database.

1.5.2 Rainfall data

Rainfall data from 4 locations was provided by SRK Consulting. The four rainfall locations are:

- Cuanja (14.68°S, 16.04°E, altitude: 1 468 mamsl)
- Cuvango (14.48°S, 16.27°E, altitude: 1 454 mamsl)
- Chipindo (13.80°S, 15.80°E, altitude: 1 642 mamsl)
- Gove (13.45°S, 15.87°E, altitude: 1 562 mamsl)

The data was sourced from the CHIRPS database. Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS) data has become a popular data source in ungauged or poorly gauged areas. CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring. (https://developers.google.com/earth-engine/datasets/catalog/UCSB-CHG_CHIRPS_DAILY). CHIRPS was created in collaboration with scientists at the USGS Earth Resources Observation and Science (EROS) Center to deliver complete, reliable, up-to-date data sets for a number of early warning objectives, like trend analysis and seasonal drought monitoring. (https://www.chc.ucsb.edu/data/chirps).

1.5.3 Evaporation data

Evaporation data was calculated using a Penman Monteith equation for the same locations as the rainfall stations listed in Section 1.5.2.

1.5.4 Powerline route and substation locations

The infrastructure locations were provided by SRK Consulting as a kmz file.

2 KEY LEGISLATIVE FRAMEWORKS AND LENDER REQUIREMENTS

To provide the relevant information in support of the ESIA, international guidelines and standards were reviewed and applied where applicable. A summary of the applicable standards, guidelines and principles are provided below.

2.1.1 Local guidelines and standards

In terms of Angolan national legislative requirements, adherence to the Presidential Decree 117 of 2020 concerning Environmental Impact Assessments is required.

The National Assembly of Angola approved the new Constitution of the Republic of Angola on 5 February 2010, to replace the 1992 Constitution. The Constitution provides the basis for the Environmental Framework Law through Article 39. This Article 39 (Environmental Rights) provides 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 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.

3. Acts that endanger or damage conservation of the environment shall be punishable by law.

Angolan legislation is issued at the national level through:

- Laws, which are issued by the National Assembly;
- Presidential Decrees, which are issued by the President's office; and
- Regulations (executive decrees), joint executive decrees and resolutions, which are normally issued by a ministry or ministries.

Note that other legislative, regulatory, and administrative requirements may pertain to the proposed projects, which will be elaborated on in the ESIA as relevant. The summary provided below is intended to highlight key environmental legislation and obligations only.

2.1.2 International Finance Corporation Performance Standards

The International Finance Corporation (IFC) has published a number of Performance Standards (1-8) on Environmental and Social Sustainability (IFS PS, 2012). Of these, Performance Standard 1 (IFC PS1) and 6 (IFC PS6) are of greatest relevance to the assessment of impacts on biodiversity.

Performance Standard 1 establishes the importance of the following aspects:

- Integrated assessment which identifies the environmental and social impacts, risks, and opportunities of proposed projects;
- Effective community engagement through disclosure of project related information and consultation with local communities on aspects that affect them; and
- The client's management of environmental and social performance throughout the life of the project.

It is therefore applicable for all projects to have studies which identify environmental and social risks and impacts. Additional aspects to considered under IFC PS1 include the following:

- The developer is required to establish and implement monitoring and management programmes.
- Implement the mitigation hierarchy which favours avoidance over minimisation.

Performance Standard 6 establishes the importance of the following aspects:

- This standard recognises the protection and conservation of biodiversity and sustainable management of natural resources;
- Three types of habitat with differing biodiversity importance are recognised under IFC PS6 - Modified Habitat, Natural Habitat and Critical Habitat (CH);
- Modified habitats are areas that a large proportion of plant or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition;
- Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, or where human activity has not modified an area's primary ecological functions and species composition;
- CH's are areas with high biodiversity value, including
    - (i) habitat of significant importance to Critically Endangered and/or Endangered 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. Requirements for mitigation of impacts in these three areas differ significantly.

2.1.3 Equator Principles

The equator principles (Version 4, 2020), provide a framework for financial institutions to assess environmental and social due diligence. These principles align with undertakings such as the 2015 Paris Agreement, United Nations Guiding Principles on Business and Human Rights and the United Nations Sustainable Development Goals. The Equator Principles apply the mitigation hierarchy. Climate change, IFC Performance standards, as well as the World Bank Group's Health and Safety Guidelines are key assessment criteria for the Equator Principles.

2.1.4 Other international guidelines and standards

For international requirements, alignment to the following standards and guidelines are required where applicable:

- IFC Environmental, Health and Safety (EHS) General Guidelines (2007).
- IFC EHS Guidelines for Electric Power Transmission and Distribution (2007).
- United Nations Sustainability Development Goals (2015).
- United Nations Guiding Principles on Business and Human Rights (2011).
- United Nations Global Compact (2000).
- OECD Guidelines for Multinational Enterprises (2011).
- OECD Due Diligence Guidance for Responsible Business Conduct (2018).
- Standard Chartered (latest internal policies and statements).
- EKN Sustainability Policy (2023).
- SEK Sustainable Finance Policy (2023).
- ILO Conventions.
- International Bill of Human Rights.
- UN Convention on the Rights of the Child.
- UN Global Compact.
- Thun Group of Banks – The Guiding Principles: an interpretation for banks.
- OECD Due Diligence Guidelines for Responsible Corporate Lending and Securities Underwriting.
- Danish Institute for Human Rights Human Rights Impact Assessment: Guidance and Toolbox.

3 APPROACH AND METHODOLOGY

3.1 Objectives

This report provides information related to the hydrology baseline condition, the anticipated impacts to these resources and mitigation measures to minimise risks and avoid significant impacts to these resources. This ESIA process is exclusively for the Cassinga Project. Based on the required aspects to support the ESIA the following aims and objectives were established:

- Establish expected Area of Influence (AoI);
- Identify hydrology resources in the AoI;
- Establish baseline condition of the identified hydrology resources by:
    - Defining baseline rainfall and evaporation;
    - Defining the catchment boundaries;
    - Defining water chemistry; and
    - Defining flow regimes.
- Establish anticipated risks to the hydrologicaland hydraulic environment that may be attributed to the proposed activities; and
- Define and provide actions to avoid, minimise and mitigate potential impacts to the hydrological environment.

3.2 Methodology

3.2.1 Peak rainfall calculation

The CHIRPS rainfall data sets for the four locations discussed in Section 1.5.2 were statistically analysed to produce the annual maximum series for each rainfall station. A Log Pearson Type 3 distribution provided a good fit to the annual maximum series for the Cuanja, Cuvango and Chipindo stations. These are shown in ***Figure 3-1*** to ***Figure 3-3***. A Log Extreme Value Type 1 distribution provided a good fit to the annual maximum series for the Gove station. These distributions were used to generate peak 24-hr rainfall depths for each station. This is shown in ***Figure 3-4***.

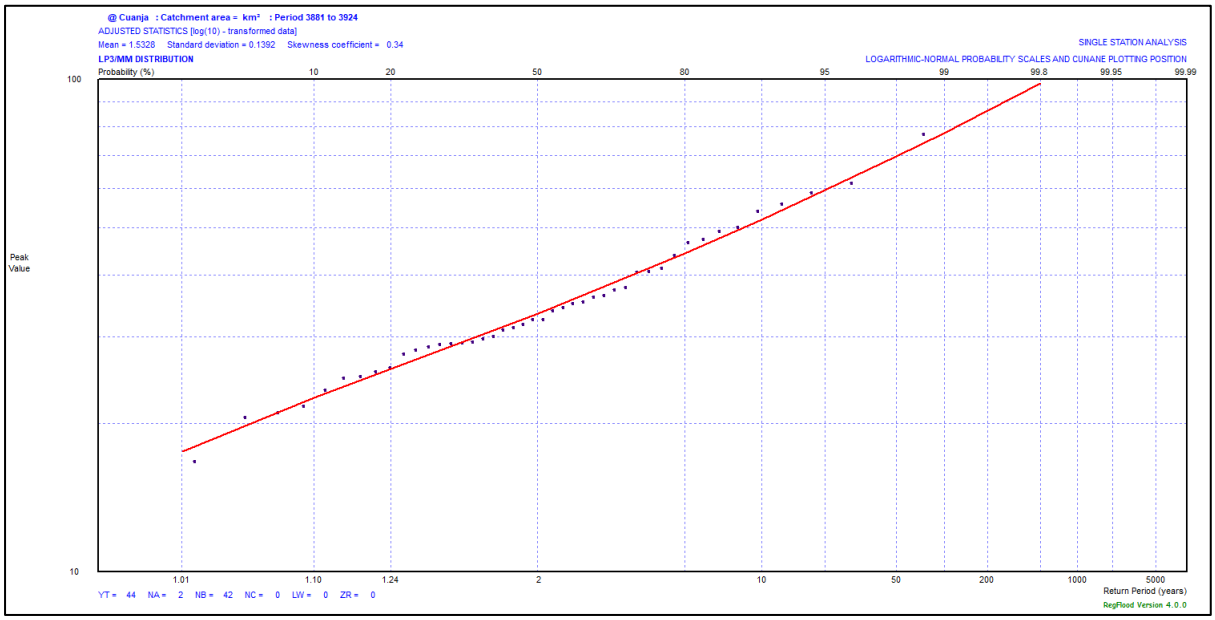


Figure 3-1: Log Pearson Type 3 distribution fitted to the Cuanja annual maximum series

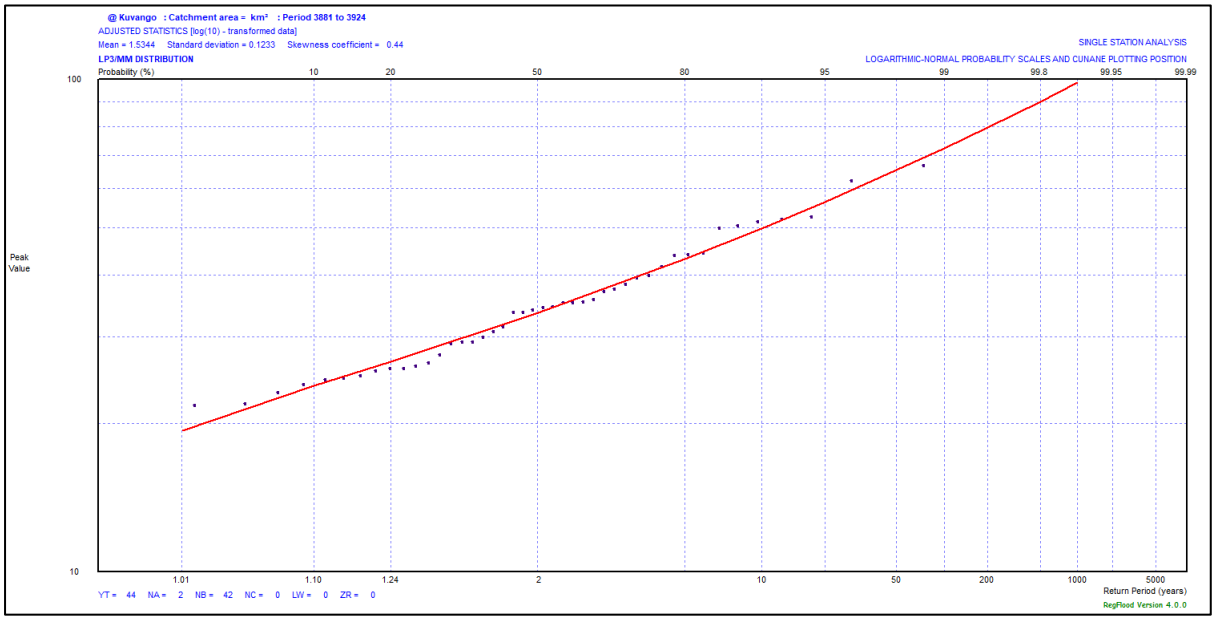


Figure 3-2: Log Pearson Type 3 distribution fitted to the Cuvango annual maximum series

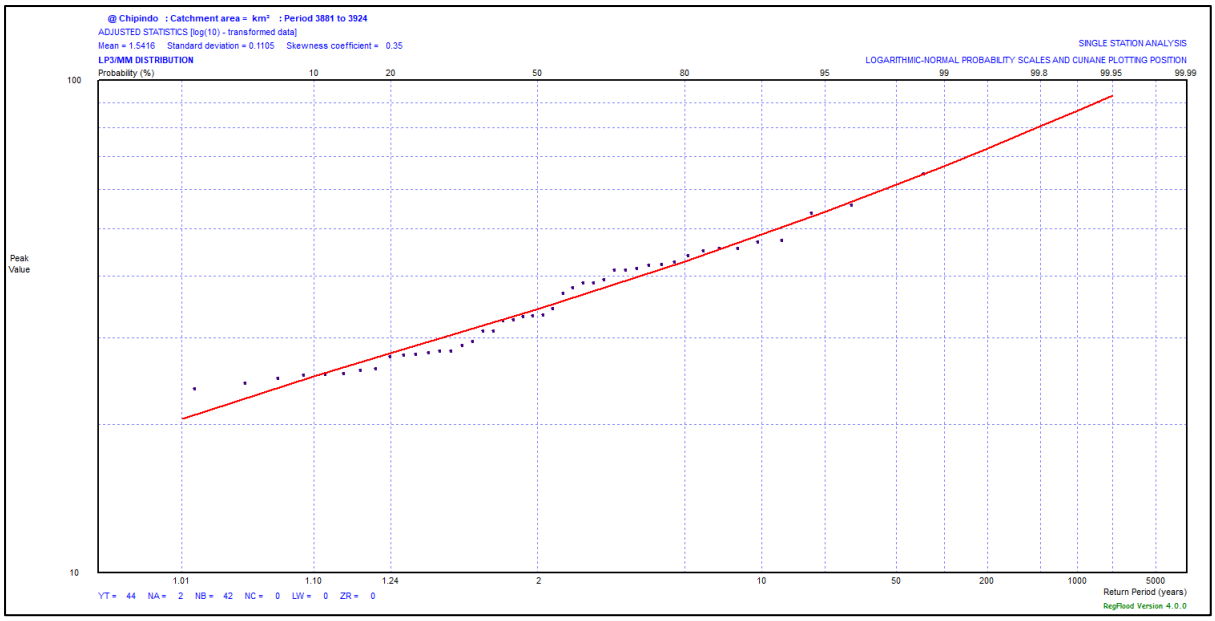


Figure 3-3: Log Pearson Type 3 distribution fitted to the Chipindo annual maximum series

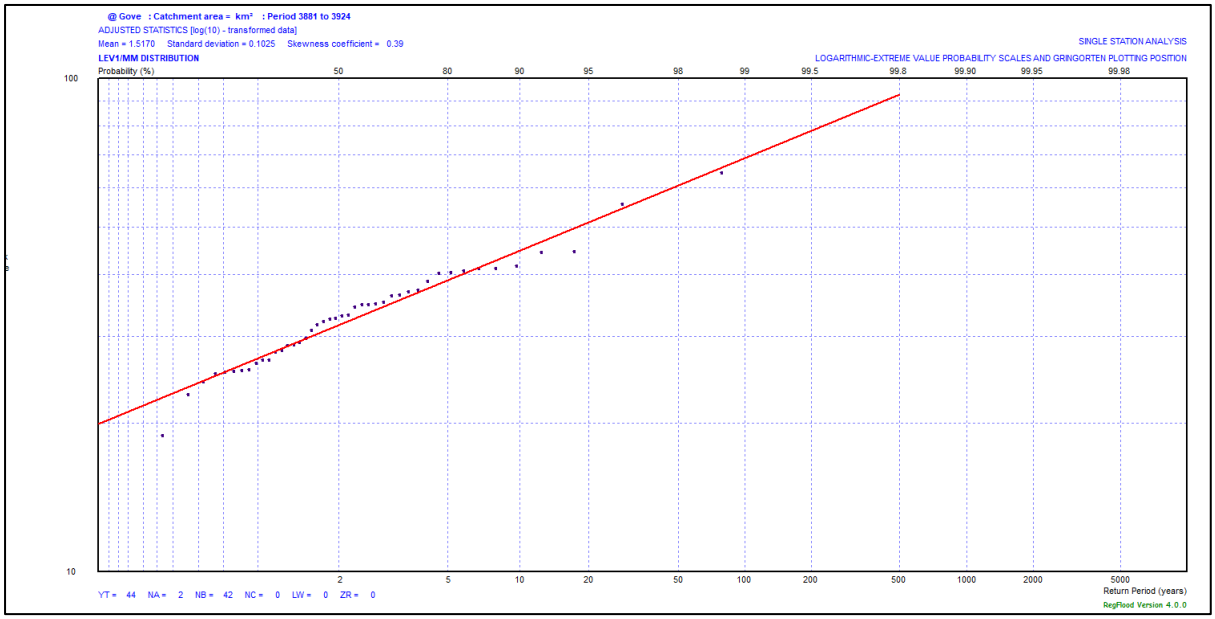


Figure 3-4: Log Extreme Value Type 1 distribution fitted to the Gove annual maximum series

D-hr storm depths were calculated based on Adamson's TR102 (1981) ratios of D-hr storm depths to the 24-hr storm depths. The inland R_1 zone was used. The data is presented in Section 5.3.2.

3.2.2 Catchment delineation

The catchments for all 104 potentially impacted streams and rivers were calculated using the FABDEM DEM. The locations of the river crossings are listed in Appendix A, and these catchment areas are listed in Appendix B.

3.2.3 Storm water flows and mean annual runoff

No flow gauging data is available on the potentially impacted streams. Literature research and previous work done provided no suitable flow or runoff data either. Mean annual runoff was therefore estimated based on work done in the region in a similar climate and with similar stream orders, vegetation and catchment sizes.

The Rational method is suitable for calculating flood peaks from rural catchment less than 30 km^2 in extent. The Rational method was used to calculate flood peaks for 87 of the catchments, with catchment sizes varying from 0.1 km^2 to 27 km^2. The old South African Department of Water Affairs' calculation sheet was used to determine the runoff coefficients. The time-to-concentration of the sub-catchments was calculated using the SCS method which is suitable for undeveloped catchments. Time to concentrations varied from 15 minutes to 1.3 hours.

The SCS method (with unit hydrographs) was used to calculate the flood peaks for eleven of the catchments, measuring between 40 km^2 and 540 km^2. The catchments are generally similar and a curve number of 85 was used. Storm durations varied between a 2-hour storm duration and a 17-hr storm duration.

The Francou Rodier envelope curves were used for the largest two catchments, which measured 1 622 km^2 and 7 549 km^2. RMF Zone 4 was assumed. The 100-yr flood peaks were scaled from the RMF flood peaks using the relationships provided in Kovacs (1988).

3.2.4 Water quality

Water quality was sampled during the dry season survey, on 15 July 2024 (due to limitations during the wet season in terms of access and ease of sampling). The sampling locations are detailed in Table 3-1 and shown in ***Figure 3-5***.

Table 3-1: 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	Ralitively 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
WQX	-14.11778	16.09406	Cuvango River tributary with lots of agriculture in catchment, cf WQ7

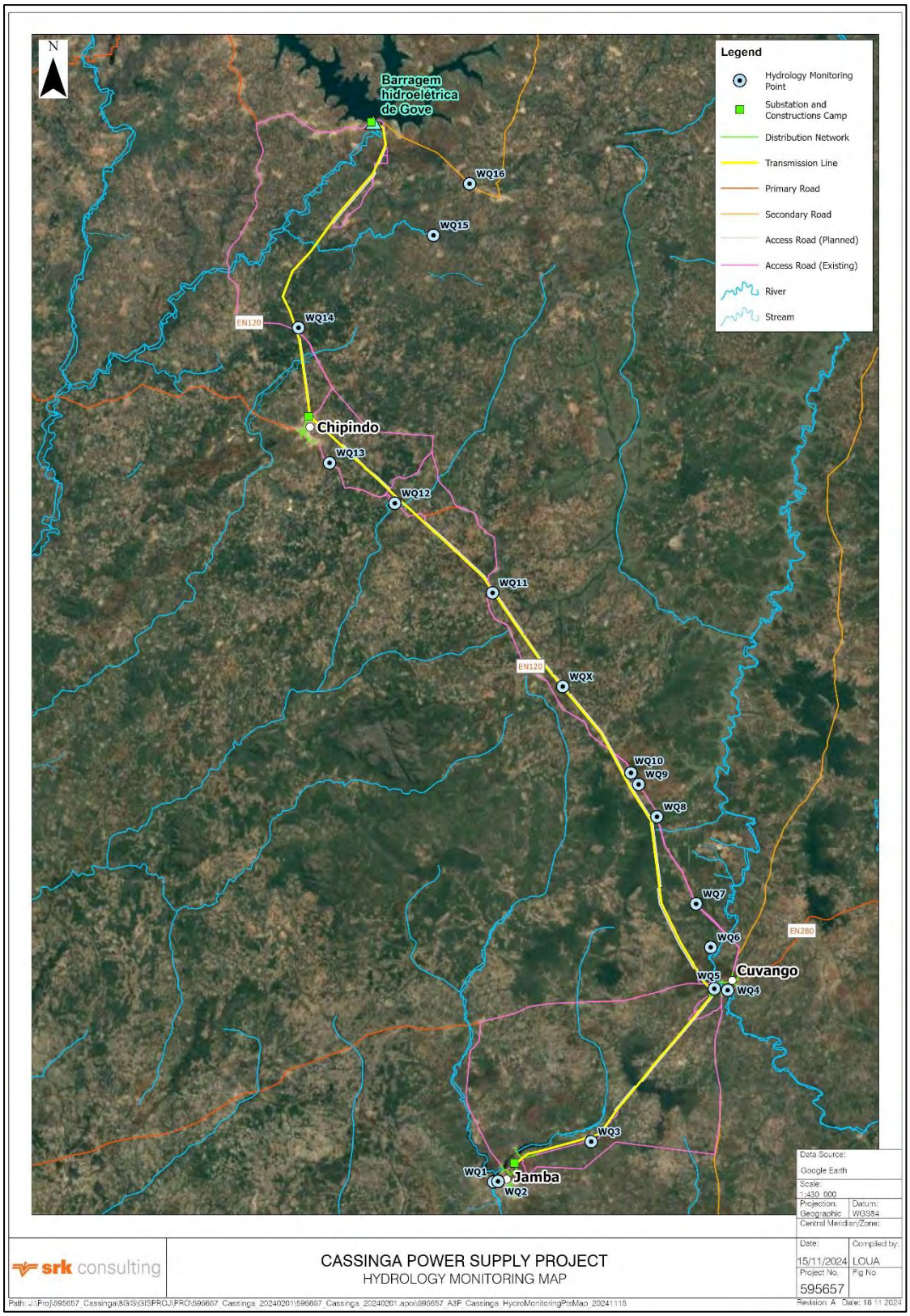


Figure 3-5: Water quality monitoring points

The water quality constituents considered in this study are presented in Table 3-2. The water quality samples were analysed by a professional laboratory. The water quality data was compared to water quality limits stated in Presidential Decree 261/11 of Angolan Law – Annex I (Class A1 – Physical Treatment and Disinfection) – Quality of Freshwater for Production of Water for Human Consumption. These are shown in Table 3-2. The emphasis is on human consumption. A comprehensive water quality analysis, focusing on aquatic water use, will likely be undertaken as part of the aquatic specialist study.

Total content refers to all present mass of the parameter in question. Dissolved metals are typically cations in solution or particulate metals in suspension. There are no guideline values for suspected solids. It is typical for Total suspended solids to be high in rainy season, especially in rural areas where agriculture takes place along watercourses. In the Angolan context, farmers typically farm the "nacas" (area between low flow level and high flow level of the river/stream). This then results in a loose substrate in the watercourse which contributes to suspended solids in the early rainy season. These impacts will be temporal and transient. These impacts will be highly variable as they are dependent on amount of activity present, and frequency, duration and timing of high-flow events, and whether stabilising vegetation has had a chance to recover or not.

Table 3-2: 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	

Iron	mg/l Fe	0.1	0.3
Fluoride	mg/l F	0.7-1	1.5
Phosphates	mg/l P_2O_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		
Sulphate	mg/l SO_4	150	250
Total organic carbon	mg/l C		
Zinc	mg/l Zn	0.5	3

4 PROJECT ACTIVITIES POSING POTENTIAL IMPACTS

The impacts on the project are divided into the construction phase, the operational phase, and the closure and rehabilitation phase of the project. These are discussed below:

4.1 Construction Phase

4.1.1 Access road (and possible river crossing) construction

Access road construction will involve vegetation clearing. Road and foundation building material will be stockpiled close to the construction activities. If bridges or river crossings are required to allow access roads to cross water courses, significant but local disturbances to the river banks and channel will occur.

These activities may introduce silt into the local streams and rivers. Annual runoff and flood flows are not expected to be changed. The river morphology may be changed if sediment beds being introduced are large enough to create sand banks.

4.1.2 Laydown areas, Pylon and substation foundation construction

Vegetation clearing and the likely removal of topsoils and upper subsoils will be required to prepare pylon and substation foundations. These soils will likely be stockpiled close to the construction area. In the case of the laydown areas, it is expected that vegetation will be cleared and area graded. These activities may introduce silt into the nearby streams and rivers.

4.1.3 Construction vehicle activities

Construction vehicles will be active along the length of the power line and at substations. Hydrocarbon leaks from these vehicles could be transported into the local streams and rivers. In addition, laydown areas and possible field service areas for these vehicles may also introduce hydrocarbon pollutants into nearby streams and rivers.

4.1.4 Construction camp grey and black water management

The construction of the power line will require the establishment of a construction camp/s at appropriate location/s along the route. Construction camps will be sited at the contractor's discretion according to their construction schedule and needs. It is estimated that a campsite will be built approximately every 80 km and will be required to house up to 100 people. Once construction activities have been concluded, the construction camp will be closed off and the area rehabilitated concurrently. The grey and black water from the construction camps has the potential to pollute nearby river systems.

4.1.5 Transformer oil leaks

The transformers at the substations may leak (or discharge, if ruptured) oil. This oil can be washed into local river systems.

4.2 Operational Phase

4.2.1 Maintenance vehicle activities

During the operational phase, maintenance vehicles will be active along the length of the power line and at substations. Hydrocarbon leaks from these vehicles could be transported into nearby streams and rivers. In addition, laydown areas and possible field service areas for these vehicles may also introduce hydrocarbon pollutants into nearby streams and rivers.

4.2.2 Access road erosion

Erosion from access roads may also introduce silt into the local streams and rivers.

4.2.3 Scouring at pylon foundations

The pylon foundations will not alter flows or flood peaks in the rivers and streams, but if these foundations are located within flow areas, scouring around the pylon foundations may cause damage to the infrastructure and may release additional sediment into the streams.

4.2.4 Climate change

Most climate change models predict that peak rainfall will increase by the turn of the century. Some predict a reduction in peak rainfall. Of those that predict an increase in peak rainfall, the magnitude of this increase is predicted to be from single digit percentage to over 100% increase. The 100% increases are considered unlikely and are not considered in this study. Increases of 10%-20% are often cited and 20% is used to assess the impacts on flood levels in this study.

Hydraulic calculations show that the changes in flood levels increase with increasing catchment size and thus flood peak. A small catchment measuring 0.5 km^2 will experience an increase in flood water level of less than 5 mm. The largest catchment in this study, upstream of crossing 24 produces a 100-yr flood peak of 2 109 m^3/s. This will increase to 2 530 m^3/s if increased by 20%. The resultant increase in flood water level at crossing point 24 is 210 mm (0.21 m).

4.3 Closure and Rehabilitation

4.3.1 Construction camp removal

After the completion of construction activities, concurrent rehabilitation will be conducted when a campsite is removed, this area will be cleared and cleaned of any debris, topsoil re-established and revegetated. During decommissioning, similar activities to the construction phase will take place. These activities may introduce silt and hydrocarbons into nearby streams and rivers.

5 BASELINE CONDITIONS

5.1 Site Description/Project Location

The Project is located South of the centre of Angola, in the provinces of Huila and Huambo (***Figure 5-1***). The Project powerline extends for about 170 km, crossing six municipalities which include Jamba, Kuvango, Dongo, Galangue, Chipindo and Kalima.

The main works will be carried out largely in Huila Province near the Gove Hydro Dam (Huambo) 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 associated with the electrification of villages at Chipindo, Cuvango and Jamba will be constructed. The project will also include a 30 kV Medium Voltage OHL network to the new substations and a Low Voltage network to supply electricity to 1 000 homes in each of the three villages (refer to ***Figure 1-1*** to ***Figure 1-3*** on page 10 and 11).



Figure 5-1: Location of the proposed 220 kV OHL and the towns it will supply with electricity

5.2 Local and Regional Context

5.2.1 Hydrological setting

The project is a 170 km long linear project that has 104 points where it crosses rivers or streams. Most of these streams are first order streams, being tributaries of larger river systems in the area. The main river systems that flow through the study area are:

- Cuandeja River (a tributary of the Cunene River)
- Cubango River
- Cunene River

These are shown in ***Figure 5-3***.

5.2.2 Area of Influence

The area of influence (AoI) for this study considered the 220 kV overhead line, substations and smaller distribution lines within Jamba, Cuvango and Chipindo (refer to ***Figure 5-1***). During the construction, operations and closure periods, downstream impacts on all river systems that are crossed are expected. These impacts are expected to be mainly during the construction period. The impacts are likely to be small. Considering this, the AoI for the hydrology study was established to be the first and second order streams that the power lines cross or where substations are located (refer to ***Figure 5-2***). The impacts are likely to be insignificant due to dilution by the time streams reach their third order. Stream orders refer to the Strahler stream order system (top-down system).

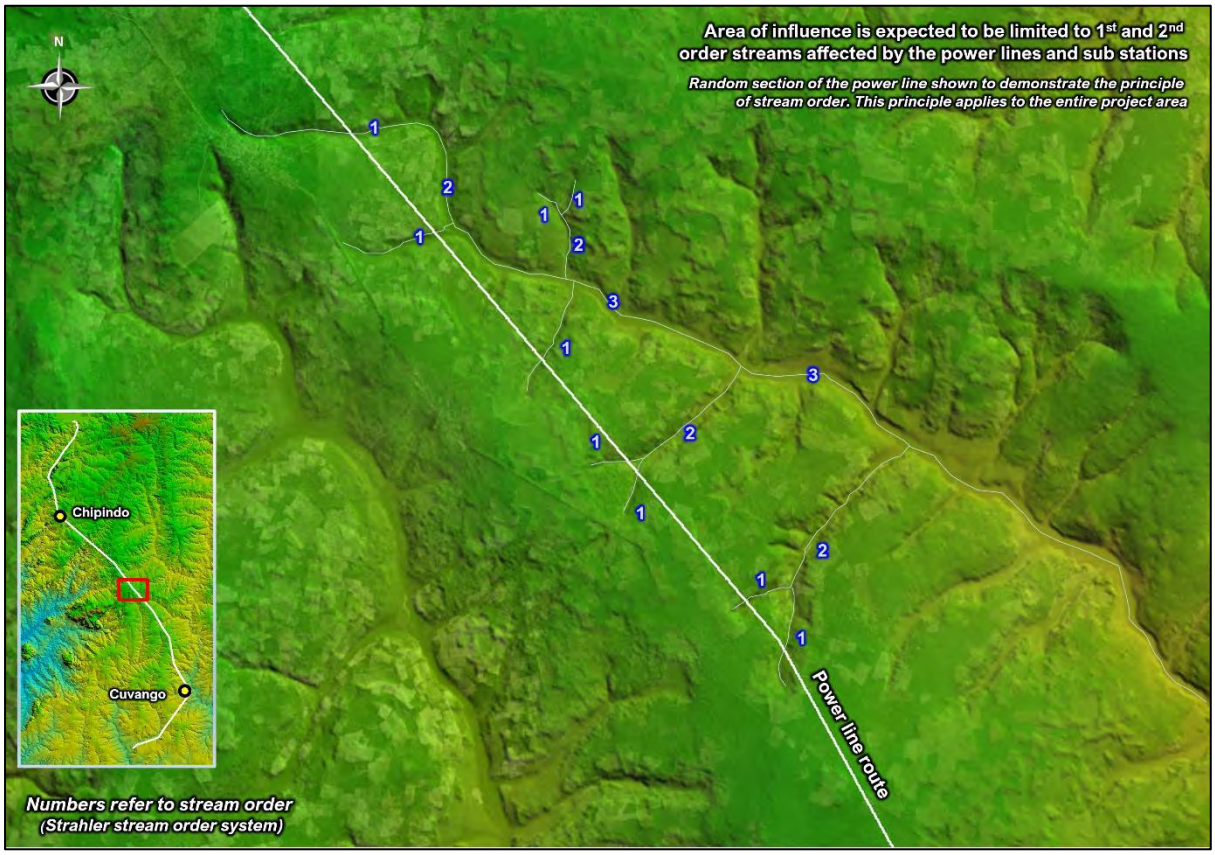


Figure 5-2: Area of influence

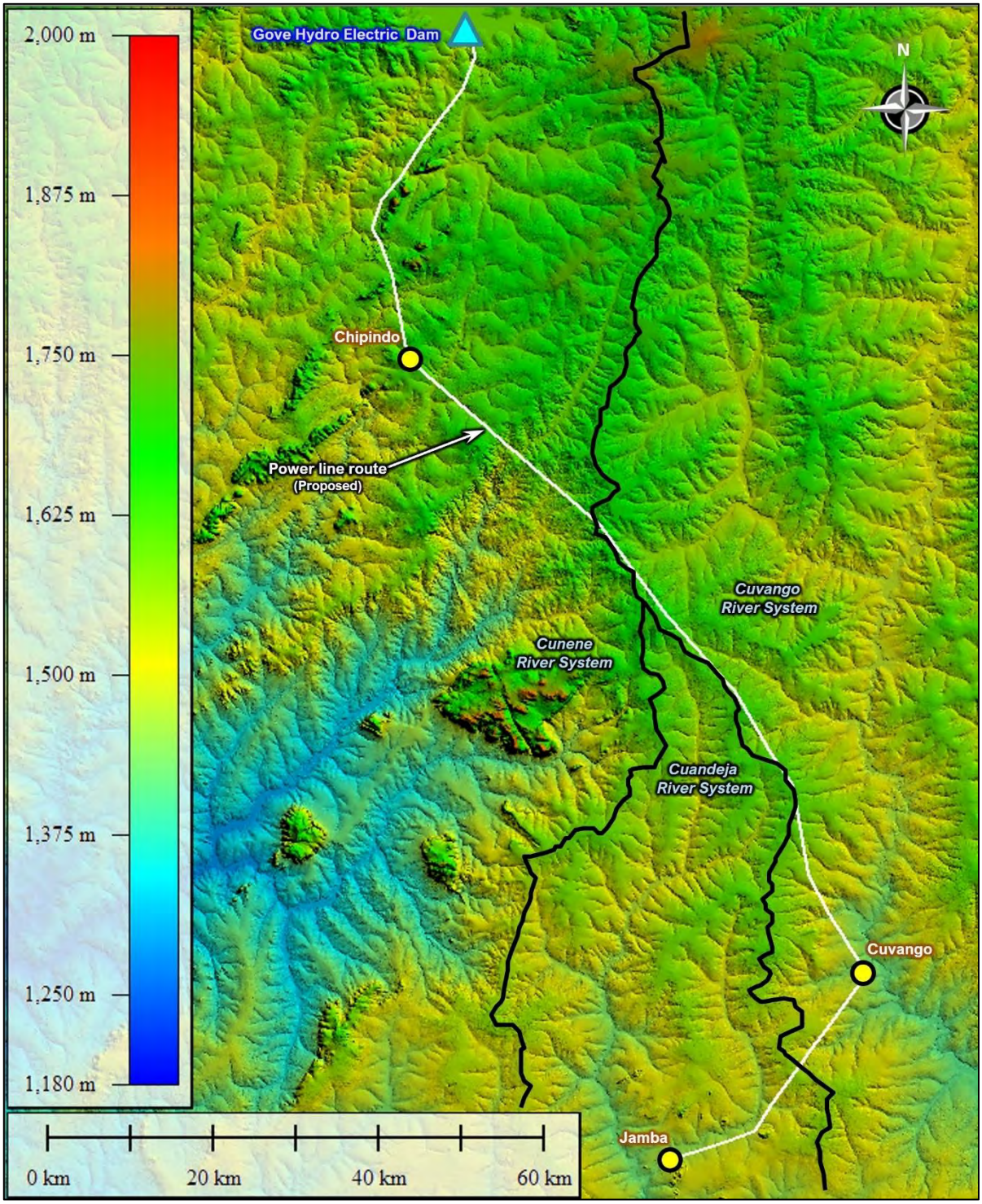


Figure 5-3: Main river systems

5.3 Ambient Conditions

5.3.1 Baseline rainfall and evaporation

The baseline rainfall and evaporation data for each gauge are provided in ***Figure 5-4*** to ***Figure 5-7***.

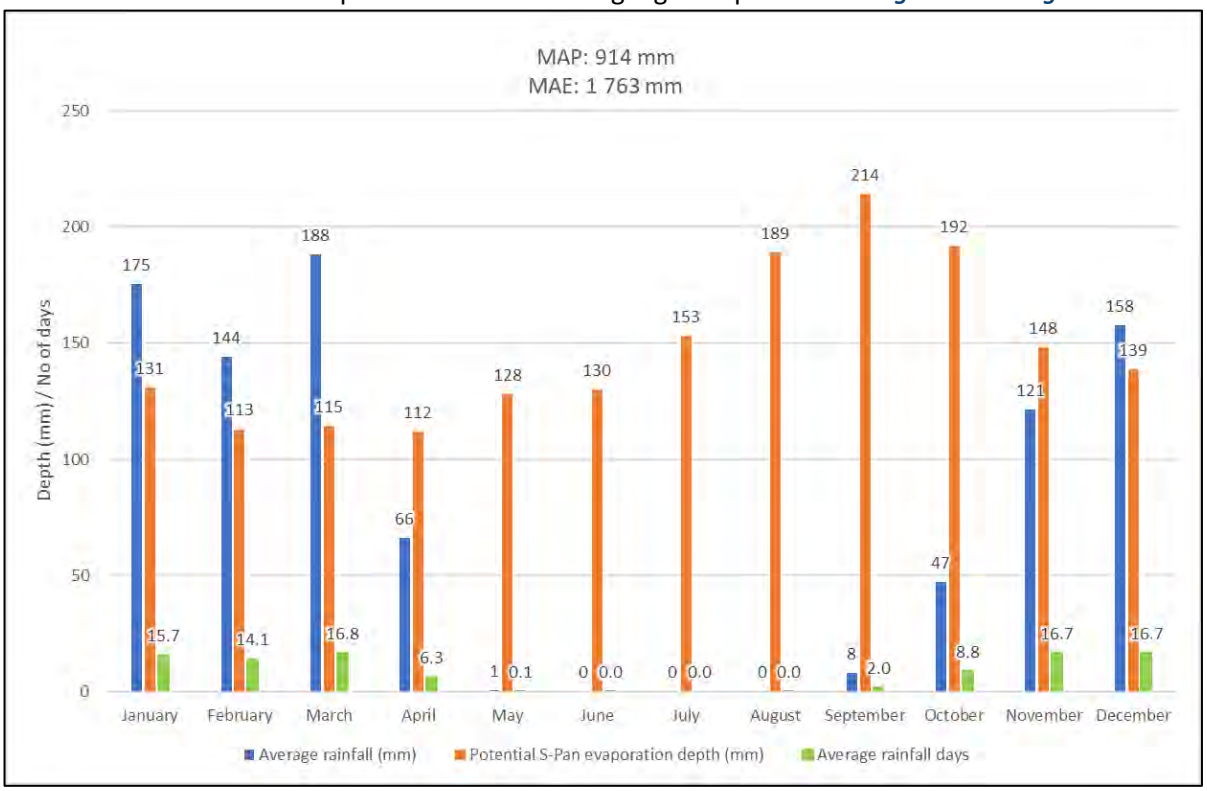


Figure 5-4: Baseline rainfall and evaporation (Cuanja)

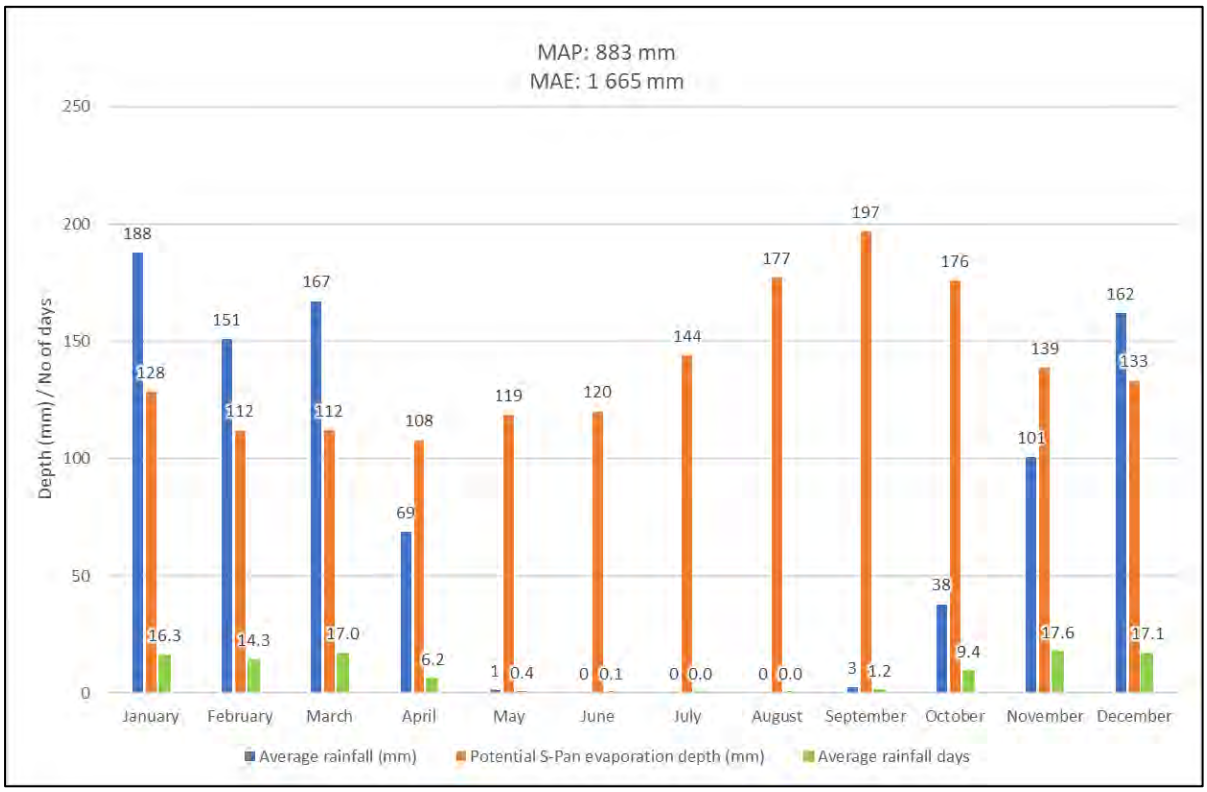


Figure 5-5: Baseline rainfall and evaporation (Cuvango)

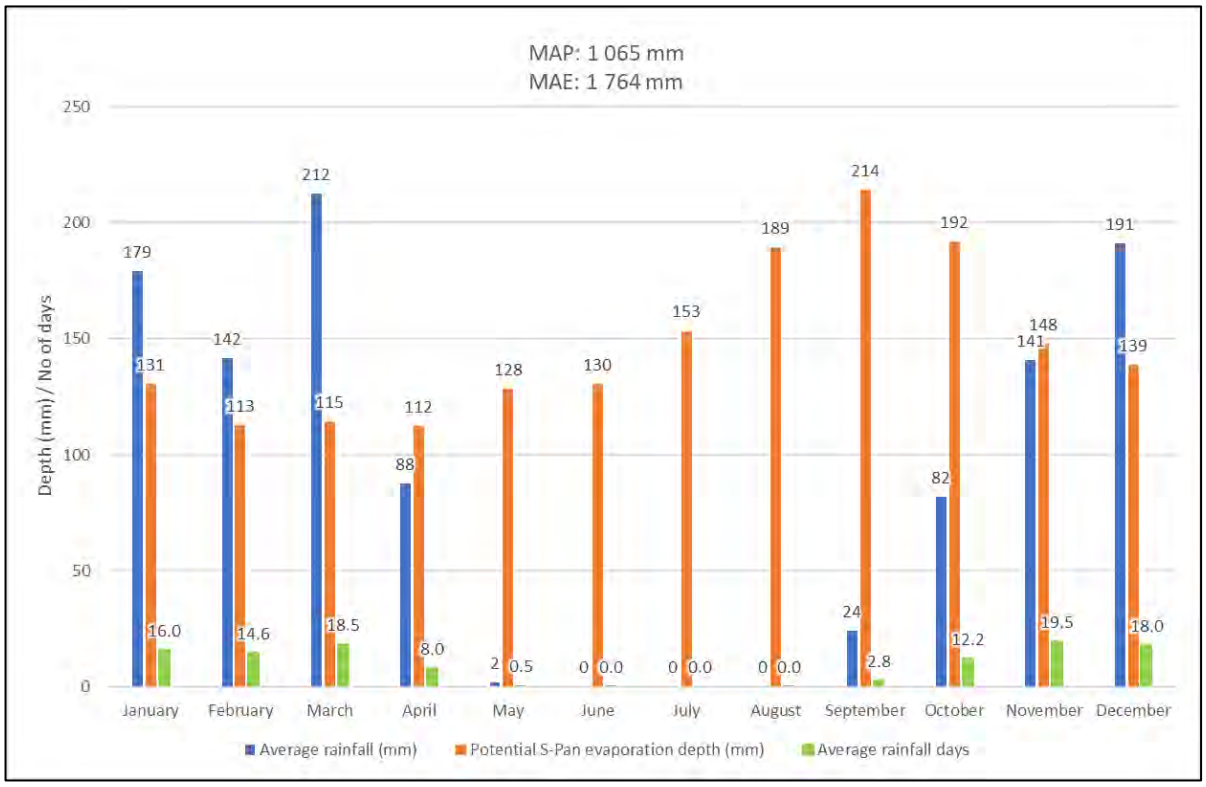


Figure 5-6: Baseline rainfall and evaporation (Chipindo)

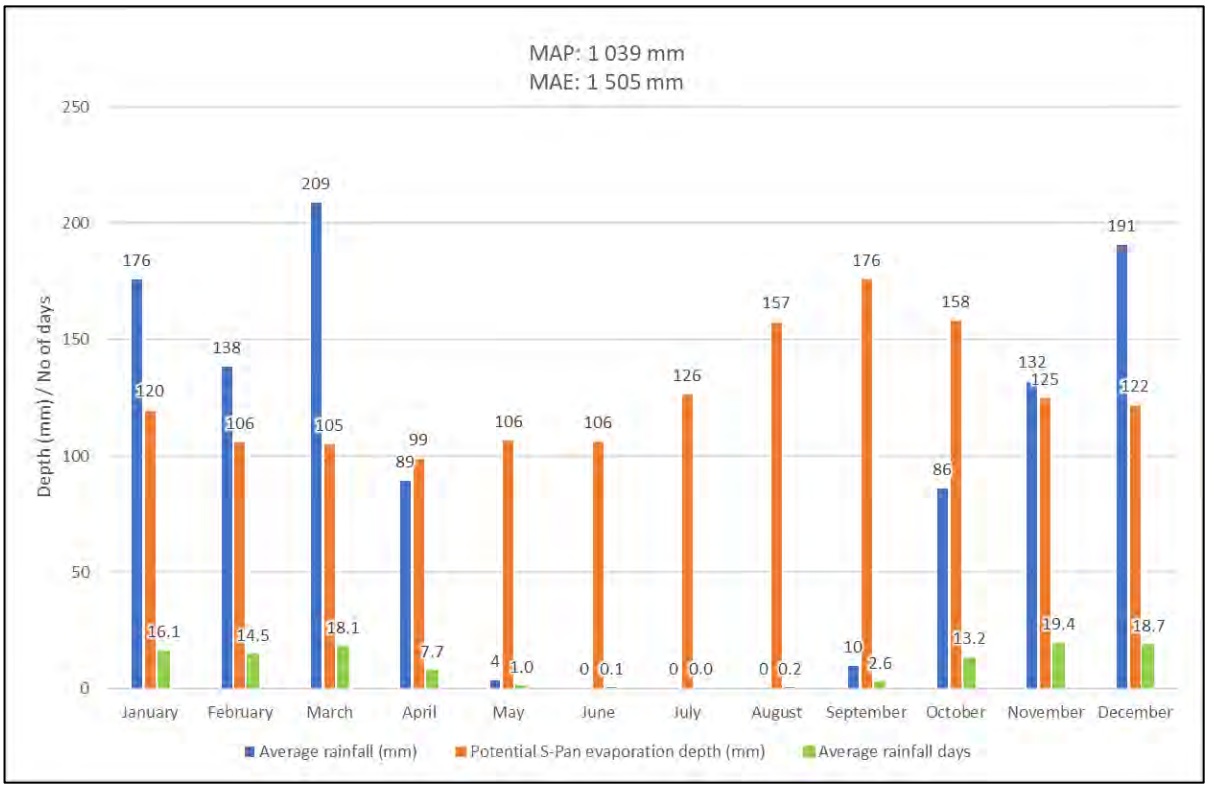


Figure 5-7: Baseline rainfall and evaporation (Gove)

5.3.2 Peak rainfall

The IDF storm depths calculated for each gauge are presented in Table 5-1 to Table 5-4.

Table 5-1: IDF storm depths (Cuanja)

Duration	Recurrence interval (yr)							
(hr)	10	20	50	100	200	500	1000	10000
0.1	9	10	12	13	15	17	18	24
0.25	17	19	22	25	28	31	35	46
0.5	24	27	32	36	40	45	50	66
1	31	35	42	47	52	59	65	86
2	37	42	50	56	62	71	78	103
3	41	46	55	61	67	76	84	112
4	43	48	57	64	71	80	89	117
5	44	50	59	66	72	82	91	120
6	45	51	61	68	75	85	94	124
7	46	52	62	69	76	87	96	127
8	47	53	63	70	77	88	97	129
9	47	54	64	71	78	89	98	130
10	48	54	64	72	79	90	99	132
11	48	55	65	73	80	91	100	133
12	49	55	66	73	81	92	102	134
13	49	56	66	74	81	93	102	135
14	50	56	67	74	82	93	103	136
15	50	57	67	75	83	94	104	137
16	50	57	68	75	83	95	104	138
17	51	57	68	76	84	95	105	139
18	51	58	69	76	84	96	106	140
19	51	58	69	77	85	96	106	141
20	51	58	69	77	85	97	107	141
21	51	58	69	77	85	97	107	142
22	52	59	70	77	85	97	107	142
23	52	59	70	78	86	98	108	143
24	52	59	70	78	86	98	108	143

Table 5-2: IDF storm depths (Cuvango)

Duration	Recurrence interval (yr)							
(hr)	10	20	50	100	200	500	1000	10000
0.1	9	10	11	12	14	15	17	22
0.25	16	18	21	23	26	29	31	41
0.5	23	26	30	33	37	41	45	59
1	30	34	39	43	48	54	59	77
2	36	40	47	52	58	65	71	93
3	39	44	51	56	62	70	76	101
4	41	46	53	59	66	74	80	106
5	42	47	55	60	67	76	82	108
6	44	49	57	63	70	78	85	112
7	44	50	58	64	71	80	87	114
8	45	50	59	65	72	81	88	116
9	46	51	59	66	73	82	89	117
10	46	52	60	66	74	83	90	119
11	47	52	60	67	74	84	91	120
12	47	53	61	68	75	85	92	121
13	47	53	62	68	76	85	93	122
14	48	53	62	69	76	86	93	123
15	48	54	62	69	77	86	94	124
16	48	54	63	70	77	87	95	125
17	49	55	63	70	78	88	95	126
18	49	55	64	71	78	88	96	126
19	49	55	64	71	79	89	96	127
20	49	55	64	71	79	89	97	127
21	50	55	64	71	79	89	97	128
22	50	56	65	72	79	89	97	128
23	50	56	65	72	80	90	98	129
24	50	56	65	72	80	90	98	129

Table 5-3: IDF storm depths (Chipindo)

Duration	Recurrence interval (yr)							
(hr)	10	20	50	100	200	500	1000	10000
0.1	8	9	10	11	12	14	15	19
0.25	16	17	20	21	23	26	28	35
0.5	23	25	28	31	34	37	40	50
1	29	32	37	40	44	49	52	65
2	35	39	44	48	53	58	63	78
3	38	42	48	52	57	63	68	85
4	40	44	50	55	60	66	71	89
5	41	45	51	56	61	68	73	92
6	43	47	53	58	64	70	76	95
7	43	48	54	59	65	72	77	96
8	44	49	55	60	66	73	78	98
9	45	49	56	61	66	74	79	99
10	45	50	56	62	67	75	80	100
11	46	50	57	62	68	75	81	101
12	46	51	57	63	69	76	82	102
13	46	51	58	63	69	77	82	103
14	47	51	58	64	70	77	83	104
15	47	52	59	64	70	78	84	105
16	47	52	59	65	71	78	84	105
17	48	53	59	65	71	79	85	106
18	48	53	60	66	72	79	85	107
19	48	53	60	66	72	80	86	107
20	48	53	60	66	72	80	86	108
21	49	53	60	66	72	80	86	108
22	49	54	61	67	73	80	86	108
23	49	54	61	67	73	81	87	109
24	49	54	61	67	73	81	87	109

Table 5-4: IDF storm depths (Gove)

Duration	Recurrence interval (yr)							
(hr)	10	20	50	100	200	500	1000	10000
0.1	8	9	10	10	11	12	13	16
0.25	14	16	18	20	21	23	25	31
0.5	21	23	26	28	30	34	36	45
1	27	30	34	37	40	44	47	58
2	32	36	40	44	48	53	56	70
3	35	39	44	48	51	57	61	76
4	37	41	46	50	54	60	64	80
5	38	42	47	51	55	61	66	81
6	39	44	49	53	57	64	68	84
7	40	44	50	54	58	65	69	86
8	41	45	50	55	59	66	70	87
9	41	46	51	56	60	66	71	88
10	41	46	52	56	61	67	72	89
11	42	47	52	57	61	68	73	90
12	42	47	53	57	62	69	73	91
13	43	47	53	58	62	69	74	92
14	43	48	53	58	63	70	74	92
15	43	48	54	59	63	70	75	93
16	44	48	54	59	64	71	75	94
17	44	49	55	59	64	71	76	94
18	44	49	55	60	65	72	76	95
19	44	49	55	60	65	72	77	95
20	44	49	55	60	65	72	77	96
21	45	50	55	60	65	72	77	96
22	45	50	56	61	66	73	77	96
23	45	50	56	61	66	73	78	97
24	45	50	56	61	66	73	78	97

5.3.3 Runoff

The daily average stream flow and mean annual runoff at each crossing point are shown in Appendix B.

The flows presented in Appendix B are consistent with site observations, and the flows are therefore deemed representative of the flows in the river systems.

Agricultural practices in the catchments are resulting in deforestation. Forests (technically Miombo woodlands) are cleared to make way for subsidence and low-intensity commercial agricultural activities. The original forests are generally left in the vicinity of the larger rivers. This deforestation will alter catchment response to rainfall events. The common theory that deforestation increases runoff is not necessarily the case (FAO, 2005).

Interception/canopy storage will be significantly reduced with deforestation, resulting in additional water available for runoff. Drier, more exposed soils may result in higher initial infiltration rates following storm events. Ploughing will increase depression storage. These two additional losses will counter and could even exceed the loss of interception/canopy storage, resulting in reduced runoff. The problem is complex though and will depend on many factors such as agricultural practices, topography, geomorphology, geology, catchment size, rainfall event size and many more factors. The increased infiltration and depression storage will increase recharge, which will return to the streams as baseflow again, albeit delayed. No data is available to confirm this supposition, or to suggest an increase or decrease in runoff in the AoI, as the bulk of the deforestation occurred years before the start of the project and no streamflow data is available during the time when the forests existed untouched. It is suggested that the deforestation may not be significantly affecting runoff in the AoI.

5.3.4 Water quality

The analysed water quality data is summarised in Table 5-5. Shaded values exceed recommended allowable limits set out in Table 3-2, on page 21.

The water quality is poor from a bacteriological perspective with Salmonella and coliforms present in most samples, including WQ8 which has limited upstream agricultural activity and no urban settlements. WQ9 has the highest Coliform bacteria count, but Salmonella is absent. This sampling point is located between 2 villages. It is also one of 3 sampling locations with an elevated APHA colour. The other two being WQ1 and WQ2 which are impacted by Jamba.

Iron is elevated in WQ1, 2, 12 and 14. These catchments do not share any development characteristic that may cause elevated Iron content and the elevated Iron concentrations are thus attributed to natural background conditions.

Ammonium and CBO_5 are elevated at all sampling locations.

Hydrocarbons and elevated salts and metals are absent in all samples. The background water quality shows significant human impact in all streams.

Table 5-5: Water quality results

Determinant	Units	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ8	WQ9	WQ10	WQ12	WQ13	WQ14	WQ16	WQX
Coliform Bacteria	Counts/100ml	52	236	52	24	308	261	179	1414	6	326	108	727	649	75
E coli	Counts/100ml	4	3	1	<1	4	<1	<1	3	<1	1	4	11	39	<1
Feacal coliforms	Counts/100ml	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/100ml	2	2	1	<1	19	15	1	17	2	<1	<1	9	81	11
Pseudomonas aeruginosa	Counts/100ml	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)
CBO_5 (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)
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_2O_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)
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)

DL: Detection limit

Shaded values exceed recommended allowable limits set out in Table 3-2.

5.4 Photographs



Figure 5-8: Bridge at river crossing point 1



Figure 5-9: Wide, poorly defined channel, common to many of the river systems that are crossed



Figure 5-10: Bridge at crossing point 24



Figure 5-11: Crossing point 23



Figure 5-12: Crossing point 49



Figure 5-13: Crossing point 77



Figure 5-14: Crossing point 84



Figure 5-15: Crossing point 104

6 IDENTIFICATION OF ISSUES

The impacts on the project are divided into the construction phase, the operational phase, and the closure and rehabilitation phase of the project. These are discussed below:

6.1 Construction Phase

The following potential impacts could occur during the construction phase:

- Siltation of receiving streams
- Hydrocarbon pollution in receiving streama

These impacts will be limited to the wet season where normal surface runoff will wash the pollutants into the receiving streams and rivers.

6.2 Operational Phase

The following potential impacts could occur during the operational phase:

- Siltation of receiving streams
- Hydrocarbon pollution in receiving streama

These impacts will be limited to the wet season where normal surface runoff will wash the pollutants into the receiving streams and rivers.

High flow events may cause scouring around pylon foundations if they are constructed within flow zones.

Climate change may increase the flood peaks and therefore flood levels.

6.3 Closure and Rehabilitation Phase

The following potential impacts could occur during the closure and rehabilitation phase:

- Siltation of receiving streams
- Hydrocarbon pollution in receiving streama

These impacts will be limited to the wet season where normal surface runoff will wash the pollutants into the receiving streams and rivers.

7 PERMIT REQUIREMENTS

It is common practice to construct all infrastructure outside of a defined floodline. In this case, it is considered best practice to construct outside of the 100-year floodline.

8 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS FOR THE CONSTRUCTION, OPERATION AND DECOMMISSIONING PHASES

8.1 Impact Statement

Surface water impacts are expected to be small and limited to the first and second order streams (Strahler stream order system). The disturbed footprints are very small compared to the footprints disturbed by agriculture. The incremental surface water siltation impacts will be unnoticed third order streams in areas where agriculture is present and will be limited to river reaches near construction works. Impacts will occur during the wet season only.

If the construction and maintenance fleet are well-maintained, hydrocarbon pollution is expected to be negligible.

8.2 Impact Assessments

8.2.1 Construction phase

Table 8-1: Impact 1: Siltation of receiving river systems – access road (and possible river crossing) construction

Activity: Access road (and possible river crossing) construction								
Project phase: Construction phase								
Impact Summary: Siltation of river systems, local disturbance to river banks and channels								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Definite*	***Medium***	-	*Medium*
Management Measures: • **The revegetation of disturbed non active cleared areas must take place within 1 month of completing the construction phase**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Definite*	***Low***	-	*Medium*

Table 8-2: Impact 2: Impact 2: Siltation of receiving river systems – pylon foundation construction

Activity: Pylon foundation construction								
Project phase: Construction phase								
Impact Summary: Siltation of river systems								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*
Management Measures: • **The revegetation of disturbed non active cleared areas must take place within 1 month of completing the construction phase**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

Table 8-3: Impact 3: Hydrocarbon pollution – vehicle traffic, overnight laydown and in-field servicing

Activity: Construction vehicle traffic, overnight laydown and in-field servicing								
Project phase: Construction phase								
Impact Summary: Hydrocarbon pollution								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Short term*	*Local*	***Low***	*Possible*	***Medium***	-	*Medium*
Management Measures: • **Regular inspections (and repair when necessary) of construction plant** • **In-field service areas to be roofed and bunded**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

Table 8-4: Impact 4: Hydrocarbon pollution – transformer oil leaks (or discharge if ruptured)

Activity: Transformers at the substations may leak (or discharge if ruptured) oil.								
Project phase: Operational phase								
Impact Summary: Hydrocarbon pollution								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Short term*	*Local*	***Medium***	*Possible*	***Medium***	-	*Medium*
Management Measures: • **Transformers to be located within bunded areas**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Unlikely*	***Low***	-	*Medium*

Table 8-5: Impact 5: River pollution

Activity: Construction camp grey and black water management								
Project phase: Construction phase								
Impact Summary: River pollution								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Short term*	*Local*	***Medium***	*Possible*	***Medium***	-	*Medium*
Management Measures: • **French drains to be adequately sized if used** • **Septic tanks to be emptied regularly if used**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

8.2.2 Operational phase

Table 8-6: Impact 6: Hydrocarbon pollution

Activity: Construction vehicle traffic, overnight laydown and in-field servicing								
Project phase: Operational phase								
Impact Summary: Hydrocarbon pollution								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Short term*	*Local*	***Low***	*Possible*	***Medium***	-	*Medium*
Management Measures: • **Regular inspections (and repair when necessary) of construction plant** • **In-field service areas to be roofed and bunded**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

Table 8-7: Impact 7: Siltation of receiving river systems – access road erosion

Activity: Access road (and possible river crossing) construction								
Project phase: Operational phase								
Impact Summary: Siltation of river systems								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor*	*Long term*	*Local*	***Medium***	*Possible*	***Medium***	-	*Medium*
Management Measures: • **Erosion gullies repaired immediately**								
After Management	*Minor*	*Long term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

Table 8-8: Impact 8: Siltation of receiving river systems – pylon foundation scouring

Activity: Pylon foundation scouring								
Project phase: Operational phase								
Impact Summary: Siltation of river systems								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor*	*Long term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*
Management Measures: • **Pylons to be constructed outside of the 100-yr floodlines where practical. Conservative offsets from the stream centerlines have been provided in Appendix B to approximate the 100-yr floodlines. Pylons required to be built within these offsets may require backwater analyses to determine flow velocities at pylon plinths.**								
After Management	*Minor*	*Long term*	*Local*	***Low***	*Unlikely*	***Low***	-	*Medium*

Table 8-9: Impact 9: Climate change impacts on flood levels

Activity: Climate change								
Project phase: Operational phase								
Impact Summary: Increase in flood level								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Minor*	*Long term*	*Local*	***Low***	*Possible*	***Low***	-	*High*
Management Measures: • **No mitigation required. The impacts are less than typical wave heights**								
After Management	*Minor*	*Long term*	*Local*	***Low***	*Possible*	***Low***	-	*High*

8.2.3 Closure and rehabilitation

Table 8-10: Impact 10: Siltation of receiving river systems – construction camp removal

Activity: Construction camp removal								
Project phase: Closure and rehabilitation								
Impact Summary: Siltation of river systems								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Definite*	***Medium***	-	*Medium*
Management Measures: • **The revegetation of disturbed non active cleared areas must take place within 1 month of completing the construction phase**								
After Management	*Minor*	*Short term*	*Local*	***Low***	*Possible*	***Low***	-	*Medium*

8.3 Cumulative Impacts

Agriculture dominates almost all catchments that are being affected by the power line. Much of this land has been cleared of natural vegetation and the land lies exposed for many months of the year, including some of the wet season. Erosion and sedimentation from these extensive areas will be orders of magnitude larger than erosion and sedimentation from the activities linked to the power line. The cumulative impacts are therefore negligible in these catchments. The cumulative sedimentation impacts in the few catchments that are not dominated by agricultural (less than 10% of the catchments) are also negligible due to the anticipated small sedimentation impacts.

Hydrocarbon pollution is unlikely to occur in most of the smaller river systems. The bigger river systems will have limited hydrocarbon pollution, but dilution effects will likely render hydrocarbon concentrations very low to undetectable. Cumulative hydrocarbon pollution impacts are expected to be low due to the anticipated low hydrocarbon pollution impacts.

8.4 Summary of Impacts

A summary of impacts is presented in Table 8-11.

Table 8-11: Summary of impacts

Impact	Table reference	Pre mitigation significance	Post mitigation significance
Impact 1: Siltation of receiving river systems – access road construction	Table 8-1	Medium	Low
Impact 2: Impact 2: Siltation of receiving river systems – pylon foundation construction	Table 8-2	Low	Low
Impact 3: Hydrocarbon pollution – vehicle traffic, overnight laydown and in-field servicing	Table 8-3	Medium	Low
Impact 4: Hydrocarbon pollution – transformer oil leaks (or discharge if ruptured)	Table 8-4	Medium	Low
Impact 5: River pollution	Table 8-5	Medium	Low
Impact 6: Hydrocarbon pollution	Table 8-6	Medium	Low
Impact 7: Siltation of receiving river systems – access road erosion	Table 8-7	Medium	Low
Impact 8: Siltation of receiving river systems – pylon foundation scouring	Table 8-8	Low	Low
Impact 9: Climate change impacts on flood levels	Table 8-9	Low	Low
Impact 10: Siltation of receiving river systems – construction camp removal	Table 8-10	Medium	Low

9 RECOMMENDATIONS FOR THE ESMP

Hydrocarbon pollution monitoring should be undertaken on streams near construction vehicle overnight laydown, and in-field servicing areas, contractor camps, and substations. This monitoring should be done monthly initially. If no signs of hydrocarbon pollution are found after three consecutive months, the monitoring frequency can be reduced to quarterly and then bi-annually.

In addition to hydrocarbon monitoring at these locations, the parameters listed in Table 3-2 must be monitored monthly. If possible, an upstream and downstream (of the construction related infrastructure) sample must be taken. The hydrocarbon sample should only be taken upstream of the construction related facility if hydrocarbons are found. This will confirm whether the hydrocarbon pollution is coming from upstream of the construction related facility or not.

10 CONCLUSION AND IMPACT STATEMENT

The results of the baseline assessment indicate a negatively impacted river system. This is currently based on visual observations made during the site visit. This will be confirmed with water quality monitoring data when this becomes available. These impacts are water quality impacts, mainly due to the agricultural and domestic activities within most of the river catchments. Flow and flood peak impacts due to the agricultural activities in the catchments are suggested to be negligible.

The outcomes of the impact assessment indicated that the proposed infrastructure may intersect with delineated and possibly sensitive freshwater habitats.

All power transmission infrastructure should be constructed above the 100-year floodline where practical. In areas where this is not practical, scour protection must be constructed around the pylon foundation footings. To alleviate the need for detailed survey of all 104 river crossings, conservative offsets from the stream centerline are provided in Appendix B. Where pylons are required to be placed within these offsets, backwater analyses may be required to determine flow velocities at pylon plinths. This will account for backwater effects of any downstream controls in channels that have subcritical flow regimes.

All substations must be constructed above the 100-yr floodline. In areas where this is not practical, or in areas where infrastructure is located close to the floodline, a levee must be constructed to protect infrastructure from flooding. The levee specifications must account for the hydraulic characteristics of the flow against the levee.

A water quality monitoring program must be set up. Monthly water quality monitoring must be done as outlined in Section 9 of this report.

With adequate mitigation measures put in place, the impacts on the surface water resources are expected to be low.

11 REFERENCES

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FAO, *Forests and Floods Drowning in Fiction or Thriving on Facts*, 2005

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International Finance Corporation (IFC) (2012) Performance Standards on Environmental and Social Sustainability.

Appendix A
Crossing locations

Point	X	Y	LATITUDE	LONGITUDE
	UTM 35S			
1	-689293.895	8345484.692	14° 42' 05.4704" S	16° 00' 44.0302" E
2	-688657.803	8345651.074	14° 42' 01.1559" S	16° 01' 05.1782" E
3	-687458.308	8345805.548	14° 41' 58.1071" S	16° 01' 44.8007" E
4	-686438.625	8344133.252	14° 42' 53.1422" S	16° 02' 15.5723" E
5	-688158.291	8347454.633	14° 41' 04.3177" S	16° 01' 24.4872" E
6	-684292.831	8349645.51	14° 40' 00.3742" S	16° 03' 34.8912" E
7	-683624.032	8349834.061	14° 39' 55.3950" S	16° 03' 57.1467" E
8	-682820.332	8350093.129	14° 39' 48.3723" S	16° 04' 23.9434" E
9	-680695.178	8350804.883	14° 39' 28.9428" S	16° 05' 34.8430" E
10	-679176.862	8351309.152	14° 39' 15.1918" S	16° 06' 25.4908" E
11	-677091.817	8352087.05	14° 38' 53.5711" S	16° 07' 35.1800" E
12	-675314.681	8353435.559	14° 38' 13.2261" S	16° 08' 35.6688" E
13	-673978.4	8355589.364	14° 37' 06.4495" S	16° 09' 22.9591" E
14	-670443.631	8360446.851	14° 34' 36.6187" S	16° 11' 26.6780" E
15	-669212.479	8362250.138	14° 33' 40.8585" S	16° 12' 09.9315" E
16	-668899.295	8362664.894	14° 33' 28.0787" S	16° 12' 20.8640" E
17	-668625.095	8363020.482	14° 33' 17.1305" S	16° 12' 30.4236" E
18	-666902.4	8365266.932	14° 32' 07.9430" S	16° 13' 30.4951" E
19	-666759.618	8365464.325	14° 32' 01.8499" S	16° 13' 35.4910" E
20	-665737.176	8366865.286	14° 31' 18.6168" S	16° 14' 11.2438" E
21	-665138.593	8367685.739	14° 30' 53.2957" S	16° 14' 32.1734" E
22	-662976.671	8370647.682	14° 29' 21.8725" S	16° 15' 47.7503" E
23	-662483.126	8372371.919	14° 28' 27.4850" S	16° 16' 06.6311" E
24	-661827.936	8373227.192	14° 28' 01.1276" S	16° 16' 29.4622" E
25	-664774.349	8375336.731	14° 26' 49.2102" S	16° 14' 56.0541" E
26	-664914.046	8375570.684	14° 26' 41.5179" S	16° 14' 51.8341" E
27	-666699.54	8378366	14° 25' 09.4351" S	16° 13' 57.5986" E
28	-668044.269	8380879.884	14° 23' 47.0228" S	16° 13' 17.3913" E
29	-668207.756	8381184.522	14° 23' 37.0353" S	16° 13' 12.5017" E
30	-669499.213	8384008.026	14° 22' 04.8090" S	16° 12' 34.5261" E
31	-669756.932	8385488.062	14° 21' 17.1010" S	16° 12' 28.3693" E
32	-670534.722	8389938.678	14° 18' 53.6369" S	16° 12' 09.7556" E
33	-673727.873	8397884.78	14° 14' 34.7966" S	16° 10' 37.3506" E
34	-675082.119	8400122.77	14° 13' 21.2174" S	16° 09' 56.4188" E
35	-678142.464	8405398.276	14° 10' 27.9841" S	16° 08' 24.2712" E
36	-678675.793	8406040.674	14° 10' 06.6494" S	16° 08' 07.7883" E
37	-680464.156	8408044.895	14° 08' 59.9024" S	16° 07' 12.2921" E
38	-680578.616	8408172.417	14° 08' 55.6546" S	16° 07' 08.7393" E
39	-681945.763	8409704.824	14° 08' 04.6229" S	16° 06' 26.3204" E
40	-682768.512	8410626.899	14° 07' 33.9169" S	16° 06' 00.7947" E
41	-683085.32	8410982.152	14° 07' 22.0871" S	16° 05' 50.9665" E
42	-683560.062	8411514.206	14° 07' 04.3696" S	16° 05' 36.2388" E
43	-684903.211	8413019.846	14° 06' 14.2332" S	16° 04' 54.5745" E

Point	X	Y	LATITUDE	LONGITUDE
	UTM 35S			
44	-686210.253	8414486.002	14° 05' 25.4144" S	16° 04' 14.0360" E
45	-687489.914	8416116.637	14° 04' 31.3824" S	16° 03' 34.6513" E
46	-689021.637	8418174.463	14° 03' 23.3228" S	16° 02' 47.6771" E
47	-689757.642	8419164.672	14° 02' 50.5759" S	16° 02' 25.1098" E
48	-691301.765	8421246.752	14° 01' 41.7274" S	16° 01' 37.7755" E
49	-692900.195	8423429.074	14° 00' 29.5978" S	16° 00' 48.8239" E
50	-692986.467	8423546.711	14° 00' 25.7096" S	16° 00' 46.1818" E
51	-694762.785	8425837.384	13° 59' 09.8549" S	15° 59' 51.5831" E
52	-695471.283	8426449.553	13° 58' 49.2327" S	15° 59' 29.3445" E
53	-696676.158	8427491.577	13° 58' 14.1323" S	15° 58' 51.5296" E
54	-696732.722	8427540.498	13° 58' 12.4844" S	15° 58' 49.7545" E
55	-696952.486	8427730.287	13° 58' 06.0910" S	15° 58' 42.8572" E
56	-697117.571	8427873.537	13° 58' 01.2666" S	15° 58' 37.6772" E
57	-699491.818	8429926.657	13° 56' 52.1097" S	15° 57' 23.1738" E
58	-700145.44	8430493.468	13° 56' 33.0206" S	15° 57' 02.6681" E
59	-700639.642	8430906.96	13° 56' 19.0690" S	15° 56' 47.1412" E
60	-700788.797	8431014.701	13° 56' 15.4031" S	15° 56' 42.4289" E
61	-701644.874	8431739.169	13° 55' 50.9739" S	15° 56' 15.5469" E
62	-702824.755	8432770.999	13° 55' 16.2402" S	15° 55' 38.5512" E
63	-703136.814	8433044.999	13° 55' 07.0188" S	15° 55' 28.7687" E
64	-704284.084	8434047.782	13° 54' 33.2629" S	15° 54' 52.7986" E
65	-704754.959	8434459.977	13° 54' 19.3888" S	15° 54' 38.0372" E
66	-704852.87	8434545.576	13° 54' 16.5074" S	15° 54' 34.9678" E
67	-705098.269	8434733.601	13° 54' 10.1326" S	15° 54' 27.2338" E
68	-705546.738	8435046.322	13° 53' 59.4695" S	15° 54' 13.0526" E
69	-707872.952	8437141.697	13° 52' 49.0451" S	15° 53' 00.2315" E
70	-709042.873	8438183.28	13° 52' 14.0188" S	15° 52' 23.5936" E
71	-709654.331	8438681.146	13° 51' 57.1981" S	15° 52' 04.3744" E
72	-710059.957	8438987.626	13° 51' 46.7996" S	15° 51' 51.5887" E
73	-710299.64	8439151.914	13° 51' 41.1920" S	15° 51' 44.0079" E
74	-710548.118	8439444.943	13° 51' 31.4598" S	15° 51' 36.3383" E
75	-711580.753	8440288.976	13° 51' 02.9505" S	15° 51' 03.8899" E
76	-711858.155	8440570.738	13° 50' 53.5348" S	15° 50' 55.2584" E
77	-714507.565	8442907.567	13° 49' 34.9215" S	15° 49' 32.2834" E
78	-717999.226	8446762.814	13° 47' 26.5617" S	15° 47' 44.1526" E
79	-718730.736	8450663.337	13° 45' 20.9264" S	15° 47' 26.2692" E
80	-719153.461	8452917.883	13° 44' 08.3098" S	15° 47' 15.9314" E
81	-719248.362	8453426.489	13° 43' 51.9291" S	15° 47' 13.6139" E
82	-719437.032	8454430.187	13° 43' 19.6008" S	15° 47' 08.9947" E
83	-719812.31	8456204.146	13° 42' 22.4011" S	15° 46' 59.4636" E
84	-720367.471	8457683.135	13° 41' 34.3499" S	15° 46' 43.6048" E
85	-720739.482	8458673.37	13° 41' 02.1780" S	15° 46' 32.9766" E
86	-721196.346	8459803.22	13° 40' 25.4223" S	15° 46' 19.7919" E
87	-721870.042	8462244.054	13° 39' 06.4897" S	15° 46' 01.5359" E

Point	X	Y	LATITUDE	LONGITUDE
	UTM 35S			
88	-721792.384	8462482.734	13° 38' 58.9861" S	15° 46' 04.4363" E
89	-721320.471	8463931.476	13° 38' 13.4406" S	15° 46' 22.0570" E
90	-721143.58	8464473.955	13° 37' 56.3859" S	15° 46' 28.6601" E
91	-719733.823	8466448.57	13° 36' 55.4468" S	15° 47' 17.6909" E
92	-718118.94	8468624.488	13° 35' 48.3770" S	15° 48' 13.7146" E
93	-715130.197	8473152.698	13° 33' 28.2179" S	15° 49' 58.1301" E
94	-714570.216	8473883.682	13° 33' 05.7031" S	15° 50' 17.5116" E
95	-714182.832	8474389.188	13° 32' 50.1326" S	15° 50' 30.9184" E
96	-713790.813	8474900.988	13° 32' 34.3673" S	15° 50' 44.4854" E
97	-712980.369	8475958.51	13° 32' 01.7907" S	15° 51' 12.5305" E
98	-712064.118	8477154.894	13° 31' 24.9325" S	15° 51' 44.2352" E
99	-711964.15	8477285.621	13° 31' 20.9046" S	15° 51' 47.6945" E
100	-711360.173	8478072.364	13° 30' 56.6668" S	15° 52' 08.5889" E
101	-710981.237	8478835.056	13° 30' 32.8653" S	15° 52' 22.1010" E
102	-709987.795	8481499.748	13° 29' 09.2182" S	15° 52' 58.5151" E
103	-710070.879	8484084.261	13° 27' 46.5524" S	15° 52' 59.6663" E
104	-711413.353	8485001.629	13° 27' 15.2917" S	15° 52' 17.2297" E

Appendix B
Hydrology at crossing locations

Stream crossing location	Catchment area (km^2)	Daily average stream flow (l/s)	Mean annual runoff (Mm^3/annum)	100-yr flood peak (m^3/s)	100-yr flood elevation (approx. mamsl)	Conservative estimated floodline offsets (m from centre)*
1	1 622	8270	261	838	1 436.68	35
2	8.3	42	1.3	35	1 465.77	85
3	6.7	34	1.1	30	1 451.46	120
4	1.6	8	0.3	11	1 477.79	55
5	417	2125	67.1	286	Weir structure	N/A
6	2.6	13	0.4	15	1 485.58	40
7	2.0	10	0.3	12	1 484.41	25
8	3.2	16	0.5	17	1 480.95	20
9	5.9	30	1.0	27	1 491.28	35
10	3.0	15	0.5	17	1 488.12	25
11	17.9	91	2.9	61	1 488.07	40
12	5.6	28	0.9	26	1 493.04	25
13	41.6	212	6.7	129	1 491.91	90
14	1.1	6	0.2	7.6	1 539.96	15
15	16.3	83	2.6	52	1 506.75	65
16	1.1	6	0.2	7.4	1 509.19	20
17	1.8	9	0.3	11	1 510.85	20
18	0.2	1	0.0	1.9	1 519.87	15
19	0.1	0	0.0	1.0	1 520.07	15
20	5.2	27	0.8	23	1 491.90	40
21	2.1	10	0.3	12	1 493.38	20
22	4.8	25	0.8	22	1 470.14	25
23	82.9	423	13.3	163	1 451.52	35
24	7 549	53 599	1 691	2 109	1 426.58	105
25	8.4	43	1.3	33	1 476.84	60
26	7.9	40	1.3	31	1 479.19	65
27	24.8	127	4.0	71	1 480.17	40
28	1.0	5	0.2	7.1	1 522.13	30
29	27.2	139	4.4	76	1 517.39	25
30	1.2	6	0.2	7.9	1 564.86	30
31	11.0	56	1.8	40	1 556.03	70
32	3.2	16	0.5	16	1 593.50	15
33	1.9	10	0.3	11	1 604.55	65
34	17.1	87	2.8	54	1 574.53	30
35	1.0	5	0.2	7.0	1 608.39	15
36	0.8	4	0.1	6.2	1 607.84	15
37	0.9	5	0.1	6.6	1 609.03	15
38	1.4	7	0.2	9.1	1 609.50	15
39	1.9	10	0.3	11	1 610.70	15
40	1.2	6	0.2	7.9	1 610.63	15
41	0.3	2	0.0	2.9	1 614.08	15
42	2.7	14	0.4	14	1 610.94	15

Stream crossing location	Catchment area (km^2)	Daily average stream flow (l/s)	Mean annual runoff (Mm^3/annum)	100-yr flood peak (m^3/s)	100-yr flood elevation (approx. mamsl)	Conservative estimated floodline offsets (m from centre)*
43	3.7	19	0.6	18	1 633.86	25
44	1.1	6	0.2	7.0	1 670.39	15
45	2.8	14	0.4	14	1 647.31	15
46	4.6	23	0.7	20	1 632.31	35
47	1.0	5	0.2	6.4	1 631.35	15
48	4.9	30	1.0	21	1 631.00	35
49	0.7	4	0.1	5.1	1 654.29	15
50	0.8	5	0.2	5.5	1 655.23	15
51	0.5	3	0.1	4.1	1 656.28	15
52	6.7	41	1.3	26	1 628.78	50
53	0.2	1	0.0	2.0	1 647.65	15
54	0.2	1	0.0	2.2	1 644.41	15
55	0.6	3	0.1	4.3	1 634.81	15
56	0.5	3	0.1	3.8	1 630.77	15
57	24.7	150	4.7	66	1 594.39	60
58	1.7	11	0.3	10	1 591.29	20
59	8.1	49	1.6	29	1 588.38	35
60	3.7	23	0.7	17	1 589.31	35
61	0.3	2	0.1	2.7	1 622.55	15
62	0.3	2	0.1	2.7	1 630.85	15
63	0.5	3	0.1	4.0	1 626.31	15
64	0.8	5	0.1	5.4	1 597.80	15
65	0.1	1	0.0	1.7	1 592.65	15
66	260	1 586	50.0	179	Weir structure	N/A
67	261	1 592	50.2	179	1 586.73	30
68	267	1 630	51.5	184	1 585.33	45
69	2.5	15	0.5	13	1 644.07	15
70	3.6	22	0.7	16	1 626.60	35
71	11.8	72	2.3	39	1 619.57	30
72	12.5	76	2.4	40	1 614.90	50
73	3.6	22	0.7	16	1 614.47	15
74	0.0	0	0.0	0.2	1 612.73	15
75	20.4	125	3.9	57	1 601.72	45
76	66.0	403	12.7	194	1 597.31	60
77	211	1 287	40.6	226	1 591.16	85
78	0.7	4	0.1	5.2	1 640.62	15
79	8.6	53	1.7	31	1 594.64	25
80	54.3	331	10.4	119	1 567.98	55
81	2.3	14	0.4	12	1 574.27	15
82	1.5	9	0.3	8.7	1 604.61	15
83	2.7	16	0.5	13	1 634.50	40
84	2.7	16	0.5	13	1 618.59	15
85	4.2	30	0.9	18	1 634.58	45

Stream crossing location	Catchment area (km^2)	Daily average stream flow (l/s)	Mean annual runoff (Mm^3/annum)	100-yr flood peak (m^3/s)	100-yr flood elevation (approx. mamsl)	Conservative estimated floodline offsets (m from centre)*
86	22.8	162	5.1	62	1 587.49	25
87	0.5	3	0.1	3.9	1 595.36	15
88	0.7	5	0.2	4.9	1 589.74	15
89	2.1	15	0.5	11	1 582.28	15
90	2.5	17	0.6	13	1 585.30	20
91	2.4	17	0.5	12	1 607.07	15
92	560	3 976	125	438	1 572.68	15
93	3.5	25	0.8	17	1 583.14	15
94	0.9	6	0.2	6.3	1 586.96	15
95	1.5	11	0.3	9.1	1 580.35	30
96	0.8	6	0.2	5.8	1 588.85	25
97	0.5	4	0.1	4.3	1 602.39	15
98	1.2	8	0.3	7.6	1 586.90	30
99	0.5	4	0.1	4.3	1 585.12	25
100	3.7	26	0.8	17	1 583.59	30
101	0.3	2	0.1	3.0	1 607.77	15
102	43.2	306	9.7	79	1 580.39	20
103	5.1	36	1.1	22	1 569.56	15
104	4 667	0	0.0	0.0	Dam outlet controlled	N/A

** To alleviate the need for detailed floodlines of all 104 river crossings, conservative offsets from the stream centerline are provided. Where pylons are required to be placed within these offsets, backwater analyses may be required to determine flow velocities at pylon plinths. This will account for backwater effects of any downstream controls in channels that have subcritical flow regimes.*

Appendix C
HCV Africa profile

Experience excellence and tailored solutions with HCV Africa.

At HCV Africa, we embody a collective of independent, seasoned environmental scientists and social specialists united by a steadfast commitment. Our mission is clear: to provide outstanding consulting services across Africa and in growing economies throughout Asia and the Middle East.
Drawing upon our extensive international expertise across key sectors (such as mining, oil and gas, renewable energy, agri-business, heavy industry, and large-scale civil infrastructure), we specialise in developing sustainable solutions through carefully tailored consulting services.
Our deep understanding of various international norms and experienced insights into African business environments, supported by long-standing partnerships with local consulting firms and experienced experts, enables us to efficiently translate complex global knowledge into practical, locally tailored solutions for our clients.
Explore our comprehensive range of environmental management services, which include:

- Applying the relevant international standards such as IFC/World Bank Standards and Equator Principles in Environmental and Social Impact Assessments (ESIA).
- Skilful navigation of legal processes, dispute resolution, directives, and rectification of environmental and water issues.
- Develop and meticulously implement environmental and social management plans/programs.
- Assurance of capital investments through thorough environmental and social audits and due diligence.
- Strategic design and seamless execution of environmental and social management systems.
- Conducting thorough environmental, social and health risk assessments.
- Specialised studies and assessments of ecosystem services.
- Design and implementation of robust environmental, social and health monitoring plans.
- Efficient management of environmental and water legal administrative functions.
- Provision of expert opinions and advisory services.

Embark on a journey with HCV Africa, and let us work together to shape a sustainable future.
For further insights, we encourage you to visit our website: www.hcvafrica.com

Appendix D

Specialist CV

CURRICULUM VITAE

Dr Bruce Randell

EDUCATION AND QUALIFICATIONS

PR Eng

BSc (Civil Engineering) University of Witwatersrand, Johannesburg, 1996

PhD, University of Witwatersrand, Johannesburg, 2002

MDP, Unisa SBL, Johannesburg, 2007

Microsoft Certified Professional (TCP/IP) – NT4, 1998

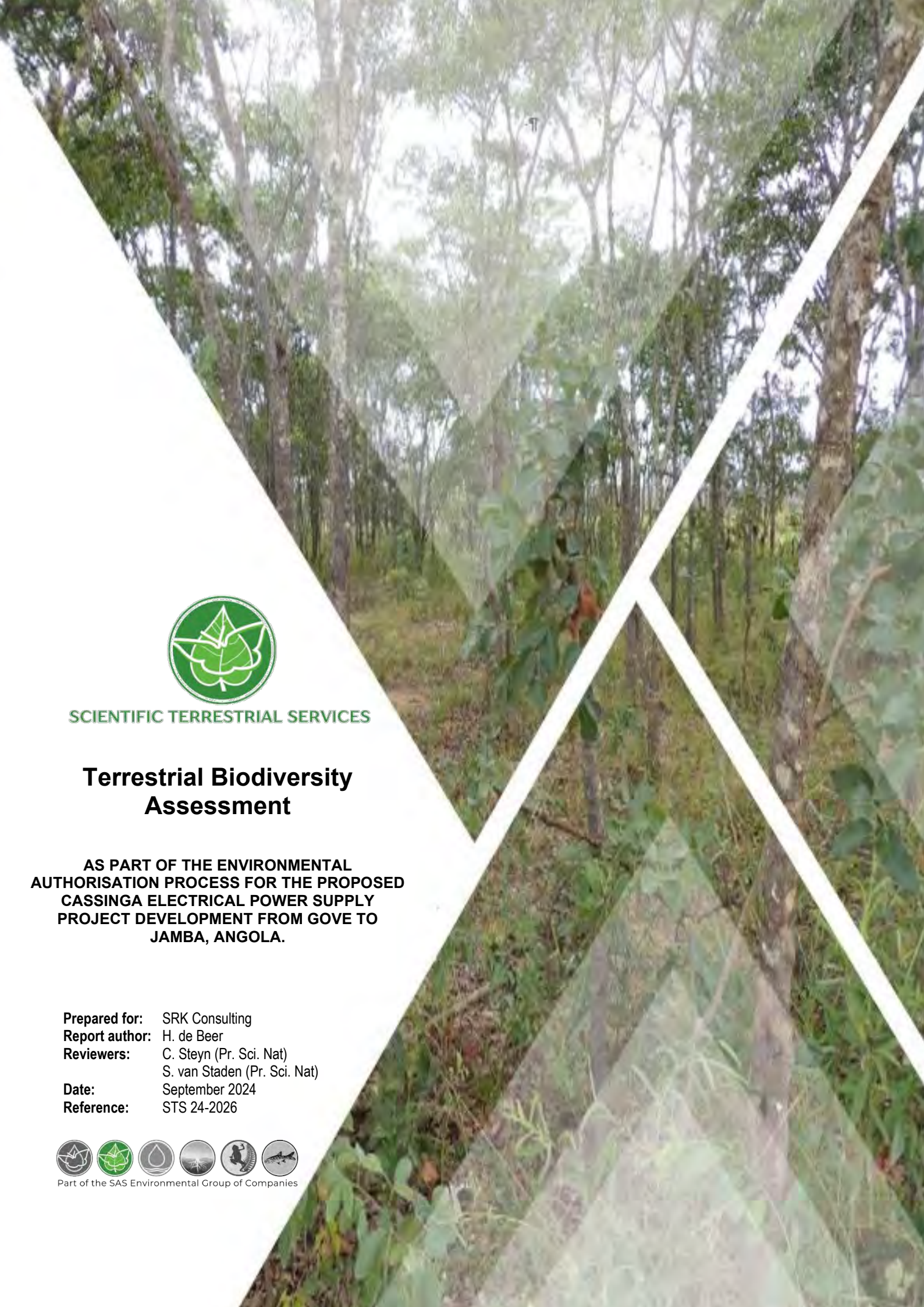
EXPERIENCE

Dr Bruce Randell is an ECSA registered professional Water Resource Engineer with over 23 years' experience in applied hydrology, hydrological and hydraulic modelling and design of stormwater and tailings dam related infrastructure. Bruce has skills in water balance modelling, water resource modelling, stormwater management plans (concept through to detailed design), ESIA specialist studies, streamflow modelling and measurement.

Dr Randell has extensive experience in ESIA surface water specialist studies (hydrology baseline as well as impact studies) throughout Africa for mining developments.

Dr Randell has experience in setting up flow and water quality monitoring programs in remote areas where limited infrastructure is available. Locations include Angola, Mozambique, the DRC and Indonesia.

Appendix H: Terrestrial flora



SCIENTIFIC TERRESTRIAL SERVICES

Terrestrial Biodiversity Assessment

AS PART OF THE ENVIRONMENTAL AUTHORISATION PROCESS FOR THE PROPOSED CASSINGA ELECTRICAL POWER SUPPLY PROJECT DEVELOPMENT FROM GOVE TO JAMBA, ANGOLA.

Prepared for:	SRK Consulting
Report author:	H. de Beer
Reviewers:	C. Steyn (Pr. Sci. Nat) S. van Staden (Pr. Sci. Nat)
Date:	September 2024
Reference:	STS 24-2026

Part of the SAS Environmental Group of Companies

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ACRONYMS

AIP	Alien and Invasive Plant
AoL	Area of Influence
BI	Biodiversity Importance
CH	Critical Habitat
CI	Conservation Importance
CR	Critically Endangered
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIS	Ecological Importance and Sensitivity
EN	Endangered
EOO	Extent of Occurrence
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FI	Functional Integrity
GPS	Global Positioning System
Ha	Hectares
IEM	Integrated Environmental Management
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Areas
km	kilometres
km^2	square kilometres
KPI	Key performance indicator
kV	Kilovolt
LC	Least Concern
m	metre
MINAMB	Ministry of Environment
MINEA	Ministry of Energy and Water
MEA	Millennium Ecosystem Assessment
MVA	Megavolt-amperes
OHL	Overhead Line
PES	Present Ecological State
PPE	Personal Protective Equipment
PS	Performance Standard
POC	Probability of Occurrence
RR	Receptor Resilience
SACNASP	South African Council for Natural Scientific Professions
SCC	Species of Conservation Concern
SEI	Site Ecological Importance
STS	Scientific Terrestrial Services [Pty] Ltd
VU	Vulnerable

GLOSSARY OF TERMS

Area of Influence (AoI)	AoL refers to all geographical regions and resources that could be impacted by a project's activities, extending beyond the immediate project site to include surrounding environments and communities. This concept encompasses direct and indirect effects on land, water, air, biodiversity, and local populations. By defining the AoI, organizations can ensure that potential environmental and social impacts are thoroughly assessed and managed, promoting responsible and sustainable development practices.
Biodiversity importance (BI)	BI of the receptor (e.g., species of conservation concern, the vegetation/fauna community or habitat type present on the site[1]) and its resilience to impacts (receptor resilience [RR])
Conservation Importance (CI)	CI is evaluated in accordance with recognised established internationally acceptable principles and criteria for the determination of biodiversity-related value, including the International Union for the Conservation of Nature (IUCN) Red List of Species, Red List of Ecosystems and Key Biodiversity Areas (KBA; IUCN [2016]).
Corridor (van Wilgen et al., 2020)	A dispersal route or a physical connection of suitable habitats linking previously unconnected regions.
Critically Endangered (CR) (IUCN Red List category) (Skowno et al., 2019)	**Applied to both species/taxa and ecosystems**: A species is CR when the best available evidence indicates that it meets at least one of the five IUCN criteria for CR, indicating that the species is facing an extremely high risk of extinction. CR ecosystem types are at an extremely high risk of collapse. Most of the ecosystem type has been severely or moderately modified from its natural state. The ecosystem type is likely to have lost much of its natural structure and functioning, and species associated with the ecosystem may have been lost. CR species are those considered to be at extremely high risk of extinction.
Degradation (Skowno et al., 2019)	The many human-caused processes that drive the decline or loss in biodiversity, ecosystem functions or ecosystem services in any terrestrial and associated aquatic ecosystems.
Disturbance (van Wilgen et al., 2020)	A temporal change, either regular or irregular (uncertain), in the environmental conditions that can trigger population fluctuations and secondary succession. Disturbance is an important driver of biological invasions.
Driver (ecological) (Lead, 2005)	A driver is any natural or human-induced factor that directly or indirectly causes a change in ecosystem. A direct driver clearly influences ecosystem processes, where indirect driver influences ecosystem processes through altering one or more direct drivers.
Endangered (EN) (Red List category) (Skowno et al., 2019)	**Applied to both species/taxa and ecosystems**: A species is EN when the best available evidence indicates that it meets at least one of the five IUCN criteria for EN, indicating that the species is facing a very high risk of extinction. EN ecosystem types are at a very high risk of collapse. EN species are those considered to be at very high risk of extinction.
Functional Integrity (FI)	FI is: 'A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.'
Ground truth	To check the accuracy of (remotely sensed data) by means of in-situ observations.
Integrity (ecological)	The integrity of an ecosystem refers to its functional completeness, including its components (species) its patterns (distribution) and its processes.
Invasive species (ecological) (van Wilgen et al., 2020)	Alien species that sustain self-replacing populations over several life cycles, produce reproductive offspring, often in very large numbers at considerable distances from the parent and/or site of introduction, and have the potential to spread over long distances.
Least Threatened	Least threatened ecosystems are still largely intact.

[1] Note that the habitat type may be independent of the vegetation community and that it may even be artificial, e.g., excavated rock quarries that provide crucial breeding habitat for cliff-nesting species such as Bald Ibis.

Native species (syn. Indigenous species)	See Indigenous Species
Receptor Resilience (RR)	RR is defined here as: 'The intrinsic capacity of the receptor to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention
Species of Conservation Concern (SCC)	The term SCC in the context of this report refers to all IUCN listed threatened species as well as protected species of relevance to the project.
Site Ecological Importance (SEI)	SEI is considered to be 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 its resilience to impacts (RR).
Threatened species	A species that has been classified as CR, EN or Vulnerable (VU), based on a conservation assessment, using a standard set of criteria developed by the IUCN for determining the likelihood of a species becoming extinct. A threatened species faces a high risk of extinction in the near future.
VU (Red List category) (Skowno et al., 2019)	Applied to both species/taxa and ecosystems: A species is VU when the best available evidence indicates that it meets at least one of the five IUCN criteria for VU, indicating that the species is facing a high risk of extinction. An ecosystem type is VU when the best available evidence indicates that it meets any of the criteria A to E for VU and is then considered to be at a high risk of collapse.

1 INTRODUCTION

Scientific Terrestrial Services (Pty) Ltd (STS) was appointed to conduct faunal and floral ecological assessments as part of the Environmental and Social Impact Assessment (ESIA) process for the proposed Cassinga Electrical Power Supply Project in Angola, henceforth referred to as the "study area".

The purpose of this report is to define the floral ecology of the study area, to identify areas of increased Ecological Importance and Sensitivity (EIS), as well as the mapping of such areas, and to describe the Present Ecological State (PES) of the study area as well as to collect sufficient data to define the site in terms of the International Finance Corporation (IFC) Performance Standards (2012).

This report (Part B) aims to map, consider, and describe the floristic assemblages associated with the study area according to data gathered during the summer survey conducted over five days in April 2024. In doing so, this report must guide the proponent, Environmental Assessment Practitioner (EAP), and regulating authorities, by means of the presentation of information on the baseline conditions[2], as to the management of the proposed project from an ecological risk management point of view as well as provide mitigation and management measures to manage potential and existing impacts.

1.1 Project Location

The study area is located south of the centre of Angola, namely, in the provinces of Huila and Huambo (Figures 1 and 2). The proposed powerline extends for about 170 kilometres (km), crossing six municipalities which include Jamba, Kuvango, Dongo, Galangue, Chipindo, and Kalima.

The main works will be carried out largely in Huila Province near the Gove Hydro Dam (Huambo) and extend for 135 km with an Overhead Line (OHL) of 220 kilovolt (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 a 220 kV OHL from Cuvango to Jamba, with an approximate length of 35 km. A new 220/30 kV – 20 megavolt-amperes (MVA) substation will be constructed in Jamba. In addition, the infrastructure associated with the electrification of villages at Chipindo, Cuvango, and Jamba will be constructed.

[2] Conditions that currently exist. Also called "existing conditions".

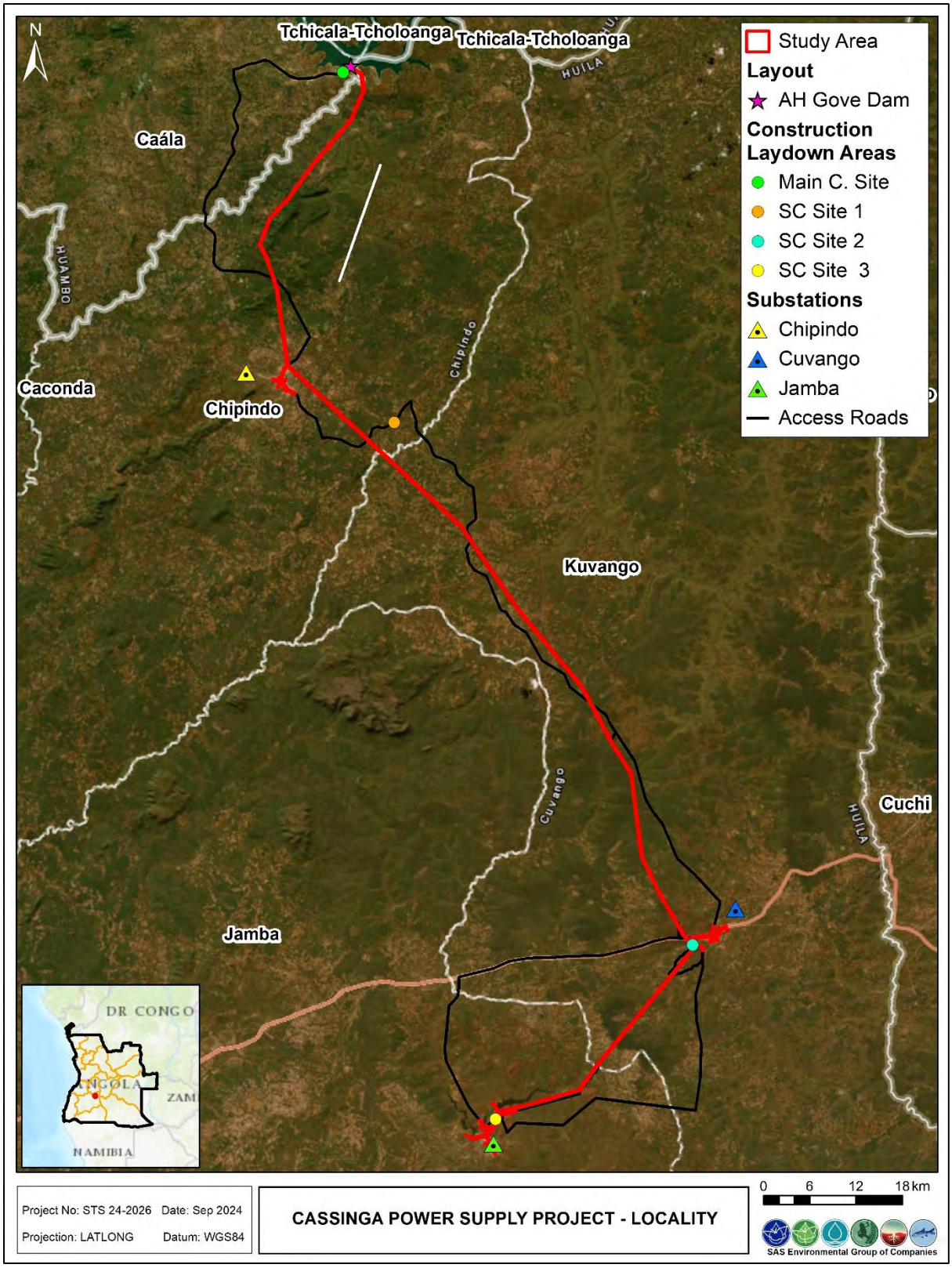


Figure 1: Digital satellite image depicting the location of the study area associated with the proposed Cassinga powerline project in relation to the surrounding area.

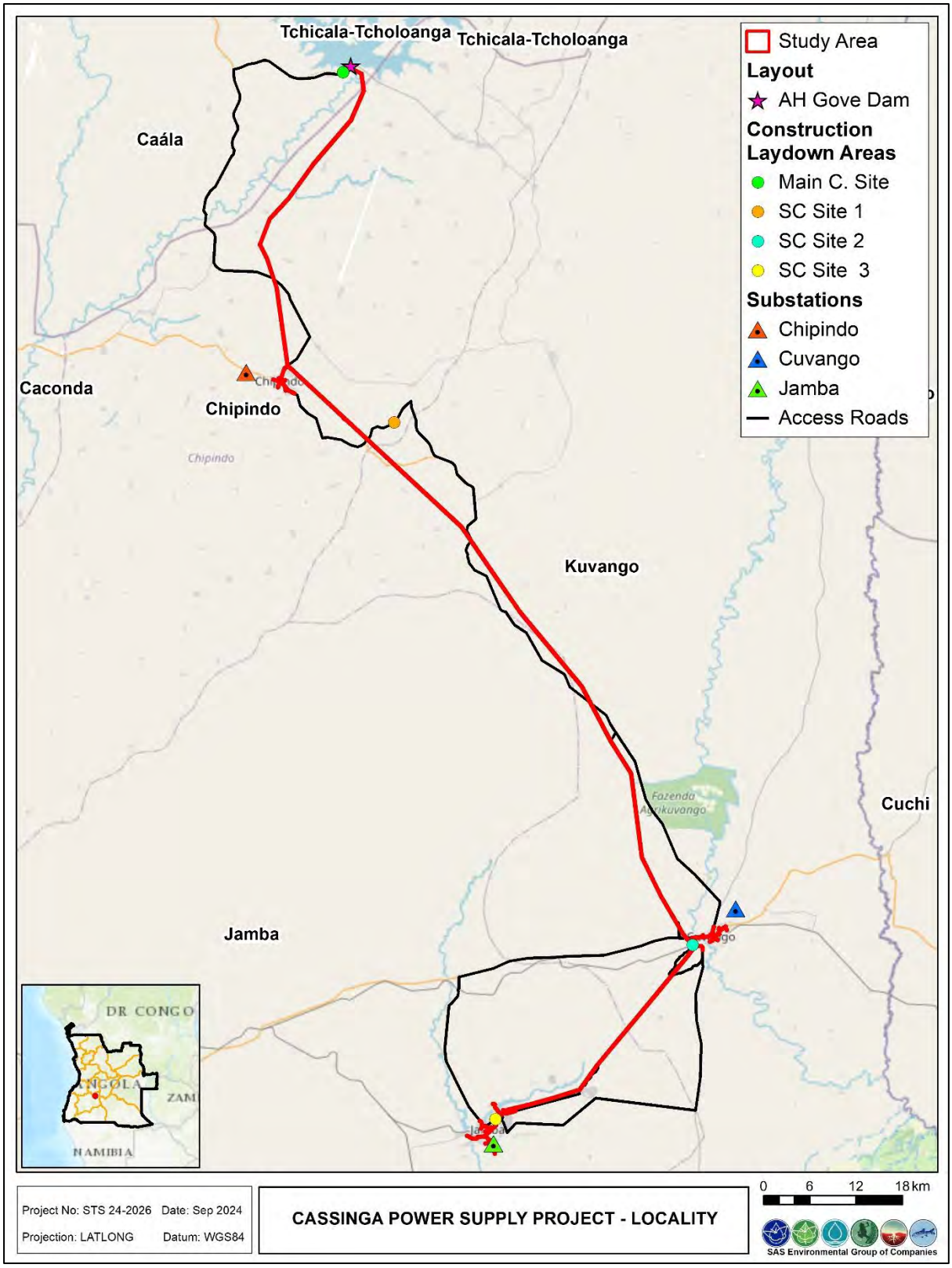


Figure 2: The study area associated with the proposed Cassinga powerline project depicted on a topographical map in relation to the surrounding area.

1.2 Legislative Requirements, National and International Guidelines

The following legislation was taken into consideration during the assessment (Refer to Appendix E for further detail). The following section has been compiled from the online data resources and previous studies conducted in Angola:

- The Constitution of the Republic of Angola (2010);
- Law No. 5/98 - Environment Framework Law;
- Law No. 6/17 - General Framework Law on Forests and Wildlife;
- Law No. 6/02 – Water Law;
- Law No. 9/04 – Land Law;
- Presidential Decree No. 117/20 - General Regulation for Environmental Impact Assessment and Environmental Licensing Procedures;
- Presidential Decree No. 26/20 (National Biodiversity Strategy and Action Plan 2019-2025);
- Executive Decree No. 469/15 on the slaughter prohibition in the national territory of protected species of the fauna and wild flora;
- Presidential Decree No. 194/11 - Environmental Damage Regulations;
- Presidential Decree No. 261/11 on Water Quality;
- Executive Decree No. 252/18 approving the Red List of Animal and Plant Species of Angola;
- Presidential Decree No. 171/18 on Forestry Regulations;
- Equator Principles Version 4 (2020);
- IFC Environmental Health and Safety General Guidelines (2007); and
- IFC Performance Standards (2012).

1.3 Scope of Work

Specific outcomes in terms of the report are as follows:

- To determine and describe habitat types, communities and the ecological state of the sites associated with the study area and to rank each habitat type based on conservation importance and ecological sensitivity;
- To provide inventories of floral species as encountered within the study area;
- To identify and consider all sensitive landscapes such as indigenous forests, rocky ridges, wetlands;
- To conduct a floral species assessment with focus on species listed under the International Union for Conservation of Nature (IUCN) as well as an assessment of

other Species of Conservation Concern (SCC), including the potential for such species to occur within the study area;

- To provide detailed information to guide the activities associated with the proposed development within the study area;
- To ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements, to allow regional and national biodiversity targets to be met, and the provision of ecological services in the local area is sustained;
- To provide descriptions pertaining to habitat types from a floral perspective, communities and the ecological state of the study area and to define the sensitivity of each habitat based on the SANBI Site Ecological Importance (SEI) method;
- To provide detailed information on preserving and enhancing ecosystem services by protecting local plant species, maintaining biodiversity, and ensuring the integrity of important habitats for water filtration, carbon sequestration, and soil stabilization throughout the proposed project; and
- To define the various habitat units in accordance with the IFC guidelines.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The floral assessment is confined to the proposed Cassinga Electrical Power Supply Project and associated infrastructure and does not include the neighbouring and adjacent properties. The immediate surroundings were, however, included in the desktop analysis of which the results are presented in **Part A: Section 3**;
- The floral assessment was primarily based within the study area, however, due to access/movement restrictions, where the OHL could not be accessed, representative sites in the adjacent areas were assessed as proxies. The study area surroundings were also considered in terms of floral habitat and species diversity;
- 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;
- In terms of site surveys along the OHL, the corridor width was assessed as 200 meters (m) (i.e., 100 m either side of the OHL); and
- Sampling by its nature means that not all individuals are assessed and identified. With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. A field assessment was undertaken from the 6th to the 10th of April 2024 (summer / wet season) and from the 15th to the 18th of July 2024 (winter

/ dry season). Moreover, on-site data was augmented with all available desktop data to improve on the overall understanding of the assessment area's floral ecology. The inclusion of a wet and dry floral assessment is deemed suitable for the purposes of an informed decision-making processes.

1.5 Information sources

Various online databases were consulted to gather information supporting the floral assessment, recognising that species data and occurrences for Angola may not be comprehensive. The available data is deemed adequate for the proposed Cassinga Electrical Power Supply Project, supplemented by desktop analysis using Google Earth Pro satellite imagery and consultation of databases and websites for floral SCC:

- Executive Decree No. 252/18 that approves the Red List of Species of Angola;
- Global Biodiversity Information Facility - https://www.gbif.org/;
- IUCN Redlist - https://www.iucnredlist.org/;
- iNaturalist - https://www.inaturalist.org/;
- Earth's Endangered Creatures - http://www.earthsendangered.com/index.asp; ; and
- Previous studies undertaken by STS within Angola
- Angola red list for plants (2018).

2 ASSESSMENT APPROACH

Initially, a desktop study was undertaken to gather background information regarding the site and its surrounding areas. This involved consulting maps, aerial photographs, and digital satellite images in order to determine broad habitats and sensitive sites; a literature review concerning habitats, vegetation types, floral species distributions and identifying the status of the land as well as conservation requirements and nearby conservation and protected areas. Following this, both wet and dry season field assessments were undertaken, during which the data gathered during the desktop assessment phase was utilised to confirm the presence or absence of potentially sensitive habitats and to compile floral species inventories for each habitat unit. Photographs were captured depicting each vegetation community representative of its typical structure, alongside images documenting all detected SCC.

The species lists generated during the field assessments include potential floral SCC, alien and invasive plant (AIP) species, as well as medicinal species. Detailed explanations of the floral methods of assessment are provided in **Appendix A** of this report.

Ecosystem services – **the benefits that people and/or a project (the beneficiaries) obtain from ecosystems –** were also assessed as part of the flora study. In the strictest sense, without beneficiaries, there are no ecosystem services. The benefits gained can be either physical or psychological, and can be obtained actively or passively, directly or indirectly. For the purposes of this assessment, the definitions of ecosystem services were based on those developed by the *Millennium Ecosystem Assessment* (MEA, 2005):

- Cultural services: Aesthetic, spiritual, recreational, and other cultural values, e.g., sacred sites, recreation, sense of place;
- Provisioning services: Supporting human needs, e.g., medicinal plants and minerals utilisation, water sources, fire wood;
- Regulating services: Control of the natural environment, e.g., maintenance of key ecological processes, protected areas, habitat of special value, groundwater recharge, catchments; and
- Supporting services: Natural processes essential to the resilience and functioning of ecosystems. e.g., primary production, soil formation and nutrient cycling.

These definitions were chosen to keep consistency with the IFC's Performance Standards (PS), and because they are widely recognised.

3 PROJECT ACTIVITIES POSING POTENTIAL IMPACTS

Vegetation clearance of floral habitat as part of the construction activities will impact on floral diversity, ecosystem services and nutrient cycling and fragmentation of floral habitat, resulting in a decrease in habitat connectivity. The increased presence of humans during the construction and operation of the proposed project will likely result in harvesting of floral species, including floral SCC, and irregular fires resulting in loss of habitat and floral species diversity. Additionally, there is a risk of introducing and spreading AIP species, further altering the floral diversity.

4 RESULTS OF THE FLORAL ASSESSMENTS

The reference vegetation type associated with the study area is Woodland (White, 1983) and typically comprise of open stands of trees that are up to eight m high but never densely locking, whereas the field layer is often dominated by grasses (Kindt, *et al*.,2012). During the field assessments, a number of habitat units were identified and refined from the reference state to indicate variation in habitat integrity, species diversities, and vegetation structure. These habitat units are:

- **Miombo Woodland Habitat (± 1953 hectares (ha) within the study area)**, comprising several deciduous[3] 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;
- **Secondary Miombo Habitat (± 947 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;
- **Freshwater Habitat (± 307 ha within the study area)**, comprising of rivers, flood plain wetlands, 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; and
- **Transformed Habitat (± 973 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.

These habitat units are described in the sections below and depicted in Figures 3 – 18 (maps are presented from the northern to southern extent of the OHL).

[3] (of a tree or shrub) shedding its leaves annually.

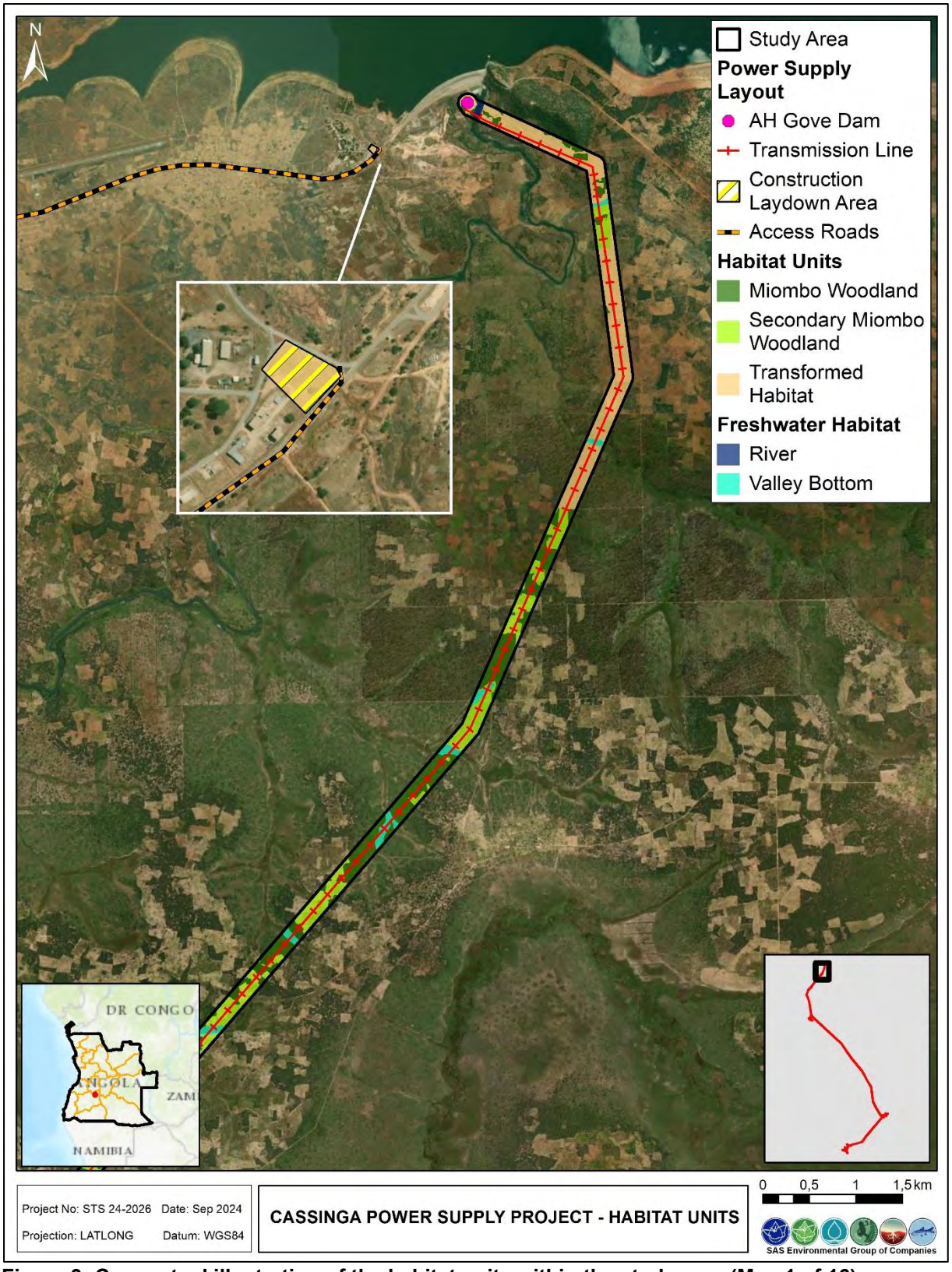


Figure 3: Conceptual illustration of the habitat units within the study area (Map 1 of 16).

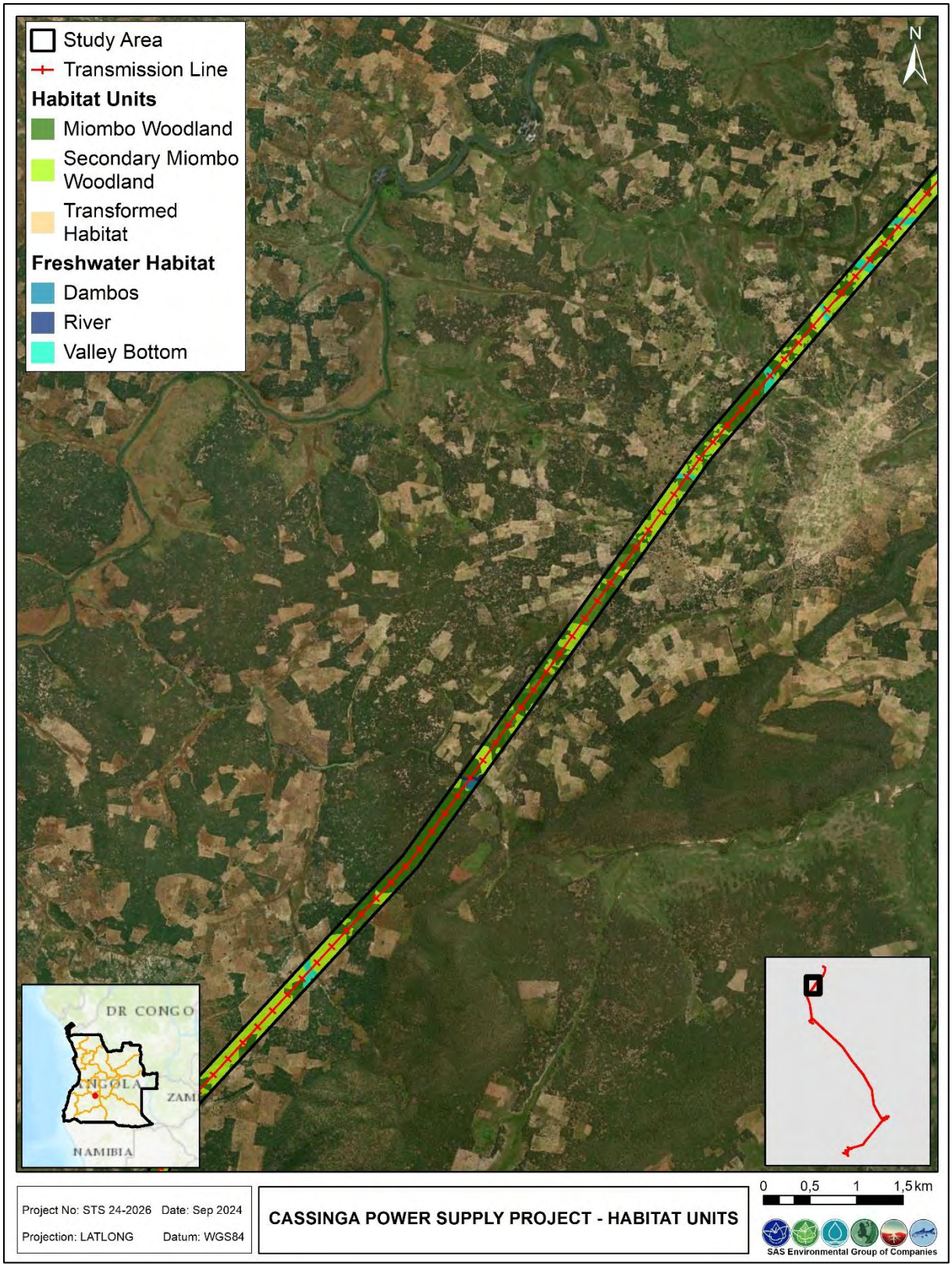


Figure 4: Conceptual illustration of the habitat units within the study area (Map 2 of 16).

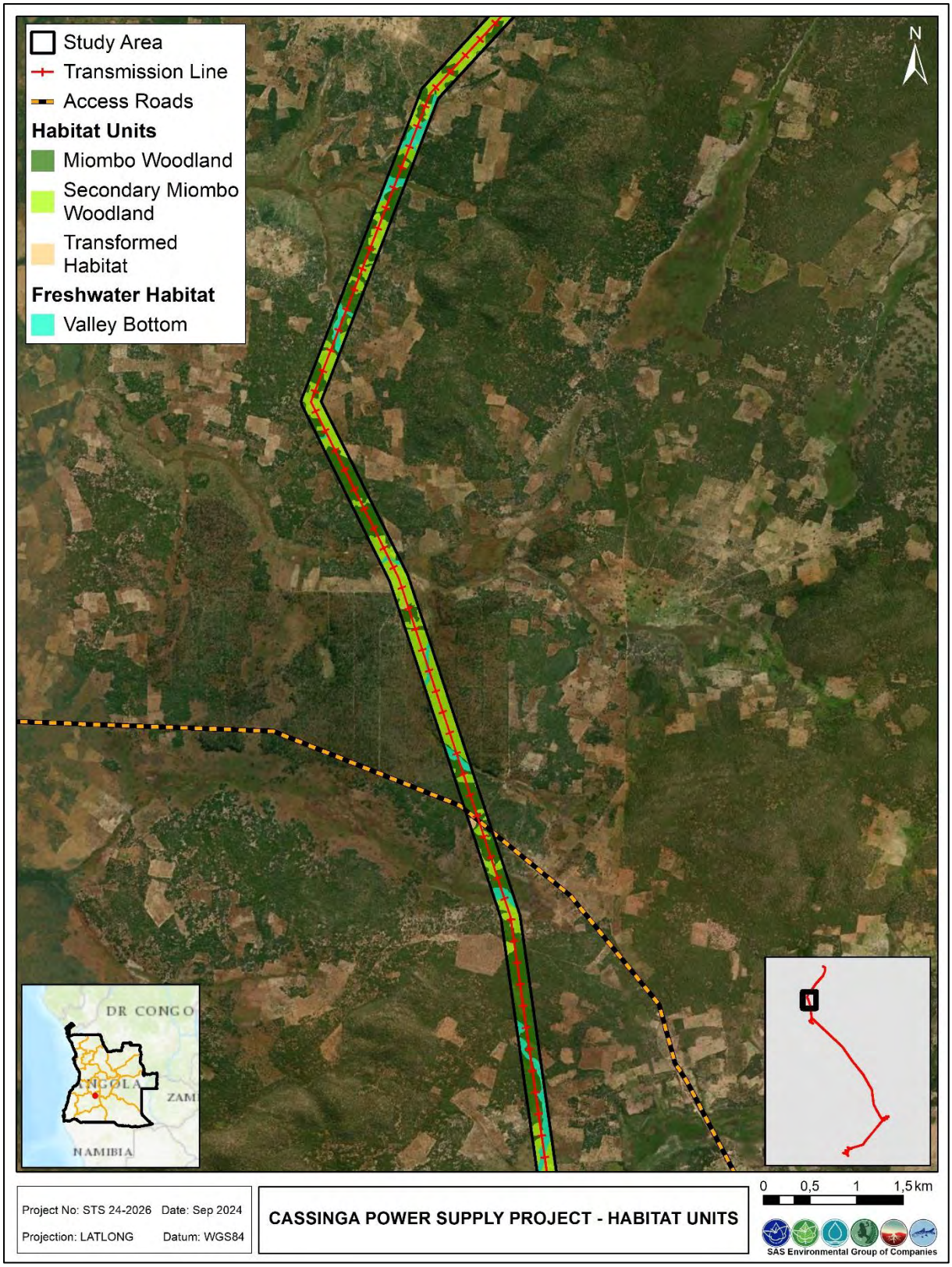


Figure 5: Conceptual illustration of the habitat units within the study area (Map 3 of 16).

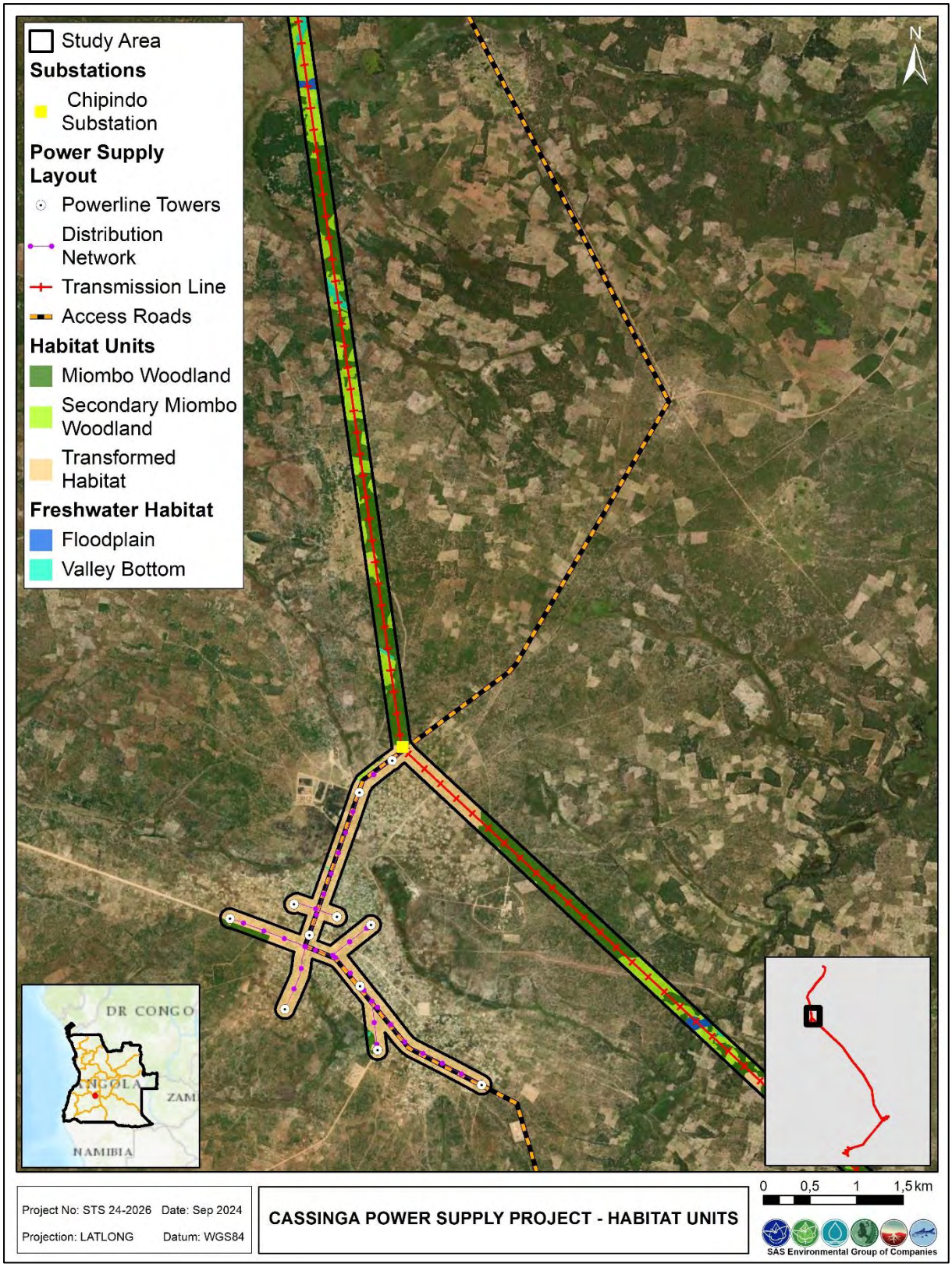


Figure 6: Conceptual illustration of the habitat units within the study area (Map 4 of 16).

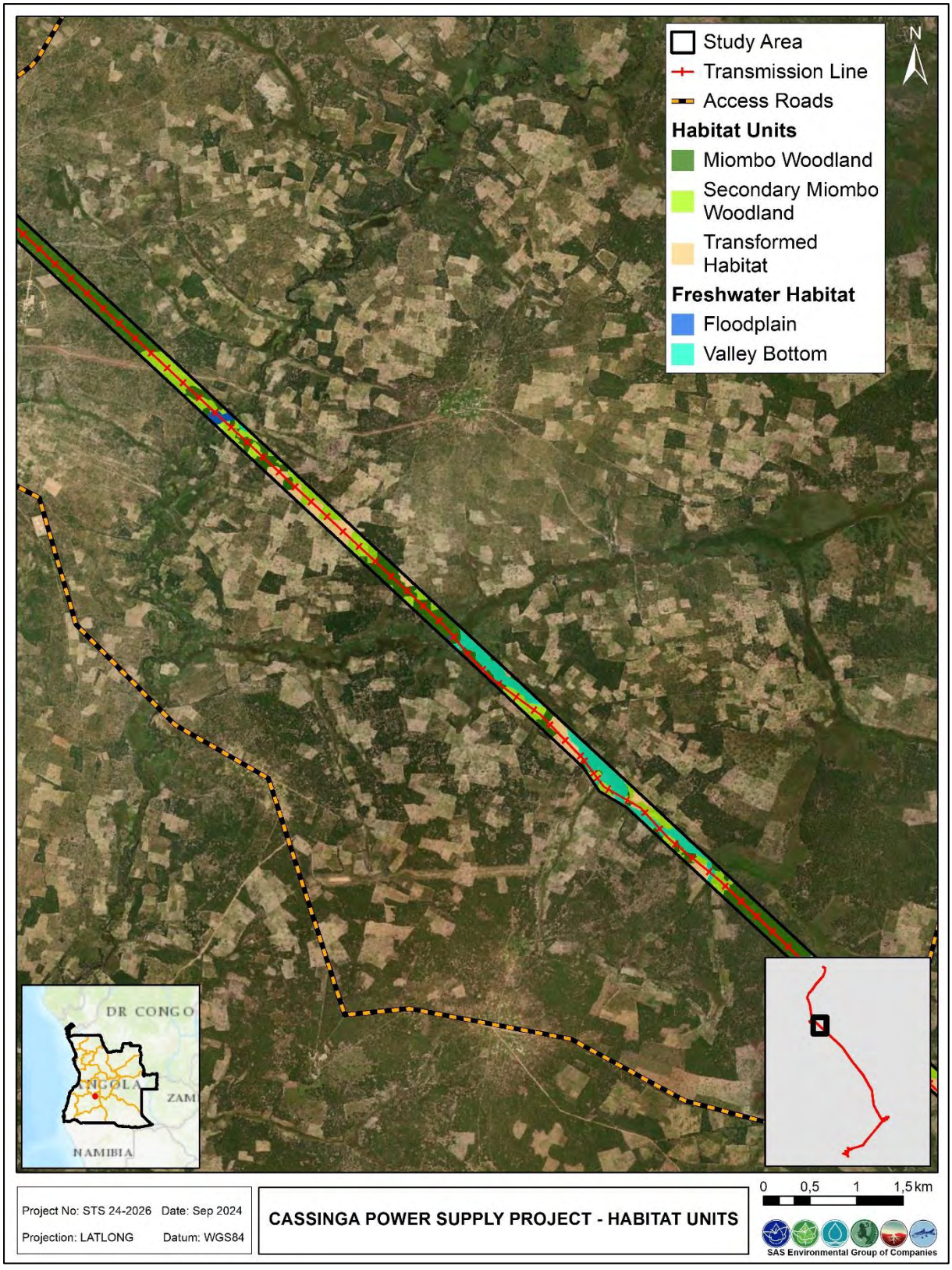


Figure 7: Conceptual illustration of the habitat units within the study area (Map 5 of 16).

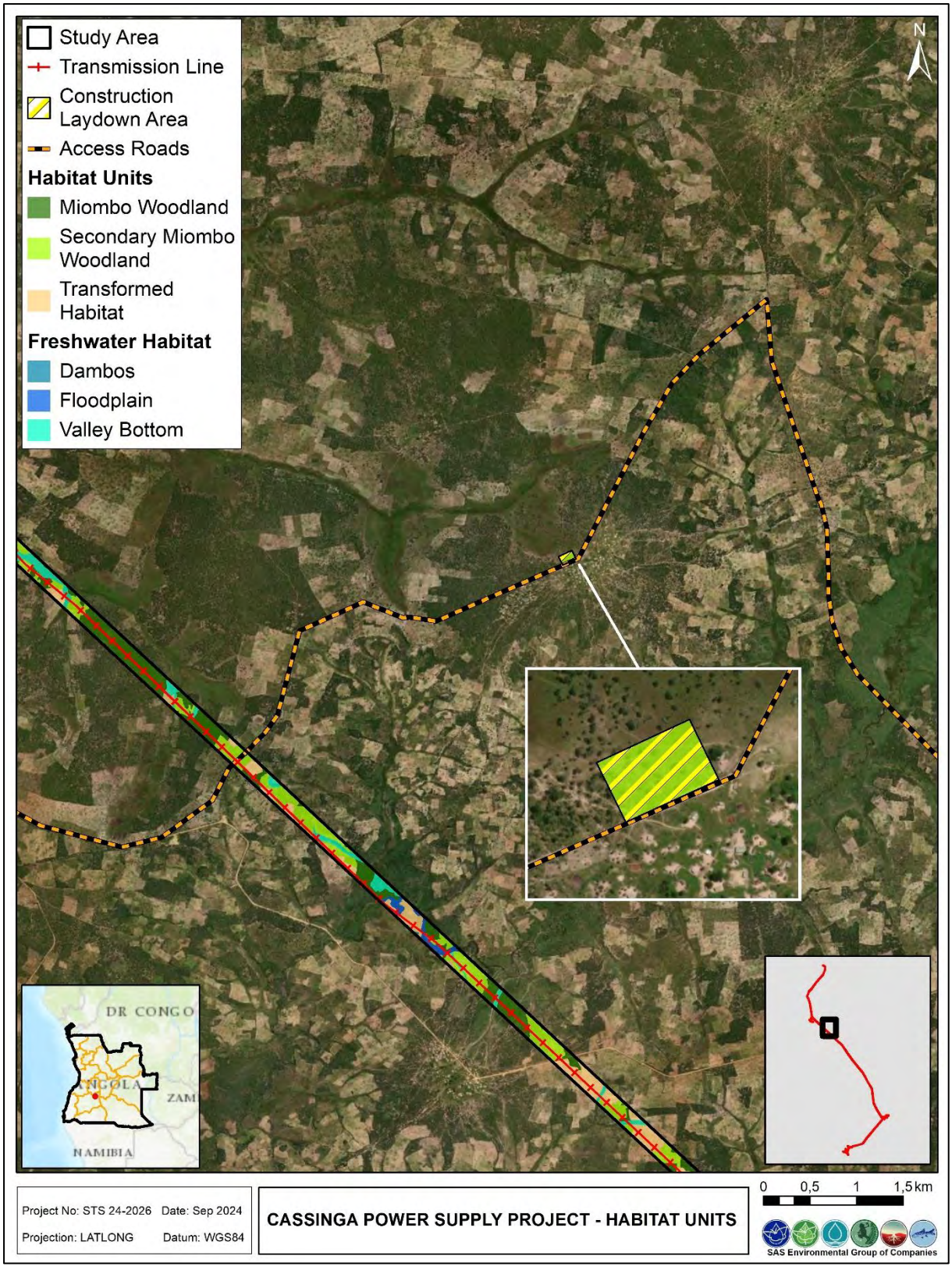


Figure 8: Conceptual illustration of the habitat units within the study area (Map 6 of 16).

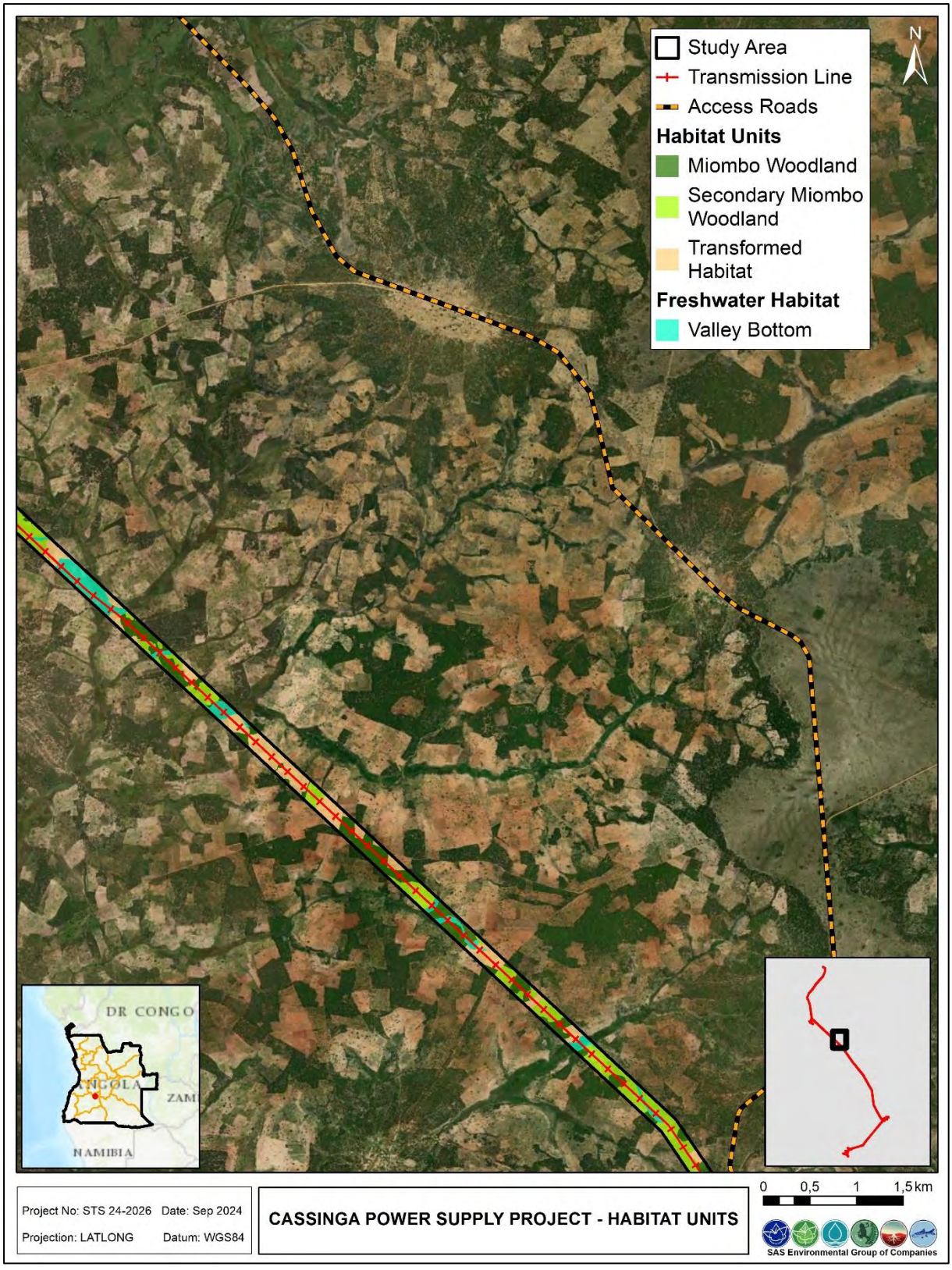


Figure 9: Conceptual illustration of the habitat units within the study area (Map 7 of 16).

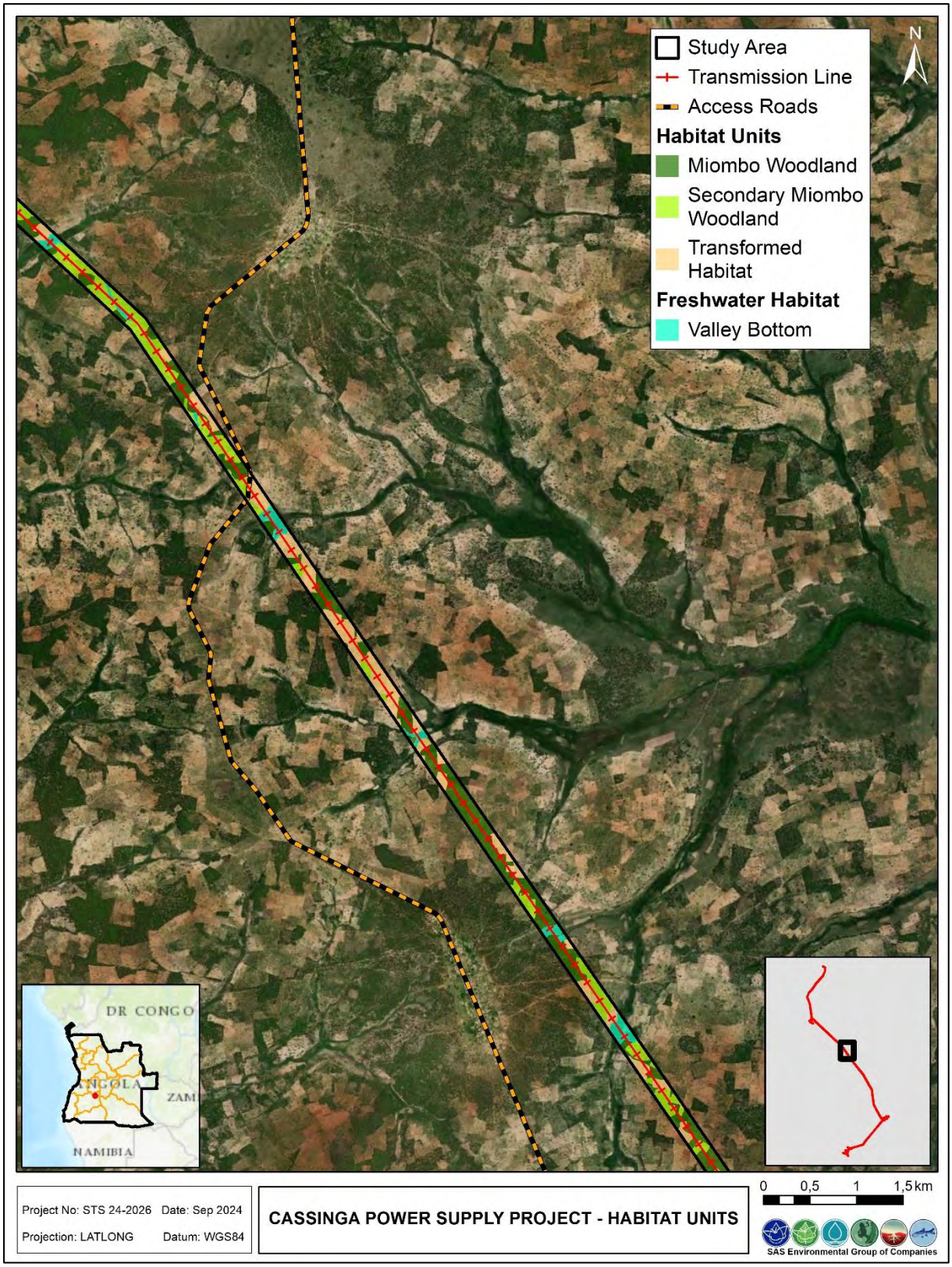


Figure 10: Conceptual illustration of the habitat units within the study area (Map 8 of 16).

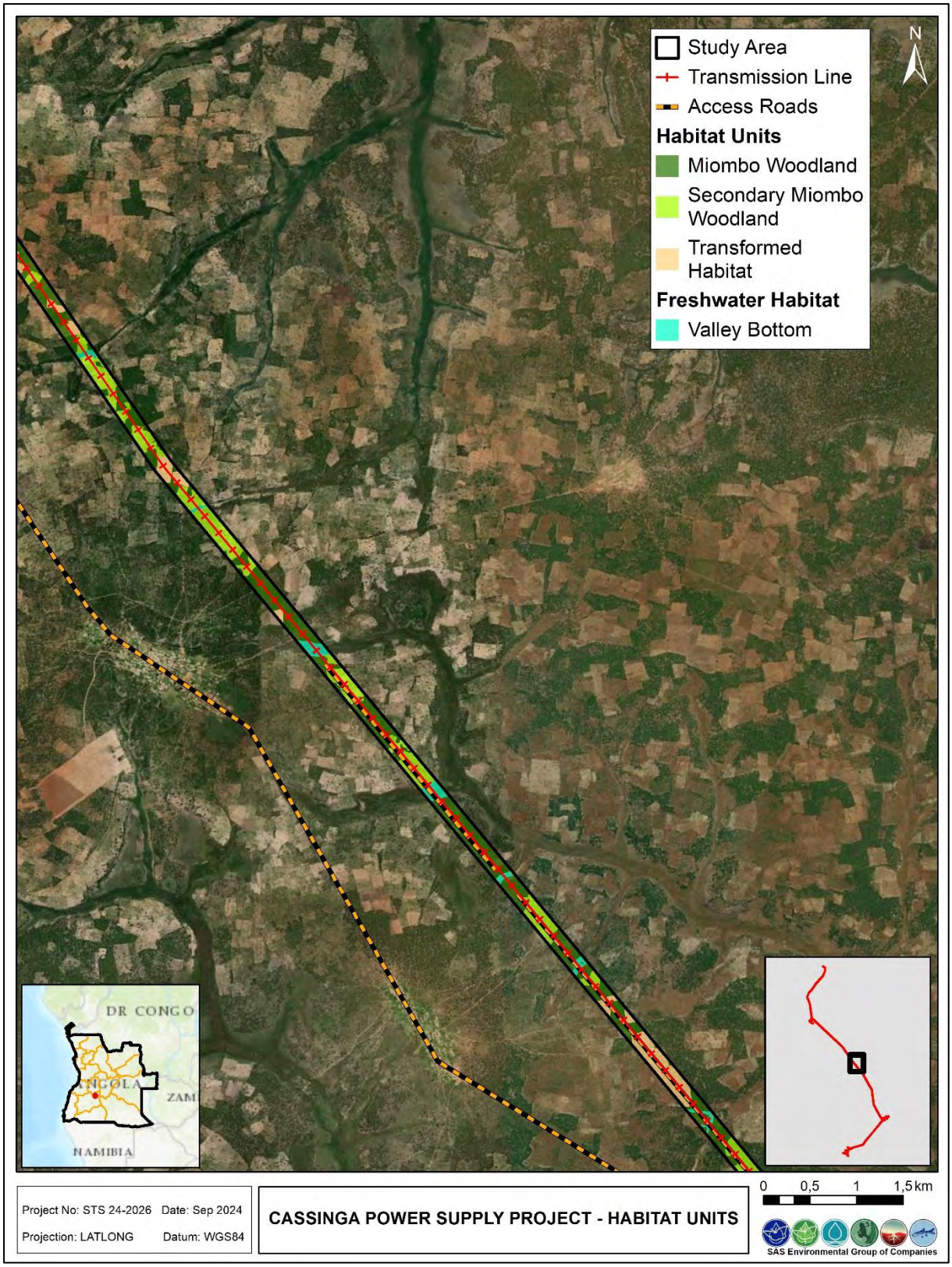


Figure 11: Conceptual illustration of the habitat units within the study area (Map 9 of 16).

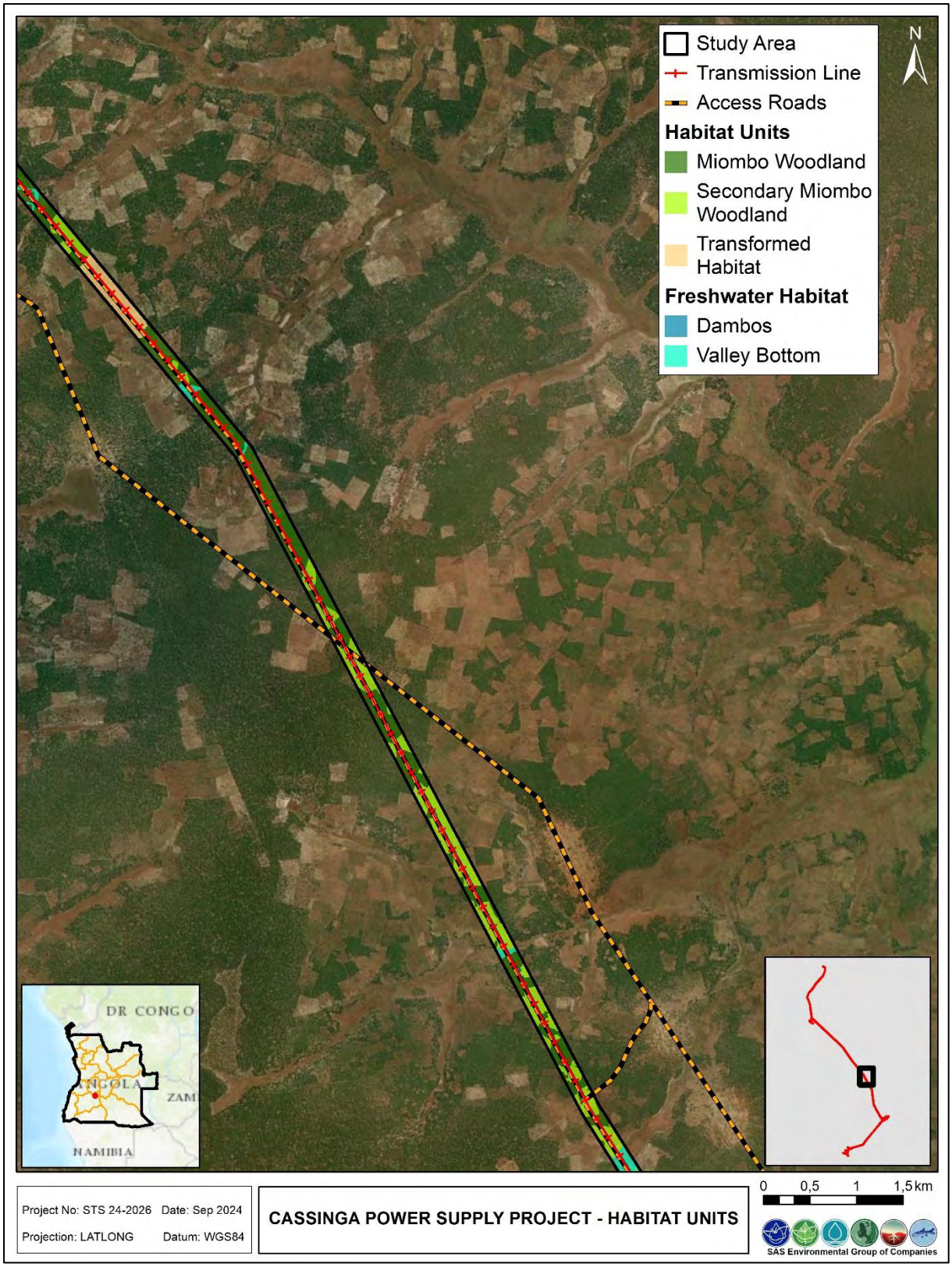


Figure 12: Conceptual illustration of the habitat units within the study area (Map 10 of 16).

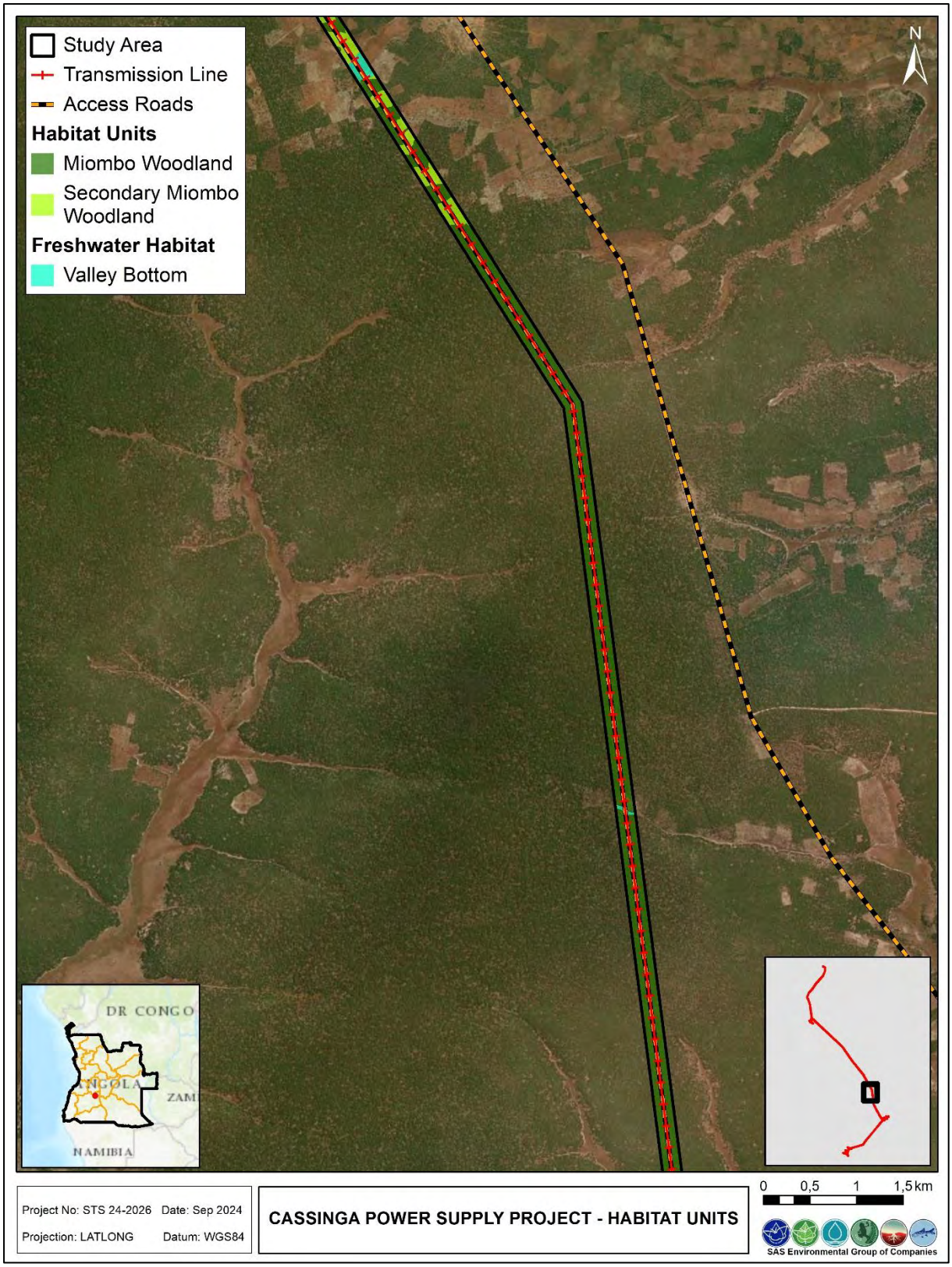


Figure 13: Conceptual illustration of the habitat units within the study area (Map 11 of 16).

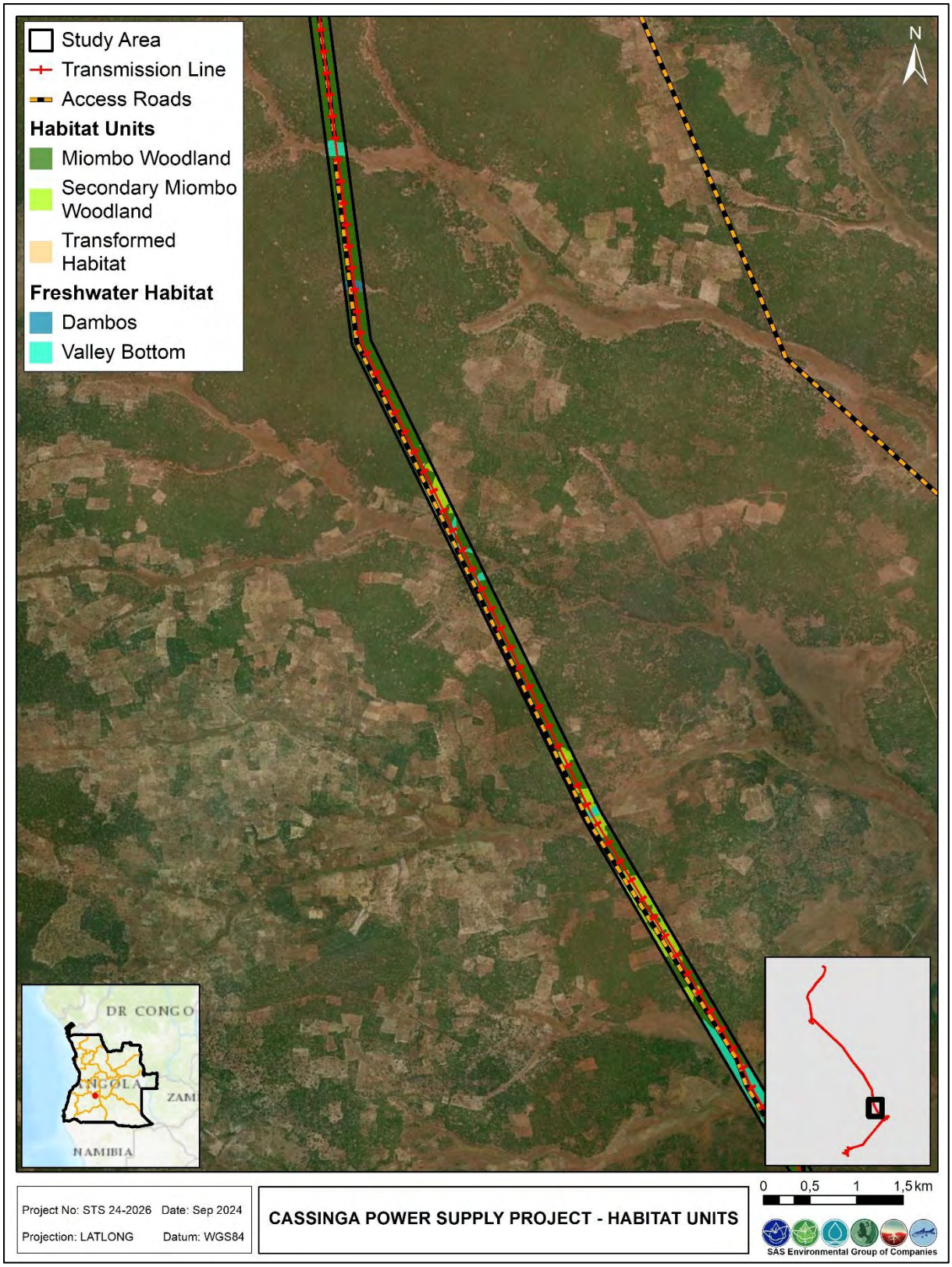


Figure 14: Conceptual illustration of the habitat units within the study area (Map 12 of 16).

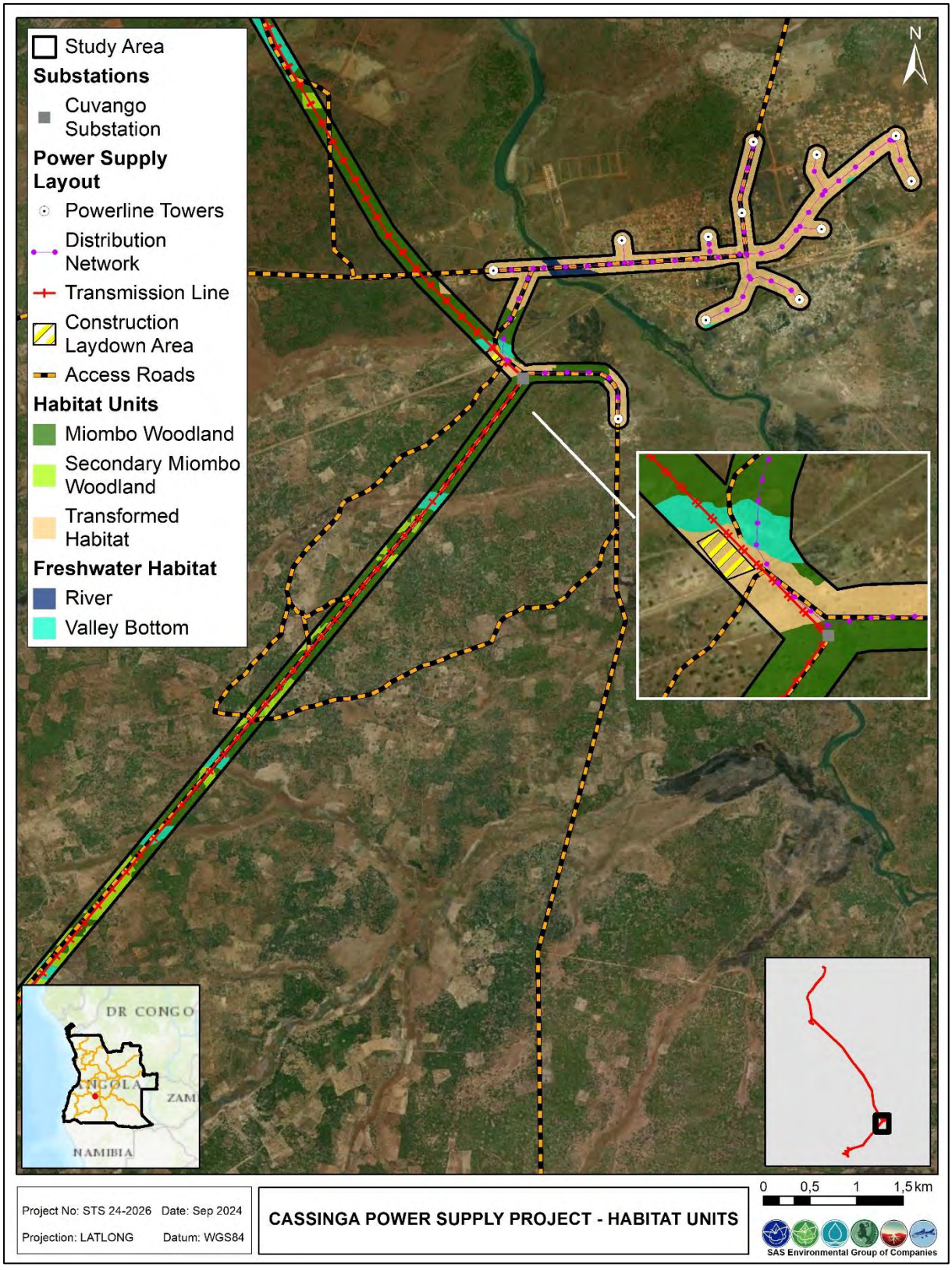


Figure 15: Conceptual illustration of the habitat units within the study area (Map 13 of 16).

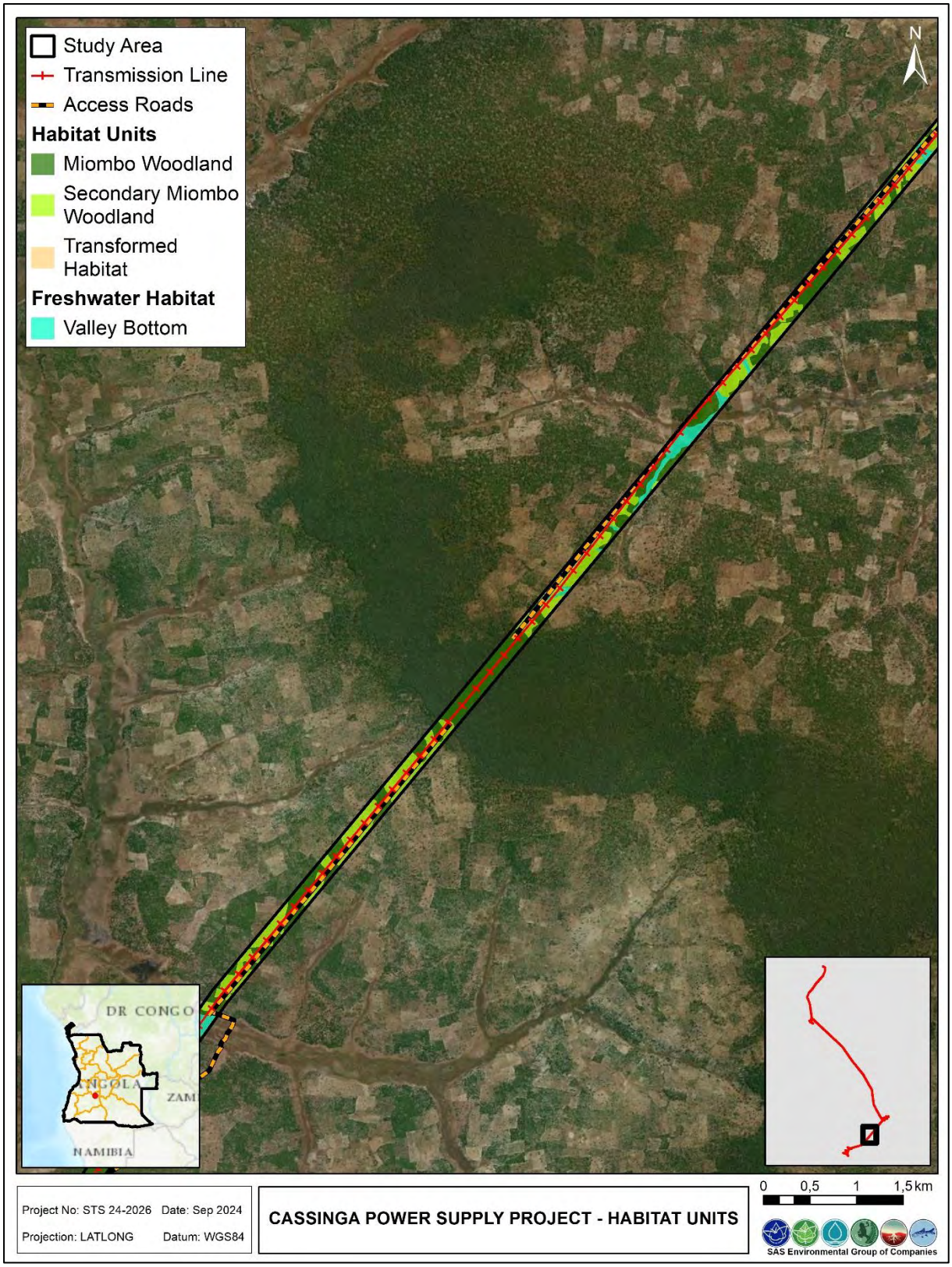


Figure 16: Conceptual illustration of the habitat units within the study area (Map 14 of 16).

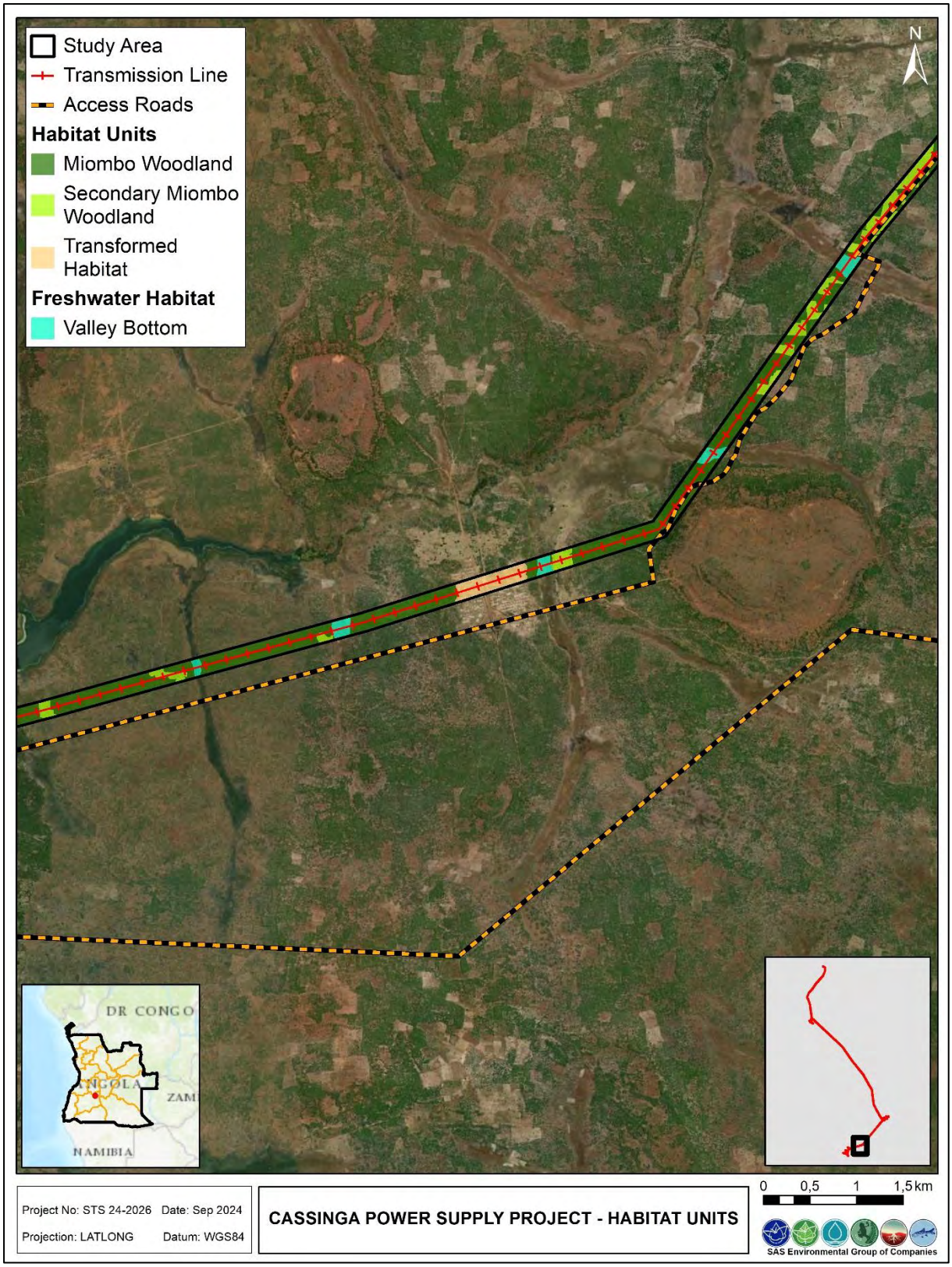


Figure 17: Conceptual illustration of the habitat units within the study area (Map 15 of 16).

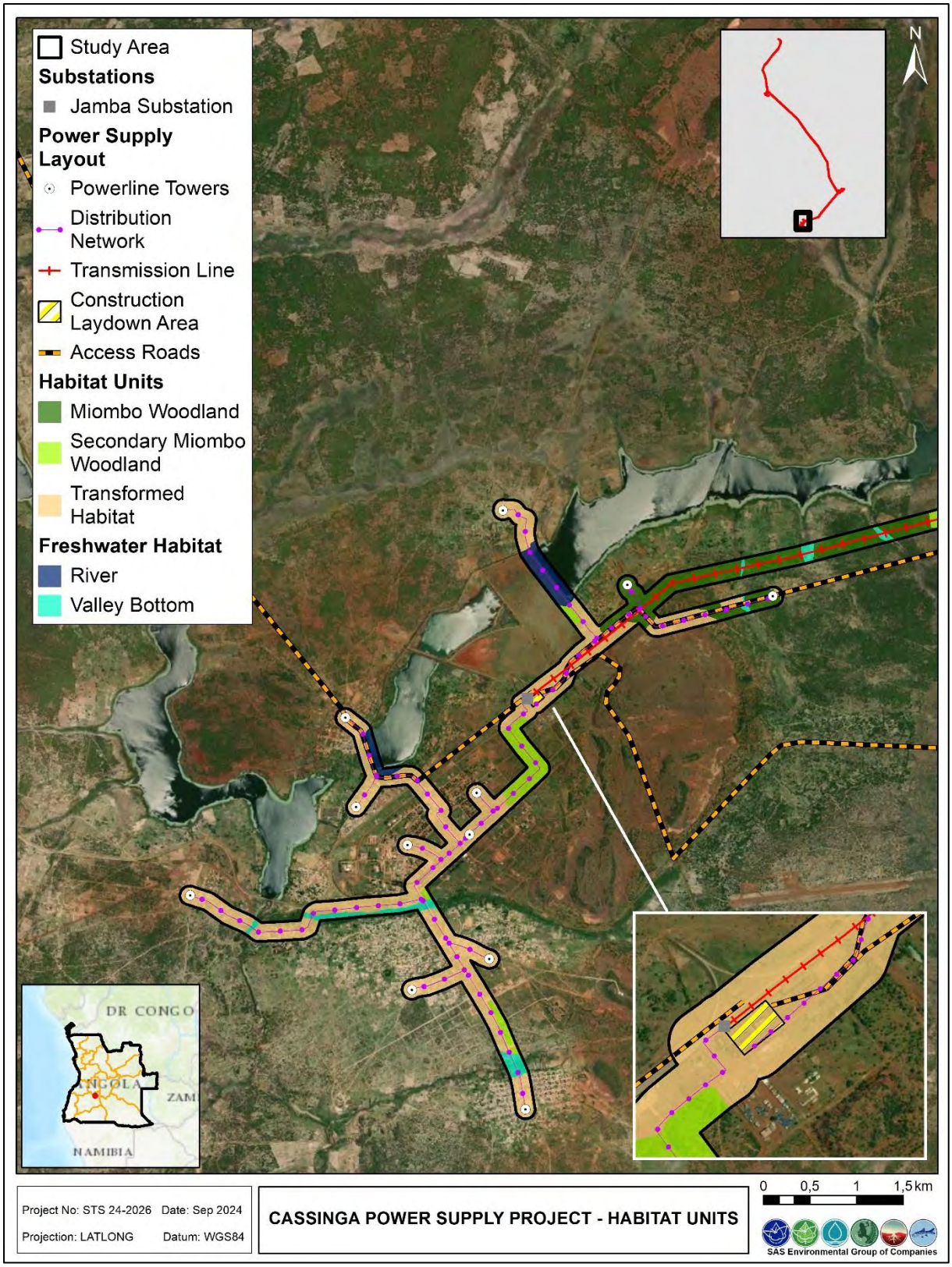


Figure 18: Conceptual illustration of the habitat units within the study area (Map 16 of 16).

4.1 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., *Brachystegia boehmii* and *Julbernardia paniculata,* 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.





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., *Julbernardia paniculata, Brachystegia boehmii, Pterocarpus angolensis, Dichrostachys cinerea* and *Terminalia brachystemma*;
- The graminoid layer was well-developed, comprising of the following species: *Digitaria eriantha, Heteropogon contortus* and *Panicum* sp.*;*
- The herbaceous layer consisted mostly of common, widespread species, such as *Commelina africana*; and
- AIP proliferation was low. Recorded species included *Tagetes minuta* and *Lantana camara*.

Refer to **Appendix C** for a more comprehensive list of species recorded within this habitat. Below are a few photographs of the species typically recorded across this habitat unit.



Species, from left to right: *Piliostigma thonningii, Julbernardia paniculata*, *Terminalia brachystemma,* and *Protea angolensis*.

4.2 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[4]. The ecological services within the Secondary Woodland still influence 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.



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*; and
- AIP proliferation was moderate. Recorded species included *Tagetes minuta* and *Lantana camara*.

Refer to **Appendix C** for a more comprehensive list of species recorded within this habitat. Below are a few of the species typically recorded across this habitat unit.

[4] https://forestry.co.za/miombo-network-calls-for-sustainable-and-integrated-management-of-miombo-forests/



Species, from left to right: *Pogonarthria squarrosa, Melinis repens*, *Brachystegia boehmiii,* and *Julbernardia paniculata*.

4.3 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 *Zea mays* (Maize) and *Glycine max* (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 *Eucalyptus* sp. were planted.



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., *Terminalia sericea*, *Dichrostachys cinerea*, *Piliostigma thonningii*, and *Erythrina zeyheri;*
- The graminoid layer was well-developed in areas where ground was covered by vegetation, comprising of the following species: *Hyparrhenia* spp, *Cynodon dactylon*, *Melinis repens* and *Eragrostis biflora*;
- The herbaceous layer *Cassytha filiformis* and *Hibiscus nigricaulis;* and
- AIP proliferation was fairly prolific. Recorded species included *Zea mays*, *Cucurbita* sp, *Tagetes minuta*, *Lantana camara* and *Bidens pilosa.*

Refer to **Appendix C** for a more comprehensive list of species recorded within this habitat. Below are a few photographs of the species typically recorded across this habitat unit.






Species, from left to right: *Musa* sp. (an alien species), *Eucalyptus* sp. (an alien species), *Opuntia ficus-indica* (and alien species), and *Melinis repens*.

4.4 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 unchanneled, 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.



Representative photographs illustrating the typical habitat associated with the Freshwater Habitat. Photographs a) and b): various valley bottom wetlands. Photographs 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., *Ficus sycomorus*, *Mucuna coriacea* and *Vitex doniana*;
- The graminoid layer was well-developed, comprising of the following species: *Cynodon dactylon*, *Cyperus* sp., and *Cyperus tenuiflorus;*
- The herbaceous layer comprising of the following species: *Floscopa glomerata* and *Ethulia conyzoides*; and
- AIP proliferation was moderate. Recorded species included *Tagetes minuta* and *Bidens pilosa*.

Refer to **Appendix C** for a more comprehensive list of species recorded within this habitat. Below are a few photographs of the species typically recorded across this habitat unit.



Species, from left to right: *Phragmites australis, Vachellia sieberiana*, *Cyperus* sp., and *Cyperus tenuiflorus*.

4.5 Floral SCC Assessment

An assessment considering the presence of any floral SCC, as well as suitable habitat to support any such species was undertaken. Threatened species are species that are facing a high risk of extinction. Any species classified in the IUCN categories as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) is a threatened species. The IUCN on a global level did not identify any threatened species. Only the national legislation recognised threatened species.

4.5.1 Executive Decree No. 252/18 that approves the Red List of Species of Angola

The Executive Decree No. 252/18 that approves the Red List of Species of Angola, was consulted for species that may be present within the study area.

Only two floral SCC listed as VU were observed during the field assessments namely *Pterocarpus angolensis* and *Brachystegia spiciformis;* however, the IUCN lists these species as Least Concern (LC) species. These species were observed within the Miombo Woodland habitat unit. None of the other floral species that have been identified during the field assessment had a conservation status higher than that of LC on the IUCN database.

4.5.2 Floral species listed under IUCN

The floral species recorded within the assessed 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 1 highlights the floral species with a medium to high POC in the study area, 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 1: 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
Ansellia africana	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	High

Species name	IUCN Status	Habitat and Direct threats	POC
		should focus on habitat protection, regulating collection, and promoting sustainable cultivation practices.	
Disa aequiloba	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
Genlisea angolensis	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
Lysimachia elegantula	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
Mesanthemum glabrum	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
Monotes rubriglans	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
Utricularia bracteata	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
Vigna procera	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
Rotala smithii	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
Croton gossweileri	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 *Croton gossweileri* include deforestation, habitat fragmentation, and land conversion for agriculture.	Medium

4.5.3 Non-threatened species of conservation concern

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 infrastructure should take into cognisance these species, and where possible limit placements within the Freshwater Habitat and Miombo Woodland Habitat as preferred habitat for floral SCC is present within these habitats. In the case of the smaller bulbous species, should they occur in a proposed 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.

4.6 International Finance Corporation: Performance Standard 6

The section below introduces the IFC Sustainability framework and applicable sections of the IFC with relation to the Cassinga Electrical Power Supply Project.

4.6.1 IFC Sustainability Framework:

The IFC articulates the Corporation's strategic commitment to sustainable development and is an integral part of IFC's approach to risk management. The sustainability framework comprises IFC's Policy and PSs on Environmental and Social Sustainability, and IFC's Access to Information Policy. The IFC PSs are designed to assist the proponent in designing and implementing a project in a manner where risks and impacts associated with the project are identified and mitigated to ensure the project is completed sustainably.

There are eight (8) PS which have to be implemented throughout the life of an investment by IFC. The PSs include:

- Assessment and Management of Environmental and Social Risk and Impacts;
- Labour and Working Conditions;
- Resource Efficiency and Pollution Prevention;
- Community Health, Safety, and Security;
- Land Acquisition and Involuntary Resettlement;
- Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Indigenous Peoples; and
- Cultural Heritage.

For the purposes of this assessment, the following PS is considered the most applicable:

- **PS 6:** Biodiversity Conservation and Sustainable Management of Living Natural Resources - Recognises that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development.

The table below summarises the IFC habitat categories and project requirements to meet the IFC Standards (according to PS 6).

Table 2: Descriptions of the IFC habitat categories and project requirements to meet IFC 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 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 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.

As Critical Habitat (CH) is defined by five (5) criteria, the following assessment evaluates the habitat units 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;
- 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 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 (km^2) and are thus also not considered “restricted-range” species. Therefore, none of the habitats within the study 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;
- 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. Therefore, 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 under Criterion 4;

Landscape level:

- Criterion 5: The study area does not include ecological gradients that support diverse plant species across varying environmental conditions, unique or isolated habitats that foster endemism, critical connectivity corridors for gene flow, or areas of high habitat diversity essential for evolutionary dynamics.

The table below indicate the habitat categories for the vegetation units identified in the study area.

Table 3. 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.

4.7 Exotic and Invasive Species

Alien floral species in the study area were mostly associated with villages and in particular agricultural areas. The table below lists the exotic and invader species identified during the assessments along with their basic methods of control. It is recommended that all AIPs that are located within the Cassinga Electrical Power Supply Projector and associated infrastructure footprint are removed and destroyed, ensuring that the seed is not dispersed into the surrounding areas. The only two exceptions on the list below are that of *Mangifera indica* (Mango) and *Psidium guajava* (Guava) which 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: Exotic or invasive species listed and identified during the assessments.

Scientific name	Common name	Listed under Category D of Executive Decree No. 252/18	Control Options
Terrestrial Species			
Acacia saligna	Orange wattle	Invasive species	Chemical and mechanical control
Acacia mearnsii	Black wattle	Not listed	Chemical and mechanical control
Argemone mexicana	Mexican prickly poppy	Invasive species	Chemical and mechanical control
Bidens pilosa	Spanish Blackjack	Not listed	Pre-emergence herbicide, mechanical control

Scientific name	Common name	Listed under Category D of Executive Decree No. 252/18	Control Options
Cosmos sulphureus	Sulfur cosmos	Not listed	Chemical and mechanical control
Chromolaena odorata	Triffid weed	Invasive species	Chemical and mechanical control
Eucalyptus sp.	Gum tree	Not listed	Chemical and mechanical control
Lantana camara	Lantana	Not listed	Mechanical control, herbicide
Leucaena leucocephala	River tamarind	Not listed	Chemical and mechanical control
Mangifera indica	Mango	Not listed	None, agricultural use
Opuntia ficus-indica	Prickly Pear	Not listed	Mechanical control, herbicide
Opuntia stricta	Prickly pear	Invasive species	Chemical and mechanical control
Prosopis glandulosa	Honey mesquite	Not listed	Chemical and mechanical control
Prosopis juliflora	Mesquite	Not listed	Chemical and mechanical control
Psidium guajava	Guava	Not listed	None, agricultural use
Ricinus communis	Castor oil plant	Invasive species	Chemical control
Solanum mauritianum	Bugweed	Invasive species	Chemical and mechanical control
Tagetes minuta	Tall Khaki Weed	Not listed	Pre-emergence herbicide, mechanical control
Tithonia diversifolia	Mexican sunflower	Invasive species	Mechanical control
Aquatic Species			
Arundo donax	Giant reed	Invasive species	Chemical and mechanical control
Azolla filiculoides	Red water fern	Not listed	Biological and mechanical control
Eichhornia crassipes	Common water hyacinth	Invasive species	Chemical, Biological and mechanical control
Myriophyllum aquaticum	Parrot feather	Not listed	Mechanical control
Pistia stratiotes	Water lettuce	Not listed	Biological and mechanical control
Salvinia molesta	Giant salvinia	Not listed	Chemical and mechanical control

4.8 Medicinal Plant Species

The table below 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. When planning the Cassinga Electrical Power Supply Project and associated infrastructure locations, 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 5: Traditional medicinal plants identified during the field assessments. Medicinal applications and application methods are also presented. Exotic and invasive species are marked with an asterisk (*).

Scientific name	Medicinal use
Adenia senensis	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.
Aframomum alboviolaceum	The plant is used as a febrifuge.
Annona senegalensis	The bark is used medicinally to treat gastrointestinal ailments and the gum from the bark is used for sealing cuts and wounds
*Bidens pilosa**	Its roots, leaves, and seeds are reported to have antibacterial, antidysenteric, anti-inflammatory, antimicrobial, antimalarial, diuretic, hepatoprotective, and hypotensive properties. In Africa, B. pilosa 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.
Boophone disticha	The outer covering of the bulb is applied to boils and abscesses; fresh leaves are used to stop bleeding of wounds.
Brachystegia spiciformis	An infusion provides treatment for dysentery and diarrhoea. A decoction is applied as an eyewash for conjunctivitis.
Cassytha filiformis	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.
Combretum zeyheri	The gum of *Combretum zeyheri* 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.
Ficus sycomorus	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.
Flacourtia indica	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.
*Mangifera indica**	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.
Opuntia ficus indica	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.
Ozoroa insignis	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.
Parinari curatellifolia	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
Pericopsis angolensis	Included in treatment for ringworm, stabbing pains, eye problems, malaria, blackwater fever, stomach problems and to increase the supply of breast milk

Scientific name	Medicinal use
Piliostigma thonningii	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.
Senna singueana (Cassia singueana)	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
Steganotaenia araliacea	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.
Strychnos cocculoides	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.
Terminalia sericea	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.
Vachellia sieberiana	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.
Vangueria infausta	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.
Ziziphus mucronata	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.

5 ECOSYSTEM SERVICES AND THE INTERNATIONAL FINANCE CORPORATION

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). It is very important to acknowledge that 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 relevant ecosystems within the study area. Habitat transformation and modification is extensive throughout the study area and surrounds, however, many of the habitats have recovered well and are contributing to ecosystem services. Several of the habitats with and surrounding the study

area have historically been excluded from significant direct impacts and transformation, thus these habitats are increasingly important for ecosystem services.

PS 6 defines ecosystem services as “the benefits that people, including businesses, obtain from ecosystems” (paragraph 2), which is in line 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 four major categories:

1. Provisioning ecosystem services:
2. Regulating ecosystem services:
3. Supporting services

The following is a summary of the ecosystem services provided by various habitat units (as identified in sections 4.1 to 4.4).

Table 6: 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; ➢ Fuel - biological materials serve as sources of energy (wood); ➢ Ethnobotanical plants; and ➢ Freshwater.	Food, fuel, and ethnobotanical plants are obtained from the habitats within the study area, especially from the Miombo Woodland and Secondary Woodland. 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	Miombo Woodland, Secondary Woodland, and Freshwater Habitat are most important for these ecosystem services.

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.	
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; and ➢ 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.

6 SITE ECOLOGICAL IMPORTANCE MAPPING

This section aims to 1) present the Site Ecological Importance (**SEI**) of the receptors identified within the study area (e.g., SCC, the floral community or habitat type present on the site), and 2) clearly define and map areas where avoidance mitigation is strongly recommended if significant, negative residual impacts are to be avoided (and to prevent potential fatal flaws).

Based on the criteria provided in Appendix A of this report, all habitats within the study area were allocated an importance category, i.e., SEI category. SEI is a function of the biodiversity importance (**BI**) of the receptor and its resilience to impacts (receptor resilience [**RR**]). BI in turn is a function of conservation importance (**CI**) and the functional integrity (**FI**) of the receptor.

Table 6 indicates the individual SEI scoring for each habitat unit respectively. Figures 19 to 34 indicate the SEI for the study area.

Table 7: SEI importance for the different habitat units associated with the study area. SEI = Site Ecological Importance, CI = Conservation Importance, FI = Functional Integrity, BI = Biodiversity Importance, and RR = Receptor Resilience.

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.

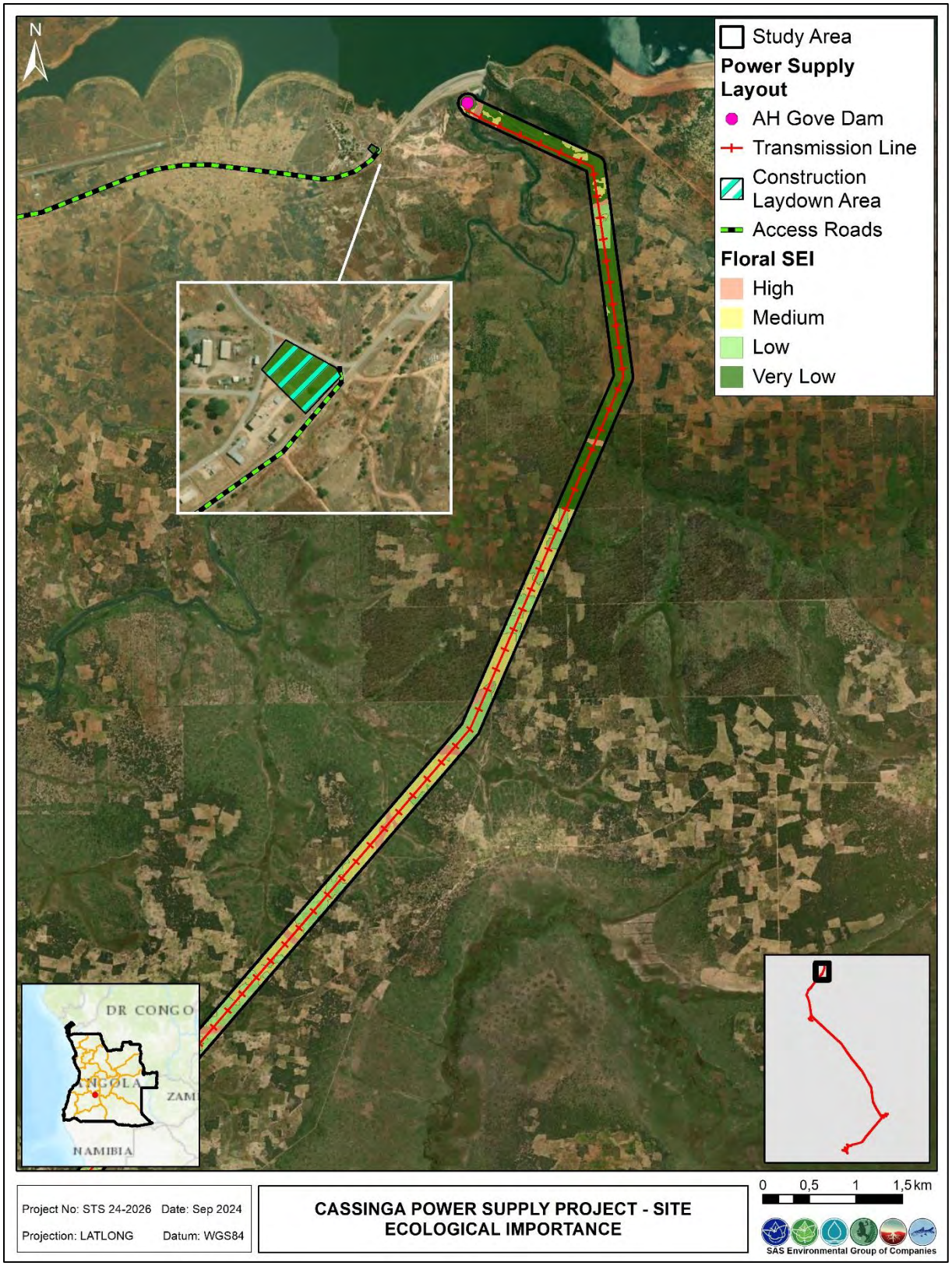


Figure 19: Sensitivity map pertaining to the floral assessment of the study area (Map 1 of 16).

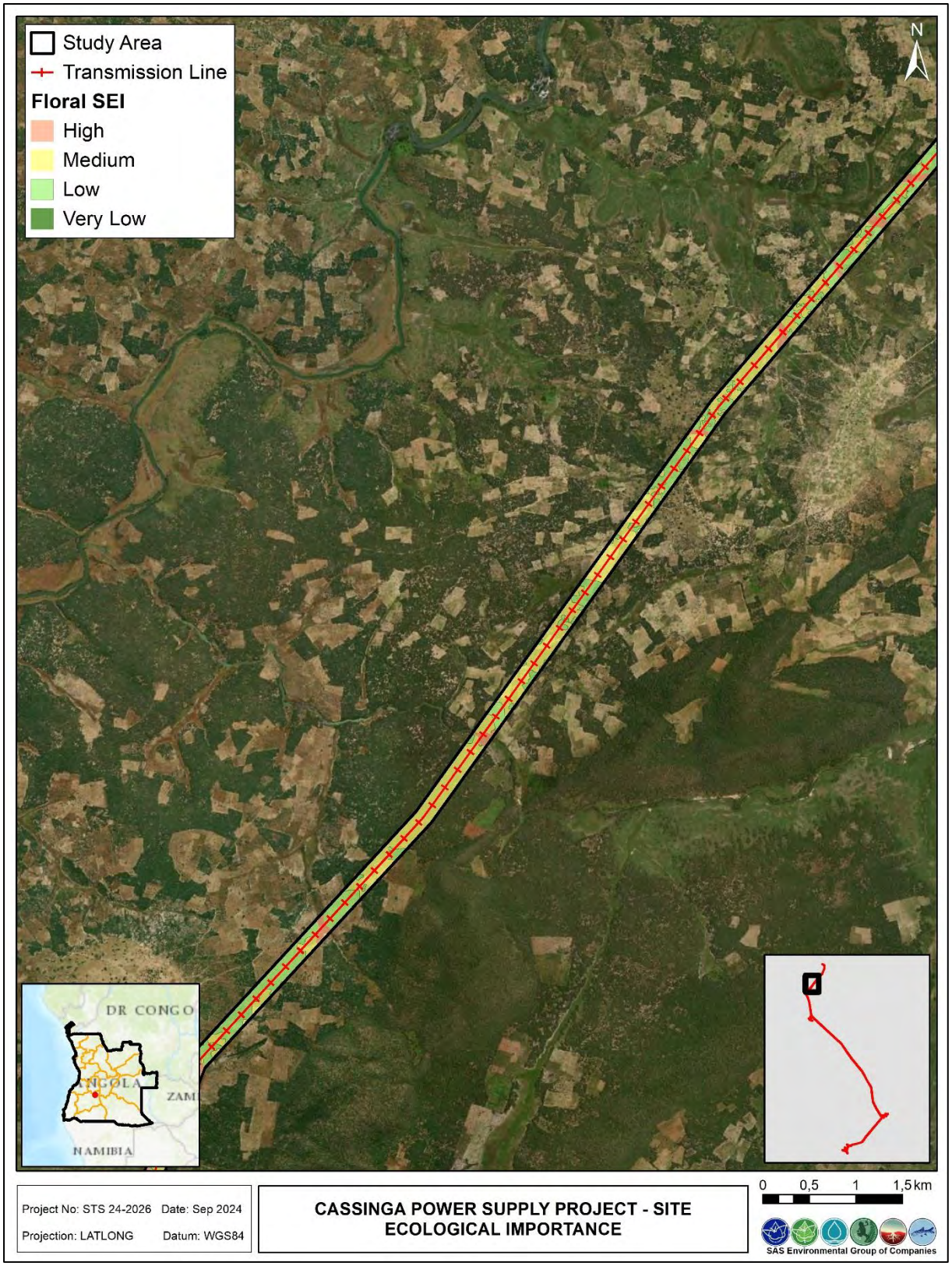


Figure 20: Sensitivity map pertaining to the floral assessment of the study area (Map 2 of 16).

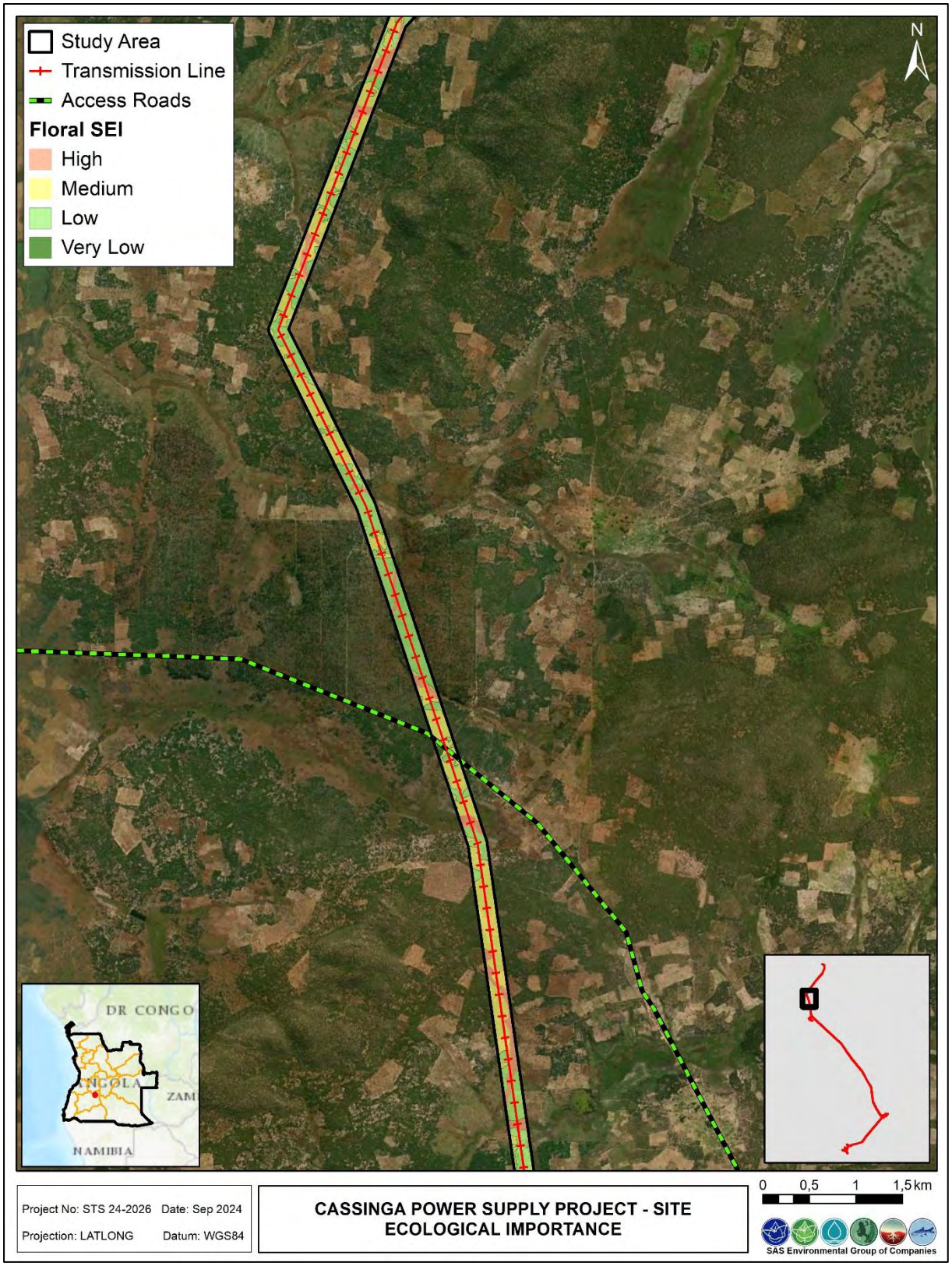


Figure 21: Sensitivity map pertaining to the floral assessment of the study area (Map 3 of 16).

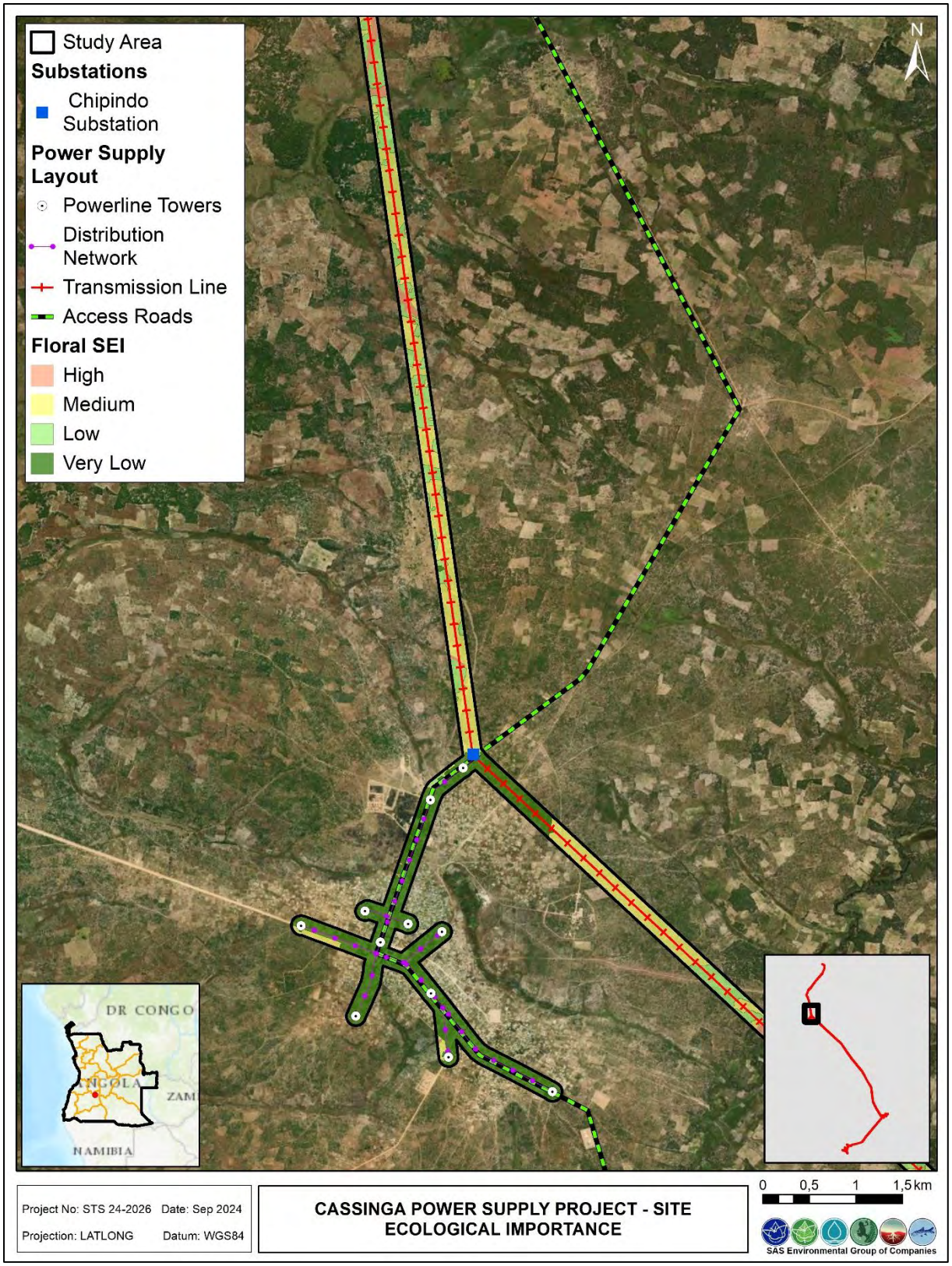


Figure 22: Sensitivity map pertaining to the floral assessment of the study area (Map 4 of 16).

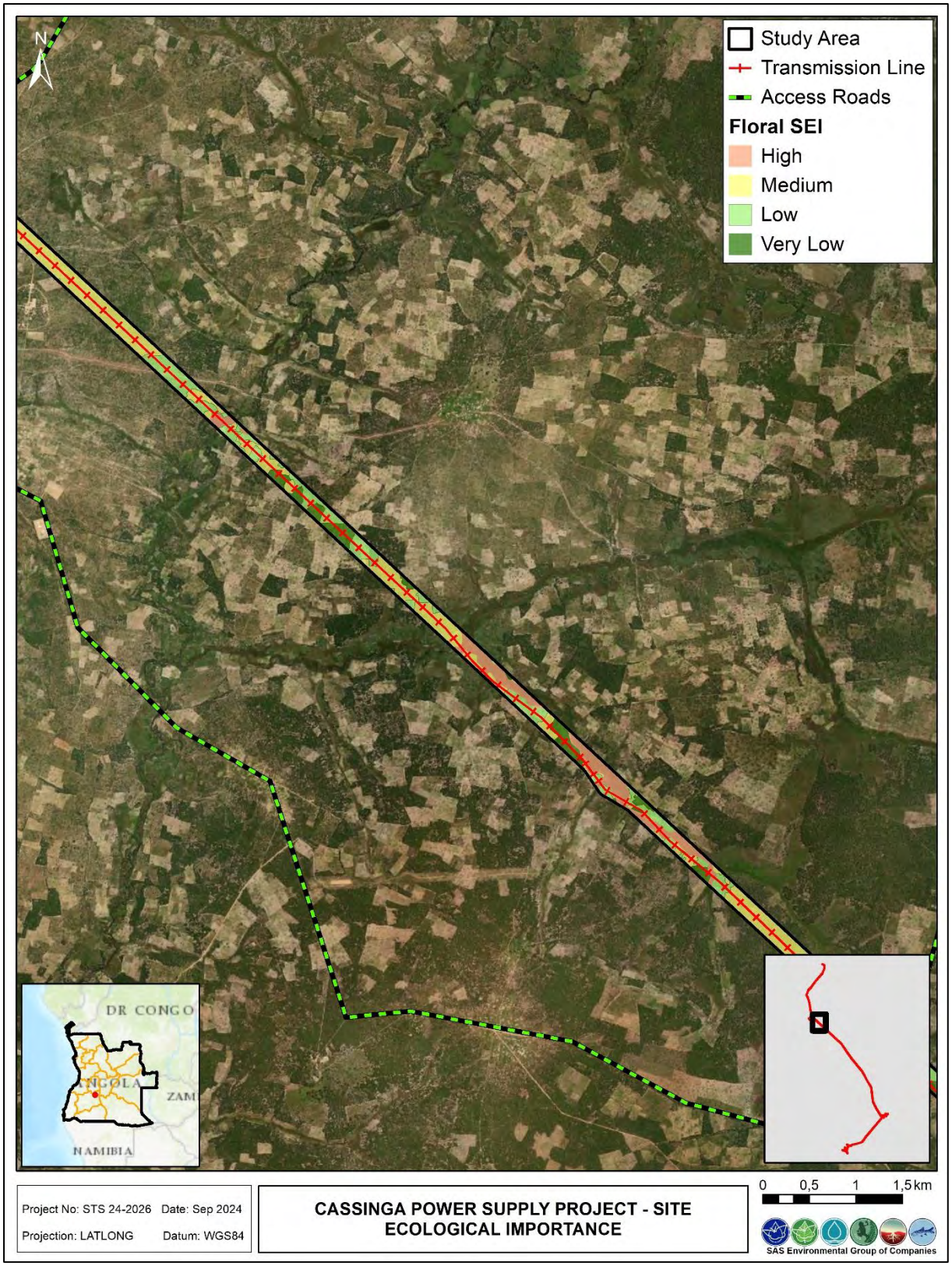


Figure 23: Sensitivity map pertaining to the floral assessment of the study area (Map 5 of 16).

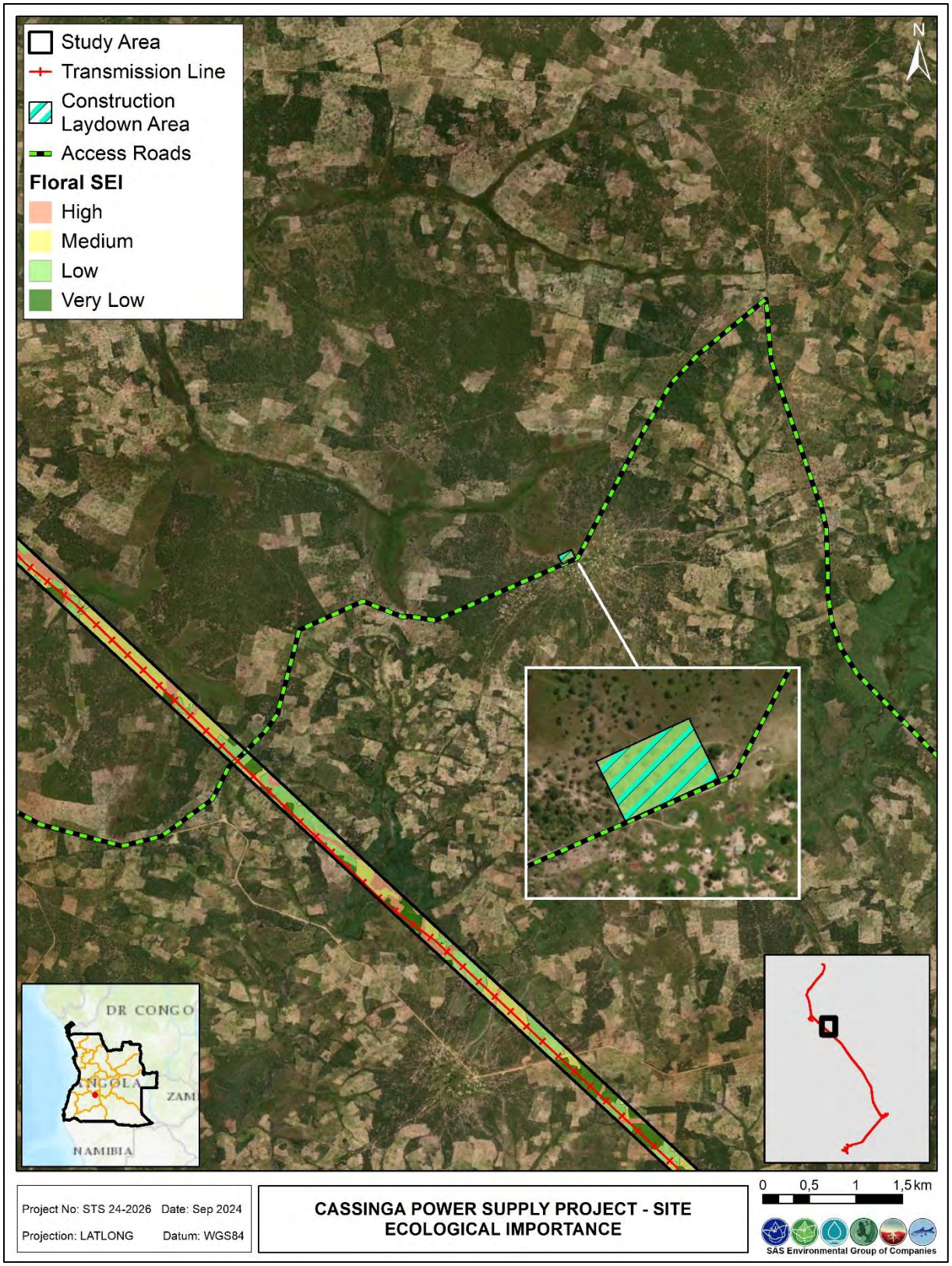


Figure 24: Sensitivity map pertaining to the floral assessment of the study area (Map 6 of 16).

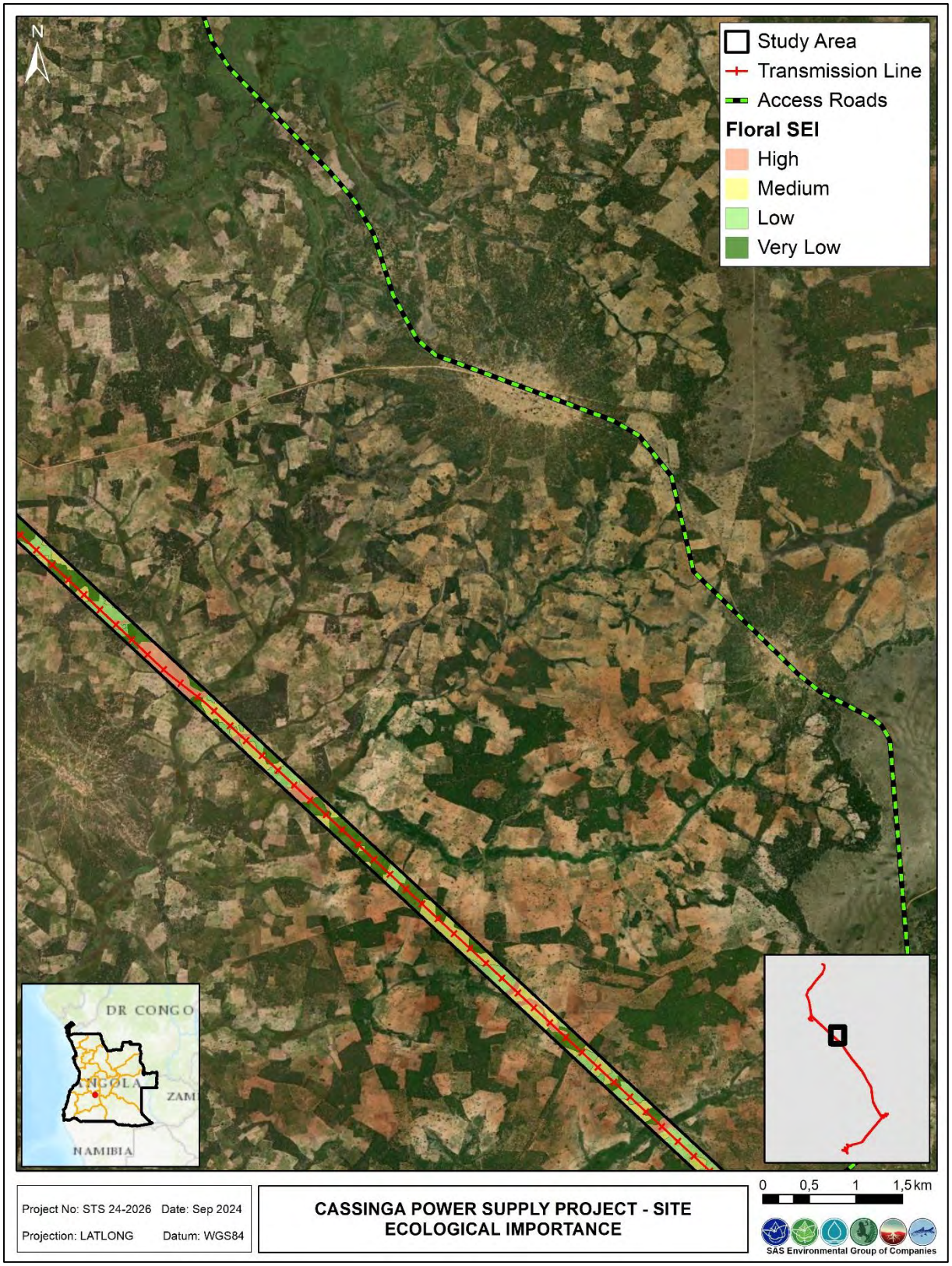


Figure 25: Sensitivity map pertaining to the floral assessment of the study area (Map 7 of 16).

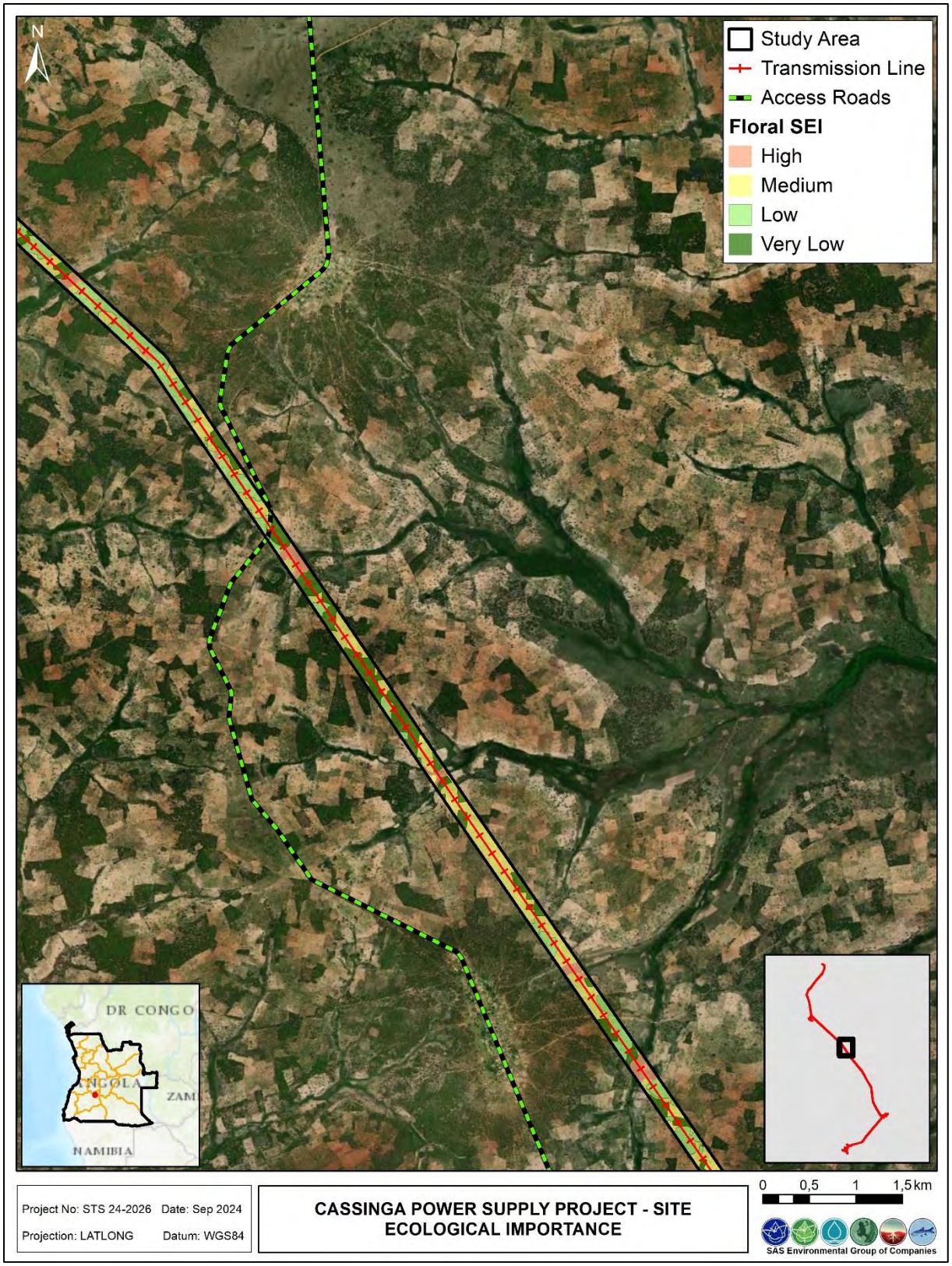


Figure 26: Sensitivity map pertaining to the floral assessment of the study area (Map 8 of 16).

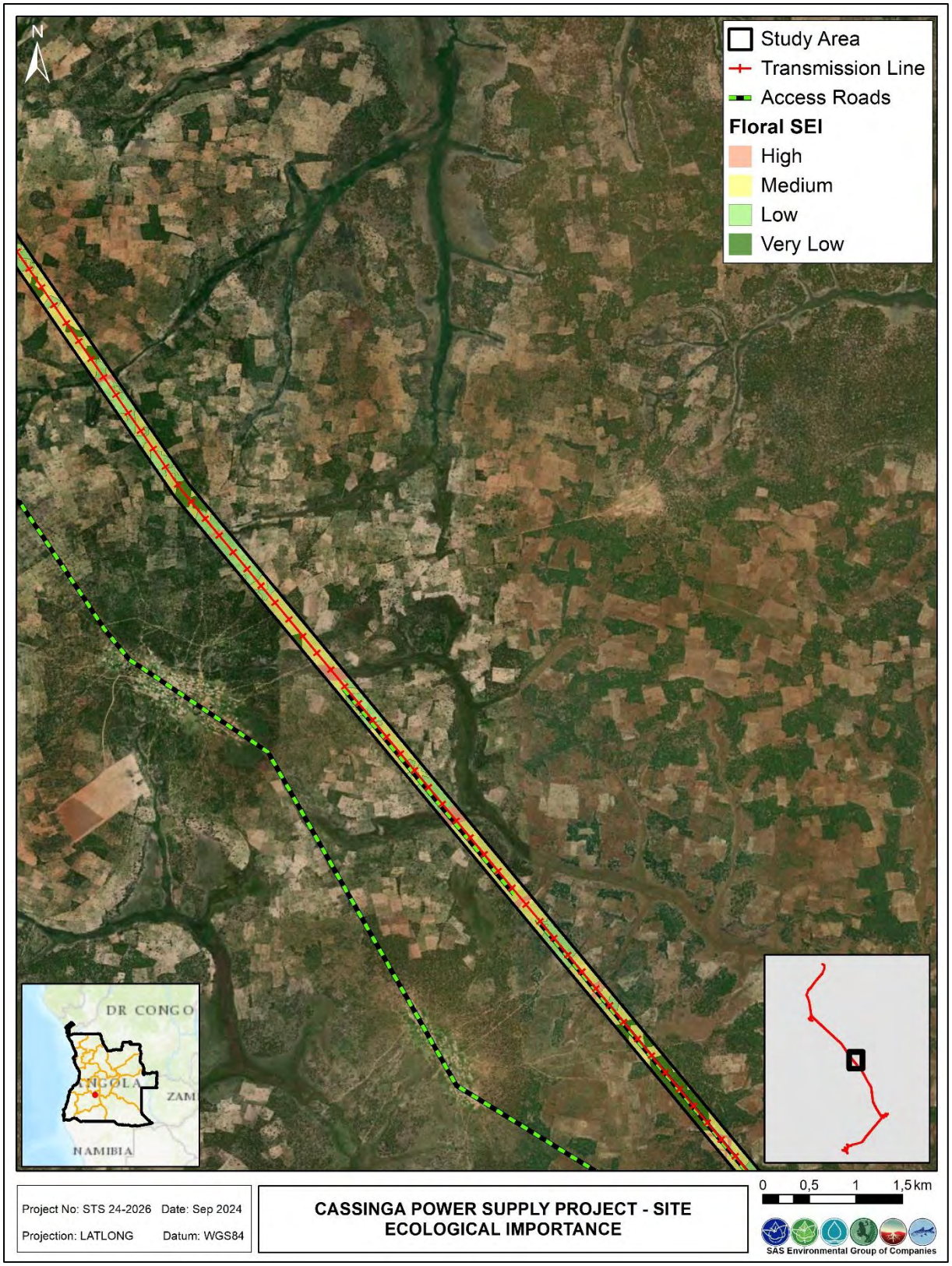


Figure 27: Sensitivity map pertaining to the floral assessment of the study area (Map 9 of 16).

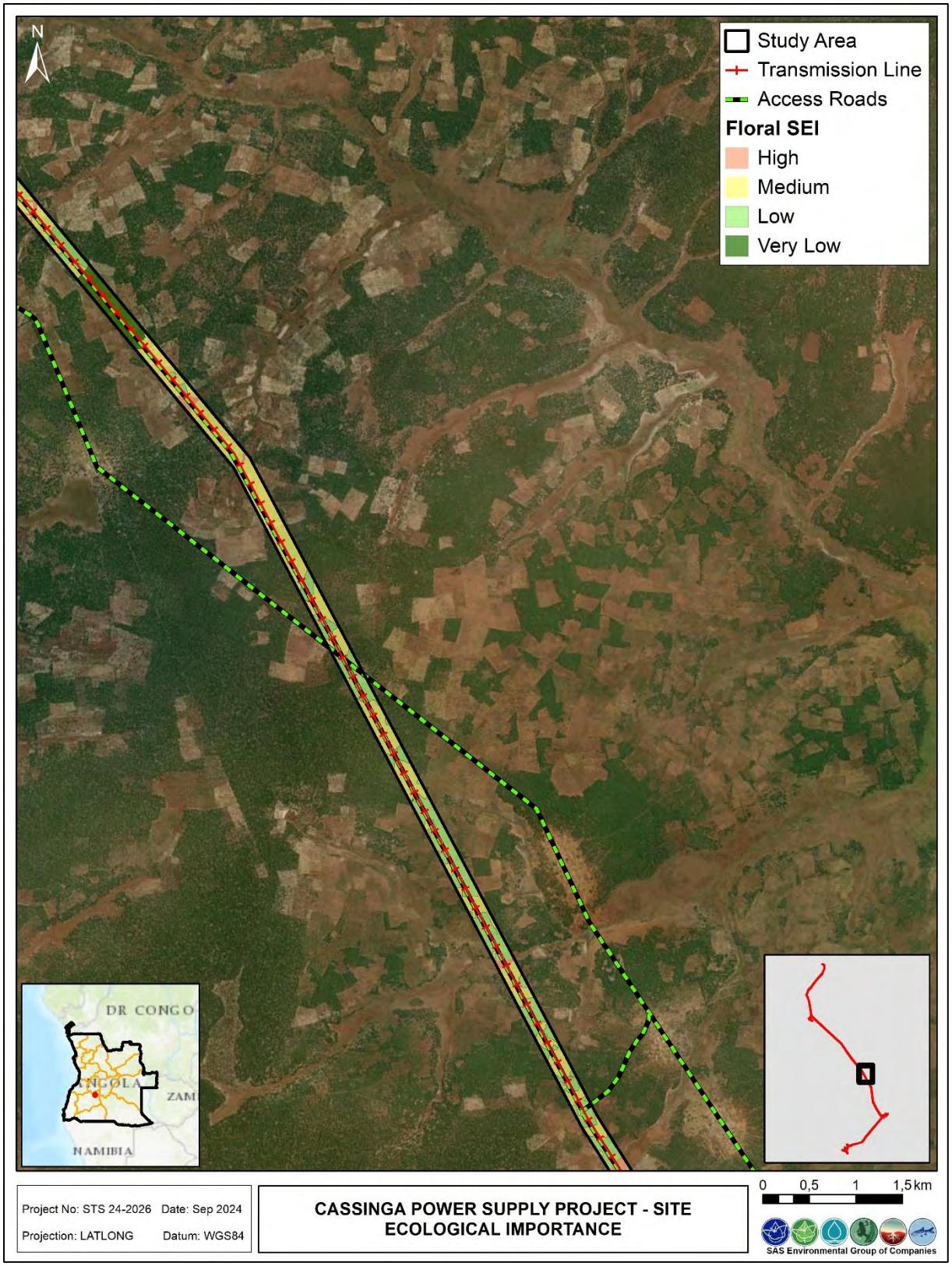


Figure 28: Sensitivity map pertaining to the floral assessment of the study area (Map 10 of 16).

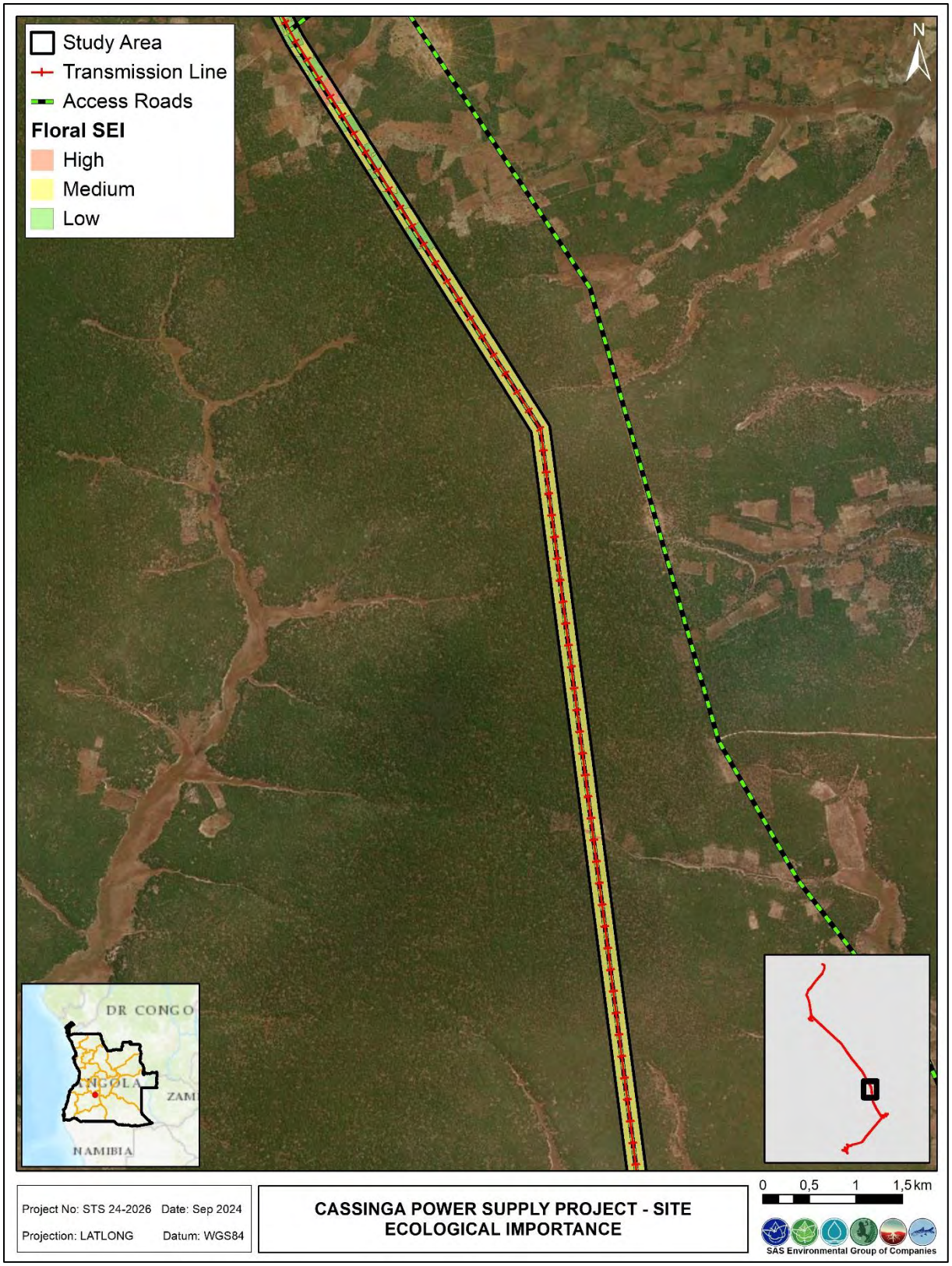


Figure 29: Sensitivity map pertaining to the floral assessment of the study area (Map 11 of 16).

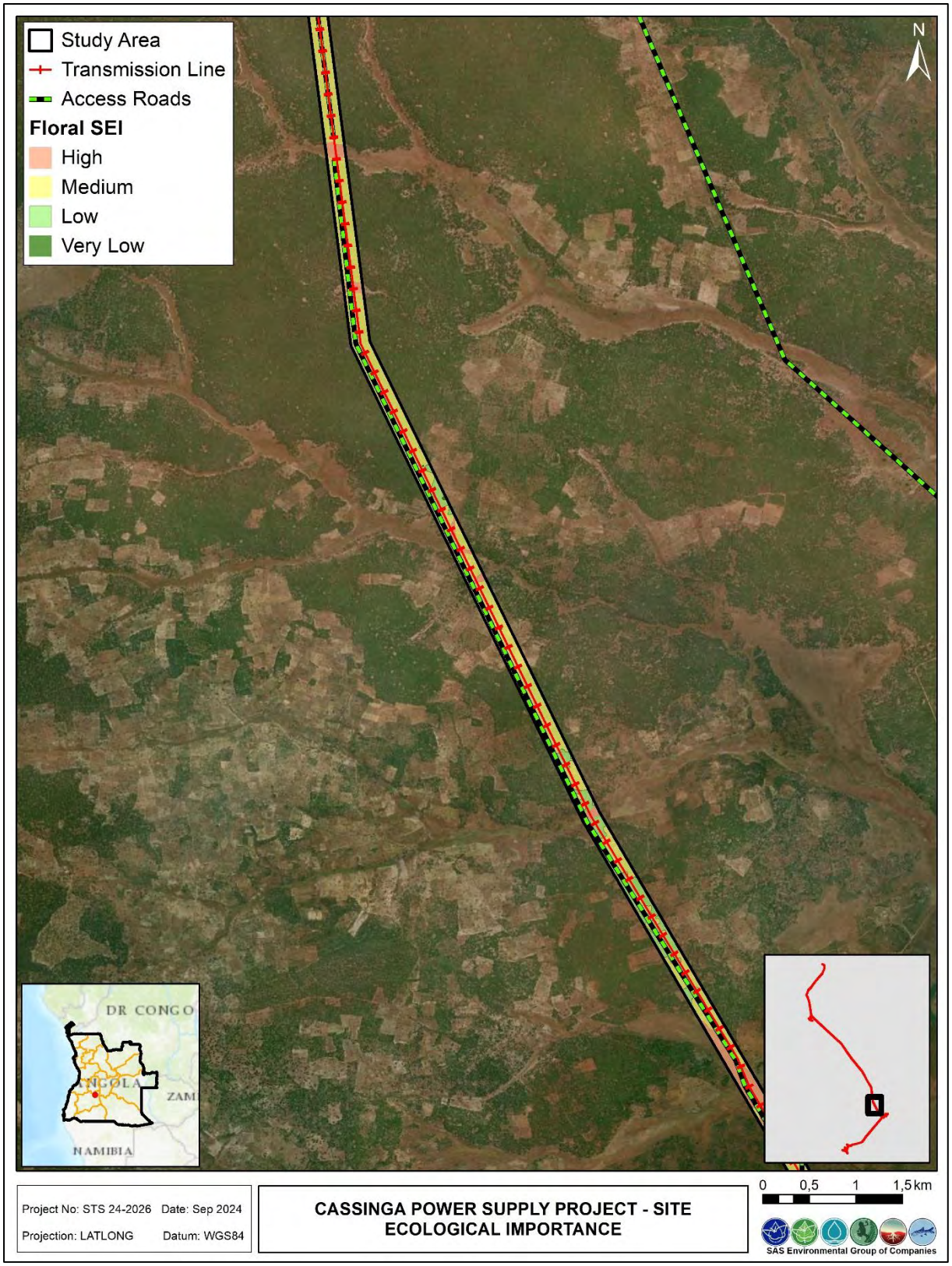


Figure 30: Sensitivity map pertaining to the floral assessment of the study area (Map 12 of 16).

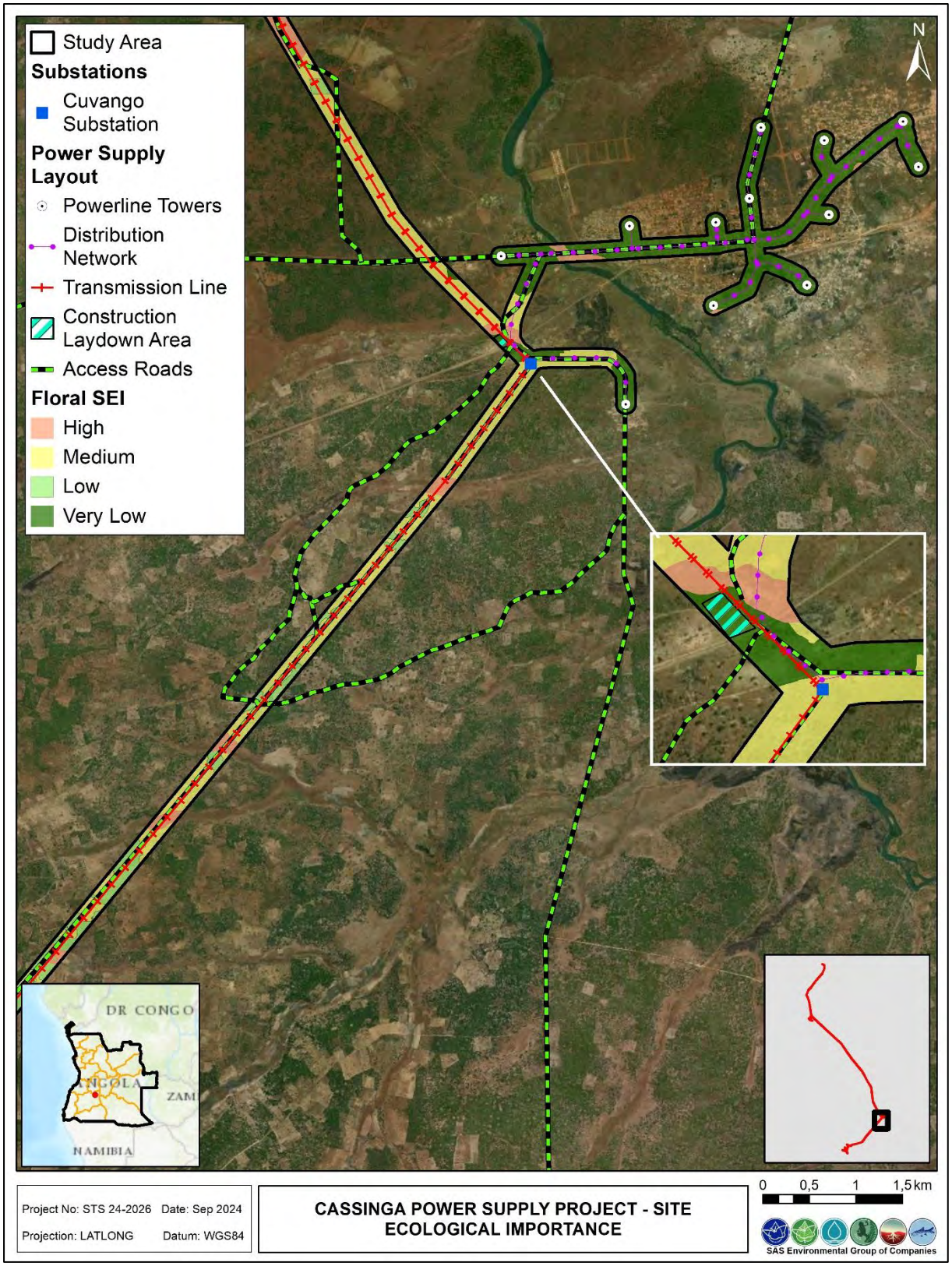


Figure 31: Sensitivity map pertaining to the floral assessment of the study area (Map 13 of 16).

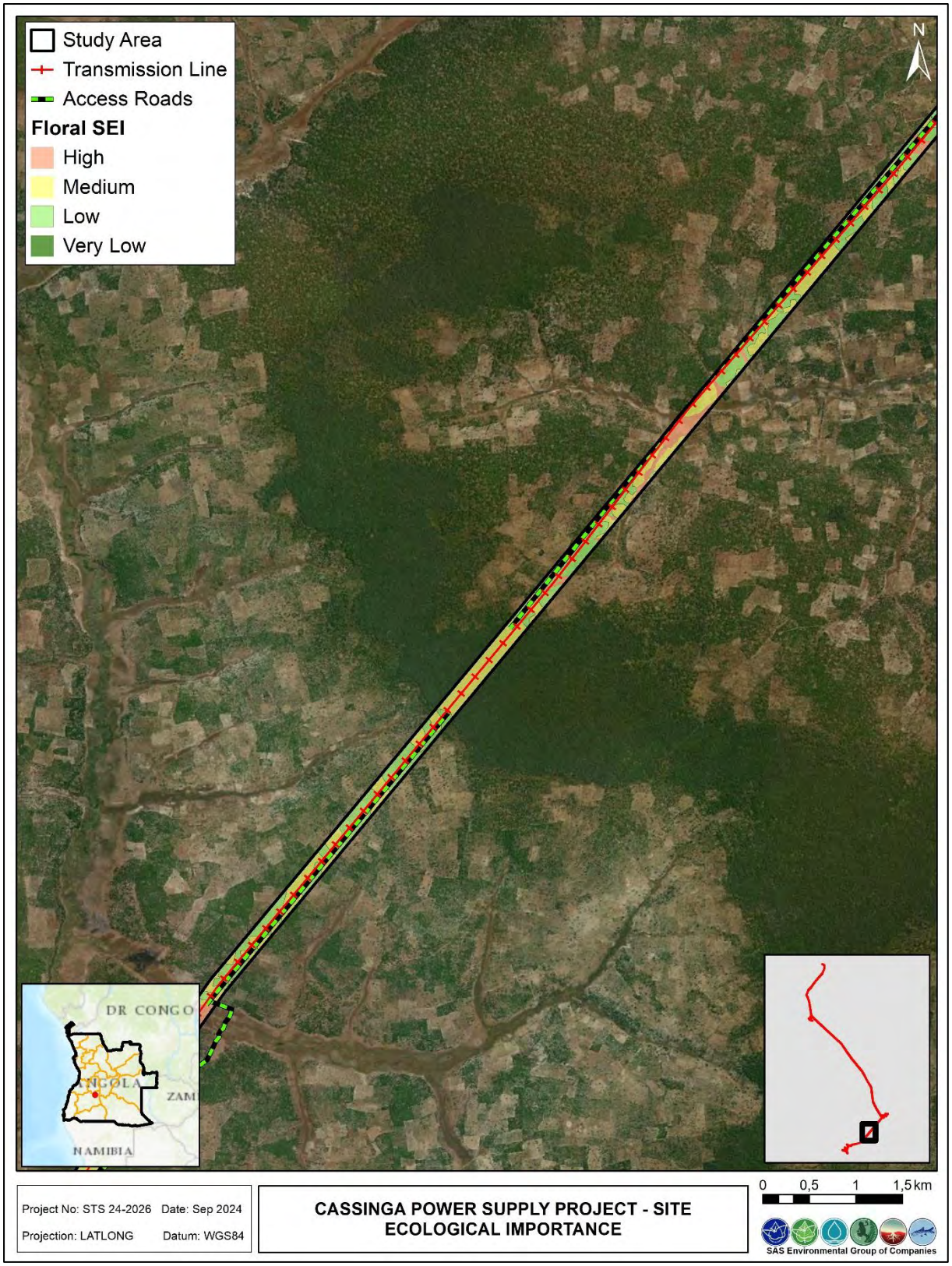


Figure 32: Sensitivity map pertaining to the floral assessment of the study area (Map 14 of 16).

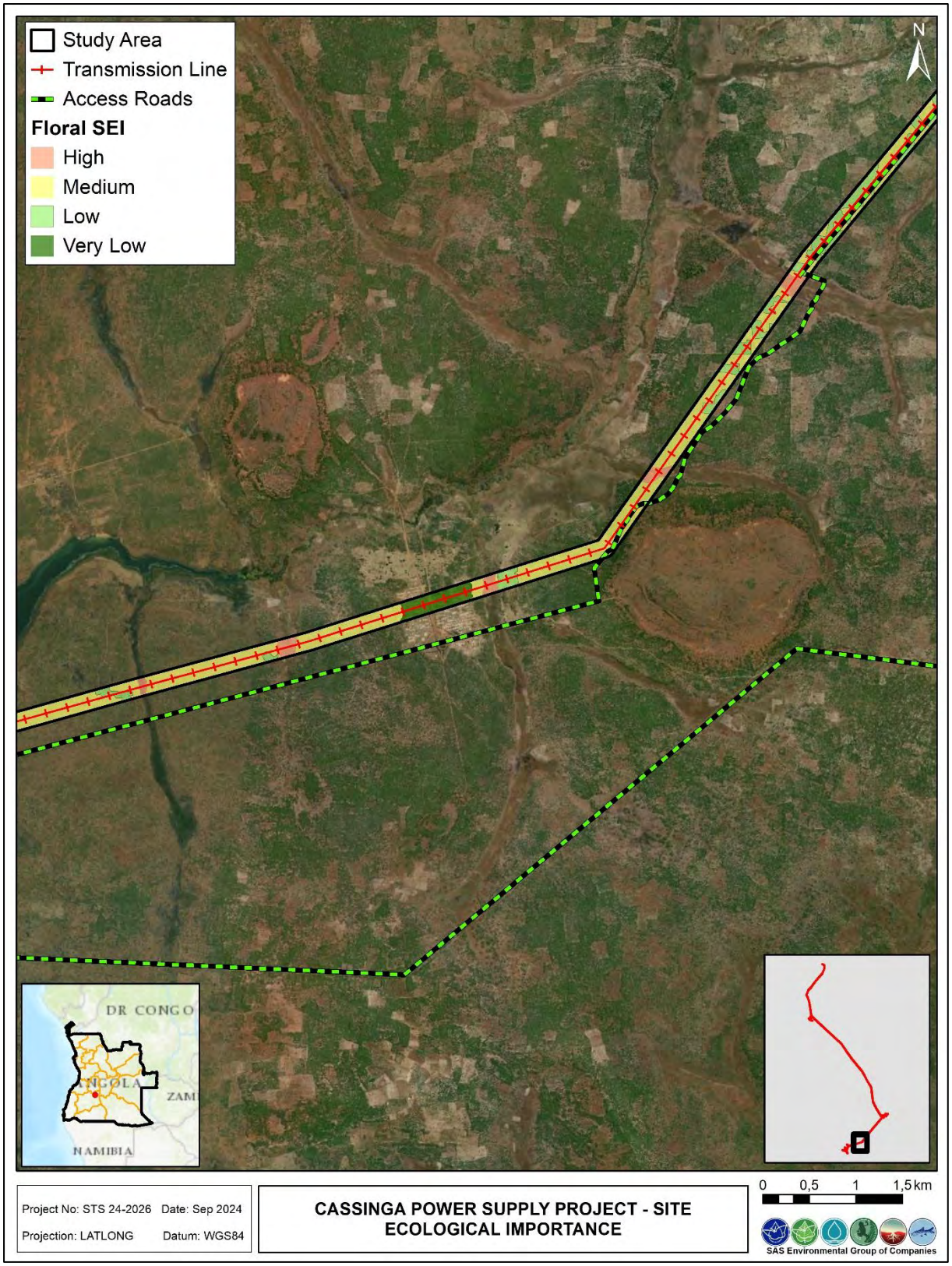


Figure 33: Sensitivity map pertaining to the floral assessment of the study area (Map 15 of 16).

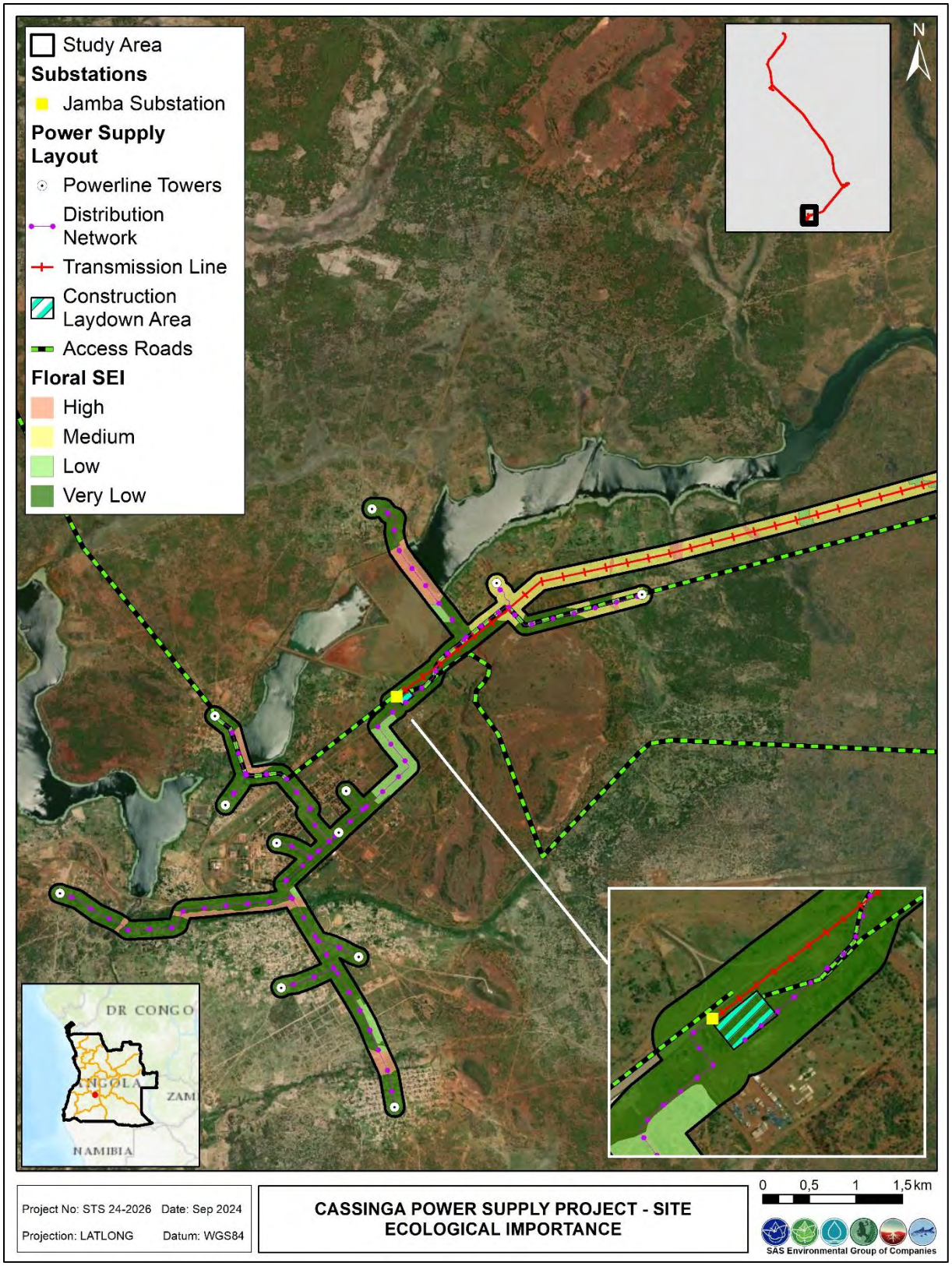


Figure 34: Sensitivity map pertaining to the floral assessment of the study area (Map 16 of 16).

7 IMPACT ASSESSMENT AND PROPOSED MANAGEMENT MEASURES

The significance of perceived impacts on the floral ecology of the Cassinga Electrical Power Supply Project, according to the method described in Appendix B, as provided by the proponent is presented in Section 7.2 (Table 8 to 24) on top of each table.

An impact discussion and assessment of all potential (1) Pre-construction & Planning, (2) Construction, (3) Operational and Maintenance, and (4) Decommissioning Phase impacts are provided in Section 7.2 (Table 8 to 24). All mitigatory measures required to minimise the perceived impacts are presented in Section 7.2 (Table 8 to 24) at the bottom of each table.

Impacts to each of the habitat units were assessed independently for each phase of the project. Where activities are perceived to have similar impacts to the receiving environment (or will be impacting in the same area), these were grouped and assessed together.

7.1 Identification of Potential Impacts

The below table presents the perceived potential impacts that will impact on floral habitat, species diversity and SCC as a result of the pre-construction, construction, and operation and maintenance phases of the proposed Cassinga Electrical Power Supply Project.

Table 8: Summary of the potential impacts to floral habitat and species associated with the project.

Potential Impacts	Description of Impacts
Pre-Construction Phase	
Loss of floral habitat and species diversity	➢ Planning of infrastructure placement and design, leading to the loss of floral habitat of varying SEI categories (i.e., very low to high scoring habitats), as well as unnecessary edge effect impacts on areas outside of the proposed development footprint due to overriding economic and socio-cultural reasons; ➢ Potential failure to develop appropriate rehabilitation and erosion control plans before the commencement of construction activities; and ➢ Potential increase in fragmentation of habitats due to pore planning.
Loss of potential floral SCC	➢ Potential loss of floral SCC habitat due to inconsiderate planning; and ➢ Potential failure to implement stormwater management activities before the commencement of construction activities
Construction Phase	
Loss of floral habitat and species diversity	➢ Site clearing and the removal of indigenous vegetation leading to a loss of floral diversity and species composition; ➢ Proliferation of AIP species that colonise 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 - allowing the establishment and spread of AIPs;

Potential Impacts	Description of Impacts
	➢ Risk of contamination from construction vehicle spills which may pollute receiving environment; ➢ Potentially poorly managed edge effects: o Potential ineffective rehabilitation of compacted areas, bare soils, or eroded areas outside of the development of the approved footprint leading to ongoing proliferation of AIP species in disturbed areas and subsequent spread to surrounding natural areas altering the floral habitat; and o Compaction of soils outside of the study area due to indiscriminate driving of construction vehicles through natural vegetation; and ➢ Possible increased fire frequency during construction.
Loss of potential floral SCC	➢ Site clearing and the removal of floral SCC; ➢ Potential failure to conduct a walkdown of the approved footprint area before construction activities for floral SCC to be mark for rescue and relocation to suitable habitat outside the development footprint within the study area; ➢ Potential failure to relocate marked SCC to suitable habitat either within the study area or to suitable habitat outside of 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 - allowing the establishment and spread of AIPs and subsequent loss of SCC habitat.
Habitat fragmentation	➢ Clearing vegetation for the proposed Cassinga Electrical Power Supply Project and its associated infrastructure 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.
Operational and Maintenance Phase	
Loss of floral habitat and species diversity	➢ 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: o 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 ➢ On-going disturbance during operational phase may lead to erosion and sedimentation of surrounding floral habitat.
Loss of potential floral SCC	➢ 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; ➢ Potentially poorly managed edge effects: o 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

Potential Impacts	Description of Impacts
	risk of fire frequency impacting on floral SCC outside of the development footprint.
Decommissioning Phase	
Loss of floral habitat and species diversity	➢ Possible increased fire frequency during the decommissioning phase; ➢ Potentially poorly managed edge effects: o Potential ineffective rehabilitation of compacted areas, bare soils, or eroded areas outside of the rehabilitation 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; o Compaction of soils outside of the study area due to indiscriminate driving of decommissioning and rehabilitation vehicles through natural vegetation; ➢ Risk of contamination from decommissioning and rehabilitation vehicle spills which may contaminate the receiving environment; ➢ Increased human presence in the area during the decommissioning phase, potentially leading to Illegal harvesting/ collection of medicinal plants or an increased risk of fire frequency impacting floral communities outside of the development footprint; ➢ On-going disturbance during the decommissioning phase (demolition activities) may lead to erosion and sedimentation of surrounding floral habitat; and ➢ Potential failure to monitor rehabilitation efforts and apply appropriate adaptive management.
Loss of potential floral SCC	➢ Increased introduction and proliferation of AIPs due to a lack of rehabilitation activities, or poorly implemented AIP Management programme, leading to habitat loss for floral SCC; ➢ Potentially poorly managed edge effects: o 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 during the decommissioning phase, 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.
Consideration of Cumulative Impacts	
Altered species diversity and occurrences	The vegetation clearance proposed for the Cassinga Electrical Power Supply Project will compound ongoing clearance efforts for subsistence agriculture in the area. The construction of new access roads could accelerate the conversion of indigenous vegetation to agricultural fields due to improved accessibility. This fragmentation can disrupt habitat connectivity crucial for floral species, resulting in reduced genetic diversity and isolated populations.
Habitat fragmentation	The fragmentation of habitats caused by activities such as vegetation clearance and the construction of new access roads can disrupt the connectivity of habitats important for the survival of floral species. As a consequence, this disruption can lead to a reduction in the genetic diversity of floral populations and the isolation of these populations from one another. Consequently, isolated populations may face challenges such as reduced gene flow, and increased vulnerability to environmental disturbances, which can ultimately threaten their long-term viability and survival.

7.2 Floral Impact Assessment Tables

The below section provides the findings of the impact assessment undertaken with reference to the perceived impacts prior to the implementation of mitigation measures and following the implementation of mitigation measures. The mitigated results of the impact assessment have been calculated on the premise that all mitigation measures as stipulated in this report are adhered to and implemented. Should such actions not be adhered to, it is highly likely that post-mitigation impact scores will increase.

Table 9: Impact Assessment considering the impacts and mitigation surrounding the floral habitat and diversity during the Pre-construction and Planning phase of the Cassinga Electrical Power Supply Project development and proposed infrastructure of new substations.

ACTIVITY 1: Site preparation prior to commencement of construction with focus on floral habitat and diversity.									
Impact Summary: ➢ Loss of favourable floral habitat beyond the authorised footprint, leading to a decline in floral diversity; ➢ Loss of sensitive habitat and /or fragmentation of vegetation communities; ➢ Increased risk of erosion and loss of topsoil; ➢ Potential increase in fragmentation of vegetation communities and disruption of natural dispersal processes; and ➢ Potential increase in fragmentation of ecological corridors and diminished ecological functionality.									
Habitat unit	**Management**	***Magnitude***	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Transformed	Before	Minor (-)	Medium term	Local	Medium	Definite	**Low**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Freshwater	Before	Major (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Secondary Miombo	Before	Moderate (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Miombo Woodland	Before	Major (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Essential management measures: ➢ At all times, ensure that sound environmental management is in place during the planning phase; ➢ The design plans should take cognisance of sensitive habitats described during the ESIA phase; ➢ Development should be prioritised in habitats of decreased sensitivity; ➢ Access roads should be kept to existing roads were possible so to reduce further fragmentation of existing natural habitat; ➢ 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; and ➢ A stormwater management plan should be developed to ensure sound stormwater design and management planning.									

Table 10: Impact Assessment considering the impacts and mitigation surrounding the floral SCC during the Pre-construction and Planning phase of the Cassinga Electrical Power Supply Project development and proposed infrastructure of new substations.

ACTIVITY 2: Site preparation prior to commencement of construction with focus on floral SCC.									
Impact Summary: ➢ Potential loss of habitat for SCC through inconsiderate planning of layout placement; and ➢ Potential unmitigated loss of floral SCC (rescue and relocation should take place during the planning phase prior to vegetation clearing).									
Habitat unit	**Management**	***Magnitude***	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Transformed	Before	Minor (-)	Medium term	Local	Medium	Definite	**Low**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Freshwater	Before	Minor (-)	Medium term	Local	Low	Possible	**Low**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Secondary Miombo	Before	Moderate (-)	Medium term	Local	Medium	Possible	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Miombo Woodland	Before	Major (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Essential management measures:									
➢ Impact must be limited to the footprint area and kept to what is essential only; ➢ A walkdown of the footprint area must take place before construction activities commence, where all anticipated floral SCC species are searched for and marked to determine the number of individuals that will be impacted; ➢ 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. This process must include collecting data regarding the condition of any relocated species (along with photographic evidence), and monitoring of relocated species must continue through all phase of the Cassinga Electrical Power Supply Project development; ➢ No unauthorised collection of floral SCC must be allowed; ➢ Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC outside of the proposed disturbance footprint area; and ➢ In the planning phase, the placement of the pylons should be adjusted as needed to minimise any potential impact on floral SCCs.									

Table 11: Impact Assessment considering the impacts and mitigation surrounding the floral habitat and diversity during the Construction phase of the Cassinga Electrical Power Supply Project development and proposed infrastructure of new substations.

ACTIVITY 3: Vegetation clearing activities for the construction of the proposed Cassinga Electrical Power Supply Project development and proposed infrastructure of new substations and OHPL with focus on impacts to floral habitat and diversity.									
Impact Summary: ➢ Loss of indigenous vegetation through vegetation clearing (specifically within the Miombo Woodland Habitat and Freshwater Habitat; ➢ Loss of floral habitat and diversity with associated decline of species diversity within the impacted areas); ➢ Loss of topsoil and seedbanks; ➢ Soil-compaction, erosion, and AIP proliferation within disturbed areas; and ➢ Loss of floral habitat beyond the project footprint due to potential footprint creep as a result of increased erosion or potential dumping of construction material within areas where no construction is planned.									
Habitat unit	**Management**	***Magnitude***	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Transformed	Before	Minor (-)	Medium term	Local	Low	Possible	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Definite	**Low**	–	Medium
Freshwater	Before	Moderate (-)	Long term	Local	High	Possible	**Medium**	–	High
	After	Moderate (-)	Long term	Site	Medium	Possible	**Low**	–	Medium
Secondary Miombo	Before	Minor (-)	Long term	Local	Medium	Definite	**Medium**	–	High
	After	Minor (-)	Long term	Site	Medium	Definite	**Low**	–	Medium
Miombo Woodland	Before	Moderate (-)	Long term	Local	High	Possible	**High**	–	High
	After	Minor (-)	Long term	Site	Medium	Possible	**Low**	–	Medium
Essential management measures: ➢ 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; ➢ The construction footprint must be kept as small as possible to minimise the impact on the surrounding environment (edge effect management); ➢ During the construction phase, it is advised that traditional healers 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; ➢ Construction footprint areas should be clearly demarcated to monitor footprint extent and avoid footprint creep; ➢ Removal of vegetation must be restricted to what is necessary and should remain within the approved development footprint; ➢ 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; ➢ Access roads should be kept to existing roads as far as is feasible so 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 construction activities. Additional road construction should be limited to what is absolutely necessary, and the footprint thereof kept to a minimal; ➢ 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; ➢ Care should be taken during the construction of the proposed development to limit edge effects to surrounding natural habitat. 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;

- 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. Adequate Personal Protective Equipment (PPE) must be supplied to the personnel involved with AIP control;
- Bi-annual monitoring of the Affected Area of Influence (AoL) should be done to determine the presence of AIP and the success of control in affected area;
- Equipment used for AIP control must be cleaned in designated areas to prevent possible contamination of herbicide used in area not to be treated for AIP proliferation;
- 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;
- Any on-site fires by construction personnel must be restricted to designated areas only, and no uncontrolled fires whatsoever must be allowed;
- 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;
- 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; and
- 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;
- Maintain vegetation corridors along the OHL servitudes and substations. 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; and
- Any additional mitigation measures provided in the freshwater report; SAS 24-2026 (2024) must also be implemented.

Table 12: Impact Assessment considering the impacts and mitigation surrounding the floral habitat and diversity during the Construction phase of the proposed construction of camp sites / laydown areas for the Cassinga Electrical Power Supply Project development.

ACTIVITY 4: Vegetation clearing activities for the construction of camp sites / laydown areas for the proposed Cassinga Electrical Power Supply Project development with focus on impacts to floral habitat and diversity.

Impact Summary:

- Loss of indigenous vegetation through vegetation clearing (specifically within the Secondary Miombo Woodland Habitat and Transformed Habitat).
- Loss of localised floral habitat and diversity with associated decline of species diversity within the impacted areas;
- Loss of topsoil and seedbanks;
- Soil-compaction, erosion, and AIP proliferation within disturbed areas; and
- Loss of floral habitat beyond the project footprint due to potential footprint creep as a result of increased erosion or potential dumping of construction material within areas where no construction is planned.

Habitat unit	Management	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Transformed	Before	Minor (-)	Medium term	Local	Low	Possible	**Low**	–	High
	After	Minor (-)	Medium term	Site	Low	Possible	**Low**	–	High
Secondary Miombo	Before	Moderate (-)	Medium term	Local	Medium	Definite	**Medium**	–	High
	After	Moderate (-)	Medium term	Site	Low	Definite	**Medium**	–	Medium

Essential management measures:

- 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;
- The construction footprint must be kept as small as possible to minimise the impact on the surrounding environment (edge effect management);
- During the construction phase, it is advised that traditional healers 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;
- Construction footprint areas should be clearly demarcated to monitor footprint extent and avoid footprint creep;
- Removal of vegetation must be restricted to what is necessary and should remain within the approved development footprint;
- Clearing of vegetation should take place in a phased manner if feasible to keep bare soil areas as small as possible to limit the erosion potential;
- Access roads should be kept to existing roads as far as is feasible so 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 construction activities. Additional road construction should be limited to what is absolutely necessary, and the footprint thereof kept to a minimal;
- 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. Additionally, construction vehicles should not drive indiscriminately through any of the surrounding natural habitats;
- Care should be taken during the construction of the proposed development to limit edge effects to surrounding natural habitat. 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;
- 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. Adequate PPE must be supplied to the personnel involved with AIP control;

- Bi-annual monitoring of the study area should be done to determine the presence of AIP and the success of control in affected area;
- Equipment used for AIP control must be cleaned in designated areas to prevent possible contamination of herbicide used in area not to be treated for AIP proliferation;
- Minimise the impact of floral habitat fragmentation and interference with habitat connectivity in freshwater habitats (including temporary crossings/roads), it is crucial to implement mitigation measures such as preserving and restoring riparian vegetation, and ensuring that construction practices avoid disturbing important plant habitats;
- Any on-site fires by construction personnel must be restricted to designated areas only, and no uncontrolled fires whatsoever must be allowed;
- 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;
- 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; and
- 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;
- 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; and
- Any additional mitigation measures provided in the freshwater report; SAS 24-2026 (2024) must also be implemented.

Table 13: Impact Assessment considering the impacts and mitigation surrounding the floral habitat and diversity during the Construction phase of the construction of the proposed access roads for the Cassinga Electrical Power Supply Project development.

ACTIVITY 5: Vegetation clearing activities for the construction of the proposed access roads for the Cassinga Electrical Power Supply Project development with focus on impacts to floral habitat and diversity.									
Impact Summary: ➢ Altered runoff patterns within the local catchment of the freshwater systems, potentially leading to increased erosion and sedimentation of the freshwater systems; ➢ Potential temporary in-channel diversion of the freshwater crossing may be required to allow excavations for the road crossing to take place. ➢ Soil-compaction, erosion, and AIP proliferation within disturbed areas; and ➢ Loss of floral habitat beyond the project footprint due to potential footprint creep as a result of increased erosion or potential dumping of construction material within areas where no construction is planned.									
Habitat unit	**Management**	***Magnitude***	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Transformed	Before	Minor (-)	Medium term	Local	Low	Possible	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Definite	**Low**	–	Medium
Freshwater	Before	Moderate (-)	Long term	Local	High	Possible	**Medium**	–	High
	After	Moderate (-)	Long term	Site	Medium	Possible	**Low**	–	Medium
Essential management measures:									
➢ 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; ➢ The construction footprint must be kept as small as possible to minimise the impact on the surrounding environment (edge effect management); ➢ During the construction phase, it is advised that traditional healers be consulted to ensure the preservation of important/medicinal plants, as they hold valuable knowledge on the sustainable use and cultural significance of these species; ➢ Construction footprint areas should be clearly demarcated to monitor footprint extent and avoid footprint creep; ➢ Removal of vegetation must be restricted to what is necessary and should remain within the approved development footprint; ➢ Clearing of vegetation for the proposed road in the southern section of the study area should take place in a phased manner if feasible as to keep bare soil areas as small as possible to limit the erosion potential; ➢ 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; ➢ 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. Additionally, construction vehicles should not drive indiscriminately through any of the surrounding natural habitats; ➢ Care should be taken during the construction of the proposed development to limit edge effects to surrounding natural habitat. 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; ➢ 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. Adequate PPE must be supplied to the personnel involved with AIP control; ➢ Bi-annual monitoring of the study area should be done to determine the presence of AIP and the success of control in affected area; ➢ Equipment used for AIP control must be cleaned in designated areas to prevent possible contamination of herbicide used in area not to be treated for AIP proliferation;									

- Minimise the impact of floral habitat fragmentation and interference with habitat connectivity in freshwater habitats (including temporary crossings/roads), it is crucial to implement mitigation measures such as preserving and restoring riparian vegetation, and ensuring that construction practices avoid disturbing important plant habitats;
- Any on-site fires by construction personnel must be restricted to designated areas only, and no uncontrolled fires whatsoever must be allowed;
- 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;
- 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; and
- 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
- Any additional mitigation measures provided in the freshwater report; SAS 24-2026 (2024) must also be implemented.

Table 14: Impact Assessment considering the impacts and mitigation surrounding the floral SCC during the Construction phase of the Cassinga Electrical Power Supply Project development and proposed infrastructure of new substations.

ACTIVITY 6: Vegetation clearing activities for the construction of the proposed Cassinga Electrical Power Supply Project development and proposed infrastructure of new OHPL and substations with focus on floral SCC.									
Impact Summary: ➢ Loss of habitat for SCC through site clearing; ➢ Potential loss of floral SCC missed during site walkdowns; and ➢ Potential loss of floral SCC due to unsuccessful relocation attempts.									
Habitat unit	**Management**	***Magnitude***	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Transformed	Before	Minor (-)	Short term	Local	Low	Unlikely	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Freshwater	Before	Moderate (-)	Short term	Local	Low	Unlikely	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Secondary Miombo	Before	Moderate (-)	Short term	Local	Low	Unlikely	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Miombo Woodland	Before	Major (-)	Medium term	Local	Medium	Definite	**Medium**	–	High
	After	Moderate (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Essential management measures:									
➢ During the construction phase, it is advised that traditional healers be consulted on the removal of important/ plants to ensure the preservation of important/medicinal plants, as they hold valuable knowledge on the sustainable use and cultural significance of these species; ➢ Monitor, where applicable, the success or failures of relocated floral SCC; ➢ 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; ➢ Impact must be limited to the footprint area and kept to what is essential only; ➢ Demarcate and monitor the floral SCC populations outside of the footprint areas to ensure construction activities do not infringe onto these species; and ➢ No collection or harvesting of floral SCC or floral species as listed within Section 4.5 of this report should be allowed by construction personnel.									

Table 15: Impact Assessment considering the impacts and mitigation surrounding the floral SCC during the Construction phase for the construction of the proposed camp sites / laydown areas of the Cassinga Electrical Power Supply Project development.

ACTIVITY 7: Vegetation clearing activities for the construction of camp sites / laydown areas for the proposed Cassinga Electrical Power Supply Project development with focus on floral SCC.									
Impact Summary: ➢ Potential loss of floral SCC missed during site walkdowns; and ➢ Potential loss of floral SCC due to unsuccessful relocation attempts.									
Habitat unit	**Management**	***Magnitude***	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Transformed	Before	Minor (-)	Short term	Local	Low	Unlikely	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Secondary Miombo	Before	Major (-)	Medium term	Local	Medium	Definite	**Medium**	–	High
	After	Moderate (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Essential management measures:									
➢ During the construction phase, it is advised that traditional healers 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; ➢ Monitor, where applicable, the success or failures of relocated floral SCC; ➢ 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; ➢ Impact must be limited to the footprint area and kept to what is essential only; ➢ Demarcate and monitor the floral SCC populations outside of the footprint areas to ensure construction activities do not infringe onto these species; and ➢ No collection or harvesting of floral SCC or floral species as listed within Section 4.5 of this report should be allowed by construction personnel.									

Table 16: Impact Assessment considering the impacts and mitigation surrounding the floral SCC during the Construction phase for the construction of the proposed access roads of the Cassinga Electrical Power Supply Project development.

ACTIVITY 8: Vegetation clearing activities for the construction of access roads for the proposed Cassinga Electrical Power Supply Project development with focus on floral SCC.									
Impact Summary: ➢ Potential loss of floral SCC missed during site walkdowns; and ➢ Potential loss of floral SCC due to unsuccessful relocation attempts.									
Habitat unit	**Management**	***Magnitude***	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Transformed	Before	Minor (-)	Short term	Local	Low	Unlikely	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Freshwater	Before	Moderate (-)	Short term	Local	Low	Unlikely	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Essential management measures:									
➢ During the construction phase, it is advised that traditional healers 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; ➢ Monitor, where applicable, the success or failures of relocated floral SCC; ➢ 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; ➢ Impact must be limited to the footprint area and kept to what is essential only; ➢ Demarcate and monitor the floral SCC populations outside of the footprint areas to ensure construction activities do not infringe onto these species; and ➢ No collection or harvesting of floral SCC or floral species as listed within Section 4.5 of this report should be allowed by construction personnel.									

Table 17: Impact Assessment considering the impacts and mitigation surrounding the floral habitat and diversity during the Operational and Maintenance Phase of the Cassinga Electrical Power Supply Project development and proposed infrastructure of new substations.

ACTIVITY 9: Operation and maintenance activities of the proposed Cassinga Electrical Power Supply Project development and proposed infrastructure of new OHPL and substations with focus on floral habitat and diversity.

Impact Summary:

- Altered drainage patterns due to reduced vegetation cover and increased impermeable surfaces;
- Potential loss of floral habitat beyond the project footprint;
- Potential loss of floral habitat and species diversity;
- Loss of dispersal trajectories, reduction to ecological integrity of the area, compromised ecological functions on a local scale due to dispersal corridors altered / impaired due to long-term fragmentation of the remaining natural habitat in the study area and surrounds;
- Potential loss of productive topsoil; and
- Potential increased erosion risk and/or further exacerbating the proliferation of AIPs.

Habitat unit	Management	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Transformed	Before	Minor (-)	Medium term	Local	Low	Possible	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Freshwater	Before	Major (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Secondary Miombo	Before	Moderate (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Miombo Woodland	Before	Major (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Local	Low	Possible	**Low**	–	Medium

Essential management measures:

- Disturbed areas are to be rehabilitated to a similar state as that of pre-disturbance conditions. 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 Cassinga Electrical Power Supply Project development and proposed infrastructure so as to ensure that no erosion occurs;
- All areas of increased ecological sensitivity beyond the approved footprint must be designated as No-Go areas and be off-limits to all operational and maintenance vehicles and personnel;
- No additional habitat is to be disturbed during the operational and maintenance phase of the project outside of the demarcated approved footprints;
- Monitor the Miombo Woodland and Freshwater Habitat within the study area to ensure that floral communities are not degraded;
- Ongoing erosion and stormwater monitoring and control to be implemented throughout the operational and maintenance phase;
- 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;
- 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;
- Monitor the success of rehabilitation efforts of disturbed areas seasonally;
- 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 operational phases.

Table 18: Impact Assessment considering the impacts and mitigation surrounding the floral habitat and diversity during the Operational and Maintenance Phase of the proposed access roads for the of the Cassinga Electrical Power Supply Project.

ACTIVITY 10: Operation and maintenance activities of the proposed access roads for the Cassinga Electrical Power Supply Project development and proposed infrastructure of construction site/ laydown areas with focus on floral habitat and diversity.

Impact Summary:

- Altered drainage patterns due to reduced vegetation cover and increased impermeable surfaces;
- Potential loss of floral habitat beyond the project footprint;
- Potential loss of floral habitat and species diversity;
- Loss of dispersal trajectories, reduction to ecological integrity of the area, compromised ecological functions on a local scale due to dispersal corridors altered / impaired due to long-term fragmentation of the remaining natural habitat in the study area and surrounds;
- Potential loss of productive topsoil; and
- Potential increased erosion risk and/or further exacerbating the proliferation of AIPs.

Habitat unit	Management	*Magnitude*	*Duration*	*Scale*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Transformed (access roads)	Before	Minor (-)	Medium term	Local	Low	Possible	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Freshwater	Before	Major (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium

Essential management measures:

- Disturbed areas are to be rehabilitated to a similar state as that of pre-disturbance conditions. 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 Cassinga Electrical Power Supply Project development and proposed infrastructure so as to ensure that no erosion occurs;
- All areas of increased ecological sensitivity beyond the approved footprint must be designated as No-Go areas and be off-limits to all operational and maintenance vehicles and personnel;
- No additional habitat is to be disturbed during the operational and maintenance phase of the project outside of the demarcated approved footprints;
- Monitor the Freshwater Habitat within the study area to ensure that floral communities are not degraded;
- Ongoing erosion and stormwater monitoring and control to be implemented throughout the operational and maintenance phase;
- 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;
- 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;
- Monitor the success of rehabilitation efforts of disturbed areas seasonally;
- 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 operational phases.

Table 19: Impact Assessment considering the impacts and mitigation surrounding the floral SCC during the Operational and Maintenance Phase of the Cassinga Electrical Power Supply Project development and proposed infrastructure of new substations.

ACTIVITY 11: Operation and maintenance activities of the proposed Cassinga Electrical Power Supply Project development and proposed infrastructure of new substations with focus on floral SCC.									
Impact Summary: ➢ Potential loss of habitat for SCC through habitat change. ➢ Potential loss of floral SCC through unsuccessful relocation activities.									
Habitat unit	**Management**	**Magnitude**	**Duration**	**Scale**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Transformed	Before	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Freshwater	Before	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Secondary Miombo	Before	Moderate (-)	Medium term	Local	Medium	Possible	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Miombo Woodland	Before	Moderate (-)	Medium term	Local	Medium	Possible	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Essential management measures: ➢ Harvesting of protected and threatened floral species by operational and maintenance personnel must be strictly prohibited, including collection of floral material by such personnel; ➢ Monitoring of any rescued and relocated floral SCC (if applicable) must commence during the construction phase and continue until it is evident that relocated species have successfully established and the population are stable; ➢ Maintenance activities must ensure that floral SCC and protected flora (where present outside of the footprint areas) will not be adversely impacted; and ➢ Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC outside of the proposed development footprint area.									

Table 20: Impact Assessment considering the impacts and mitigation surrounding the floral SCC during the Operational and Maintenance Phase of proposed access roads for the Cassinga Electrical Power Supply Project development.

ACTIVITY 12: Operation and maintenance activities of the proposed access roads for the Cassinga Electrical Power Supply Project development with focus on floral SCC.									
Impact Summary: ➢ Potential loss of habitat for SCC through habitat change. ➢ Potential loss of floral SCC through unsuccessful relocation activities.									
Habitat unit	**Management**	**Magnitude**	**Duration**	**Scale**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Transformed	Before	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Freshwater	Before	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Essential management measures:									
➢ Harvesting of protected and threatened floral species by operational and maintenance personnel must be strictly prohibited, including collection of floral material by such personnel; ➢ Monitoring of any rescued and relocated floral SCC (if applicable) must commence during the construction phase and continue until it is evident that relocated species have successfully established and population are stable; ➢ Maintenance activities must ensure that floral SCC and protected flora (where present outside of the footprint areas) will not be adversely impacted; and ➢ Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC outside of the proposed development footprint area.									

Table 21: Impact Assessment considering the impacts and mitigation surrounding the floral habitat and diversity during the Decommissioning Phase of the Cassinga Electrical Power Supply Project development and proposed OHPL and infrastructure of new substations.

ACTIVITY 13: Decommissioning Phase activities of the proposed Cassinga Electrical Power Supply Project development and proposed OHPL infrastructure of new substations with focus on floral habitat and diversity.									
Impact Summary: ➢ Potential loss of floral habitat beyond the project footprint and a reduction in species diversity; ➢ Landscapes left fragmented, resulting in reduced dispersal capabilities of floral species and an overall decrease in floral diversity; ➢ Potential loss of productive topsoil; ➢ Compacted soils limiting the re-establishment of natural vegetation; and ➢ Potential increased erosion risk and/or further exacerbating the proliferation of AIPs.									
Habitat unit	**Management**	***Magnitude***	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Transformed	Before	Minor (-)	Medium term	Local	Low	Possible	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Freshwater	Before	Moderate (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Secondary Miombo	Before	Moderate (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Miombo Woodland	Before	Major (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Essential management measures: ➢ 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 the proposed Cassinga Electrical Power Supply Project development and proposed 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; ➢ Monitor the Miombo Woodland and Freshwater Habitat within the study area to ensure that floral communities are not degraded; ➢ 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.									

Table 22: Impact Assessment considering the impacts and mitigation surrounding the floral habitat and diversity during the Decommissioning Phase of the Cassinga Electrical Power Supply Project development and proposed construction sites/ laydown areas.

ACTIVITY 14: Decommissioning Phase activities of the proposed Cassinga Electrical Power Supply Project development and proposed construction site/ laydown area with focus on floral habitat and diversity.									
Impact Summary: ➢ Potential loss of floral habitat beyond the project footprint and a reduction in species diversity; ➢ Landscapes left fragmented, resulting in reduced dispersal capabilities of floral species and an overall decrease in floral diversity; ➢ Potential loss of productive topsoil; ➢ Compacted soils limiting the re-establishment of natural vegetation; and ➢ Potential increased erosion risk and/or further exacerbating the proliferation of AIPs.									
Habitat unit	**Management**	***Magnitude***	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Transformed	Before	Minor (-)	Medium term	Local	Low	Possible	**Low**	–	High
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Secondary Miombo	Before	Moderate (-)	Medium term	Local	Medium	Definite	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Essential management measures: ➢ 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 the proposed construction sites\laydown areas 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; and ➢ No illicit fires must be allowed during the decommissioning phase.									

Table 23: Impact Assessment considering the impacts and mitigation surrounding the floral SCC during the Decommissioning Phase of the Cassinga Electrical Power Supply Project development and proposed OHL infrastructure of new substations.

ACTIVITY 15: Decommissioning Phase activities of the proposed Cassinga Electrical Power Supply Project development and proposed OHPL infrastructure of new substations with focus on floral SCC.									
Impact Summary: ➢ Potential loss of habitat for SCC through habitat change; ➢ Failure to rehabilitate bare areas or disturbed sites; and ➢ Inadequate stormwater management resulting in loss of viable soils and potentially increasing erosion risk.									
Habitat unit	**Management**	**Magnitude**	**Duration**	**Scale**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Transformed	Before	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Freshwater	Before	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Secondary Miombo	Before	Moderate (-)	Medium term	Local	Medium	Possible	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Miombo Woodland	Before	Moderate (-)	Medium term	Local	Medium	Possible	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Essential management measures: ➢ Harvesting of protected and threatened floral species by decommissioning phase personnel must be strictly prohibited, including collection of floral material by such personnel; ➢ Monitoring of any rescued and relocated floral SCC (if applicable) must continue during the decommissioning phase (three years after commencement of the decommissioning phase) until it is evident that relocated species have successfully established and population are stable; ➢ Rehabilitation activities must ensure that floral SCC and protected flora (where present outside of the footprint areas) will not be adversely impacted; ➢ Impact must be limited to the footprint area and kept to what is essential only; and ➢ Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC outside of the proposed development footprint area.									

Table 24: Impact Assessment considering the impacts and mitigation surrounding the floral SCC during the Decommissioning Phase of the Cassinga Electrical Power Supply Project development and proposed construction sites/ laydown areas.

ACTIVITY 16: Decommissioning Phase activities of the proposed Cassinga Electrical Power Supply Project development and proposed construction sites/ laydown areas with focus on floral SCC.									
Impact Summary: ➢ Potential loss of habitat for SCC through habitat change; ➢ Failure to rehabilitate bare areas or disturbed sites; and ➢ Inadequate stormwater management resulting in loss of viable soils and potentially increasing erosion risk.									
Habitat unit	**Management**	**Magnitude**	**Duration**	**Scale**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Transformed	Before	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
	After	Minor (-)	Short term	Site	Low	Unlikely	**Low**	–	Medium
Secondary Miombo	Before	Moderate (-)	Medium term	Local	Medium	Possible	**Medium**	–	Medium
	After	Minor (-)	Short term	Site	Low	Possible	**Low**	–	Medium
Essential management measures:									
➢ Harvesting of protected and threatened floral species by decommissioning phase personnel must be strictly prohibited, including collection of floral material by such personnel; ➢ Monitoring of any rescued and relocated floral SCC (if applicable) must continue during the decommissioning phase (three years after commencement of the decommissioning phase) until it is evident that relocated species have successfully established and population are stable; ➢ Rehabilitation activities must ensure that floral SCC and protected flora (where present outside of the footprint areas) will not be adversely impacted; ➢ Impact must be limited to the footprint area and kept to what is essential only; and ➢ Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC outside of the proposed development footprint area.								

Table 25: Impact Assessment considering the impacts and mitigation surrounding the floral habitat fragmentation during all phases of the Cassinga Electrical Power Supply Project development and proposed infrastructure of new substations.

ACTIVITY 17: Vegetation clearing activities for the construction of the proposed Cassinga Electrical Power Supply Project development and proposed infrastructure of new substations with focus on impacts to floral habitat fragmentation.									
Impact Summary: ➢ Fragmentation of vegetation communities; ➢ Potential increase in fragmentation of vegetation communities and disruption of natural dispersal processes; and ➢ Potential increase in fragmentation of ecological corridors and diminished ecological functionality.									
Habitat unit	**Management**	***Magnitude***	***Duration***	***Scale***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Transformed	Before	Minor (-)	Long term	Local	Medium	Possible	**Low**	–	High
	After	Minor (-)	Long term	Site	Medium	Unlikely	**Low**	–	Medium
Freshwater	Before	Moderate (-)	Long term	Local	High	Possible	**High**	–	High
	After	Minor (-)	Long term	Site	Medium	Unlikely	**Low**	–	Medium
Secondary Miombo	Before	Moderate (-)	Long term	Local	High	Possible	**High**	–	High
	After	Minor (-)	Long term	Site	Medium	Unlikely	**Low**	–	Medium
Miombo Woodland	Before	Major (-)	Long term	Local	High	Possible	**High**	–	High
	After	Moderate (-)	Long term	Site	Medium	Unlikely	**Low**	–	Medium
Essential management measures:									
➢ The construction footprint must be kept as small as possible to minimise the impact on the surrounding environment (edge effect management); ➢ Construction footprint areas should be clearly demarcated to monitor footprint extent and avoid footprint creep; ➢ Removal of vegetation must be restricted to what is necessary and should remain within the approved development footprint; ➢ Development should be prioritised in habitats of decreased sensitivity wherever possible given the linear nature of the project; ➢ Access roads should be kept to existing roads were possible so to reduce further fragmentation of existing natural habitat; ➢ 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; ➢ 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; ➢ 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; and ➢ Maintain vegetation corridors along the OHL servitudes. 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.									

7.3 Impact Discussion

The impact assessment was undertaken on all aspects of floral ecology deemed likely to be affected by the proposed Cassinga Electrical Power Supply Project development. After rating impacts on floral ecology resulting from the proposed development, the impacts associated with the floral habitat, diversity, and SCC are anticipated to be medium to high prior to the implementation of mitigation measures. These associated impacts are anticipated to be reduced provided that strict mitigation measures are implemented.

For floral habitat and diversity, the construction will have the greatest immediate impacts, with the operational and maintenance phase likely to have ongoing, long-term impacts on habitat and diversity outside of the proposed project footprints if edge effect management is not appropriately implemented.

7.3.1 Impact on Floral Habitat and Diversity

The data gathered during the site visit indicates that the Freshwater Habitat has a high SEI, Miombo Woodland has a medium SEI, Secondary Miombo Woodland has a low SEI, whereas the Transformed Habitat has a very low SEI. The total area per habitat loss for the Miobo Woodland (+- 45 ha), Secondary Woodland (+- 23 ha), Freshwater Habitat (+- 4 ha) and Transformed Habitat (+- 11 ha).

The loss of floral habitat and subsequent floral diversity will be greater and more significant where footprints are within the intact and more sensitive Miombo Woodland habitat and Freshwater Habitat. Impacts on these habitat units must be minimised (Miombo Woodland) and avoided (Freshwater Habitat) as far as possible to ensure the impacts from the proposed activities will not be highly significant. Secondary Miombo Woodland is classified as natural habitat. 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 minimize habitat fragmentation, such as biological corridors, and restoring habitats during operations and/or after operations.

Moreover, the habitat associated with the Transformed Habitat is more degraded, homogenous, and fragmented; as such, impacts in these habitat units will not result in significant declines in floral diversity or habitat.

Prior to mitigation measures implemented

Impact significance on floral habitat and diversity will be **medium**. The *Pre-construction Phase* will have limited direct impacts on floral habitat and diversity with the only direct impact

stemming from the rescue and relocation of floral SCC (potential threatened species) that must take place prior to the vegetation clearing.

The *Construction Phase* will have the greatest impact on floral habitat and diversity due to vegetation clearing activities, with impact significance on habitat and diversity within the habitat units anticipated to be high to low, resulting in a marginal loss of a diversity of floral species. If the impacts are not managed the negative impacts will extend into the surrounding areas and the loss of floral habitat and diversity will increase.

For the *Operational and Maintenance Phase*, impacts on floral habitat and diversity will largely be indirect in nature and will stem from edge effects such as a lack of AIP control, poor rehabilitation of areas outside of the approved footprint that has been impacted by construction activities, poor stormwater management, as well as increased human movement through natural areas outside of the approved footprint. Impact significance on habitat and diversity within the affected habitat units is anticipated to be medium to low and will result in a marginal loss of floral species. If the impacts are not managed, the negative impacts will extend into the surrounding areas and the loss of flora habitat and diversity will increase.

For the *Decommissioning Phase*, will have a negative impact on floral habitat and diversity due to vegetation clearing activities associated with rehabilitation activities, with impact significance on habitat and diversity within the habitat units anticipated to be medium to low, resulting in a marginal loss of a diversity of floral species. If the impacts are not managed the negative will extent into the surrounding areas and the loss of flora habitat and diversity will increase.

With mitigation measures implemented

With mitigation measures implemented, the direct and indirect impacts on the floral habitat and diversity can be reduced to **low** significance levels. Generally, impacts across the study area are anticipated to be localised (given the nature of the project) with edge effects of limited extent if well managed. To ensure impacts remain localised, it must be ensured that planned and authorised footprints do not increase during the Construction Phase and/or Operational & Maintenance Phase.

7.3.2 Impacts on Floral SCC

The region has seen extensive transformation through clearance of vegetation from Miombo Woodland to agricultural areas as well as for charcoal production. Two floral SCC were observed within the Miombo Woodland and Secondary Miombo Woodland habitats at the time of assessment, namely *Pterocarpus angolensis* (locally listed as VU but LC on the IUCN) and *Brachystegia spiciformis* (locally listed as VU but LC on the IUCN); however, species such as

Brachystegia boehmii, Julbernardia paniculata and *Boophone disticha*, although of LC, are also considered to be of concern due to increased harvesting in the region. No SCC were recorded within the Transformed Habitat, nor are any anticipated to be located within this habitat.

The loss of floral habitat and subsequent floral SCC will be more pronounced and significant in areas within the intact and sensitive Miombo Woodland habitat. It is imperative to minimise impacts on these habitats (Miombo Woodland) and avoid them altogether. No floral SCC was observed during the field assessments and preferred habitat was present within the Secondary Miombo Woodland and Freshwater Habitat. No suitable habitat for floral SCC was found within the Transformed Habitat, being more degraded, homogenous, and fragmented, are less likely to experience significant declines in floral SCC due to impacts from the proposed activities.

Prior to mitigation measures implemented

Without mitigation measures implemented, the impact significance on floral SCC communities is anticipated to be medium to low. The greatest impacts on SCC will be within the *Pre-construction Phase* where SCC are rescued and relocated. During the construction phase there is likely to be further loss of SCC individuals that were either missed during relocation activities or that were not eligible for relocation. Indirect impacts on SCC are anticipated during the *Operational and Maintenance* and *Decommissioning Phase* potentially resulting from the harvesting of SCC or due to pressure on the remaining habitat of SCC resulting from an increased presence of humans in the area.

With mitigation measures implemented

With mitigation measures implemented, the impact significance on floral SCC communities is anticipated to be low. If the proposed development is authorised, it is recommended that a walkthrough of the site be undertaken prior to the commencement of any construction activities and all SCC identified be marked and considered for possible relocation to suitable habitat outside of the disturbance footprint. If no suitable habitat is located within the footprint area, these species need to be relocated to (suitable) habitat outside of the footprint area. With the implementation of the mitigations within this report, the impact significance will be lower from a medium to low significance to a low significance.

7.3.3 Probable Residual Impacts

Even with extensive mitigation, residual impacts on the receiving floral ecological environment are deemed likely. The following points highlight the key residual impacts that have been identified:

- Permanent loss of niche floral habitat within the Freshwater Habitat on a local scale;
- Permanent loss of and altered floral species diversity on a local scale;
- Edge effects such as habitat fragmentation and AIP proliferation;
- The ongoing loss of SCC and suitable habitat for such species; and
- Disturbed areas not rehabilitated to an ecologically functioning state.

7.3.4 Cumulative Impacts

A major threat to the biodiversity of the study area (including floral diversity), and particularly the surrounding areas, is continued fragmentation of natural habitat and anthropogenic activities (agricultural and charcoal production). Continued development will negatively impact the remaining biodiversity of the area (i.e., through removal and/or transformation of suitable habitat by expanding construction).

Apart from the proposed development, another threat to the floral ecology within the study area is the continued proliferation of AIP species, resulting in the overall loss of indigenous floral communities within the local area. The proposed development will increase the movement of humans within the area and could lead to increased harvesting of floral SCC and / or the degradation of suitable floral habitat for SCC due to continued exposure to anthropogenic disturbances.

8 PERMIT REQUIREMENTS

Currently, no known permitting requirements specifically address floral species. This absence of specific regulations may pose challenges for the protection and conservation of floral diversity, as it may result in inadequate oversight and management of activities impacting floral species and their habitats.

9 BIODIVERSITY MANAGEMENT AND MONITORING ACTIONS

Biodiversity management and monitoring during the construction and operational phase of the Cassinga Electrical Power Supply Project development is important to ensure that all aspects of the receiving environment in terms of floral species are taken into account and that aspects are not overlooked. Whilst management aspects are used to define or highlight biodiversity goals / objectives, monitoring is required to assess the suitability and effectiveness of the management actions and if needed, highlight shortcomings or areas of change which are needed in order to better meet the overall management objectives.

The overall biodiversity management goal is to ensure that the construction and operation of the Cassinga Electrical Power Supply Project development has as low an impact as possible on the receiving environment, and in the case of this report, with specific reference to floral species.

The table below details tasks / objectives for the project as well as monitoring activities and potential outcomes that should be implemented along with the mitigation measures already mentioned in Section 6 which are to be included in the Environmental and Social Management Plan (ESMP).

It should be noted that this report does not include monitoring assessments of the Freshwater Habitat itself (although the associated Freshwater Habitats are assessed in this report from a botanical perspective).

Table 25 below summarises the objectives and monitoring activities that needs to be incorporated in the ESMP.

Table 26: Objectives and monitoring activities to be incorporated into the ESMP.

OBJECTIVE / TASK	SITE MANAGEMENT AND MONITORING ACTIVITIES	KEY PERFORMANCE INDICATOR (KPI)
Ensure that project footprints earmarked for clearance of vegetation are clearly demarcated.	➢ Using bunting/reflective tape, clearly demarcate all proposed laydown areas, pylons footprint areas, and any new access roads where vegetation clearance will take place. ➢ Ensure that the teams responsible for vegetation clearance activities are well briefed on their tasks and understand that they are only to clear vegetation within the demarcated areas.	1. Footprints have been clearly demarcated. 2. Vegetation clearance teams have only cleared within the demarcated footprint areas.
Ensure that footprint creep does not occur and that floral habitat beyond the demarcated areas is not impacted upon.	➢ Inspections of the project footprints are to take place to ensure that no footprint creep is taking place. ➢ Where clearance is taking place beyond the demarcated footprints, ensure that those activities cease and that where necessary, rehabilitation measures are implemented.	1. Report is compiled detailing any issues encountered on site and areas where footprint extensions have occurred. 2. Rehabilitation / rectification actions have been implemented (if and where needed).
Monitor for any erosion activities or significant sedimentation of the adjacent floral habitat taking place due to ground clearing activities.	➢ Erosion monitoring of footprints is to take place. ➢ Erosion control measures implemented to reduce erosion and surface water runoff.	1. Reporting on erosion. 2. Erosion management interventions have been implemented.
Monitoring for any AIP within the proposed footprint areas.	➢ AIP monitoring of footprints is to take place on a bi-annual basis during the construction phase detailing any AIP species observed within the footprint area and noting localities.	3. Bi-annual reporting on AIP. 4. AIP management interventions have been implemented.
Rehabilitation of old laydown areas and construction footprints once activities therein are completed.	➢ Ensure all waste material and construction equipment has been removed from the site/footprint area. ➢ Implement suitable rehabilitation / revegetation plan to ensure that no bare soil area remain post construction.	1. All waste and construction equipment has been removed. 2. Revegetation activities are taking place and plant cover is starting to re-establish in the disturbed areas.
Pylon footprint inspections are to be undertaken.	➢ Footprint inspections undertaken to assess revegetation progress. ➢ Assess footprints for erosion/alien plant proliferation so timeous preventative measures can be taken.	1. Report submitted detailing vegetation regrowth in the disturbed areas including photographic evidence and locality data. 2. Erosion / alien plant control measures implemented based on site inspection outcomes.

9.1 Monitoring philosophy and requirements

Prudent floral monitoring of the study area is of utmost importance, as this will ensure a continual flow of data, enabling all parties involved to accurately assess and manage floral diversity-related progress and issues. To ensure the accurate gathering of data, the following techniques and guidelines should be followed:

- Monitoring of floral species structure and composition should be undertaken at the various footprint areas during the construction and operational phase;
- All data gathered should be measurable (qualitative and quantitative);
- Monitoring reports should be repeatable and ideally temporally and spatially comparable;
- Data should be auditable;
- Data gathered should be an accurate representation of the PES of the study area, as well as the various floral communities represented by each monitoring site;
- Data gathered should represent all aspects of all communities, i.e., grasses, forbs, shrubs and trees; and
- General habitat overviews (ad hoc observations) should also be undertaken.

Several protocol(s) are applicable for the collection of floral data (refer to Table 26).

Table 27: Floral Data Capturing Protocols.

Aspect	Monitoring Location	Frequency of sampling	Frequency of Reporting	Report Content	Equipment
Floral Monitoring	Footprint areas	Construction Phase: ➢ Annual	Construction Phase: ➢ Annual	1. Floral species composition and vegetation structure changes; and 2. Increase in alien plant species.	1. Camera 2. Global Positioning System (GPS) (if available)
		Operational Phase: ➢ Every three years	Operational Phase: ➢ Every three years		
		Decommissioning Phase: ➢ Monitoring should be done in a phaseout manner, ensuring that floral species composition and vegetation structure are monitored until the areas are revegetated in order to relinquish the site.	Decommissioning Phase: ➢ Annual (Should be done in a phased-out manner until the site is relinquished).		
Erosion	Erosion-prone areas and where vegetation clearing activities took place.	Construction Phase: ➢ Monthly basis	➢ After every major rainstorm and/or flood. ➢ Monthly monitoring report compiled by the appointed Environmental Control Officer (ECO).	1. Brief indication of the method of assessment; 2. Assumptions and Limitations must be listed; 3. Photos and GPS point locations taken erosion sites within the footprint areas. 4. Management recommendations made; and 5. Map indicating where erosion is present.	1. GPS (if available) 2. Camera 3. Field Form
		Operational Phase: ➢ Annual basis	➢ Annual monitoring report compiled by the appointed ECO ➢ After every major flood event if more than once a year		
		Decommissioning Phase: ➢ After every major rainstorm and/or flood; and ➢ Should be done in a phaseout manner, ensuring that rehabilitated areas are monitored until the areas are revegetated in order to relinquish the site.	➢ After every major rainstorm and/or flood. ➢ Monthly monitoring report compiled by the appointed ECO		
Alien vegetation control	Areas where vegetation clearing took place	Construction Phase: ➢ Bi-annual basis	At the end of the first growing season following the completion of construction.	1. Provide a list of species occurring within the study area; 2. Ad hoc discussion of density/abundance of species; 3. Recommend control measures to be undertaken; and 4. Assess the necessity of further alien and invasive vegetation control.	1. GPS (if available) 2. Camera 3. Field Form
		Operational Phase: ➢ Annual basis	During the growing season		
		Decommissioning Phase: ➢ Annual basis for two years after the decommissioning phase.	During the growing season		

10 CONCLUSION AND IMPACT STATEMENT

The study area is associated with habitat of varying degrees of ecological importance, and each will be impacted to different extents. Floral communities identified for the Cassinga Electrical Power Supply Project that will be impacted by the proposed activities include the following:

- Transformed Habitat of **very low SEI** (within the proposed project footprint);
- Secondary Miombo Woodland of **low SEI** (within the proposed project footprint);
- Freshwater Habitat of **high SEI** (within the proposed project footprint); and
- Miombo Woodland of **medium SEI** (within the proposed project footprint).

During the field assessments, it became apparent that the ongoing expansion of residential communities, coupled with prevailing economic conditions, has spurred increased small-scale crop cultivation and charcoal production from harvested trees. These activities have resulted in significant and ongoing loss of floral habitat and species diversity due to widespread vegetation clearance. While providing communities with areas for food crop cultivation, the clearing of vegetation within the study area has led to notable changes in floral species composition, particularly affecting woody species due to wood harvesting and clearing activities.

Table 27 below provides a summary of the impacts associated with the proposed Cassinga Electrical Power Supply Project. Provided that the mitigation measures as discussed within this report are implemented, the impacts can be suitably managed and mitigated to low significance levels.

Table 28: A summary of the impact assessment associated with the proposed Cassinga Electrical Power Supply Project during all phases.

Habitat unit	Management	Loss of Floral Habitat and Species Diversity	Loss of Sensitive Floral Species
Pre-construction and Planning phase			
Transformed	Before	Low	Low
	After	Low	Low
Freshwater	Before	Medium	Low
	After	Low	Low
Secondary Miombo	Before	Medium	Medium
	After	Low	Low
Miombo Woodland	Before	Medium	Medium
	After	Low	Low
Construction phase			
Transformed (OHPL and associated infrastructure)	Before	Low	Low
	After	Low	Low
Freshwater (OHPL and associated infrastructure)	Before	Medium	Low
	After	Low	Low
	Before	Medium	Low

Habitat unit	Management	Loss of Floral Habitat and Species Diversity	Loss of Sensitive Floral Species
Secondary Miombo (OHPL and associated infrastructure)	After	Low	Low
Miombo Woodland (OHPL and associated infrastructure)	Before	High	Medium
	After	Low	Low
Transformed (Construction site/ laydown area)	Before	Medium	Low
	After	Low	Low
Secondary Miombo (Construction site/ laydown area)	Before	Medium	Medium
	After	Medium	Low
Access roads (Transformed Habitat)	Before	Low	Low
	After	Low	Low
Access road (Freshwater Habitat)	Before	Medium	Low
	After	Low	Low
Operational and Maintenance Phase			
Transformed (OHPL and associated infrastructure)	Before	Low	Low
	After	Low	Low
Freshwater (OHPL and associated infrastructure)	Before	Medium	Low
	After	Low	Low
Secondary Miombo (OHPL and associated infrastructure)	Before	Medium	Medium
	After	Low	Low
Miombo Woodland (OHPL and associated infrastructure)	Before	Medium	Medium
	After	Low	Low
Access roads (Transformed Habitat)	Before	Low	Low
	After	Low	Low
Access road (Freshwater Habitat)	Before	Medium	Low
	After	Low	Low
Decommissioning Phase			
Transformed (OHPL and associated infrastructure)	Before	Low	Low
	After	Low	Low
Freshwater (OHPL and associated infrastructure)	Before	Medium	Low
	After	Low	Low
Secondary Miombo (OHPL and associated infrastructure)	Before	Medium	Medium
	After	Low	Low
Miombo Woodland (OHPL and associated infrastructure)	Before	Medium	Medium
	After	Low	Low
Transformed (Construction site/ laydown area)	Before	Low	Low
	After	Low	Low
Secondary Miombo (Construction site/ laydown area)	Before	Medium	Medium
	After	Low	Low
Habitat fragmentation			
Transformed	Before	Low	
	After	Low	
Freshwater	Before	High	
	After	Low	
Secondary Miombo	Before	High	
	After	Low	
Miombo Woodland	Before	High	
	After	Low	

The construction of the proposed Cassinga Electrical Power Supply Project is likely to result in further vegetation clearance and habitat fragmentation for the proposed infrastructure footprint areas, access roads, construction / laydown areas and the proposed new powerlines. These activities will result in further loss of habitat and floral species within the footprint areas, with potential secondary impacts stemming from the increased levels of area access created by the new access roads which may lead to increased wood harvesting and additional habitat degradation.

From a floral perspective, it is recommended that the sensitivity map is taken into consideration when refining the layouts for the proposed Cassinga Electrical Power Supply Project, and that as far as possible all infrastructure, but especially pylons, are located outside of the sensitive Freshwater Habitats.

From a precautionary approach, the Miombo, Secondary Woodland and Freshwater Habitats have been listed as critical habitat for the purpose of this report, due to the limited availability of data on these species and access restrictions on site, which hindered thorough data collection. 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.

The objective of this study was to provide sufficient information on the floral ecology of the area in order for the EAP and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. It is the opinion of the specialist that whilst the Cassinga Electrical Power Supply Project will lead to loss of habitat within the study area, the overall impact within the study area is expected to be limited, provided that mitigation measures as stipulated within this report are implemented.

11 REFERENCES

NOTE: Reliable reference material at the required level of detail and accuracy is scant, and thus verified and accurate reference material was utilised. These references are internationally accepted and although many of them do not specifically cover the study area, the species ranges and distributions overlap. Notes on ecological and biological requirements allowed the specialists to reliably extrapolate data.

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APPENDIX A: FLORAL METHOD OF ASSESSMENT

Vegetation Surveys

Various field sampling methods are available for the purpose of collecting floristic data. Generally, the selection of chosen field methods is dependent on serval factors, including the size of the area to be assessed, the heterogeneity of the vegetation/habitat present, time and budget allocated for field assessments, the scale and magnitude of potential project impacts, and the scope of work to be assessed.

When planning the timing of a floristic survey, it is important to remember that the primary objective is not an exhaustive species list but rather to ensure that sufficient data are collected to describe all the vegetation communities present in the area of interest, to optimise the detection of SCC and to assess habitat suitability for other potentially occurring SCC (SANBI, 2020). An understanding of the location and extent of vegetation types of increased sensitivity, and the location of areas of increased importance for various species of SCC, will focus efforts for the identification and marking of SCC during detailed pre-construction walkdown efforts.

Given the restricted time frames in which the proposed field surveys need to be conducted and the combined objective of accurately demarcating sensitive habitats within the area of interest, the method chosen needs to allow for:

I. Rapid, accurate data collection; and
II. The optimisation of time spent in habitats that are likely to sustain SCC.

Several survey methods, known as rapid biological assessments (Larsen, 2016)[5], can be employed. Example of rapid biological assessments include plot-based assessments or transect-based assessments. SANBI (2020) recommends the use of a transect-based approach, namely timed-meander searches (TMS; Goff et al., 1982[6]). The vegetation surveys presented below are a modified version of the TMS methods (hereafter referred to as modified-meander searches (MMS)). The TMS and MMS are subjective sampling methods which employs techniques where the specialist chooses specific sample sites within the area of interest, based on their professional experience in the area and background research done prior to the site visit. This allows representative recordings of floral communities and optimal detection of SCC.

The difference in the TMS and MMS is that the MMS is not timed. The below list presents the reasons for selection of a modified approach:

- Time, access, and safety constraints are often unpredictable and cannot be planned for prior to a site assessment, especially within remote areas and areas where local communities may not provide consent to specialist to survey their lands. As such, a timed approach may result in disproportionate efforts in some pre-defined habitats.
- Vegetation surveys are conducted at the same time as the SCC assessments which limits the potential for timed assessments as SCC often occur either sporadically, or are difficult to detect and hence, longer surveys in certain areas are necessary (skewing the timed approach). This is especially true for the pre-defined broad habitats within more sensitive areas such as the Sekhukhune Centre of Plant Endemism where desktop databases may not be a true reflection of on-site habitat extent and heterogeneity. Micro habitats where SCC are often found, are often difficult to detect on digital satellite imagery. As such, timing the surveys according to unverified field data will increase the risk of overlooking importance SCC data or habitat integrity features.
- Subjective decisions need to be made on-site that would otherwise interfere with a times-meander approach.

The employment of the presented field methods is beneficial because they allow for rapid data collection and subjective placement (based on professional experience and previous fieldwork knowledge) of the

[5] Larsen, T.H. ed., 2016. Core standardized methods for rapid biological field assessment. Conservation International.
[6] Goff, F.G., Dawson, G.A. and Rochow, J.J., 1982. Site examination for threatened and endangered plant species. Environmental Management, 6(4), pp.307-316.

MMSs in habitats that have a higher likelihood of sustaining SCC. Furthermore, this method allows for extensive coverage of the subject property, thus increasing the probability of SCC and micro habitat detection. Extensive coverage of the area of interest will also be advantageous where properties are of large extents that need to be assessed.

Based on the broad habitat units delineated before going to site and the pre-identified points of interest, which is updated based on on-site observations and access constraints, the selected sample areas are surveyed on foot, following the subjective MMT, to identify the occurrence of the dominant plant species and habitat diversities, but also to detect SCC which tend to be sparsely distributed. Photographs are taken of each vegetation community that is representative of typical vegetation structure of that community, as well as photos of all detected SCC (sensitive species will not be presented in the report).

Vegetation structure has been described following the guideline in Edwards (1983). Refer to Figure A1 below:

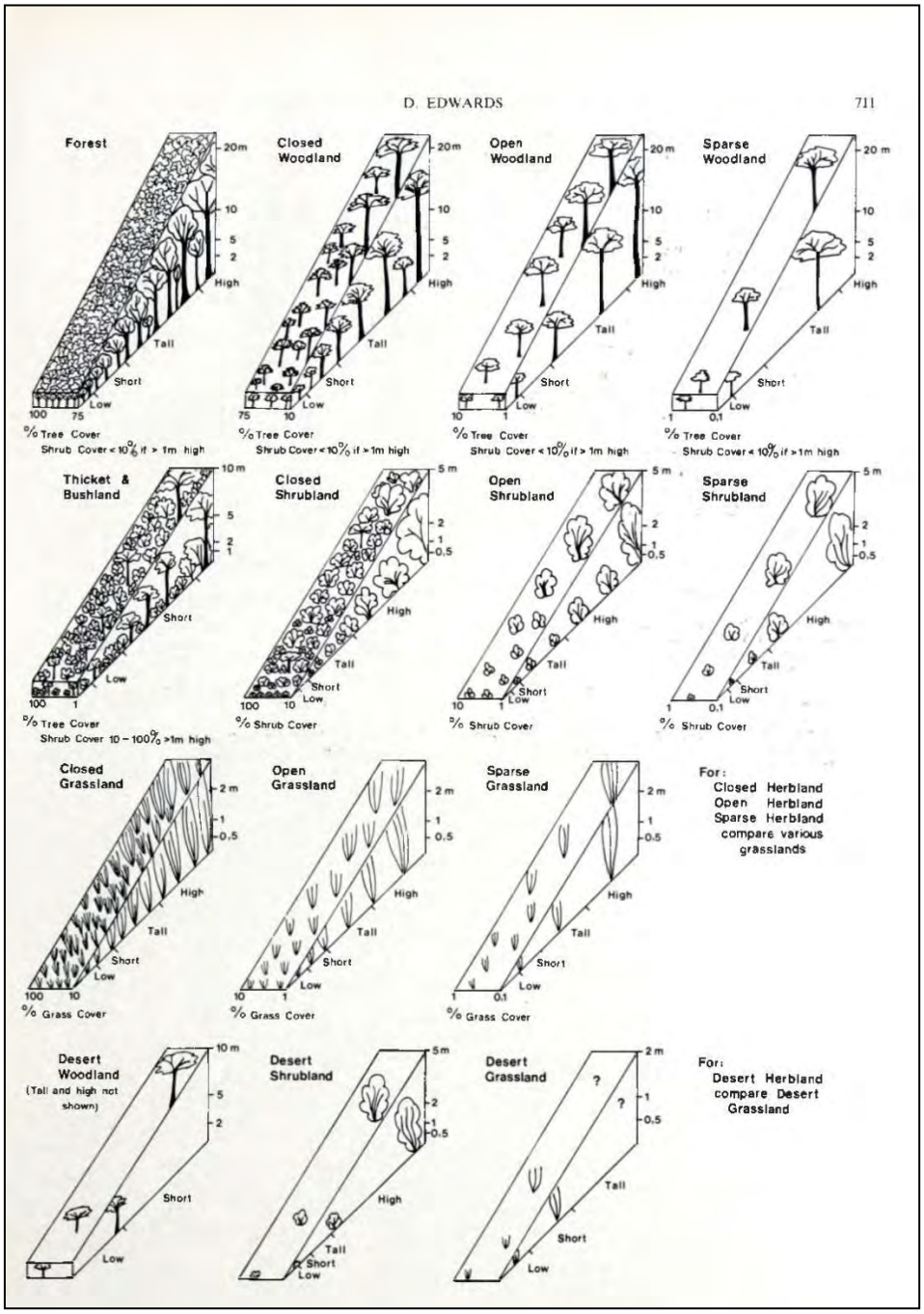


Figure A1: Diagrammatic representation of structural groups and formation classes. Only dominant growth forms are shown.

Floral Species of Conservational Concern Assessment

Prior to the site visit, a record of floral SCC and their habitat requirements was developed for the study area. Throughout the floral assessment, special attention was paid to the identification of any of these SCC as well as the identification of suitable habitat that could potentially support these species.

The Probability of Occurrence (POC) for each floral SCC is described:

- "**Confirmed'**: if observed during the survey;
- "**High**": if within the species' known distribution range and suitable habitat is available;
- "**Medium**": if either within the known distribution range of the species or if suitable habitat is present; or
- "**Low**": if the habitat is not suitable and falls outside the distribution range of the species.

Low POC	Medium POC	High POC	Confirmed

The accuracy of the POC is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research.

Consideration and application of the precautionary approach

The precautionary principle is defined by Tickner & Raffensperger (1999) as follows:

"*When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically*".

Given time and resource constraints within the field, it is not always feasible to definitively state the presence or absence of particular Species of Conservation Concern (SCC) or sensitive habitats. In such instances, the precautionary principle should be applied (SANBI, 2020). By applying such principles, a preventative action is taken in the face of uncertainty. Furthermore, for cryptic species that are often difficult to detect, it is not always easy to provide undeniable proof that a species occurs within a particular area within a subject property. As such, if suitable habitat is identified within the subject property and there is potential evidence to suggest the species did or can occur within the subject property (i.e., confirmed sightings in adjacent properties), then the precautionary principle will be to assume that the species does indeed occur within the area of interest. Appropriate mitigation and management efforts would then need to follow accordingly.

Floral Site Ecological Importance (SEI)

SEI is considered to be a function of the biodiversity importance (BI) of the receptor (e.g., species of conservation concern, the vegetation/fauna community or habitat type present on the site[7]) and its resilience to impacts (receptor resilience [RR]) as follows:

SEI = BI + RR

SEI can be derived from a simple matrix of BI and RR as follows:

Table A1: Matrix of CI and FI to determine BI.

Site Ecological Importance (SEI)		Biodiversity Importance				
		Very high	High	Medium	Low	Very low
Receptor Resilience	Very low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very high	Medium	Low	Very low	Very low	Very low

[7] Note that the habitat type may be independent of the vegetation community and that it may even be artificial, e.g., excavated rock quarries that provide crucial breeding habitat for cliff-nesting species such as Bald Ibis.

Interpretation of the SEI in the context of the proposed development is provided below.

Table A2: Guidelines for interpreting SEI in the context of the proposed development activities.

Site ecological importance	Interpretation in relation to proposed development activities
Very high	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e., last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
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.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

BI in turn is a function of conservation importance (CI) and the functional integrity (FI) of the receptor as follows:

BI = CI + FI

BI can be derived from a simple matrix of CI and FI as follows:

Table A3: Matrix of CI and FI to determine BI.

Biodiversity importance		Conservation importance				
		Very high	High	Medium	Low	Very low
Functional Integrity	Very high	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

Conservation importance (CI) is evaluated in accordance with recognised established internationally acceptable principles and criteria for the determination of biodiversity-related value, including the IUCN Red List of Species, Red List of Ecosystems and Key Biodiversity Areas (KBA; IUCN [2016]).

Conservation importance is defined here as:

'The importance of a site for supporting biodiversity features of conservation concern present, e.g., populations of IUCN threatened and Near Threatened species (CR, EN, VU and NT), Rare species, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes.'

These criteria are defined as follows:

- IUCN threatened and Near Threatened species (CR, EN, VU and NT) are defined as either the global or national assessments of the risk of extinction as evaluated by a dedicated panel of species specialists according to the criteria of the International Union for The Conservation of Nature (www.iucnredlist.org). Where the global and national assessments differ for the same taxon, the national evaluation of status[8] should be used in calculating SEI unless the global assessment is both more recent and of a more threatened category. It is important to note that

[8] http://speciesstatus.sanbi.org/. For mammals: https://www.ewt.org.za/wp-content/uploads/2020/04/2020-updated-2016-Red-List-of-Mammals-of-South- Africa-Lesotho-Swaziland-Summary-Listings.xlsx; for plants: http://redlist.sanbi.org.

the specialist is required to have a firm understanding of the IUCN Red List Categories and Criteria (IUCN 2012) in order to appropriately apply these for the evaluation of SEI. This criterion can be assessed using confirmed occurrences of species or the suitability of the habitat to support these species. Rare species are those included on South Africa's National Red List as Rare or Critically Rare or Extremely Rare. These are highly restricted species that are currently not declining. However, should any development impact on a population of these species they will immediately qualify under one of the IUCN categories of threat. y Range-restricted species – the presence of terrestrial flora, vertebrate, and invertebrate fauna with a global population extent of occurrence (EOO) of 10 000 km^2 or less.

- Globally significant populations of congregatory species – a roughly estimated proportion (%) of the global population of a fauna species that congregate for breeding/feeding/hibernation/other reasons. y Significant areas of threatened vegetation types – this is a function of both the area (size) being considered in relation to the total extent of that vegetation type (i.e., proportion) and how threatened (CR, EN, VU) the vegetation types are.
- Natural processes – natural unmanaged areas with low levels of ecological disturbance have largely intact natural processes such as pollination, seed dispersal and migration, and thus have greater intrinsic conservation importance than those that are modified through ecological disturbance.

While most of the features that will be included in the CI will be provided by the screening tool, it is important to note that CI is evaluated at a much finer spatial scale and based on fieldwork data collection and comprehensive desktop analyses performed by the specialist during the EA process. As a minimum requirement, CI needs to be determined for each identified habitat within the project footprint, but best practice recommendation is that it should be determined for all habitats within the entire PAOI[9].

Fulfilling criteria to evaluate CI do not rely on a single specific threshold for each of the above defining characteristics but can act in combination or in isolation, providing a more robust evaluation of CI (Table A4). Furthermore, while CI is most likely to be assessed based on data collected during the fieldwork survey, it can also be an assessment of the suitability of the receptor to support populations conforming to the fulfilling criteria. As can be seen from the worked example below, each of these evaluations of the fulfilling criteria demand necessary justification.

Table A4: Conservation importance (CI) criteria.

Conservation importance	Fulfilling criteria
Very high	- Confirmed or highly likely occurrence of CR, EN, VU or Extremely Rare[10] or Critically Rare[11] species that have a global EOO of < 10 km^2. - Any area of natural habitat[12] of a CR ecosystem type or large area (> 0.1% of the total ecosystem type extent[13]) of natural habitat of EN ecosystem type. - Globally significant populations of congregatory species (> 10% of global population).
High	- Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km^2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. - Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type.

[9] Because CI needs to be assigned to a receptor (e.g., the vegetation/fauna community or habitat type), it is customary to use the flora community delineation developed for a PAOI by a botanical specialist. However, such delineation is often too fine scaled to define fauna-specific habitats, which are generally more structural than phytosociological in nature. Where this is the case, the fauna specialist should merge two or more relevant floral communities to correlate with the specific fauna habitat type that is characteristic of a particular taxon assemblage. In certain cases, the faunal specialist will have to demarcate habitats that have not been classified by the botanical specialist; a pertinent example is the presence of cliffs, which are frequently important breeding habitat for some bird SCC.

[10] For butterflies, as per Armstrong *et al*. (2013).

[11] For plants, as per Raimondo *et al*. (2009).

[12] This excludes areas of Transformed Habitat within a defined ecosystem even if these are partially restored, e.g., Highveld grasslands that have been converted to maize fields and then abandoned so that some form of functional grassland is restored; this is not natural habitat as it does not and will not in the future have species composition representative of the original natural habitat.

[13] This can be calculated from the threatened ecosystem of South Africa shapefile available from the SANBI (current available version 2011: http://bgis.sanbi. org/Projects/Detail/49).

Conservation importance	Fulfilling criteria
	- Presence of Rare species. - Globally significant populations of congregatory species (> 1% but < 10% of global population).
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. - Any area of natural habitat of threatened ecosystem type with status of VU. - Presence of range-restricted species. - > 50% of receptor contains natural habitat with potential to support SCC.
Low	- No confirmed or highly likely populations of SCC. - No confirmed or highly likely populations of range-restricted species. - < 50% of receptor contains natural habitat with limited potential to support SCC.
Very low	- No confirmed and highly unlikely populations of SCC. - No confirmed and highly unlikely populations of range-restricted species. - No natural habitat remaining.

Functional integrity (FI) of the receptor (e.g., the vegetation/fauna community or habitat type) is defined here as the receptors' current ability to maintain the structure and functions that define it, compared to its known or predicted state under ideal conditions. Simply stated, FI is:

'A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.'

These criteria can be defined as:

- Connectivity to other natural areas – connectivity, which can also be measured conversely as the degree of habitat fragmentation, refers to how connected habitat patches are to each other, which has a significant influence on numerous ecological processes, such as migration and dispersal opportunities of biota and therefore genetic exchange between populations. Connectivity to other similar habitats becomes more important as the remaining intact and functional area of a habitat decreases, mainly because population sizes decrease and are therefore at greater risk from ecological perturbations and inbreeding effects. The degree of connectivity between habitat patches varies greatly with the dispersal ability of the taxon or taxon group (e.g., fossorial reptiles) in question.
- Degree of current persistent negative ecological impacts – persistent negative impacts such as uncontrolled spread of alien and invasive flora effectively decreases both the remaining intact area and ecosystem functioning of a particular habitat. Persistent ecological disruptors must not include components that landowners are legally obliged to address or that should be addressed as norm for best practice. Wilful neglect of these legal obligations or the presence of invasive alien species that can practically be controlled through management actions should not negatively influence the FI score to a major extent.
- Remaining intact and functional area – the proportion of the receptor that supports natural habitat with intact ecological processes – small areas are less likely to withstand ecological degradation compared to large areas, and the latter are therefore better able to maintain structure and function allowing for intact ecological processes.

Ecological processes can be considered to be mostly intact and functional if the receptor area has low levels of current ecological disruptors, has good connectivity to other areas and is a relatively large area. As for CI, the fulfilling criteria to evaluate FI do not rely on a single specific threshold for each of the above defining characteristics but can act in combination or in isolation (Table A5) and will require justification by the specialist.

Table A5: Functional integrity (FI) criteria.

Functional integrity	Fulfilling criteria
Very high	- Very large (> 100 ha) intact area for any conservation status of ecosystem type or > 5 ha for CR ecosystem types. - High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. - No or minimal current negative ecological impacts with no signs of major past disturbance (e.g., ploughing).
High	- Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type or > 10 ha for EN ecosystem types. - Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. - Only minor current negative ecological impacts (e.g., few livestock utilising area) with no signs of major past disturbance (e.g., ploughing) and good rehabilitation potential.
Medium	- Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types. - 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 (e.g., established population of alien and invasive flora) and a few signs of minor past disturbance. Moderate rehabilitation potential.
Low	- Small (> 1 ha but < 5 ha) area. - Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. - Several minor and major current negative ecological impacts.
Very low	- Very small (< 1 ha) area. - No habitat connectivity except for flying species or flora with wind-dispersed seeds. - Several major current negative ecological impacts.

Ecological processes can be considered to be mostly intact and functional if the receptor area has low levels of current ecological disruptors, has good connectivity to other areas and is a relatively large area. As for CI, the fulfilling criteria to evaluate FI do not rely on a single specific threshold for each of the above defining characteristics but can act in combination or in isolation (Table 8.2) and will require justification by the specialist (see worked example below).

Receptor resilience (RR) is defined here as:

'The intrinsic capacity of the receptor to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention.'

The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor (Table A4) and will require justification by the specialist. The specialist needs to bear in mind that resilience will often be linked to a particular disturbance or impact, or even time of year, and needs to be described in relation to these factors. For example, large birds of prey have different levels of resilience to noise disturbance depending on whether they are breeding or not; these species would have low resilience to noise disturbance such as construction of a road adjacent to a nest site during the breeding season but a higher resilience to lodge construction in an area with limited breeding habitat outside of the breeding season.

Receptor resilience needs to be evaluated by the specialist and justification for each evaluation must be provided in the report (see worked example below). Finally, after the successful evaluation of both BI and RR as described above, it is possible to evaluate SEI from the final matrix as follows:

SEI should be described in the above manner for each impact receptor within the area of influence and clearly mapped in relation to the proposed development activities and infrastructure. Interpretation of SEI in the context of the proposed development activities (Table A1) must be provided by the specialist.

It is very important to note that SEI is specific to the proposed development activities and cannot be meaningfully compared between different proposed projects with different associated

activities on the same spatial location. However, SEI for the same proposed development with multiple alternative layouts and/or locations may be compared within the same study.

Table A6: Resilience criteria.

Resilience	Fulfilling criteria
Very high	Habitat that can recover rapidly (~ less than 5 years) to restore > 75%[28] 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.
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.
Medium	Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed.
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.
Very low	Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring, or species that are unlikely to return to a site once the disturbance or impact has been removed.

APPENDIX B: IMPACT ASSESSMENT METHODOLOGY

The project impact assessment method was supplied by SRK Consulting.

Impact assessment methodology

Potential impacts (direct, indirect, cumulative) will be assessed using information gathered during the baseline assessment in combination with previously collected desktop data and compared with the detailed project description.

Impact significance rating

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 4-1 and involves the following 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.
- 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 B1: Method for rating significance of importance

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	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*					
Impact characteristics	Definition		Criteria		
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

After determining the significance rating, practicable management measures are suggested for each specific impact. The impact description should indicate the significance rating prior to and following mitigation/optimisation. As explained above:

"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 is then re-assessed with assumed management measures in place ("after management"). Specialists also recommend and describe 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 4-2.

APPENDIX C: FLORAL SPECIES LIST

Table C1: Floral species encountered during the wet- and dry field assessments. Exotic and invasive species are marked with an asterisk (*).

Species	Miombo woodland	Secondary Miombo Woodland	Freshwater Habitat	Transformed
WOODY SPECIES				
*Acacia mearnsii**				x
*Acacia saligna**				x
Adenia senensis	x			
Albizia adianthifolia	x	x		x
Annona senegalensis		x	x	x
Antidesma venosum			x	
Azanza garckeana				x
*Azolla filiculoides**			x	
Bobgunnia madagascariensis		x		
Brachystegia boehmiii	x	x		
Brachystegia spiciformis		x		
Brachystegia utilis	x	x		
Cassia singueana	x			
Combretum adenogonium			x	
Combretum molle	x	x		
Combretum zeyheri	x	x		
Commiphora africana	x			
Crossopteryx febrifuga				x
Dalbegiella nyasae		x		
Dichrostachys cinerea	x	x		x
Diospyros kirkii	x			
Diplorhynchus condylocarpon	x	x		
Eichhornia crassipes			x	
Erythrina zeyheri	x			
Ethulia conyzoides			X	
Eucalyptus sp.*				x
Ficus sycomorus			x	
Flacourtia indica				x
Grewia flavescens	x	x		x
Hexalobus monopetalus		x		x
Hymenocardia acida		x		
Julbernardia paniculata		x		
Kigelia africana	x	x		
*Lantana camara**		x		x
*Leucaena leucocephala**			x	
*Mangifera indica**				x
Myriophyllum aquaticum			x	
*Ozoroa insignis**		x		x
Parinari curatellifolia	x	x		
Pericopsis angolensis	x			x
Piliostigma thonningii		x		x
*Pistia stratiotes**			x	
*Prosopis glandulosa**		x		x
*Prosopis juliflora**				x

Species	Miombo woodland	Secondary Miombo Woodland	Freshwater Habitat	Transformed
Protea angolensis	x	x		
Pseudolachnostylis maprouneifolia	x	x		
*Psidium guajava**			x	x
Pterocarpus angolensis	x			
Salvinia molesta			x	
*Senna spectabilis**				x
*Solanum mauritianum**		x		x
Steganotaenia araliacea		x		x
Strychnos cocculoides		x		
*Tagetes minuta**			x	x
Terminalia sericea	x	x		x
*Tithonia diversifolia**		x		x
Uapaca sansibarica		x		
Uapaca siberiana				x
Vachellia sieberiana			x	
Vangueria infausta		x	x	
Vangueriopsis lanciflora		x		
Xylomphis obovata				x
Ziziphus mucronata	x	x		x
SUCCULENTS				
Opuntia ficus-indica		x		x
*Opuntia stricta**		x		x
FORBS AND GRAMINOIDS				
Albuca abyssinica		x		
*Argemone Mexicana**		x		x
Aristida adscensionis		x		x
Aristida congesta		x		x
*Arundo donax**			x	
Ascolepis protea			x	
*Azolla filiculoides**			x	
*Bidens pilosa**	x		x	x
Bidens schimperi				x
Boophone disticha		x		
Brachiaria serrata		x		
*Cassytha filiformis**		x		x
Cenchrus ciliaris		x		x
Chloris gayana	x	x		x
*Cosmos sulphureus**				x
Commelina africana	x	x		
*Chromolaena odorata**		x		
Cynodon dactylon		x	x	x
Cyperus sp.			x	
Cyperus tenuiflorus			X	
Digitaria eriantha	x	x	x	
Diheteropogon amplectens	x	x		
Eragrostis biflora				x
*Eichhornia crassipes**			x	
Floscopa glomerata			X	
Heteropogon contortus	x	x		x
Hibiscus nigricaulis		x		x
Hyparrhenia sp.	x	x		

Species	Miombo woodland	Secondary Miombo Woodland	Freshwater Habitat	Transformed
Hypoxis nyasica			x	
Kyllinga pumila			x	
*Myriophyllum aquaticum**			x	
Panicum sp.	x	x	x	
Phragmites australis			x	
*Pistia stratiotes**			x	
Salvinia molesta			x	
Setaria pumila				x
*Ricinus communis**		x		x
Sporobolus africanus		x		x
Sporobolus fimbriatus		x		x
*Tagetes minuta**		x		x
*Tithonia diversifolia**		x		x

APPENDIX D: FLORAL SCC

Table D1: Executive Decree No. 252/18 Red List of Plant Species of Angola (2018). Listed under Category C – Vulnerable (VU).

Class		Common Name	Scientific Name	Direct threat	POC
Plants	1	Moreira	*Chiorophora excelsa*	Unsustainable exploitation	Low
	2	Munguba	*Entandrophragma utile*	Unsustainable exploitation	Low
	3	Muanza	*Albizia glaberrima*	Unsustainable exploitation	Low
	4	Undianuno/Kibaba	*Khaya anthotheca*	Unsustainable exploitation	Low
	5	Tacula	*Pterocarpus angolensis*	Unsustainable exploitation	Confirmed
	6	Ako	*Antiaris welwitschii*	Unsustainable exploitation	Low
	7	Longui	*Gambeya africana*	Unsustainable exploitation	Low
	8	Mafumeira	*Ceiba pentandra*	Unsustainable exploitation	Low
	9	Tola-Chifuta	*Oxystigma oxyphylium*	Unsustainable exploitation	Low
	10	Xinga-Xinca/Muazmza	*Piptadeniastrum africanum*	Unsustainable exploitation	Low
	11	Munguela	*Ricinodendron heudeloti*	Unsustainable exploitation	Low
	12	Imbondeiro	*Adansonia digitata*	Urbanisation and industrialisation	Low
	13	Kitiba	*Entandrophragma angolense*	Unsustainable exploitation	Low
	14	Ebano	*Diospyros mespiliformis*	Unsustainable exploitation	Low
	15	Pau-faro	*Caesalpinia leostachya*	Unsustainable exploitation	Low
	16	Pau-preto	*Dalbergia latifolia*	Unsustainable exploitation	Low
	17	Sândalo africano	*Santalum album*	Unsustainable exploitation	Low
	18	Mogna	*Khaya sp.*	Unsustainable exploitation	Low
	19	Kungulo-Mukungulo	*Autrenella congolensis*	Unsustainable exploitation	Low
	20	Mupanda	*Brachystegia spiciformis*	Unsustainable exploitation	Confirmed
	21	Welwitschia	*Welwitschia mirabilis*	Overgrazing	Low
	22	Mucumbi-Kumbi	*Lannea Welwitschii*	Unsustainable exploitation	Low
	23	N'Dulu-Ako	*Autriaris Welwitschia*	Unsustainable exploitation	Low
	24	Kababa-Ohia	*Celtis mildbraedii*	Unsustainable exploitation	Low
	25	Os mangais (todas as espécies)	*R macronata B. gymnorrhiza*	Indiscriminate harvesting and chemical pollution	Low
	26	Nfumbua	*Gnetum africanum*	Unsustainable exploitation	Low
	27	Makakata	*Harpagopphytum procumbens*	Unsustainable exploitation	Low
	28	Palmeiras Nativas		urbanization	Low
	29	Pau de Cabinda	*Pausinystalia macroceras*	Unsustainable exploitation	Low
	30	Pau-Rosa	*Swartzia fistuloide*	Unsustainable exploitation	Low

Table D2: Threatened and Protected flora listed on the IUCN list.

Species name	IUCN Status	Habitat and Direct threats	POC
Albizia ferruginea	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	Low

		infrastructure development. These activities contribute to habitat loss and fragmentation, putting pressure on the species and reducing its natural populations.	
Ansellia africana	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
Baphia dewevrei subsp. marquesii	VU	*Baphia dewevrei* subsp. *marquesii* 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
Barleria cyanea	NT	This species occurs in a variety of habitats including among open sandy flats with *Colophospermum mopane* and *Catophractes alexandri* woodland and thickets, at the 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.	Low
Barleria namba	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
Combretum aureonitens	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 *Combretum aureonitens* include habitat loss due to deforestation, land conversion for agriculture, and overgrazing by livestock.	Low
Croton gossweileri	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 *Croton gossweileri* include deforestation, habitat fragmentation, and land conversion for agriculture.	Medium
Ctenolophon englerianus	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
Dactyladenia floribunda	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 *Dactyladenia floribunda* include habitat destruction due to deforestation, agricultural expansion, and logging.	Low
Dalbergia macrosperma	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

Daniellia alsteeniana	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 *Daniellia alsteeniana* include deforestation, habitat fragmentation due to logging, and agricultural expansion.	Low
Disa aequiloba	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
Drypetes euryodes	CR	*Drypetes euryodes* is known from a woody rocky cliff and was collected at around 1,000 m in elevation. The primary threats to *Drypetes euryodes* include habitat loss due to deforestation, logging, and agricultural expansion.	Low
Entandrophragma angolense	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
Eugenia dewevrei	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 *Eugenia dewevrei* include habitat loss due to deforestation, illegal logging, and agricultural expansion, which fragment and degrade its natural environment.	Low
Fernandoa ferdinandi	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 *Fernandoa ferdinandi* include deforestation, habitat fragmentation due to logging, and agricultural expansion.	Low
Genlisea angolensis	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
Gnetum africanum	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 *Gnetum africanum* include deforestation, habitat fragmentation due to logging, and agricultural expansion, which impact its natural habitat and reduce its availability.	Low
Guibourtia carrissoana	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
Inversodicraea cristata	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	Low

		Cameroon; plus Tello and possibly Vina: J.-P. Gogue pers. comm. 2008).	
Inversodicraea warmingiana	VU	Aquatic herb, annual, submerged or not, growing fixed on rocks in waterfalls and rapids. It grows fixed by a thallus on rocks or any other hard object. Threats to this species include dams, misuse of water management that will negatively impact on preferred habitat.	Low
Isolona pilosa	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
Khaya anthotheca	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
Khaya senegalensis	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
Lysimachia elegantula	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
Mesanthemum glabrum	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
Mesanthemum reductum	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
Millettia gracilis	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
Millettia nudiflora	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
Mitragyna stipulosa	NT	It occurs in swamps and marshy localities and on the edge of wetlands. It is a light-demanding species dispersed by 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.	Low
Monotes pearsonii	VU	It occurs on wooded slopes on shallow rocky soils (Meerts et al. 2017). It occurs in woodland associated with Brachystegia and	Low

		other Monotes 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.	
Monotes rubriglans	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
Pavetta gossweileri	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
Piptostigma exellii	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
Pogostemon micangensis	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
Polyscias letestui	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 Polyscias letestui include habitat loss due to deforestation, illegal logging, and agricultural expansion, which cause fragmentation and degradation of its natural habitat.	Low
Prunus africana	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
Rotala smithii	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
Schumanniophyton hirsutum	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
Scleria pulchella	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

Turraeanthus africanus	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
Utricularia bracteata	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
Vepris welwitschii	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
Vigna procera	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
Vitex cuspidata	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, which result in fragmentation and degradation of its natural habitat.	Low
Albizia ferruginea	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

APPENDIX E: LEGISLATION

Ministry of Environment (MINAMB)

The Ministry of Environment (MINAMB) is the Ministerial Department responsible to formulate, conduct, supervise, evaluate, and execute the Executive's policy in the field of protection, preservation and conservation of environmental quality, pollution control, areas of conservation and enhancement of natural heritage, as well as the preservation and rational use of mineral resources.

MINAMB comprises a set of agencies and services, in particular, the National Directorate for the Prevention and Assessment of Environmental Impacts (Direcção Nacional de Prevenção e Avaliação de Impactes Ambientais (DNPAIA)), which is the service responsible for the conception and implementation of policies and strategies to prevent the incidences of environmental impacts.

Depending on the type of project being developed, the Environmental Impact Assessment (EIA) report must also be approved by the line ministry. This ensures that the EIA not only addresses the requirements of the Environmental Baseline Law and the Presidential Decree on EIA and Environmental Licensing, but also the relevant sectoral legislation.

MINAMB is responsible for the implementation of the Environment Framework Law 5/98, the approval of EIAs under the Presidential Decree 117/20 on EIA and Environmental Licensing Procedure, and all associated Regulations.

Environmental Legislation

The General Environmental Law No. 5/98

The General Environmental Law (Lei de Bases do Ambiente, LBA) was promulgated in accordance with the Constitutional Law of the Republic of Angola. The purpose of the law is to provide the framework for environmental legislation and regulations; more specifically to define the basic concepts and principles for the protection, preservation and conservation of the Environment, promotion of quality of life and the rational use of natural resources (Article 1). The LBA incorporates international declarations which Angola has ratified and defines citizens' rights and responsibilities. Further, the LBA introduces the concept of legal penalties for illegal activities that have caused damage to the environment.

Article 4 includes a number of principles guiding LBA, including a principle in respect of liability: all persons or organisations which through their actions cause harm to the environment, or the degradation, destruction or depletion of national resources, shall be held liable for the same, and shall be required to repair such damage and/or pay compensation for the damage caused.

Article 16(1) of LBA stipulates that an EIA, including public consultation (Articles 10 and 32), is mandatory for all undertakings which have an impact on the balance and wellbeing of the environment and society. Article 16(2) states that more specific legislation on EIAs will be developed by the government.

An Environmental License is issued on the basis of an EIA/EIS and a license is required before any other license required by law will be granted (Article 17(2)). According to the LBA, MINAMB is responsible for issuing environmental licenses.

Decree No.117/20 on General Regulation for Environmental Impact Assessment and Environmental Licensing Procedure

This decree establishes the standards and procedures that regulate the environmental impact assessment of public and private projects and the environmental licensing procedure for activities that, due to their nature, location or dimension, may cause significant environmental and social impact (Article 1). Applies to all public or private activities that may directly or indirectly influence environmental components (Article 2).

This decree revokes the regulations previously in force on these matters (Decree No. 51/04, of 23 July 2004, on EIA, and Decree No. 59/07, of 13 July, on Environmental Licensing), as well as all legislation that contradicts its wording. Chapter II of the decree focuses on EIA, and Chapter III establishes the provisions applicable to Environmental Licensing. Chapter IV sets out the requirements for monitoring the provisions of the decree, the fees to be paid and the fines and accessory penalties applicable to infractions.

Article 7 refers to the categorization of the activities and therefore Annexes I to V list the activities that are classified under Category A, B, C, D and E, respectively, and specifies the requirements for each one of those categories. For activities under category A, an EIA is required as well as Terms of Reference (TOR) and an Environmental Pre-Feasibility Study and Scoping (EPDA) (Article 7 and 12); Category B requires an EIA and the preparation of TOR for its elaboration; and Category C will require a Simplified Environmental Study and TOR.

At the beginning of an EIA procedure, the project owner (in this instance, Soul Rock) must register the proposed activity, under the terms of the applicable legislation in force, in the Integrated Environmental System (SIA). The Ministerial Department that oversees the proposed activity must, within 5 (five) days, after receiving the Environmental Impact Study, issue an opinion on the project to be licensed (Article 6 (3)).

Within a maximum period of 30 (thirty) days from the date of receipt of the documentation, the Ministerial Department responsible for the Environment Sector sends the respective opinion to the competent authority to license or authorize the project (Article 17). Therefore, the project that has received a negative opinion from the Minister responsible for the Environment cannot be given authorization or license (Article 18 (1)). Furthermore, the decision taken by MINAMB can be appealed under the general terms of administrative procedures and litigation (Article 18 (2)).

This decree adopts provisions concerning requirements, criteria and administrative procedures related to Environmental Licenses. In terms of Article 26, any activity requiring an EIA must apply for an Environmental License, which the MINAMB issues.

Water Law No. 6/02

Article 10 states that the objective of the State is “to ensure the use of available water for all purposes through its rational and planned use for the sustained development of the national economy” and also to “promote, frame and regulate the use of water for agricultural, livestock, industrial and hydroelectric purposes”.

The law states that private use of water cannot come before public use: “Common uses, as described in articles 21 and 22, have priority over any private use, so that private use cannot be granted or maintained to the detriment of those”.

Pursuant to Articles 22 and 24, water uses are classified as (1) common (public) use, which refers to water taken from natural sources without any administrative approval, and (2) private water use, which requires a license. Common (public) water uses have priority over private water uses. Articles 24 and 26 of the Act further clarify private uses that require and do not require a license or concession.

The supply of water to the population for human consumption and health needs has priority over other private uses (Article 33(2)).

Article 41 (1) establish that private use of water depends on licensing, in which its use does not significantly change the quality and quantity of the water and the environmental balance, in accordance with the Regulation. n.º2 of the same Article states that the following also depends on licensing: a) prospecting, pumping water and use of groundwater, except the activities described line c) of n.º1 of article 26 of this law[1]; b) deposits installation, the crops implantation or plantations and the cut down of trees on the beds and banks of the continuous or discontinuous natural currents and lakes, lagoons and marshes; and c) the extraction of inert materials, such as sand and gravel, from the beds and margins of continuous or discontinuous natural currents and from lakes, lagoons and marshes.

In terms of Article 68, Section 1 of the law, "the discharge of wastewater, wastes or other substances, and any activities that cause pollution or degradation of public water, is dependent on authorisation granted by the institution responsible for managing water resources".

Law No. 9/04, Land Law

The present law establishes the general bases of the legal regime of the lands integrated in the original property of the State, the land rights and the general regime of transmission, constitution, exercise and extinction of these rights (Article 2).

This law shall apply to rural and urban land over which the State constitutes any of the land rights provided for the benefit of natural persons or legal persons governed by public or private law, in particular with a view to pursuing agricultural purposes, livestock, forestry, mining, industrial, commercial, housing, urban or rural building, land use planning, environmental protection and anti-erosion (Article 3(1)).

The State respects and protects the land rights held by rural communities, including those based on custom or custom (Article 9(1)). Number 2 of the same Article establishes that land in rural communities may be expropriated for the purpose of public utility and to be an object of requisition, with fair compensation.

According to Article 16(1), "The occupation, the use, and usufruct of the land is subject to the rules on environmental protection, in particular those related to the protection of the landscape, and the species of flora and fauna, preservation of the ecological balance, and the citizens' rights to a healthy, and unpolluted environment".

Article 19(3) states that grantable land[2] is classified into urban and rural land. Rural land is considered to be the rustic building situated outside the area bounded by a charter or the area of an urban agglomeration and intended to be used for agricultural, livestock, forestry and mining purposes (Article 19(5)).

According to Article 22(1), rural land is classified according to the purpose for which it is intended and the legal regime to which it is subject, in rural community land, to agricultural land, forest land, installation land and road land. Rural community land is land occupied by families of local rural communities for their dwelling, practice of their activity or for other purposes recognised by custom or this law and its regulations (Article 22(2)). Number 5 of the same article defines that the installation land is the land provided for the implementation of mining, industrial or agro-industrial installations, under the terms of the present law and the respective legislation applicable to mining and oil activities and industrial parks.

Community rural land are considered, according to the Article 23(1), as land used by a rural community in accordance with customary land use, including, as appropriate, complementary areas for shifting agriculture, transhumance corridors for access by livestock to water sources and pastures and crossings, whether or not subject to the easement regime, used to access water or roads or access roads to urban areas.
It is competent, for the classification of a land as land of mining and oil installation, the body that oversees the planning of the territory and the environment, upon proposal or prior opinion of the entities that oversee the respective area (Article 25(2)).

Presidential Decree No. 26/20 (National Biodiversity Strategy and Action Plan 2019-2025)

To implement the recommendations from the United Nations Convention on Biological Diversity (UNCBD, ratified by Resolution No. 23/97), the Government approved through Resolution No. 42/06 of 26 July 2006, the National Biodiversity Strategy and Action Plan (NBSAP). However, this Resolution was revoked by Presidential Decree No. 26/20 that approves the National Biodiversity Strategy and Action Plan 2019-2025, an annex of this Presidential Decree.

This strategy aims to incorporate measures for the conservation and sustainable use of biological diversity and the fair and equitable distribution of biological resources favouring all Angolans into policies and development programmes.

The NBSA) of the Republic of Angola was developed to serve as an integrated strategic framework. the conservation and sustainable use of biodiversity can be organized and coordinated to fulfil an Action Plan over seven years (2019-2025).

Presidential Decree No. 194/11 on Liability on Environmental Damage

This decree establishes strict liability for degradation of the environment. Aimed at preventing and repairing environmental damage, the decree establishes that all activities capable of causing damage to the environment (Article 3(1)) are considered liabilities and are subject to regulation under the “polluter pays” principle.

According to the decree, any entity responsible for pollution (by act of wilful misconduct or negligence) will be held responsible for cleaning up and restoring the environmental damage. Responsibility will be held for losses and damages caused to the environment by way of compensation for damages and environmental recovery measures.

Article 18º informs the right of the public to request intervention when there is concern that environmental damage has taken place. In Article 21º, the Decree also states that any individuals or legal entities which carry out activities that impose environmental risks shall have civil liability insurance.

Presidential Decree No. 261/11 on Water Quality

This decree serves as an addition to the national Water Law No. 6/02, dealing specifically with water quality. It establishes the roles within the Angolan governmental administration for overseeing water quality issues and addressing the water quality standards relating to human consumption and waste water. The decree also lists the role of water quality monitoring and the standard parameters for drinking water, surface water and emissions limits for wastewater discharge (in Annex VI).

According to item 3 of Article 1, this law also regulates the control standards of wastewater discharge in water bodies and soil to preserve the quality of the aquatic environment and protect public health.
Article 13 of Chapter III (Protection of Waters Against Pollution of Discharged Wastewater) defines that the discharge of wastewater from a treatment facility into water and soil requires a license issued by the Ministry of Environment, in which discharge standards for mitigation or prevention of damage are set.

Presidential Decree No. 82/14, approves the Regulation on the General Use of Water Resources

This decree applies to surface water and groundwater, namely watercourses, lakes, lagoons, swamps, springs, reservoirs, estuarine areas and other water bodies, without prejudice to the respective watercourse bed, river banks and surroundings.

Article 17 states that the use of water resources for private use need a specific title of use (concession or license).

Article 109(2) establishes that holders of rights to use water resources shall in general be prohibited from:
"b) Accumulate solid wastes, liquids or any substances in places and conditions that may contaminate or create danger of water resources contamination;
c) Carry out any activities that imply or may imply the degradation or pollution of the water resources;
d) Make any changes to the regime, flow, quality and use of water resources that may affect the public health, natural resources, the general environment, security and national sovereignty;
e) Carry out any activities in the water protection zones."

Article 110 establishes that proponents shall consider a 200m buffer zone as follows: "*areas of protection of water resources, the water course beds, river banks and water courses adjacent zones of up to a distance of 200 metres*".

Article 111 defines, as it is forbidden, in the protection zones of the water resources, in terms of the present Diploma and other applicable laws:
"d) Install dumps or heaps resulting from mining activity;
f) Install pipelines and reservoirs of hydrocarbons or wastewater."

Article 119 states that: "*without prejudice the provisions of this legal document, the assignment of any permits for the use of water resources, independently of its end, is subject to prior approval by the corresponding environmental impact studies, provided that that the legislation in force to require, by virtue of its nature, size or location, which may have significant environmental and social impacts*."

Sections I and II from Chapter VIII (Fees) presents the calculations related with the fees to be paid for water abstraction and wastewater discharge.

Executive Decree No. 469/15 on the slaughter prohibition in the national territory of protected species of the fauna and wild flora

This executive decree establishes a ban on the slaughtering of wild fauna and flora (protected species) on national territory, in order to avoid the illegal hunting and trafficking of valuable objects, activities which, in recent years have assumed high levels, endangering the biodiversity, under the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES), assigning to the Ministry of Environment inspectors the responsibility for overseeing and define the regime of sanctions.

Joint Executive Decree No. 201/16 on Animals that may not be Hunted

The joint executive decree establishes a list of animals for which hunting is prohibited in Angola (Table 2) and a list of animals for which hunting is permitted in each season (Table 3) and respective amounts of compensation rates due to the State.

Law No. 6/17, General Framework Law on Forests and Wildlife

This law regulates the protection of forests and wildlife, with the objectives of conservation and sustainable use. Article 30(1) forbids tree felling and deforestation; article 30(2) states the need for authorization from the Department responsible for Forest and Fauna sectors for any purpose, especially agricultural, mining and public works.
According to Article 35 (EIA), projects that are likely to significantly impact forests, wildlife, and ecosystems require environmental impact assessments. This shall be emphasised by the Department responsible for Forests and Fauna sectors, collaborating with other departments.

Executive Decree No. 252/18 that approves the Red List of Species of Angola

This decree approves the Angolan Red List of Species. According to Article 2, this list consists of four categories:

a. Category A - Extinct Species (Ex), when the species has a natural occurrence in Angola and is considered extinct or has never been seen in its habitat;
b. Category B - Threatened Species of Extinction (AEx), when several factors seriously threaten its existence, hindering its reproduction or natural regeneration, bringing its populations below sustainable levels;
c. Category C - Vulnerable Species (Vul), when human activity threatens its natural occurrence in the National Territory; and
d. Category D - Invasive Species, when the species does not occur naturally or is introduced into the National Territory.

The categories of each species are updated using available scientific information every five years.

Presidential Decree No. 171/18 on Forestry Regulations

This decree regulates the sustainable management of forest resources and related ecosystems. It aims to establish standards for its conservation and rational use, taking into account these resources' environmental, social, economic and cultural dimensions.

According to Article 14(1), "*Protected trees has the status of natural monuments and are identified on the ground by a sign indicating the common and scientific names of the species and classification*". Article 14(2) states that "*It is prohibited to cut or damage protected trees*".

APPENDIX F: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Hennie de Beer	BTech Nature Conservation (Tshwane University of Technology)
Christien Steyn	MSc Plant Science (University of Pretoria)
Stephen van Staden	MSc Environmental Management (University of Johannesburg)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Terrestrial Services		
Postal address:	PO. Box 751779, Gardenview		
Postal code:	2047	Fax:	086 724 3132
Telephone:	011 616 7893		
Name / Contact person:	**Hennie de Beer**		
E-mail:	hennie@sasenvgroup.co.za		
Qualifications	BTech Nature Conservation (Tshwane University of Technology) National Diploma Nature Conservation (Tshwane University of Technology)		
Name / Contact person:	**Christien Steyn**		
E-mail:	christien@sasenvgroup.co.za		
Qualifications	MSc (Plant Science) (University of Pretoria) BSc (Hons) Plant Science (University of Pretoria) BSc (Environmental Sciences) (University of Pretoria)		
	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Member of the South African Association of Botanists (SAAB) Member of the Botanical Society of South Africa (BotSoc) Southern African Wildlife Management Association (SAWMA) Grassland Society of South Africa (GSSA) Land Rehabilitation Society of Southern Africa (LaRSSA)		
Name / Contact person:	**Stephen van Staden**		
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health Practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum Member of the Gauteng Wetland Forum Member of International Association of Impact Assessors (IAIA) South Africa; Member of the Land Rehabilitation Society of South Africa (LaRSSA)		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Hennie de Beer, declare that -

- I act as the **independent specialist** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



Signature of the Specialist

I, Christien Steyn, declare that -

- I act as the **independent specialist (reviewer)** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that June compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or June have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.



Specialist Signature

I, Stephen van Staden, declare that -

- I act as the **independent specialist (reviewer)** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF HENNIE DE BEER

PERSONAL DETAILS

Position in Company	Faunal Ecologist
Joined SAS Environmental Group of Companies	2014, 2023

EDUCATION

Qualifications

BTech Nature Conservation (Tshwane University of Technology)	2021
National Diploma Nature Conservation (Tshwane University of Technology)	2008

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Eastern Cape, Western Cape, Northern Cape, Free State
Africa - Mozambique

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Floral Assessments
- Faunal Assessments
- Avifaunal Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

Freshwater Assessments

- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Rehabilitation Assessment / Planning

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTIEN STEYN

PERSONAL DETAILS

Position in Company	Senior Floral Ecologist and Discipline Lead
Joined SAS Environmental Group of Companies	2018

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 127823/21)
Member of the Botanical Society of South Africa (BotSoc)
Member of the Grassland Society of South Africa (GSSA)
Member of the Land Rehabilitation Society of Southern Africa (LARSSA)
Member of the South African Association of Botanists (SAAB)

EDUCATION

Qualifications

MSc Plant Science (University of Pretoria)	2017
BSc (Hons) Plant Science (Invasion Biology) (University of Pretoria)	2014
BSc Environmental Science (University of Pretoria)	2013

Short courses and Training

- BotSoc Branch: Species Environmental Assessment Guidelines Course (2022).
- Advanced Grass Identification Course (2021).
- Practical Plant Identification, including Herbarium Usage and Protocols.
- Vegetation Classification and Mapping: Use of Geographic Information System for understanding vegetation pattern and biodiversity conservation.
- Introduction to Statistics for Biologists: Applications of plant ecology principles in plant conservation, i.e., species distribution modelling, alien plant invasions, conservation planning.
- International Plant Functional Trait Course: Hands-on, field-based exploration of plant functional traits, along with experience in the usage of plant traits data in climate-change research and ecosystem ecology. https://www.uib.no/en/rg/EECRG/97477/plant-functional-traits-course-2

AREAS OF WORK EXPERIENCE

South Africa – Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West.
Africa – Lesotho, Sierra Leone.

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Terrestrial Ecological and Biodiversity Scoping Assessments
- Terrestrial Ecological and Biodiversity Screening Assessments
- Floral Assessments
- Input into Terrestrial Rehabilitation Plan design with the focus on the re-establishment of vegetation
- Floral Rescue and Relocation Plans
- Alien and Invasive Plant Control and Management Plans (AIPCPs)
- Alien and Invasive Plant Identification and awareness training
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting
- Desktop Studies, Mapping and Background Information Research

Freshwater Assessments

- Desktop Freshwater Ecosystem Delineation

- Freshwater Ecosystem Rehabilitation Assessment / Planning
- Freshwater Ecosystem Maintenance and Management Plans
- Freshwater Ecosystem Plant Species Plans

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health Practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)
5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits

- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

Appendix I: Terrestrial fauna





Section C: Faunal Assessment

FOR THE PROPOSED CASSINGA POWERLINE SUPPLY PROJECT IN ANGOLA

Prepared for: SRK Consultants
Report authors: C. Hooton
Report reviewers: S. van Staden (Pr. Sci. Nat)

Report Reference: STS 24-2026
Date: September 2024
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Part of the SAS Environmental Group of Companies
Website: http://www.sasenvironmental.co.za

SCIENTIFIC TERRESTRIAL SERVICES

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GLOSSARY OF TERMS

Alien species (syn. exotic species; non-native species)	A species that is present in a region outside its natural range due to human actions (intentional or accidental) that have enabled it to overcome biogeographic barriers.
Biological diversity or Biodiversity (as per the definition in NEMBA)	The variability among living organisms from all sources including, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part and includes diversity within species, between species, and of ecosystems.
Biodiversity priority areas	Features in the landscape or seascape that are important for conserving a representative sample of ecosystems and species, for maintaining ecological processes, or for the provision of ecosystem services. They include the following categories, most of which are identified based on systematic biodiversity planning principles and methods: Protected Areas, Critically Endangered and Endangered ecosystems, Critical Biodiversity Areas and Ecological Support Areas, Freshwater Ecosystem Priority Areas, high water yield areas, flagship free-flowing rivers, priority estuaries, Priority Areas for land-based protected area expansion, and focus areas for offshore protection. Marine ecosystem priority areas and coastal ecosystem priority areas have yet to be identified but will be included in future. The different categories *are not mutually exclusive* and, in some cases, overlap, often because a particular area or site is important for more than one reason. They should be *complementary*, with overlaps *reinforcing the importance* of an area.
Community Characterisation	Comparisons can be made among communities using attributes such as species richness, species diversity, and evenness. ➢ **Species richness** is simply the number of species in a community. ➢ **Species diversity** is more complex and includes a measure of the number of species in a community, and a measure of the abundance of each species. ➢ **Species evenness** is a description of the distribution of abundance across the species in a community. Species evenness is highest when all species in a sample have the same abundance. Evenness approaches zero as relative abundances vary. Source: https://tinyurl.com/2p9yr3j8
Corridor	A dispersal route or a physical connection of suitable habitats linking previously unconnected regions.
Critically Endangered (CR) (IUCN[1] Red List category)	**Applied to both species/taxa and ecosystems**: A species is CR when the best available evidence indicates that it meets at least one of the five IUCN criteria for CR, indicating that the species is facing an extremely high risk of extinction. CR ecosystem types are at an extremely high risk of collapse. Most of the ecosystem type has been severely or moderately modified from its natural state. The ecosystem type is likely to have lost much of its natural structure and functioning, and species associated with the ecosystem may have been lost. CR species are those considered to be at extremely high risk of extinction.
Degradation	The many human-caused processes that drive the decline or loss in biodiversity, ecosystem functions or ecosystem services in any terrestrial and associated aquatic ecosystems.
Disturbance	A temporal change, either regular or irregular (uncertain), in the environmental conditions that can trigger population fluctuations and secondary succession. Disturbance is an important driver of biological invasions.

[1] International Union for Conservation of Nature (IUCN)

Driver (ecological)	A driver is any natural or human-induced factor that directly or indirectly causes a change in ecosystem. A direct driver clearly influences ecosystem processes, where indirect driver influences ecosystem processes through altering one or more direct drivers.
Ecological Condition	"Ecological condition" means the extent to which the composition, structure and function of an area or biodiversity feature has been modified from a reference condition of "natural". Various terminology can be used for precision of language: ➢ Fair ecological condition: Areas that are moderately modified, semi-natural. An ecological condition class in which ecological function is maintained even though composition and structure have been compromised. Can apply to a site or an ecosystem. ➢ Good ecological condition: Areas that are natural or near natural. An ecological condition class in which composition, structure and function are still intact or largely intact. Can apply to a site or an ecosystem. ➢ Poor ecological condition: Areas that are severely or irreversibly modified. An ecological condition class in which ecological function has been compromised in addition to structure and composition. Can apply to a site or an ecosystem.
Ecological processes	The functions and processes that operate to maintain and generate biodiversity. To include ecological processes in a biodiversity plan, their spatial components need to be identified and mapped.
Endangered (EN) (IUCN Red List category)	**Applied to both species/taxa and ecosystems**: A species is EN when the best available evidence indicates that it meets at least one of the five IUCN criteria for EN, indicating that the species is facing a very high risk of extinction. EN ecosystem types are at a very high risk of collapse. EN species are those considered to be at very high risk of extinction.
Endemic species	Species that are only found within a pre-defined area. There can therefore be sub-continental (e.g., southern Africa), national (South Africa), provincial, regional, or even within a particular mountain range.
Faunal Class	In biological classification, class (Latin: classis) is a taxonomic rank, as well as a taxonomic unit. Class specifically refers to major groups, namely: mammals, avifauna (birds), reptiles and invertebrates.
Ground-truth	Ground truth is a term used in various fields to refer to information provided by direct observation (i.e., empirical evidence) as opposed to information provided by inference.
Habitat	A place where a species or ecological community naturally occurs.
Habitat loss	Conversion of natural habitat in an ecosystem to a land use or land cover class that results in irreversible change in the composition, structure and functional characteristics of the ecosystem concerned.
Indigenous vegetation	Vegetation occurring naturally within a defined area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.
Integrity (ecological)	The integrity of an ecosystem refers to its functional completeness, including its components (species) its patterns (distribution) and its processes.
Invasive species	Alien species that sustain self-replacing populations over several life cycles, produce reproductive offspring, often in very large numbers at considerable distances from the parent and/or site of introduction, and have the potential to spread over long distances.
Least Threatened	Least threatened ecosystems are still largely intact.
Near Threatened (according to IUCN)	Close to being at high risk of extinction in the near future.
Niche (ecological)	The role and position a species have in its environment; how it meets its needs for food and shelter, how it survives, and how it reproduces. A species' niche includes all of its interactions with the biotic and abiotic factors of its environment.
Protected	Species of high conservation value or national importance that require protection, according to TOPS 2007 and NEMBA.

Red Data Listed (RDL) species	According to the Red List of South African plants (http://redlist.sanbi.org/) and the International Union for Conservation of Nature (IUCN), organisms that fall into the Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.
Resource (ecological)	A resource is a substance or object in the environment required by an organism for normal growth, maintenance, and reproduction. Resources can be consumed by one organism and, as a result, become unavailable to another organism.
Species of Conservation Concern (SCC)	The term SCC in the context of this report refers to all RDL and IUCN listed threatened species as well as provincially and nationally protected species of relevance to the project.
Threatened ecosystem	An ecosystem that has been classified as CR, EN or VU, based on an analysis of ecosystem threat status. A threatened ecosystem has lost or is losing vital aspects of its structure, function, or composition. The NEMBA allows the Minister of Environmental Affairs or a provincial MEC for Environmental Affairs to publish a list of threatened ecosystems. To date, threatened ecosystems have been listed only in the terrestrial environment. In cases where no list has yet been published by the Minister, such as for all aquatic ecosystems, the ecosystem threat status assessment in the National Biodiversity Assessment (NBA) can be used as an interim list in planning and decision making.
Threatened species	A species that has been classified as CR, EN or VU, based on a conservation assessment (Red List), using a standard set of criteria developed by the IUCN for determining the likelihood of a species becoming extinct. A threatened species faces a high risk of extinction in the near future.
Vulnerable (VU) (Red List category)	**Applied to both species/taxa and ecosystems**: A species is VU when the best available evidence indicates that it meets at least one of the five IUCN criteria for VU, indicating that the species is facing a high risk of extinction. An ecosystem type is VU when the best available evidence indicates that it meets any of the criteria A to E for VU and is then considered to be at a high risk of collapse.

LIST OF ACRONYMS

AIP	Alien and invasive plant
BI	Biodiversity Importance
CI	Conservation Importance
CR	Critically Endangered
CVB	Channelled Valley Bottom
EAP	Environmental Assessment Practitioner
EOO	Extent of occurrence
ESIA	Environmental and Social Impact Assessment
EIS	Ecological Importance and Sensitivity
EN	Endangered
ESMP	Environmental and Social Management Plan
FI	Functional Integrity
GIS	Geographic Information Systems
GN	Government Notice
GPS	Global Positioning System
IEM	Integrated Environmental Management
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Areas
km	kilometres
LC	Least Concern
NA	Not Applicable
NT	Near Threatened
OHL	Overhead Line
PAOI	Project Area of Influence
PES	Present Ecological State
POC	Probability of Occurrence
RDL	Red Data listed
RLE	Red List of Ecosystems
RR	Receptor Resilience
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
SEI	Site Ecological Importance
STS	Scientific Terrestrial Services [Pty] Ltd
UCVB	Unchannelled valley bottom
VU	Vulnerable

1 INTRODUCTION

Scientific Terrestrial Services (STS) was appointed to conduct faunal and floral ecological assessments as part of the Environmental and Social Impact Assessment (ESIA) process for the proposed Overhead Powerline (OHL) with a 200m buffer (100m either side of the OHL) and associated substations, henceforth referred to as the "study area".

1.1 Project Location

The study area is located is located south of the centre of Angola, namely, in the provinces of Huila and Huambo (Figure 1 and 2). The Project powerline extends for about 170 km, crossing six municipalities which include Jamba, Kuvango, Dongo, Galangue, Chipindo and Kalima.

The purpose of this report is to define the faunal ecology of the study area, to identify areas of increased Ecological Importance and Sensitivity (EIS), as well as the mapping of such areas, and to describe the Present Ecological State (PES) of the study area as well as to collect sufficient data to define the site in terms of the International Finance Corporation (IFC) Performance Standards (2012).

1.2. Scope of Work

The objective of this study:

- To provide inventories of faunal species or signs thereof as encountered within the study area;
- To provide descriptions pertaining to habitat types from a faunal perspective, communities and the ecological state of the study area and to define the sensitivity of each habitat based on the SANBI Site Ecological Importance (SEI) method;
- To identify and consider the integrity of all sensitive landscapes including rocky ridges, wetlands and/ or any other special features;
- To conduct a Red Data Listed (RDL) species assessment as well as an assessment of other species of conservational concern (SCC), including potential for such species to occur within the study area;
- To define the various habitat units in accordance with the IFC guidelines;
- To provide detailed information to guide the final layout of the proposed construction of a tailings dam; and
- To assess the potential impacts and risks that the proposed OHL and substations will pose to faunal species and faunal habitat.

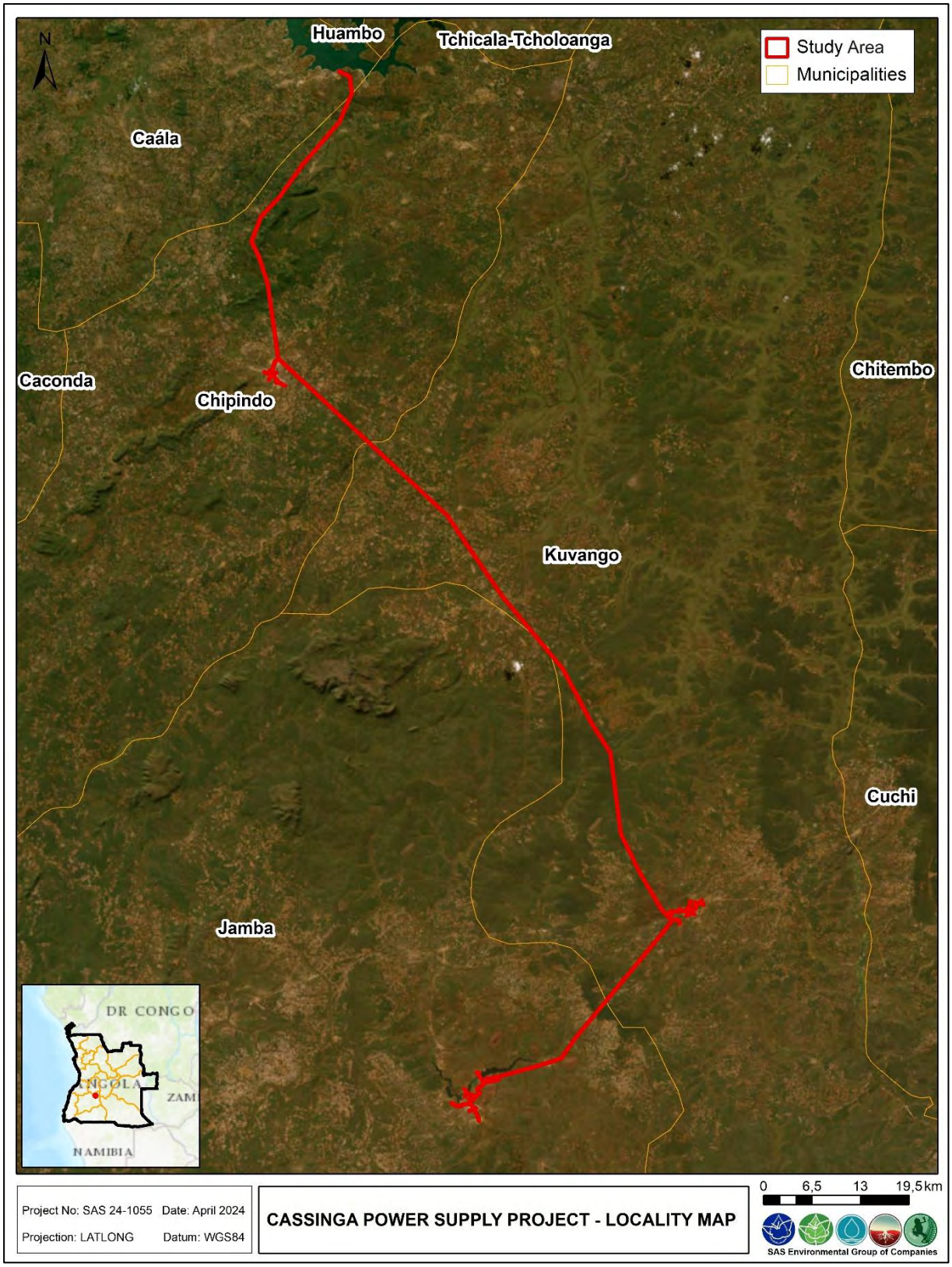


Figure 1: Digital satellite imagery depicting the location of the study area associated with the proposed Cassinga OHL.



Figure 2: Topography map depicting the location of the study area associated with the proposed Cassinga OHL.

1.3. Legislative requirements

The following legislation was taken into consideration during the assessment (Refer to Part A, Appendix B for further detail):

- The Constitution of the Republic of Angola (2010);
- Law No. 5/98 - Environment Framework Law;
- Law No. 6/17 - General Framework Law on Forests and Wildlife;
- Law No. 6/02 – Water Law;
- Law No. 9/04 – Land Law;
- Presidential Decree No. 117/20 - General Regulation for Environmental Impact Assessment and Environmental Licensing Procedures;
- Presidential Decree No. 26/20 (National Biodiversity Strategy and Action Plan 2019-2025);
- Executive Decree No. 469/15 on the slaughter prohibition in the national territory of protected species of the fauna and wild flora;
- Joint Executive Decree No. 201/16 on Animals that may not be hunted;
- Presidential Decree No. 194/11 - Environmental Damage Regulations;
- Presidential Decree No. 261/11 on Water Quality;
- Executive Decree No. 252/18 approving the Red List of Animal and Plant Species of Angola;
- Presidential Decree No. 171/18 on Forestry Regulations
- Equator Principles Version 4 (2020);
- IFC Environmental Health and Safety General Guidelines (2007); and
- IFC Performance Standards (2012).

1.4. Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The faunal assessment was primarily based on the study area, however, due to access/movement restrictions, where the OHL could not be accessed, representative sites in the adjacent areas were assessed as proxies. The study area surroundings were also considered in terms of faunal habitat utilisation and movement patterns;
- Due to the increased risk of land mines along the proposed study area, on foot investigations were restricted and often confined to areas cleared and deemed safe to

access by the de-mining team. Such restrictions limited extensive on foot investigations of the study area and reference sites;

- With ecology being dynamic and complex and the habits of many faunal species, some aspects (some of which may be important) may have been overlooked. Due to the access restrictions, proxies and database information has been heavily relied upon in order to infer species diversity. The information provided is however considered sufficient to allow informed decision making to take place and facilitate integrated environmental management;
- The field assessment took place during the wet season (6th – 10th April and 15th – 19th July 2024), however a more comprehensive assessment would require that assessments take place in all seasons of the year so a better understanding of faunal communities in the study area can be determined. However, on-site data was augmented with all available desktop data which is deemed sufficient for the study;
- A dry season assessment is still planned and the data collected during this site visit will be incorporated into this report to further saturate species lists and habitat assessments; and
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa within the footprint area may therefore have been missed during the assessment.

1.5. Information Sources

For the purposes of this study, various online databases were consulted in order to gather information in support of the site assessment. It is noted that species data and occurrences for Angola are not as comprehensive, however the available data is still considered sufficient for the purpose of the proposed OHL.

Databases consulted for the purpose of this study include:

- The IUCN Red List for Angola;
- iNaturalist online database records;
- Previous studies undertaken by STS within Angola; and
- Angola red list for animals (2018).

2 ASSESSMENT APPROACH

An on-site visual investigation of the study area was conducted from the 6th – 10th April and 15th – 19th July 2024 to confirm and ground truth the assumptions made during the consultation of the background maps and datasets and to determine whether the sensitivity of the terrestrial biodiversity associated with the study area confirms the outcome of the Screening Tool.

General habitat types found throughout the study area were determined based on satellite imagery and background information, which were then, where possible, ground truthed during the site assessment. Specific study sites were selected that were considered to be representative of the habitats found within the study area, with special emphasis being placed on areas that may potentially support faunal SCC. As far as possible, sites were investigated on foot to identify the occurrence of fauna within the study area.

A detailed explanation of the method of assessment is provided in Appendix A of this report. The faunal categories covered in this assessment are mammals, avifauna, herpetofauna (reptiles and amphibians), general invertebrates, and arachnids. For the methodologies relating to the impact assessment and development of the mitigatory measures, please refer to Appendix B.

2.1 General approach

In order to accurately determine the Present Ecological State (PES) of the study area and capture comprehensive data with respect to faunal taxa, the following methodology were applied:

- Maps and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. An initial visual on-site assessment of the study area was made in order to confirm the assumptions made during consultation of the digital satellite imagery;
- A literature review with respect to habitats, vegetation types and species distribution was conducted;
- Relevant databases considered during the assessment of the study area included the International Union for Conservation of Nature (IUCN), iNaturalist databases, and any previous assessments undertaken by STS in Angola;
- Specific methodologies for the assessment, in terms of field work and data analysis of faunal ecological assemblages are presented in Appendix A of this report; and
- For the methodologies relating to the impact assessment and development of the mitigatory measures, please refer to Appendix B.

2.2 Sensitivity Mapping

All the ecological features of the assessment areas were considered, and sensitive areas were delineated with the use of a Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these features onto satellite imagery. The sensitivity map should assist the Environmental Assessment Practitioner (EAP) / proponent as to the suitability of the proposed development within the assessment areas. These habitat types were assigned SEI categories based on their ecological integrity, conservation value, the presence of species of conservation concern and their ecosystem processes. The SEI was determined for every habitat unit within the study area observations. (Refer to Appendix A for details regarding the descriptions of the SEI criteria and scoring).

2.3 Faunal Species of Conservational Concern Assessment

During field assessments, it is not always feasible to identify or observe all species within an area, largely due to the secretive nature of many faunal species, possible low population numbers or varying habits of species. As such, and to specifically assess an area for faunal SCC, a Probability of Occurrence (POC) estimation is used, considering several factors to determine the probability of faunal SCC occurrence within the study area. Species listed in Appendix C with known distribution ranges and habitat preferences included in the proposed infrastructure development sites were taken into consideration. Faunal species likely to occur within the study area are indicated and briefly discussed within each of the relevant dashboards, along with their POC.

3 PROJECT ACTIVITIES POSING POTENTIAL IMPACTS

The clearance of vegetation (faunal habitat) as part of the construction process will impact faunal upon faunal species and lead to their displacement from the footprint areas. The increased presence of people and equipment at the construction sites and laydown areas will likely further result in species displacement as fauna seek to move away from high usage area (natural predatory / threat avoidance behaviour by fauna). The overhead line may also pose a threat to avifauna, notably adjacent and within the freshwater habitat. Suspended cables pose a collision risk to avifauna, notably in the early mornings, late evenings and at night. Pylon structures may further be utilised by avifauna for roosting/nesting, placing them at increased risks of electrocution whilst large nests pose a fire hazard to electrical infrastructure.

4 FAUNAL ASSESSMENT RESULTS

Based on the results of the field investigations undertaken in April and July 2024, four broad habitat units were distinguished within the study area. These habitat units are briefly discussed below and depicted within Figures 3 -18. Sections 4.1 – 4.5 discuss the various faunal classes assessed as part of this project as well as SCC that were observed, or may be associated with the study area.

4.1 Faunal Habitat

After investigation, it is evident that four faunal habitat units exist within the study area, namely:

- Miombo Woodland Habitat;
- Secondary Miombo Woodland Habitat;
- Transformed Habitat; and
- Freshwater Habitat.

Miombo Woodland Habitat

Areas where intact miombo woodland is still present. This habitat unit is representative of the vegetation type for the region, and as such, provides habitat to several faunal species. Current impacts to this habitat unit include wood harvesting and vegetation clearance activities for agriculture. This has resulted in the fragmentation of this habitat within the larger landscape, though it was observed that there are still some areas which remain fairly intact. These intact areas along with the linear freshwater habitats provides movement corridors for faunal species, supporting species movement/dispersal of fauna and genetic diversity in the landscape.

Secondary Miombo Woodland Habitat

Characterised by areas where vegetation was cleared for agricultural purposes however following the cessation of farming, these areas have been left to recover and natural succession has taken place, with indigenous herbaceous and woody species beginning to return. This habitat is in a state of secondary succession and though it comprises vegetative species commensurate with Miombo Woodlands, the floral species diversity is less species rich and consequently, supports a lower diversity and abundance of faunal species.

Freshwater Habitat

Comprises of rivers, valley bottom wetland systems made up of both channelled valley bottom (CVB) wetlands and unchannelled valley bottom (UCVB) wetlands as well as floodplain wetlands and dambos. The river systems had definitive riparian areas whilst the wetland systems were dominated by dense stands of herbaceous plant species adapted to areas of

increased soil moisture. The linear nature of the CVB and UCVB wetlands serve as movement corridors for several faunal species, helping to maintain connectivity between intact habitats, notably within areas of increased habitat fragmentation. The freshwater habitats further provide niche habitat for water dependant species (amphibians) as well as other species that are reliant on these systems for food resources such as certain avifaunal species (Kingfishers etc).

Transformed Areas

Subsistence agricultural fields of varying crops, sometimes interspersed with indigenous trees which have not been felled. The northern portion of the powerline also traverses plantations (*Eucalyptus* sp.). Alien and invasive plant species were present but in low densities. This habitat also includes towns and villages associated with the study area. Though these areas were not completely devoid of faunal species, they did harbour a low diversity and abundance, comprising of common, resilient species, notably insects, common avifaunal species and small reptiles (geckos and skinks).

The above-mentioned habitat units are discussed in further detail within the floral report (Section B). The abovementioned habitat units are depicted in Figures 3 – 18 below. Maps are filtered from North to South of the OHL.

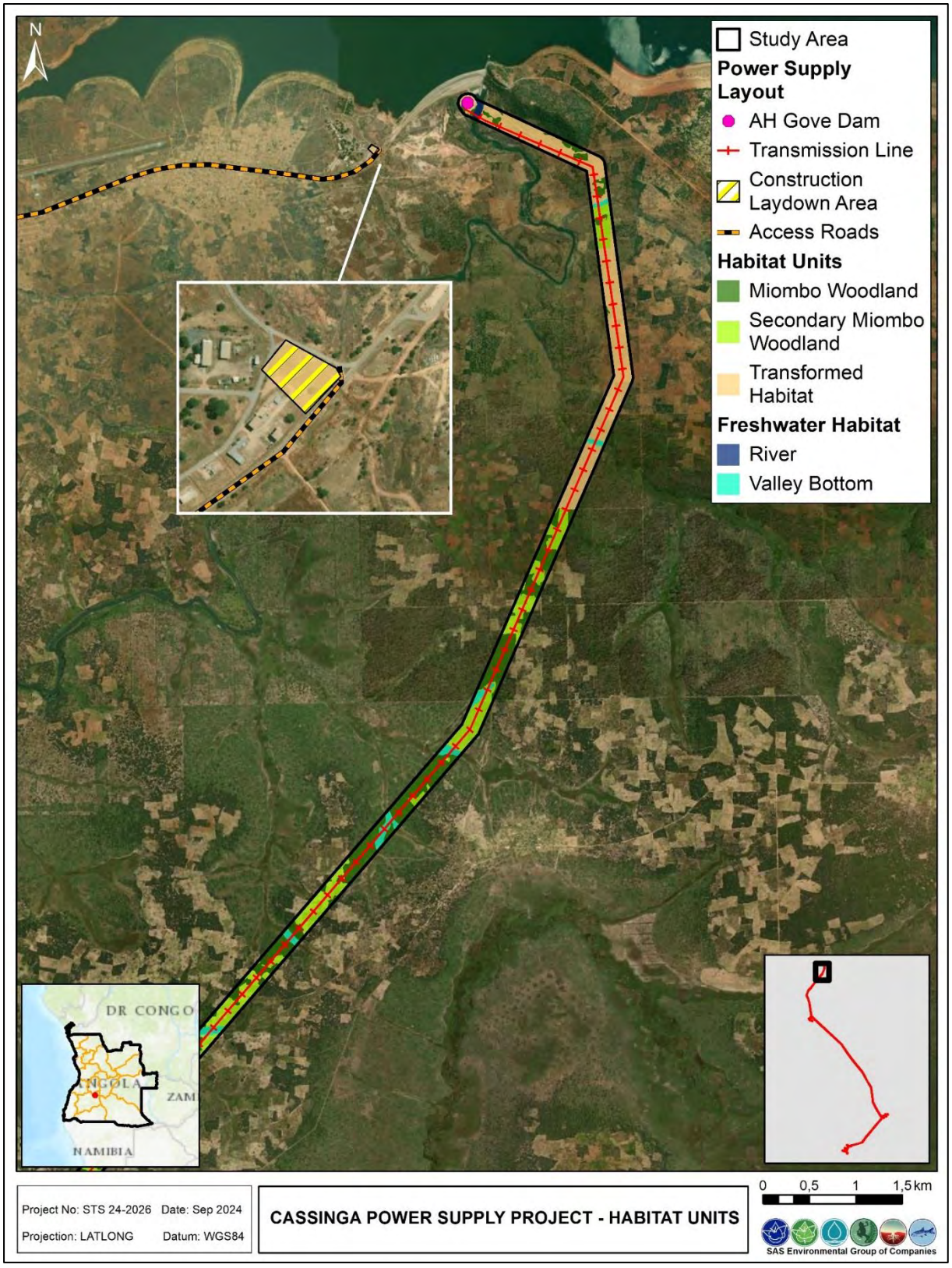


Figure 3: Habitat units associated with the study area.

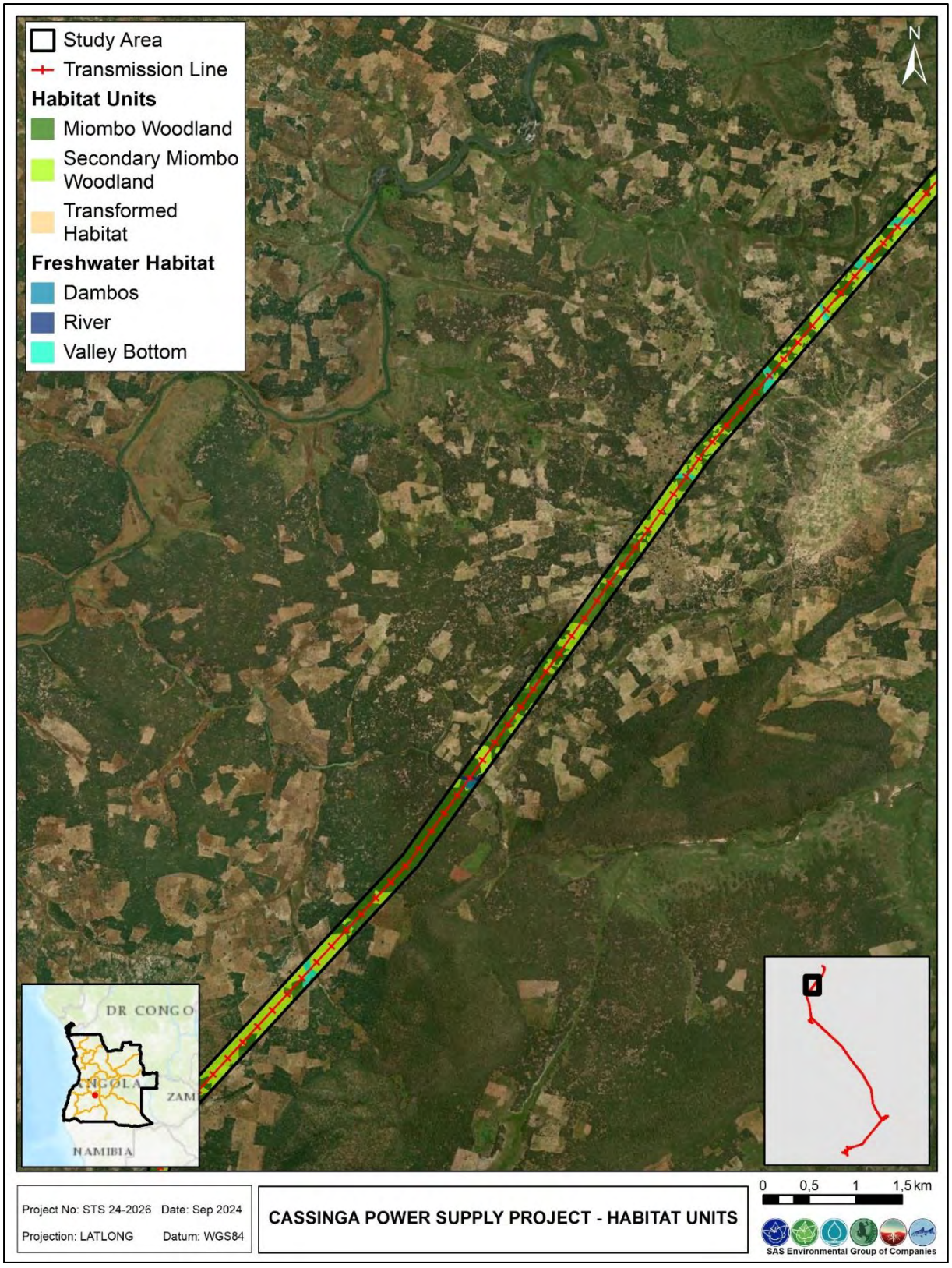


Figure 4: Habitat units associated with the study area.

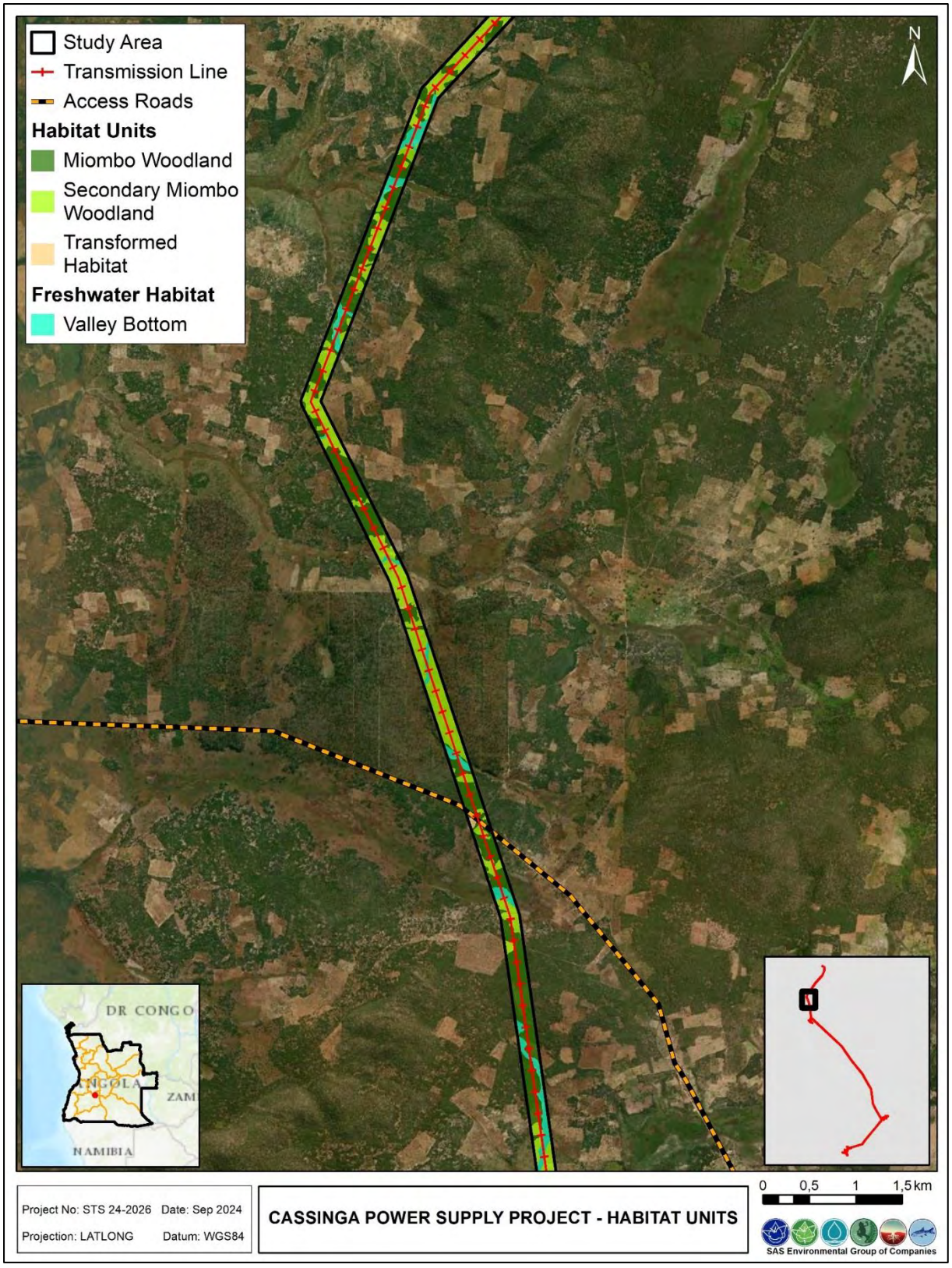


Figure 5: Habitat units associated with the study area.

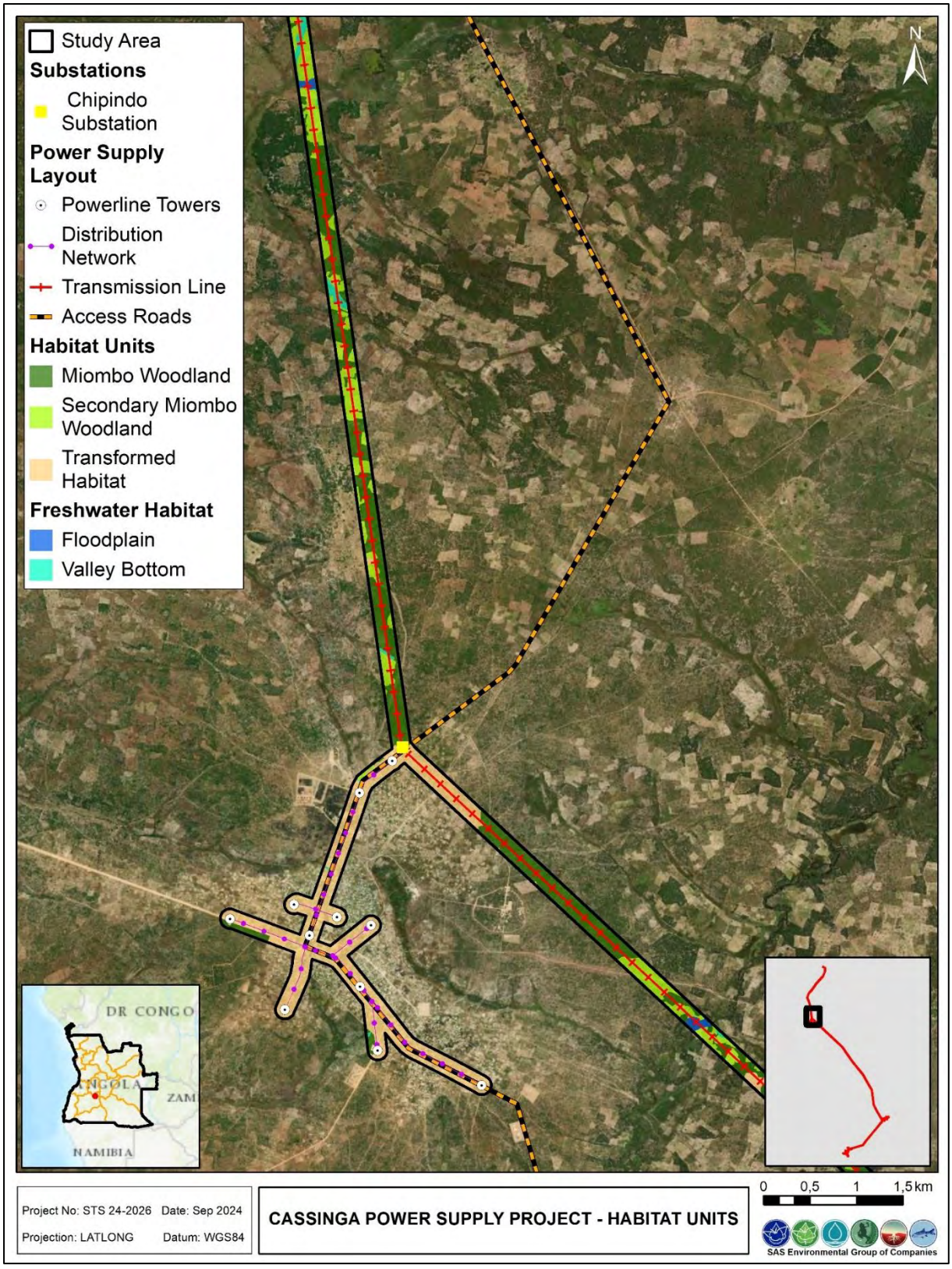


Figure 6: Habitat units associated with the study area.

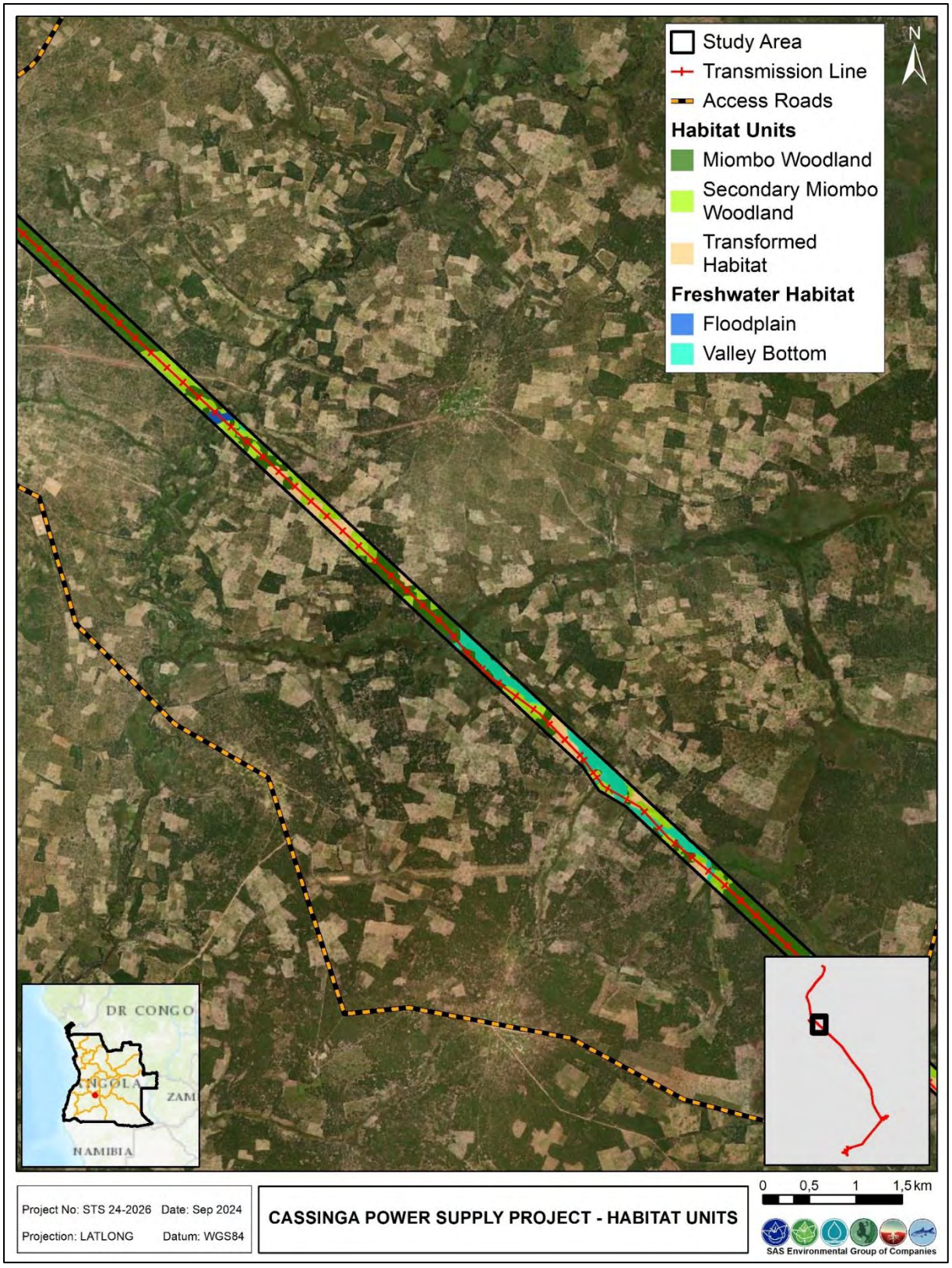


Figure 7: Habitat units associated with the study area.

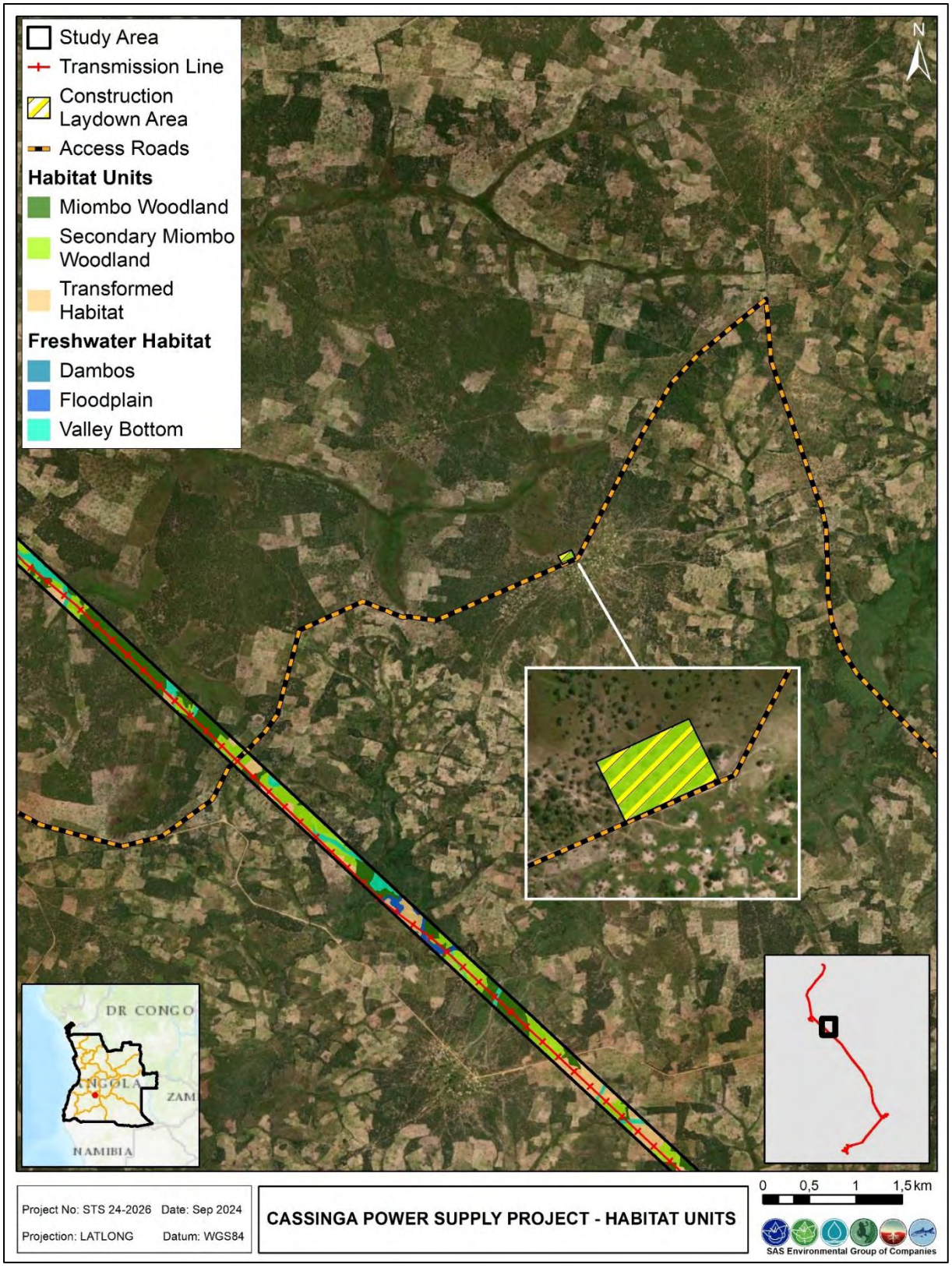


Figure 8: Habitat units associated with the study area.

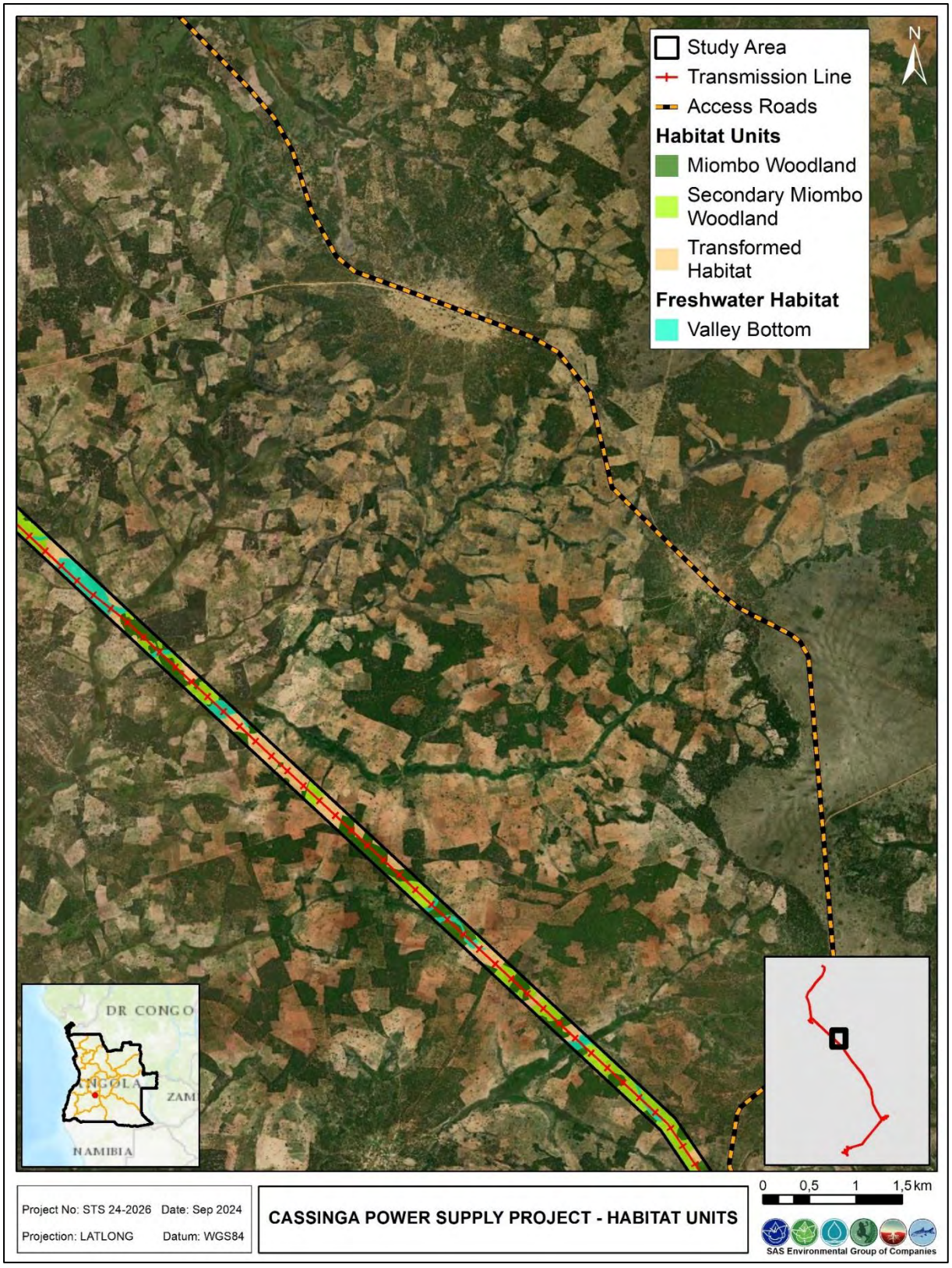


Figure 9: Habitat units associated with the study area.

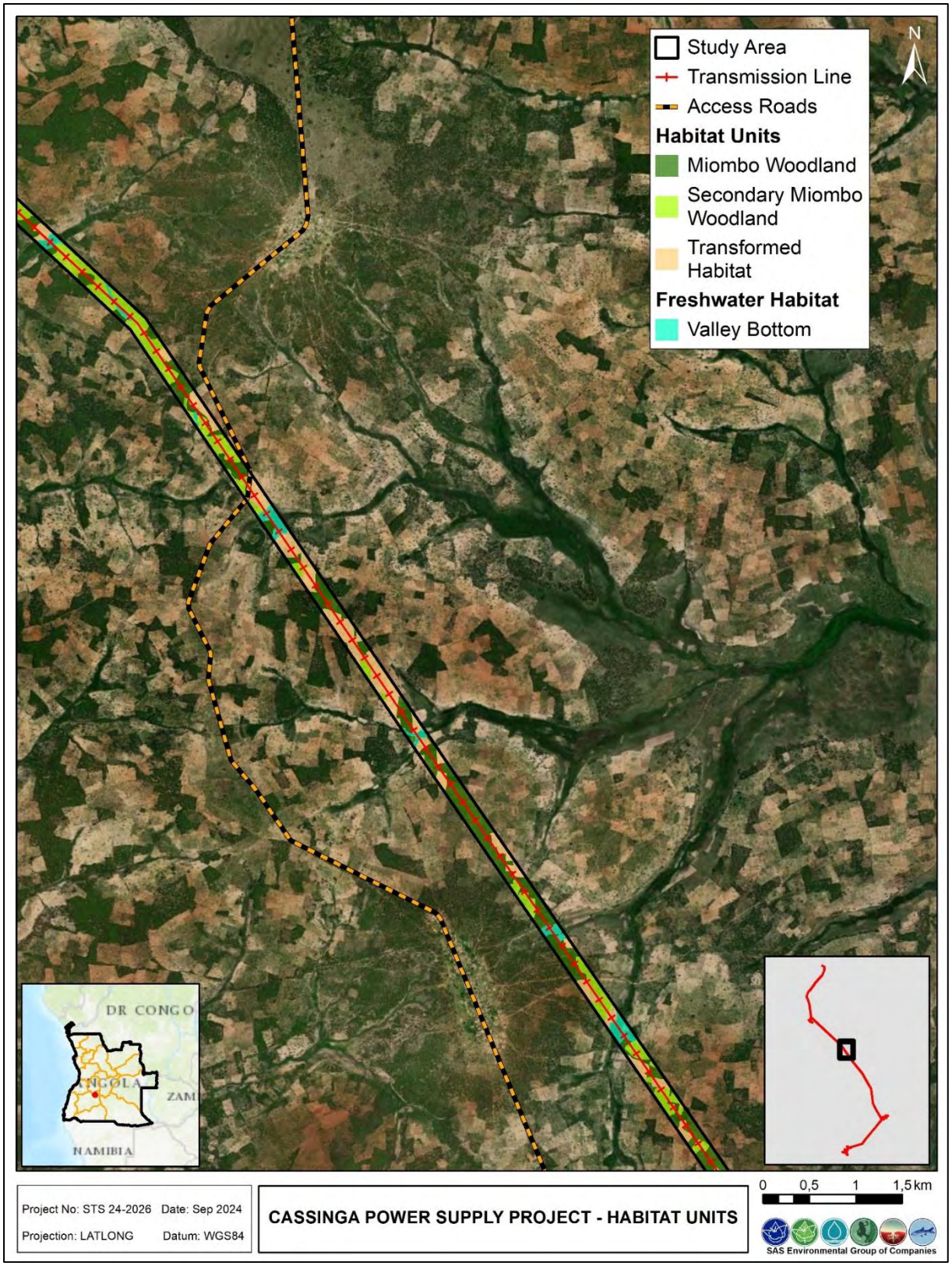


Figure 10: Habitat units associated with the study area.

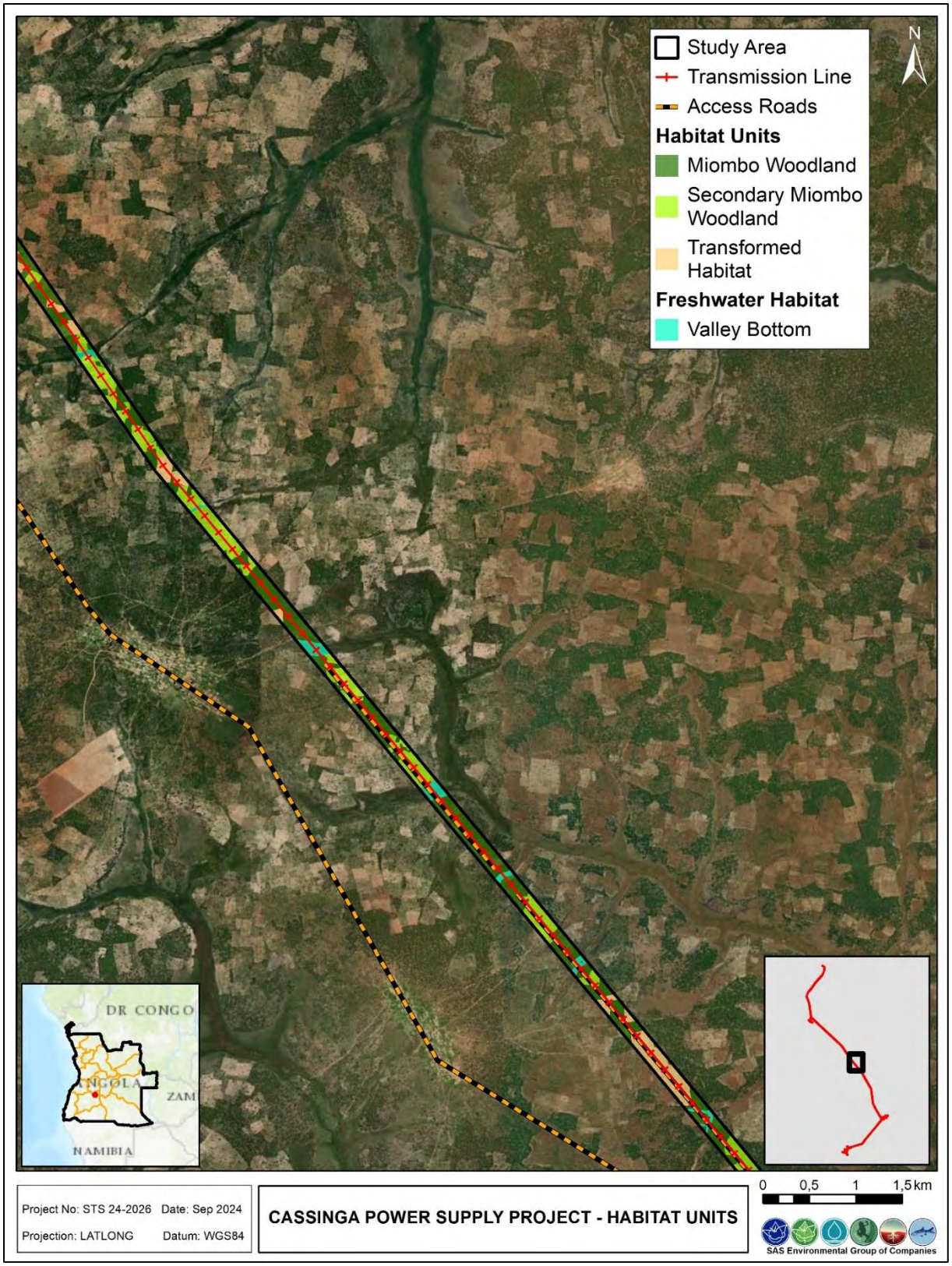


Figure 11: Habitat units associated with the study area.

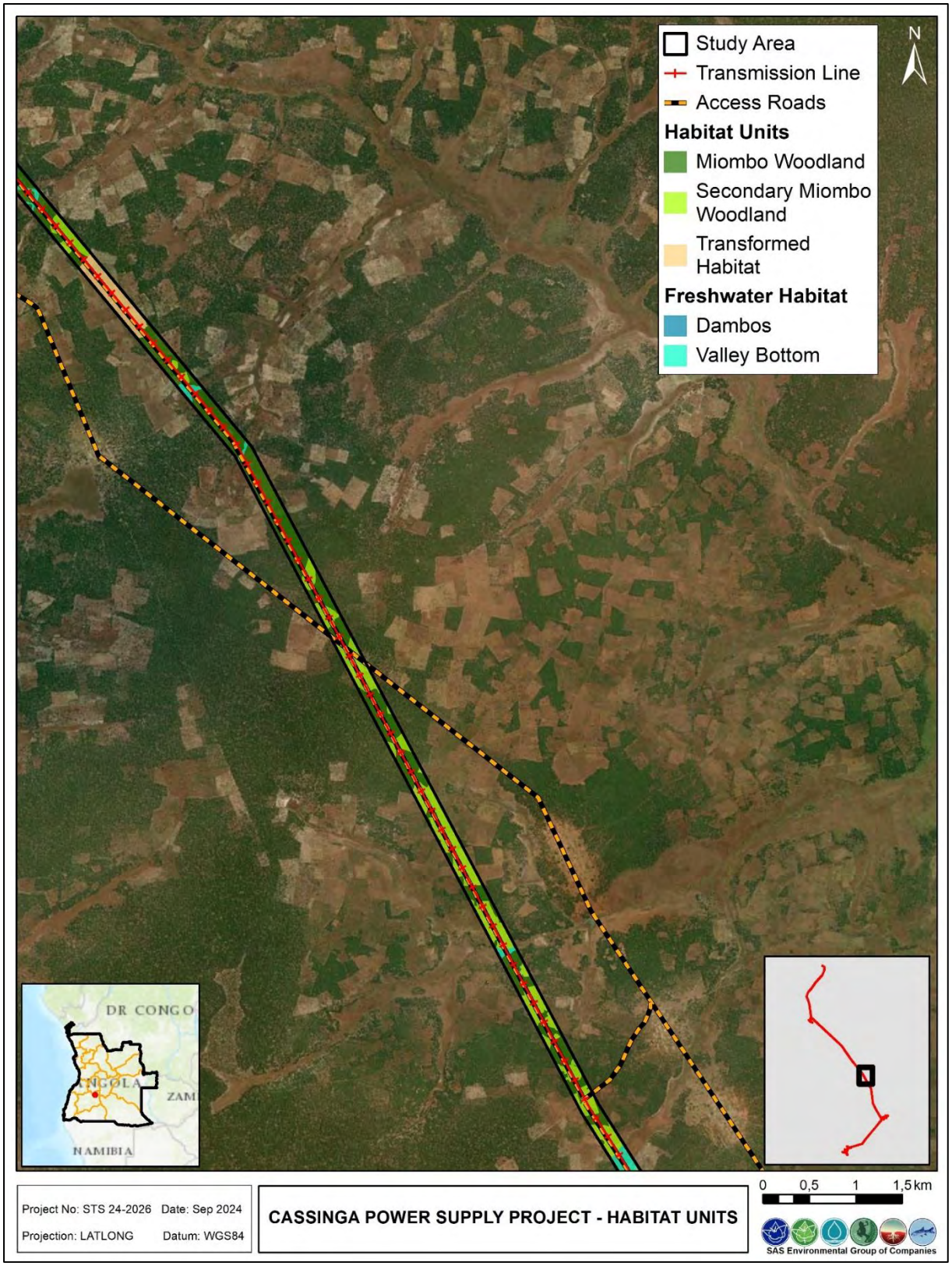


Figure 12: Habitat units associated with the study area.

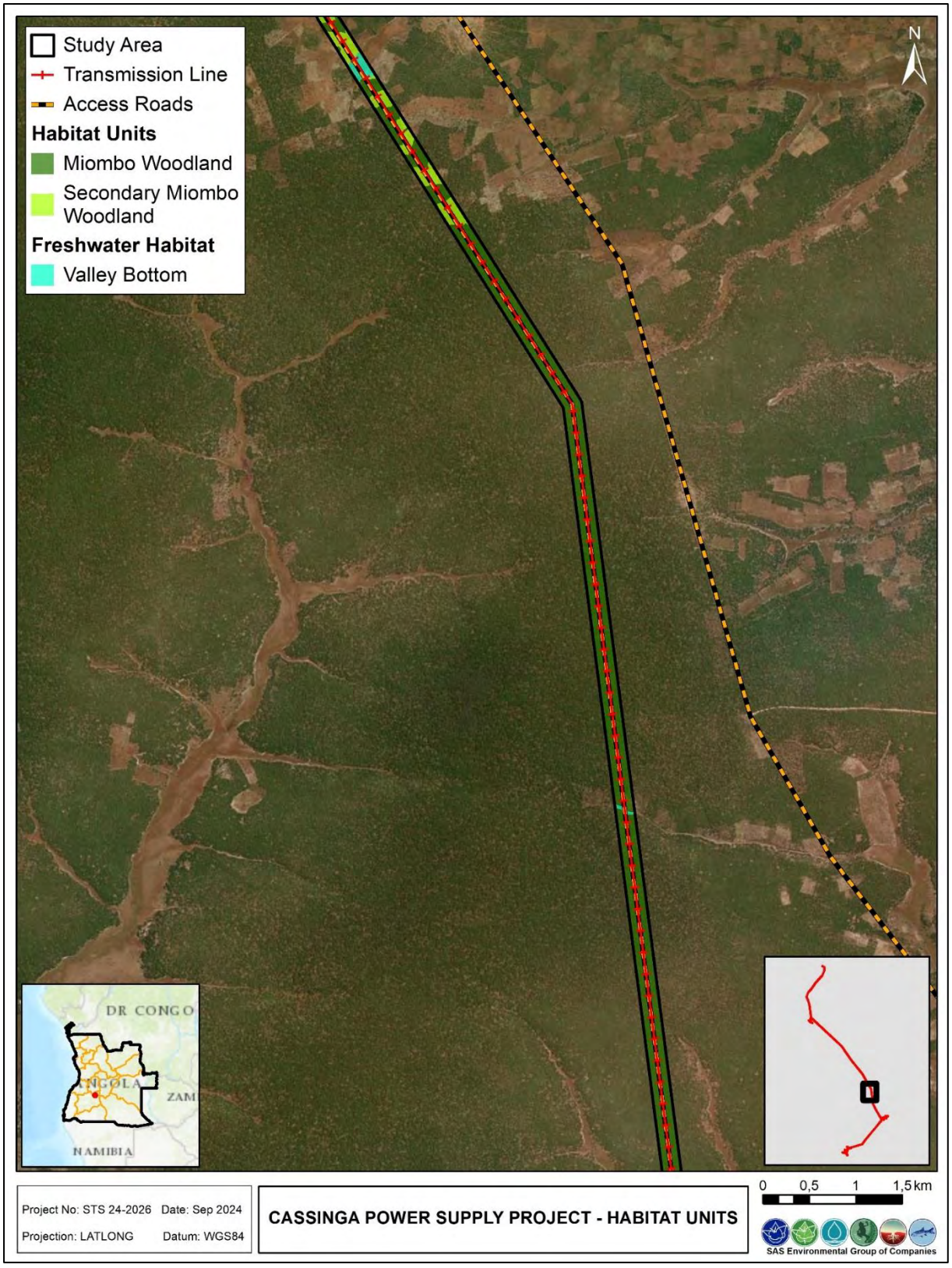


Figure 13: Habitat units associated with the study area.

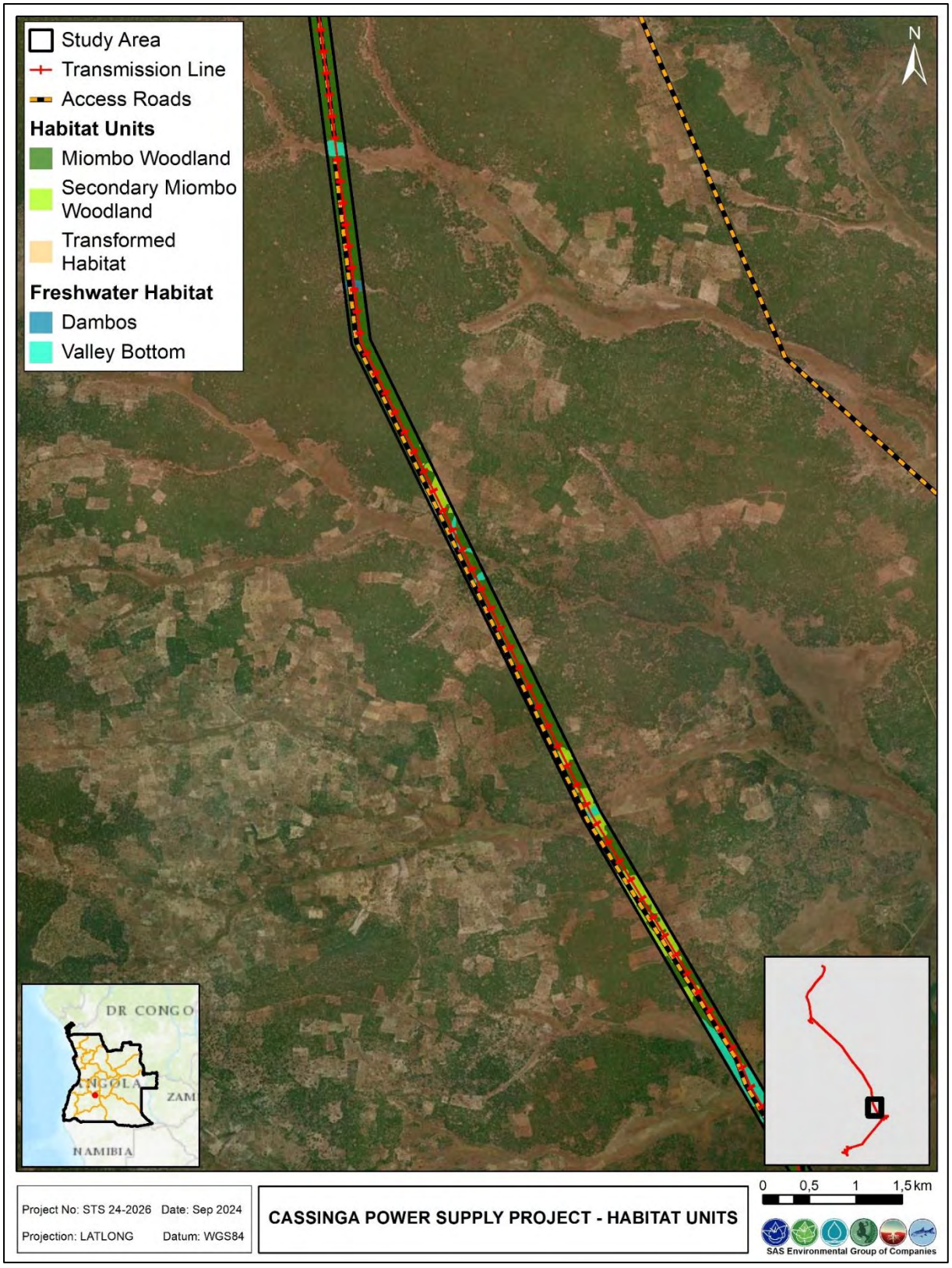


Figure 14: Habitat units associated with the study area.

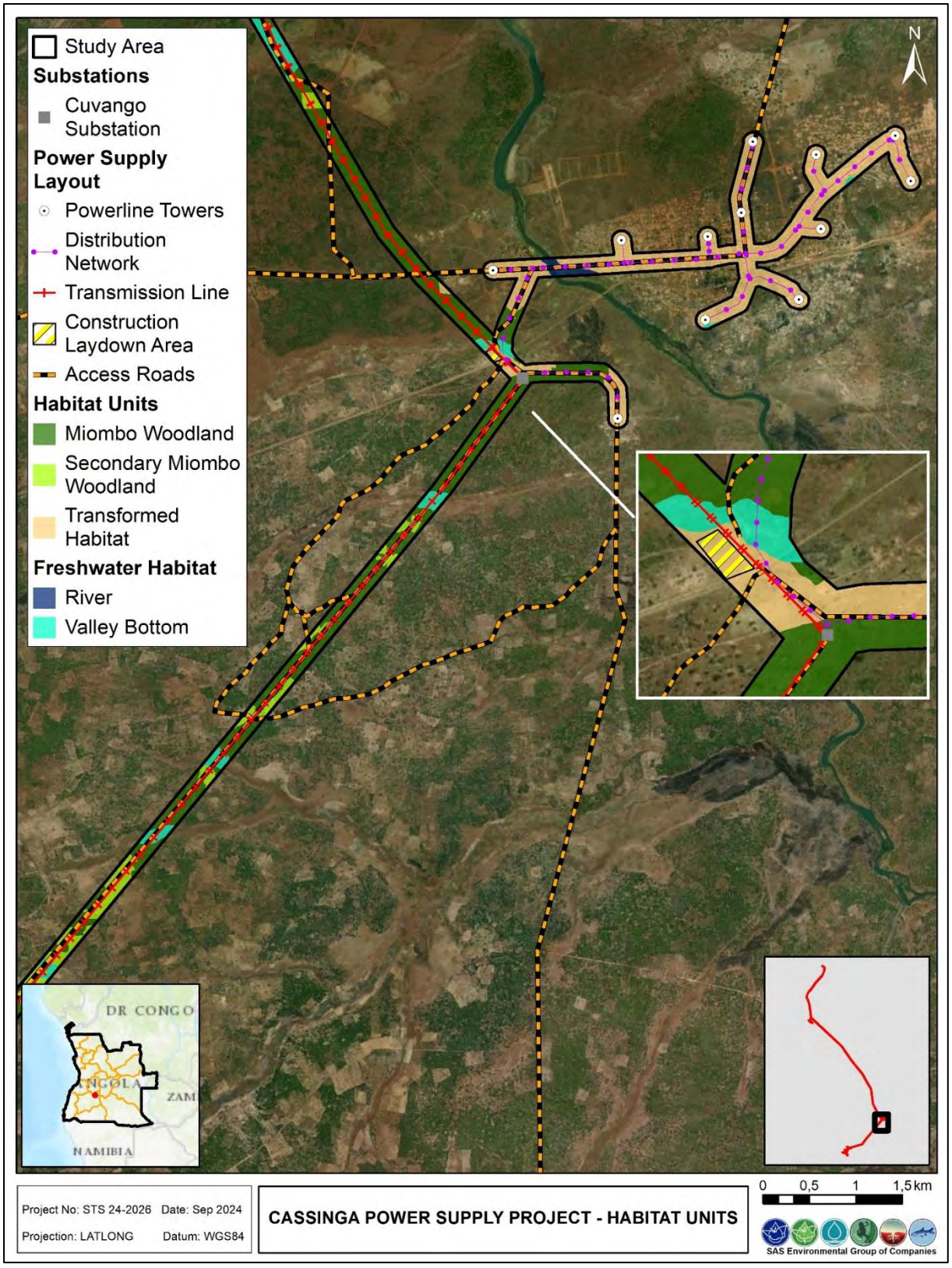


Figure 15: Habitat units associated with the study area.

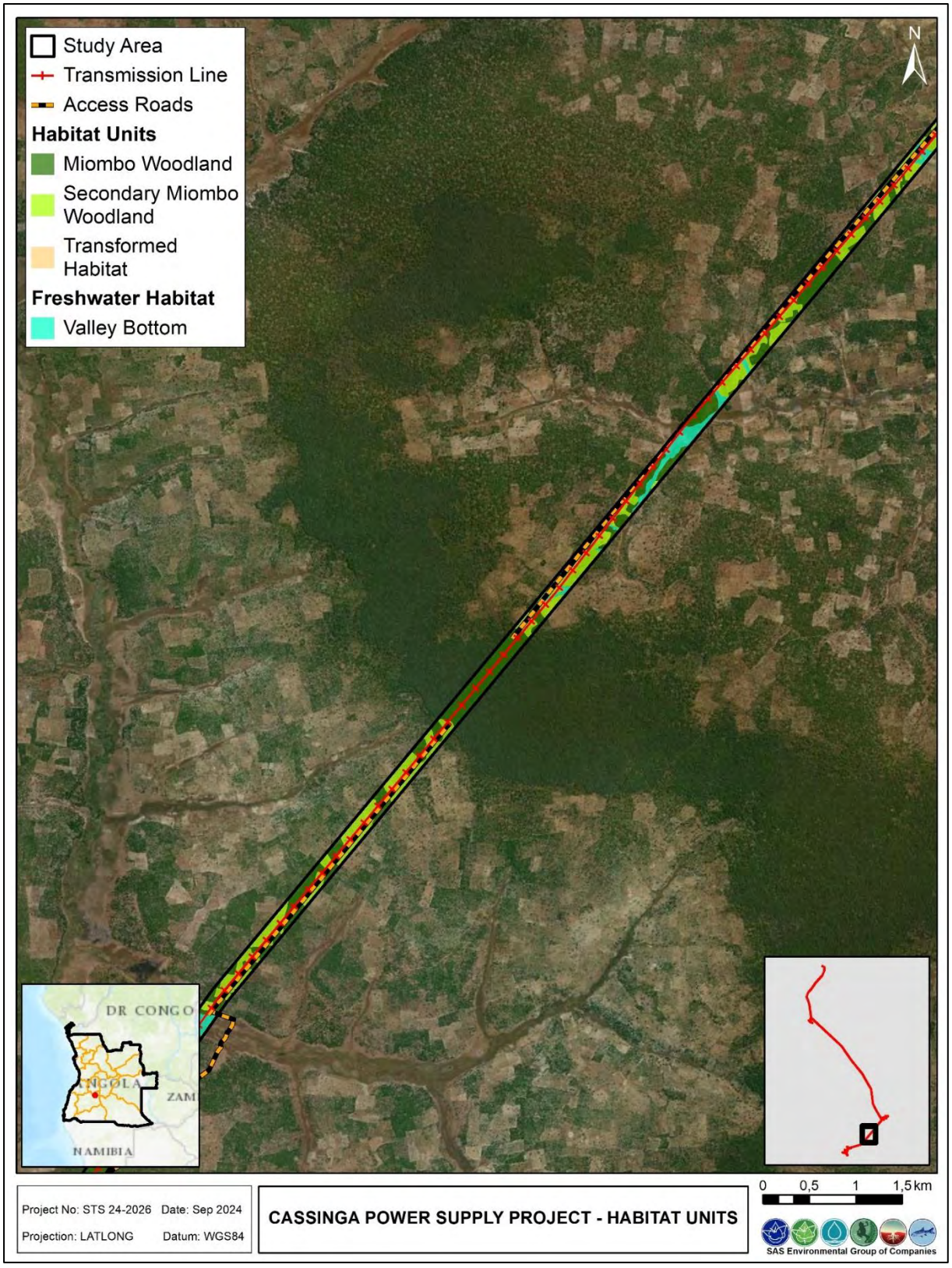


Figure 16: Habitat units associated with the study area.

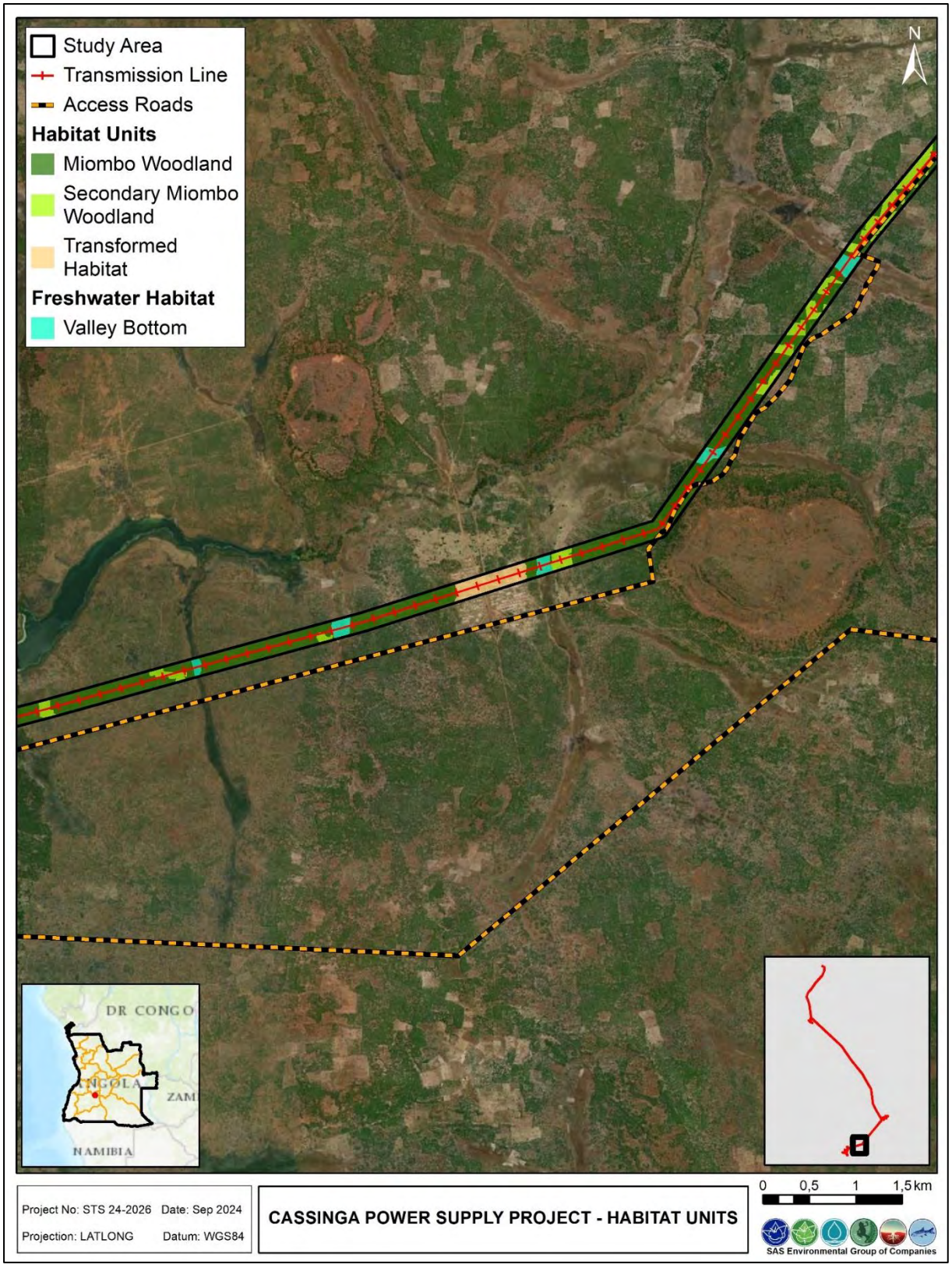


Figure 17: Habitat units associated with the study area.

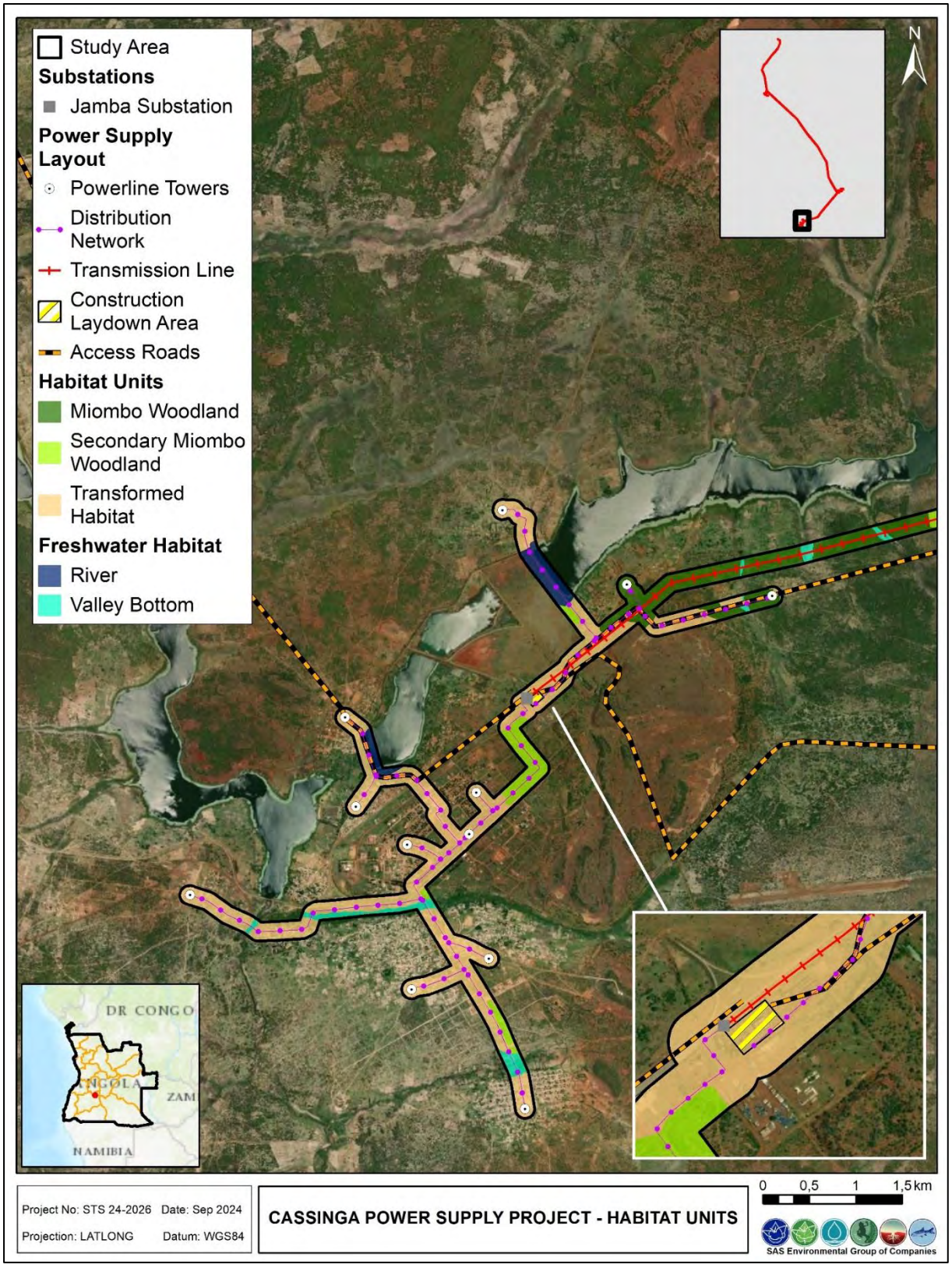


Figure 18: Habitat units associated with the study area.

4.2 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 practices guidelines of PS6 are based (IFC PS6, 2012). When considering Performance Standard 6 (PS6), the IFC PS6 recognizes 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 that which is likely to be the most susceptible to the environmental impacts associated with development. The definitions and potential implication for the client / developer as stipulated in IFC PS6 (2012) are given in Table 1.

Table 1: Descriptions of the IFC habitat categories and project requirements to meet IFC 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 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 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 2 below.

Table 2: 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 (≥ 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 ≥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.
4: Highly Threatened or Unique Ecosystems	A: Areas representing ≥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 3 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 3: Initial screening of CH-qualifying Species Confirmed or Likely to Occur in the Study Area.

Scientific Name	Common Name	STATUS	POC	Rationale for Critical Habitat Screening
Sagittarius serpentarius	Secretarybird	EN	High	Included in assessment - Refer to Section 4 for summary of species discussion
Torgos tracheliotos	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.
Calidris ferruginea	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.
Smutsia temminckii	Temminck's Pangolin	VU	Medium	Included in assessment - Refer to Section 4 for summary of species discussion
Gyps coprotheres	Cape Vulture	VU	Medium	Included in assessment - Refer to Section 4 for summary of species discussion
Panthera pardus	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.
Egretta vinaceigula	Slaty Egret	VU	Medium	Included in assessment - Refer to Section 4 for summary of species discussion
Aquila nipalensis	Steppe Eagle	EN	Medium	Included in assessment - Refer to Section 4 for summary of species discussion
Diceros bicornis	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.
Falco vespertinus	Red-footed Falcon	VU	Medium	Included in assessment - Refer to Section 4 for summary of species discussion
Pluvialis squatarola	Grey Plover	VU	Low	Not included in the assessment as they are associated with the coastal region for Angola.
Gyps africanus	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.
Acinonyx jubatus	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.
Panthera leo	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.
Bitis heraldica	Angolan Adder	VU	Medium	Included in assessment - Refer to Section 4 for summary of species discussion
Polemaetus bellicosus	Martial Eagle	EN	Medium	Included in assessment - Refer to Section 4 for summary of species discussion
Terathopius ecaudatus	Bateleur	EN	Confirmed	Included in assessment - Refer to Section 4 for summary of species discussion
Aquila rapax	Tawny Eagle	VU	Medium	Included in assessment - Refer to Section 4 for summary of species discussion

Lophocebus aterrimus	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.
Phymeurus chianga	Huambo Agile Grasshopper	VU	Low	Not included in the assessment as population, both extant and possibly extant are located outside of the study area
Galagoides kumbirensis	Angola Dwarf Galago	NT	Low	Not included in the assessment as known population occurrence is located in the west of the country, near Luanda.
Phymeurus machadoi	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.
Miopithecus talapoin	Southern Talapoin Monkey	VU	Low	Not included in the assessment as the known distribution range of this species doe does not intersect with the study area.
Kobus ellipsiprymnus ssp. *defassa*	Defassa Waterbuck	NT	Low	Species restricted to protected game reserves within Angola, outside of the study area.
Cercopithecus nictitans ssp. *nictitans*	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.
Ardeotis kori	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
Hydrictis maculicollis	Spotted-necked Otter	NT	Medium	Included in assessment - Refer to Section 4 for summary of species discussion
Kobus ellipsiprymnus	Waterbuck	NT	Low	Species restricted to protected game reserves within Angola, outside of the study area.
Neotis denhami	Denham's Bustard	NT	Medium	Included in assessment - Refer to Section 4 for summary of species discussion
Bucorvus leadbeateri	Southern Ground Hornbill	VU	High	Included in assessment - Refer to Section 4 for summary of species discussion
Equus quagga	Plains zebra	NT	Low	Species restricted to protected game reserves within Angola, outside of the study area.
Aonyx capensis	African Clawless Otter	NT	Confirmed	Included in assessment - Refer to Section 4 for summary of species discussion
Giraffa camelopardalis	Giraffe	VU	Low	Species restricted to protected game reserves within Angola, outside of the study area.
Hippopotamus amphibius	Hippo	VU	Low	Species largely restricted to protected areas within Angola, outside of the study area.
Lycaon pictus	African Wild Dog	EN	Low	Species restricted to protected game reserves within Angola, outside of the study area.
Trigonoceps occipitalis	White-headed Vulture	CR	Confirmed	Included in assessment - Refer to Section 4 for summary of species discussion
Bugeranus carunculatus	Wattled Crane	VU	Low	Specis apears 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.
Necrosyrtes monachus	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.
Pternistis swierstrai	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
Kobus leche	Lechwe	NT	Low	Species restricted to protected game reserves within Angola, outside of the study area.
Umma femina	Angola Sparklewing	VU	Medium	Included in assessment - Refer to Section 4 for summary of species discussion

Considering the above tables, the qualifying criteria for CH was applied to the various habitats and or species discussed in table 3 which had a medium or high POC, or which were confirmed on site. The below discussion evaluates the habitat/species based on these criteria to confirm or refute the presence of Critical habitat.

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 Cassinga OHL 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 808400 hectares (ha) or 8084 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 19).

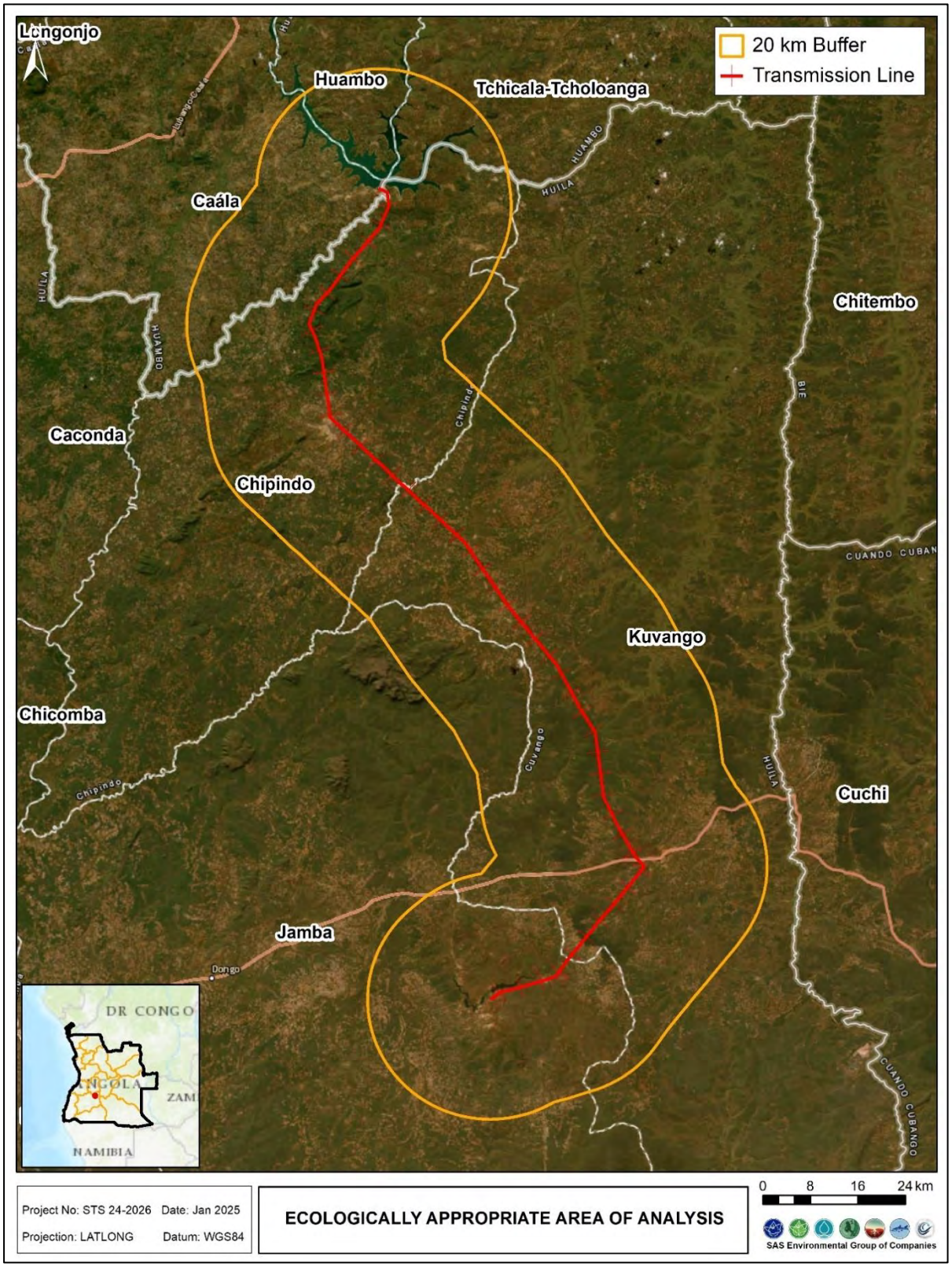


Figure 19: Ecologically Appropriate Area of Analysis for Critical Habitat determination

The discussion below analyse the species listed in Table 3 and the EAAA of 8084 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 3 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)

3 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 23500000 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 10000 to 100000 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 10000 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 2500 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 21100000 km². Considering the EAAA of 8084 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 23200000 km². The current estimated population for this species is 6700 individuals. When considering the EAAA of 8084 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 12600000 km². The current estimated population for this species is no more than 37000 breeding pairs (50000 - 75000 individuals). When considering the EAAA of 8084 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 26000000 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 8084 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 ≥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 ≥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 discussions, the habitat units observed within the study area have been grouped accordingly in terms of the IFC habitat categories (Table 4).

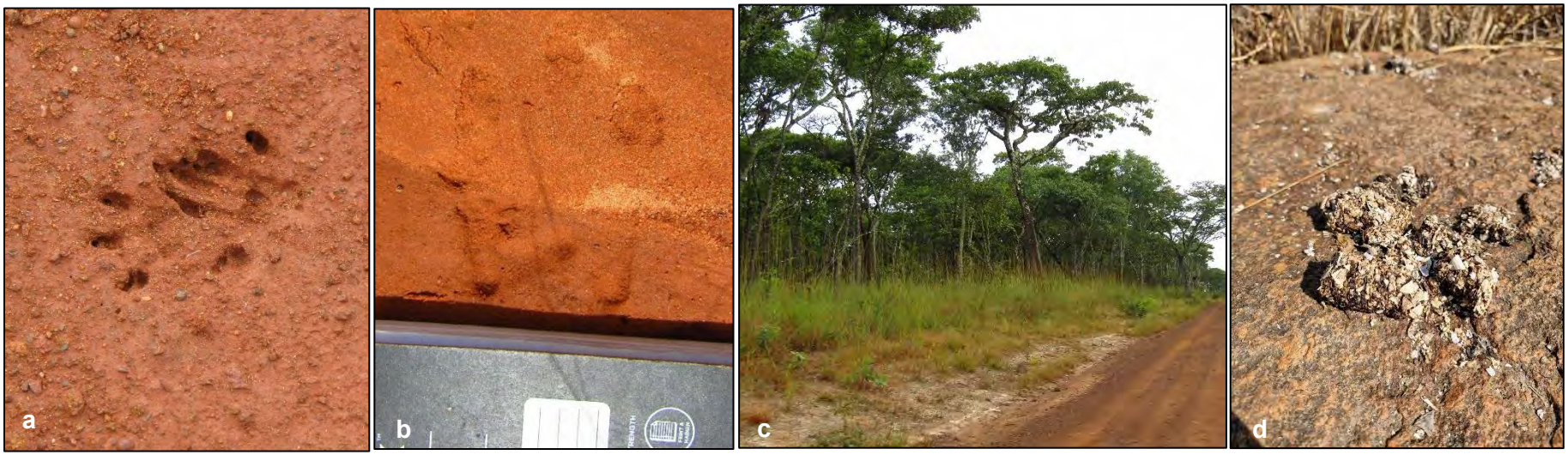
Table 4. IFC PS 6 Habitat categories for the vegetation units identified in the study area.

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.

4.3 Mammals

Table 5: Field assessment results pertaining to mammal species within the study area.

SPECIES RECORDED IN THE STUDY AREA



a) *Funisciurus congicus* (Congo Rope Squirrel) tracks; b) *Lepus victoriae* (African Savannah Hare) tracks; c) Typical Miombo Woodland habitat and d) *Aonyx capensis* (African Clawless Otter) scat.

MAMMAL SCC

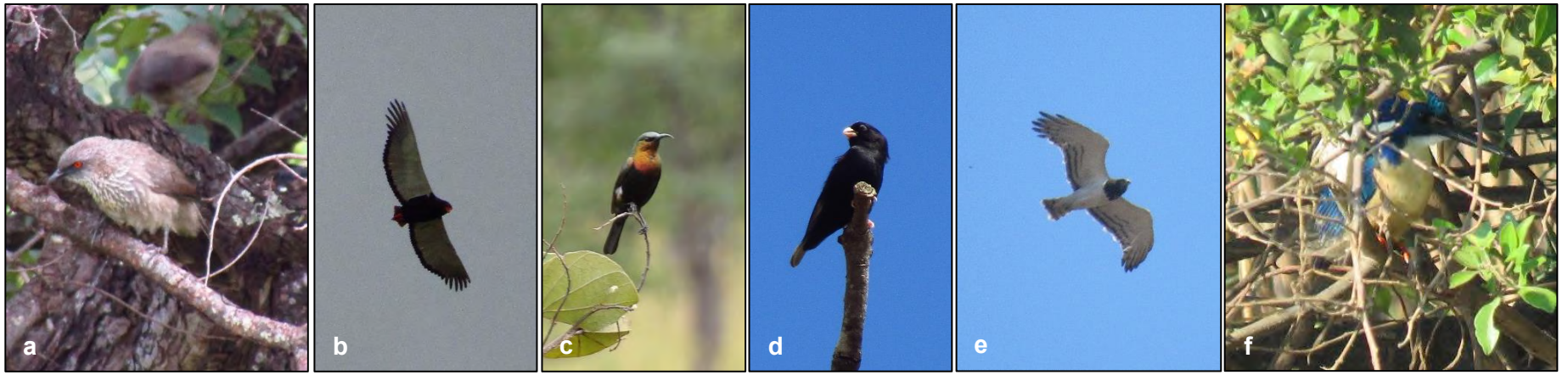
Species	Discussion	Angolan Status	IUCN Status	POC
Epomophorus angolensis (Angolan Epauletted Fruit Bat)	Known from wetter miombo woodlands, likely predominating in areas of riverine forest and other forest areas with fruit-bearing trees. May be seen roosting in trees either singularly or in loose colonies.	N/A	NT	Medium
Hydrictis maculicollis (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
Aonyx capensis (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**

Smutsia temminckii (Temminck's Ground Pangolin)	Dispersed throughout southern, central, and east Africa, *S. temminckii* 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
Civettictis civetta (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
Caracal caracal (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
Sylvicapra grimmia (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.				

4.4 Avifauna

Table 6: Field assessment results pertaining to avifaunal species within the study area.

SPECIES RECORDED IN THE STUDY AREA



a) *Turdoides jardineii* (Arrow-marked Babler); b) *Terathopius ecaudatus* (Bateleur); c) *Cinnyris cupreus* (Copper Sunbird); d) *Vidua funerea* (Variable Indigobird); e) *Circaetus pectoralis* (Black-chested Snake-Eagle) and f) *Alcedo semitorquata* (Half-collared Kingfisher).

AVIFAUNAL SCC

Species	Discussion	Angolan Status	IUCN Status	POC
Terathopius ecaudatus (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.	NA	EN	**Confirmed**
Gyps africanus (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
Aquila rapax (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 scarcer. A single individual has been recorded in Bicuar National Park to the south west of the study area in 2023, however no other record for the area of the study area are known.	NA	VU	Medium

Bucorvus leadbeateri (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
Trigonoceps occipitalis (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**
Neotis denhami (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
Aquila nipalensis (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
Sagittarius serpentarius (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
Torgos tracheliotos (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
Necrosyrtes monachus (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
Gyps coprotheres (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
Egretta vinaceigula (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
Falco vespertinus (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	NA	VU	Medium

	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.			
Polemaetus bellicosus (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 area will likely limit the occurrence of this species, as they are known to be largely absent from agricultural dominated areas.	NA	EN	Medium
Mirafra angolensis (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
Bradornis boehmi (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

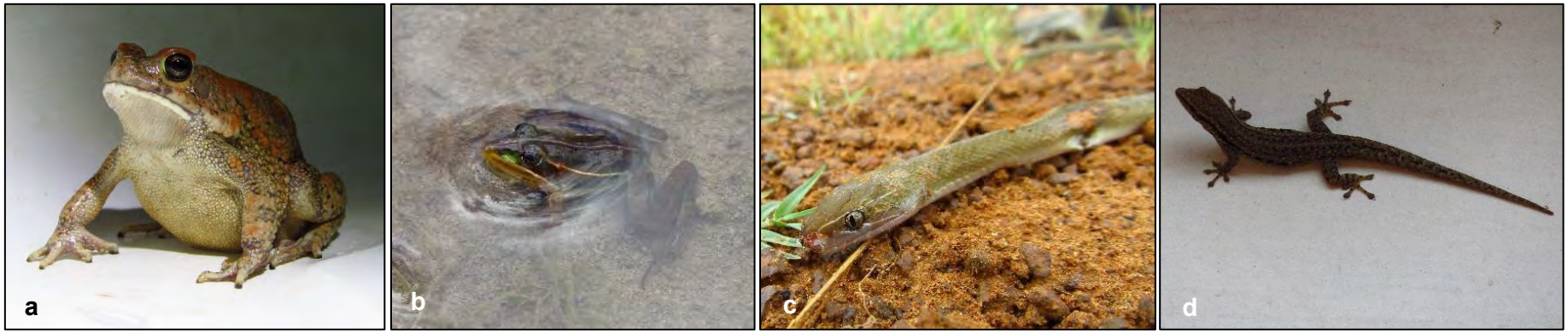
Habitat structure/heterogeneity is generally accepted as a primary determinant for avifaunal diversity. The miombo woodlands within the study area were relatively heterogenous in structure, comprises tall woody species as well as a complex layer of shrubs and herbaceous plant species in the understory. 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 *Terathopius ecaudatus* (Bateleur) was observed 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 (Appendix D, Table D4) may be associated with the study area, however none of these species were observed within the study area 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. Several of the species listed are north-south, migratory with some species being south-north east migrants, 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.

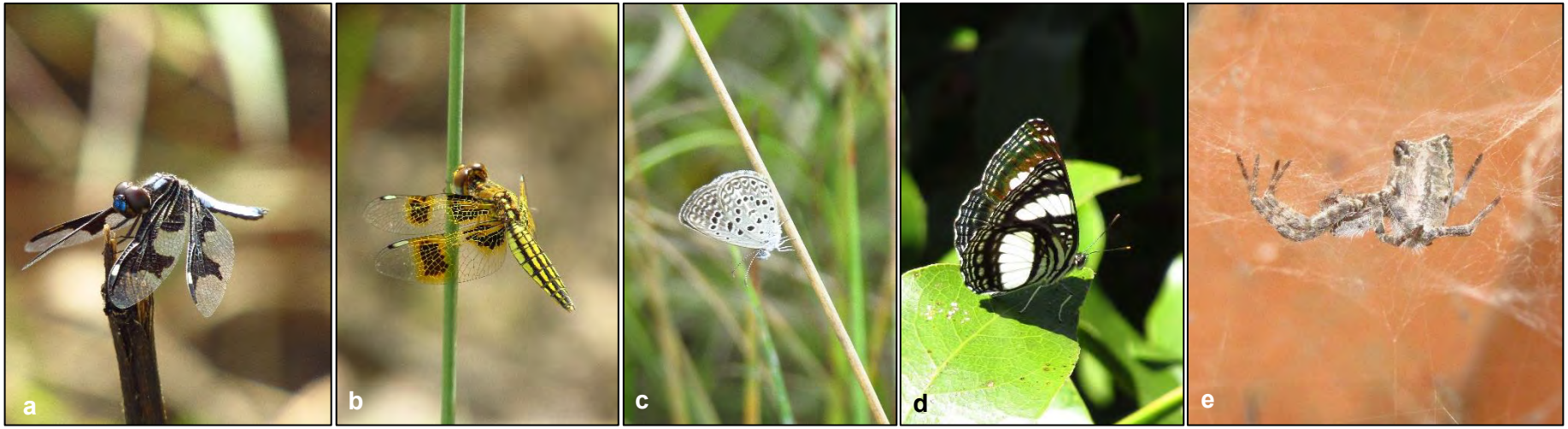
4.5 Herpetofauna

Table 7: Field assessment results pertaining to herpetofaunal species within the study area.

HERPETOFAUNAL SPECIES RECORDED IN THE STUDY AREA
 **a) *Sclerophrys pusilla* (Eastern Flat-backed Toad) b) *Ptychadena taenioscelis* (Small Ridged Frog); c) *Boaedon fuliginosus* (Brown House Snake); d) *Lygodactylus bradfieldi* (Bradfield's Dwarf Gecko).**
HERPETOFAUNAL SCC
Bitis heraldica (Angolan Adder, VU) was the only reptile species associated with the study area. It is believed to be associated with rocky mountainous habitats. Mt. Moco lies within a region characterized by remnant, isolated areas of humid Afromontane forest, and retains the most pristine remaining area of this forest type in Angola (Gonçalves et al. 2019), however this habitat is being rapidly cleared. A medium POC was assigned to this species.
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 (*Boaedon fuliginosus*) 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.

4.6 Invertebrates (Insects and Arachnids)

Table 8: Field assessment results pertaining to insect species within the study area.

INVERTEBRATE SPECIES RECORDED IN THE STUDY AREA
 **a) *Palpopleura portia* (Portia Widow); b) *Palpopleura jucunda* (Yellow-veined Widow); c) *Zizeeria knysna* (African Grass Blue); d) *Neptis laeta* (Albizia Sailer); e) *Cyrtophora citricola* (Tropical Tent-web Spider).**
INVERTEBRATE SCC
Umma femina (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 whit 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.

5 ECOSYSTEM SERVICES AND THE INTERNATIONAL FINANCE CORPORATION

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). It is very important to acknowledge that 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 relevant ecosystems within the study area. Habitat transformation and modification is extensive throughout the study area and surrounds, however, many of the habitats have recovered well and are contributing to ecosystem services. Several of the habitats with and surrounding the study area have historically been excluded from significant direct impacts and transformation, thus these habitats are increasingly important for ecosystem services.

PS 6 defines ecosystem services as “the benefits that people, including businesses, obtain from ecosystems” (paragraph 2), which is in line 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 four major categories:

- Provisioning ecosystem services.
- Regulating ecosystem services.

Table 9: 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. ➢ 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. 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.	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. 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.

6 SENSITIVITY MAPPING

Site Ecological Importance

The Site Ecological Importance (**SEI**) was determined for each habitat unit within the study 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. The criteria for SEI can be found in Appendix A.

Table 5 below conceptually illustrates the faunal SEI as per SANBI guidelines for specialist assessments for the various habitats. The habitats are depicted according to their sensitivity in terms of the presence or potential for faunal SCC, habitat integrity, levels of disturbance and overall levels of diversity.

Figures 20 - 35 illustrates the habitat sensitivities as they relate to the Cassinga Power project for faunal species.

Table 10: Site Ecological Importance for the different habitat units within the study area.

Habitat Unit	Conservation Importance (CI)	Functional Integrity (FI)	Biodiversity Importance (BI)	Receptor Resilience (RR)	Site Ecological Importance (SEI)
Miombo 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 Miombo 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.

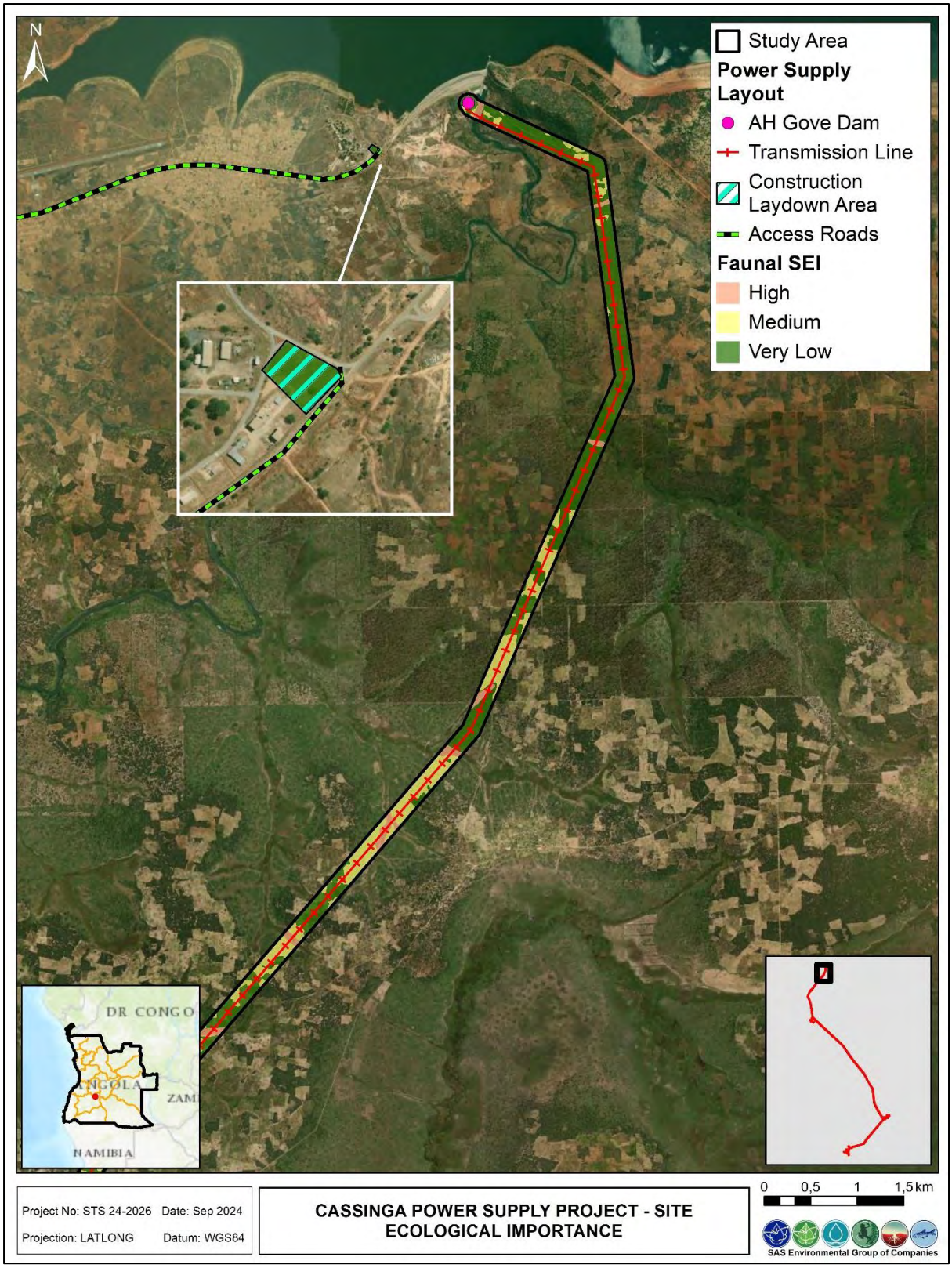


Figure 20. Site Ecological Importance regarding the faunal habitat within the study area.

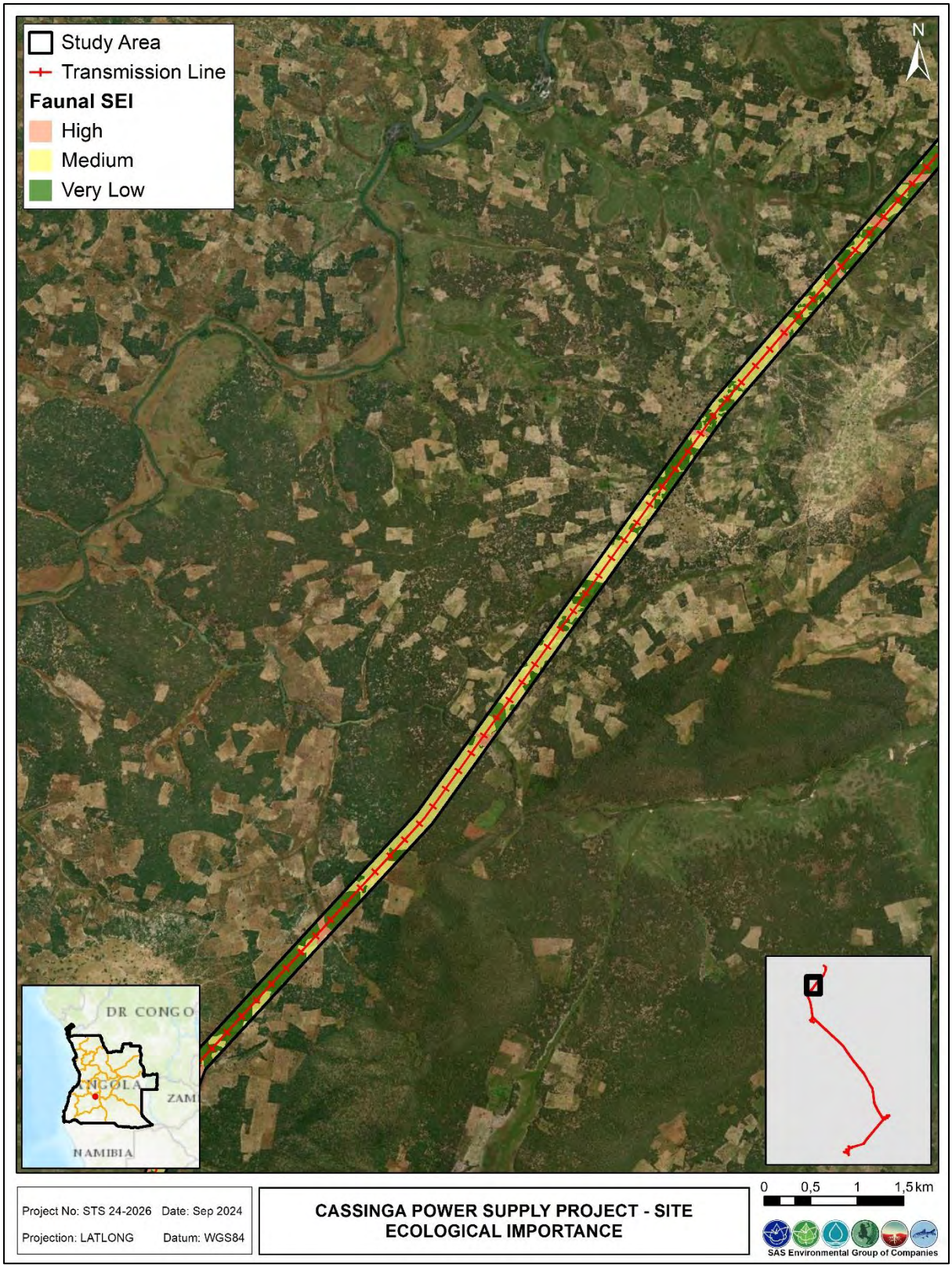


Figure 21. Site Ecological Importance regarding the faunal habitat within the study area.

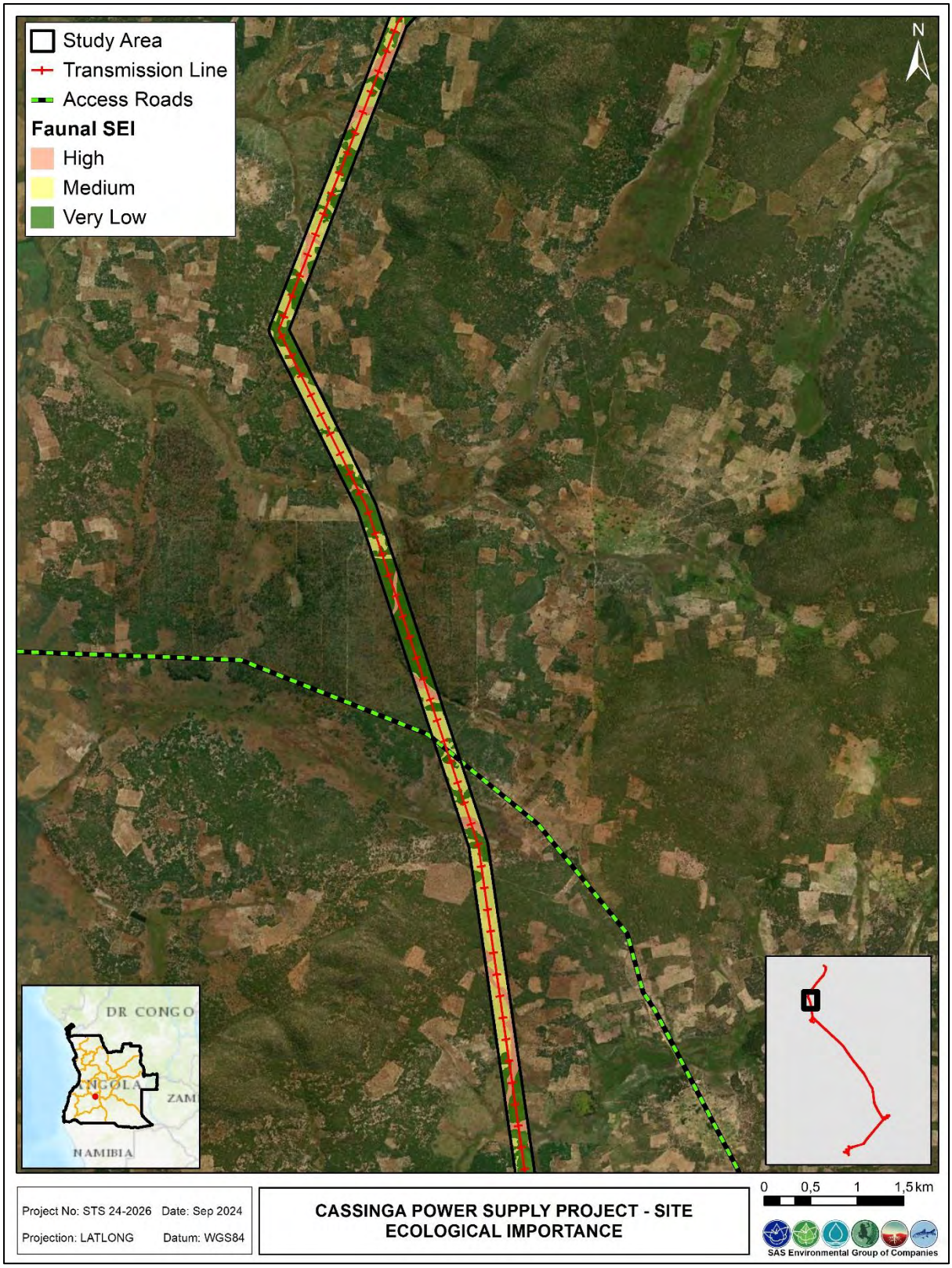


Figure 22. Site Ecological Importance regarding the faunal habitat within the study area.

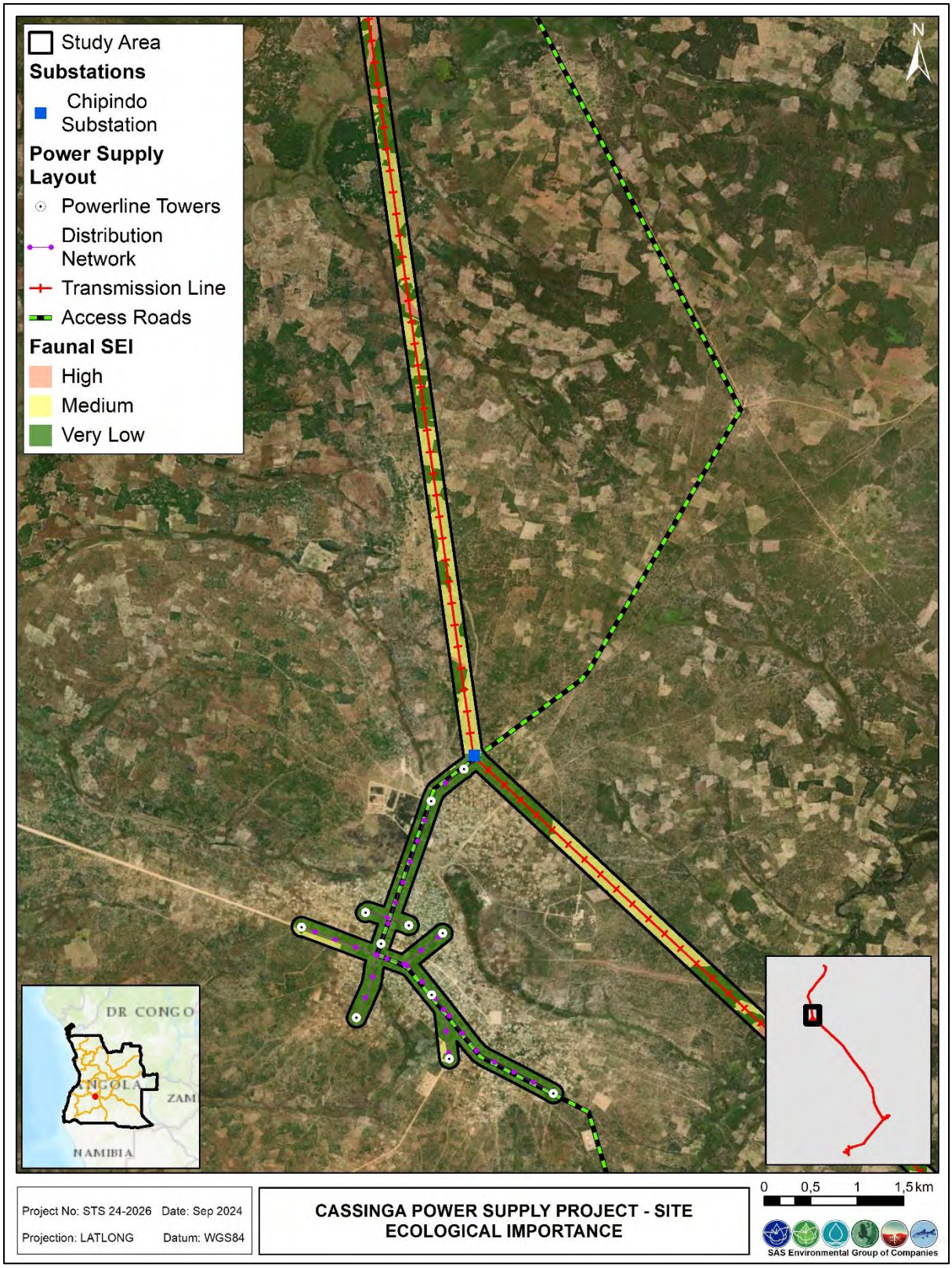


Figure 23. Site Ecological Importance regarding the faunal habitat within the study area.

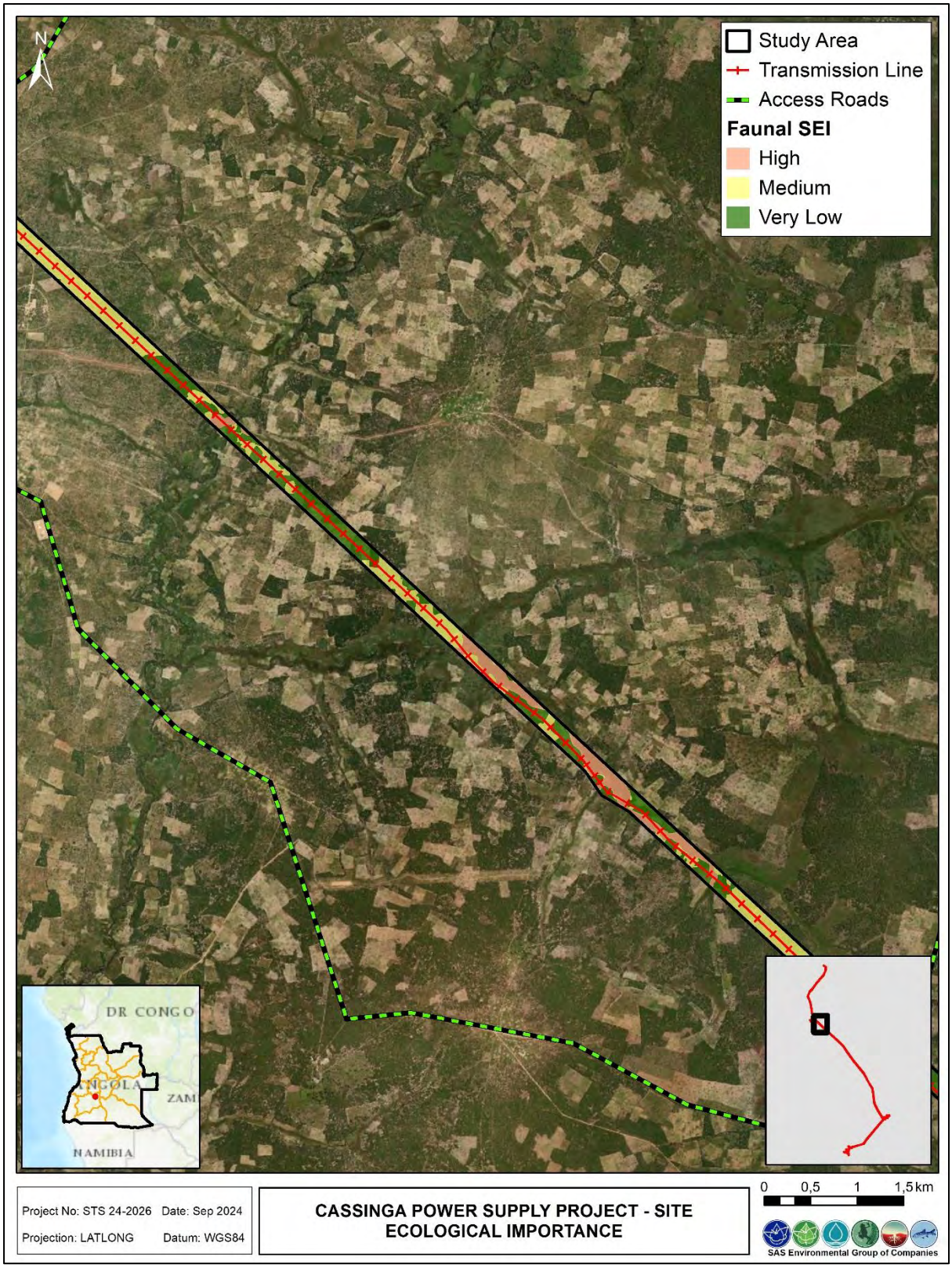


Figure 24. Site Ecological Importance regarding the faunal habitat within the study area.

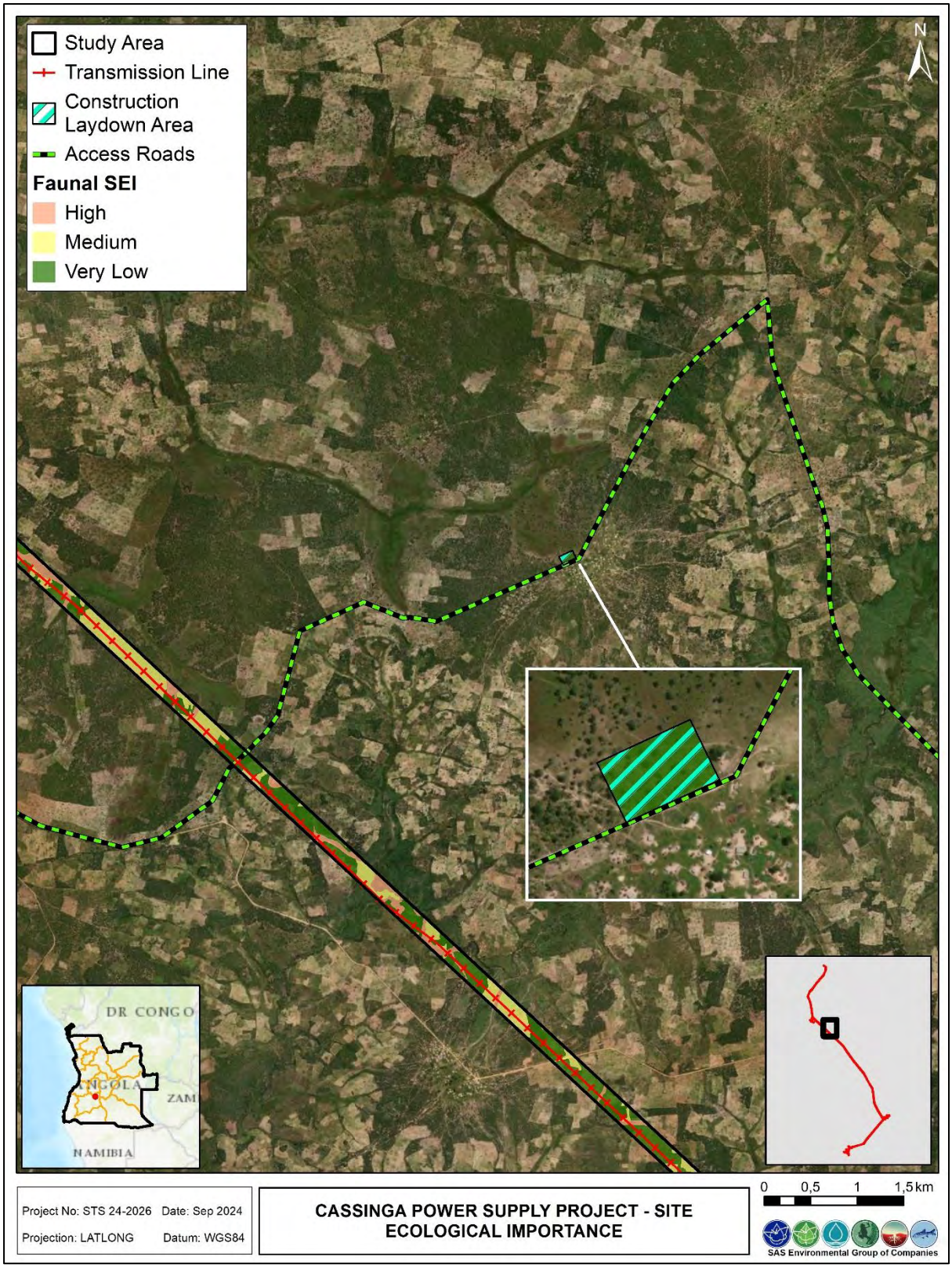


Figure 25. Site Ecological Importance regarding the faunal habitat within the study area.

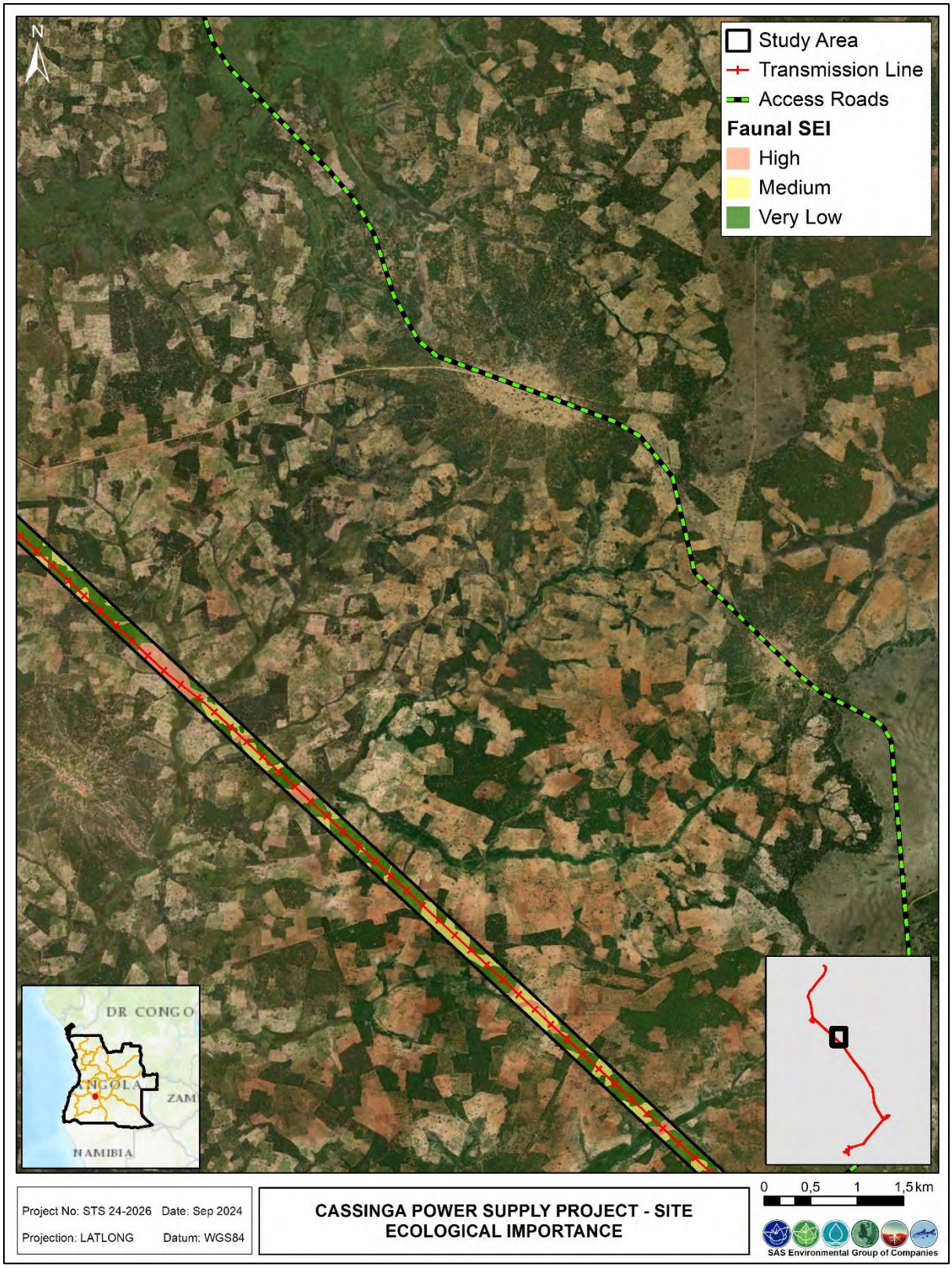


Figure 26. Site Ecological Importance regarding the faunal habitat within the study area.

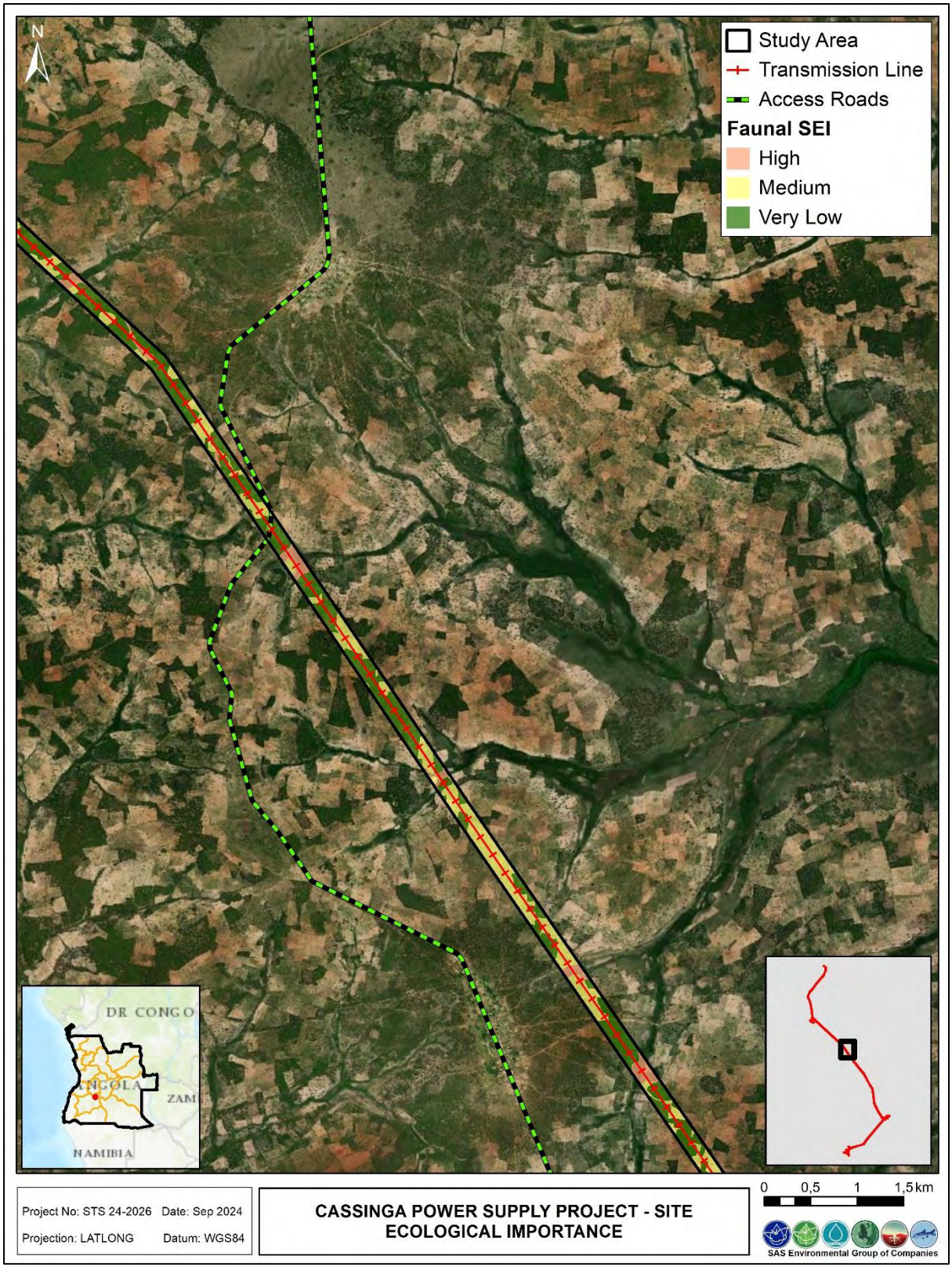


Figure 27. Site Ecological Importance regarding the faunal habitat within the study area.

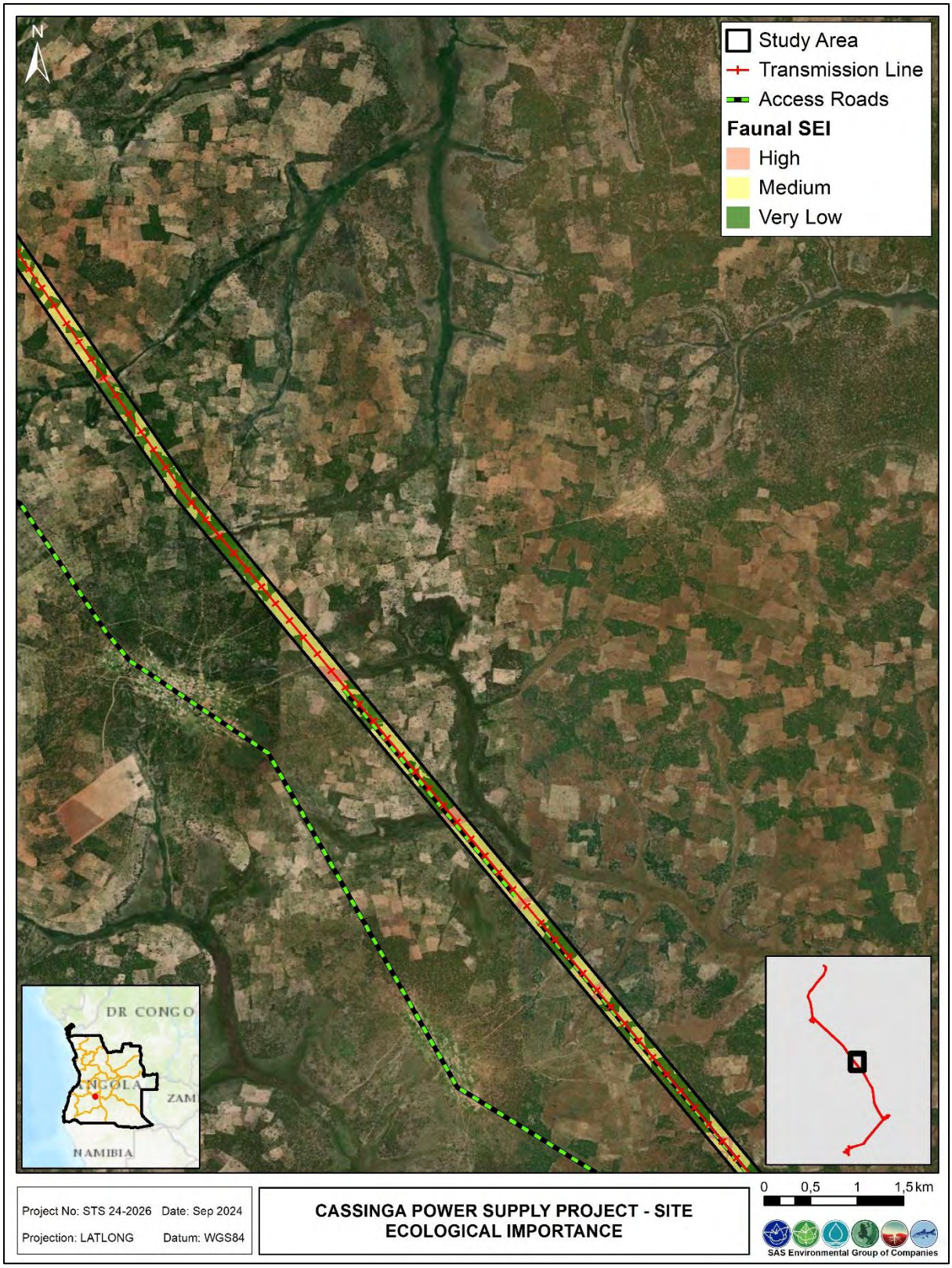


Figure 28. Site Ecological Importance regarding the faunal habitat within the study area.

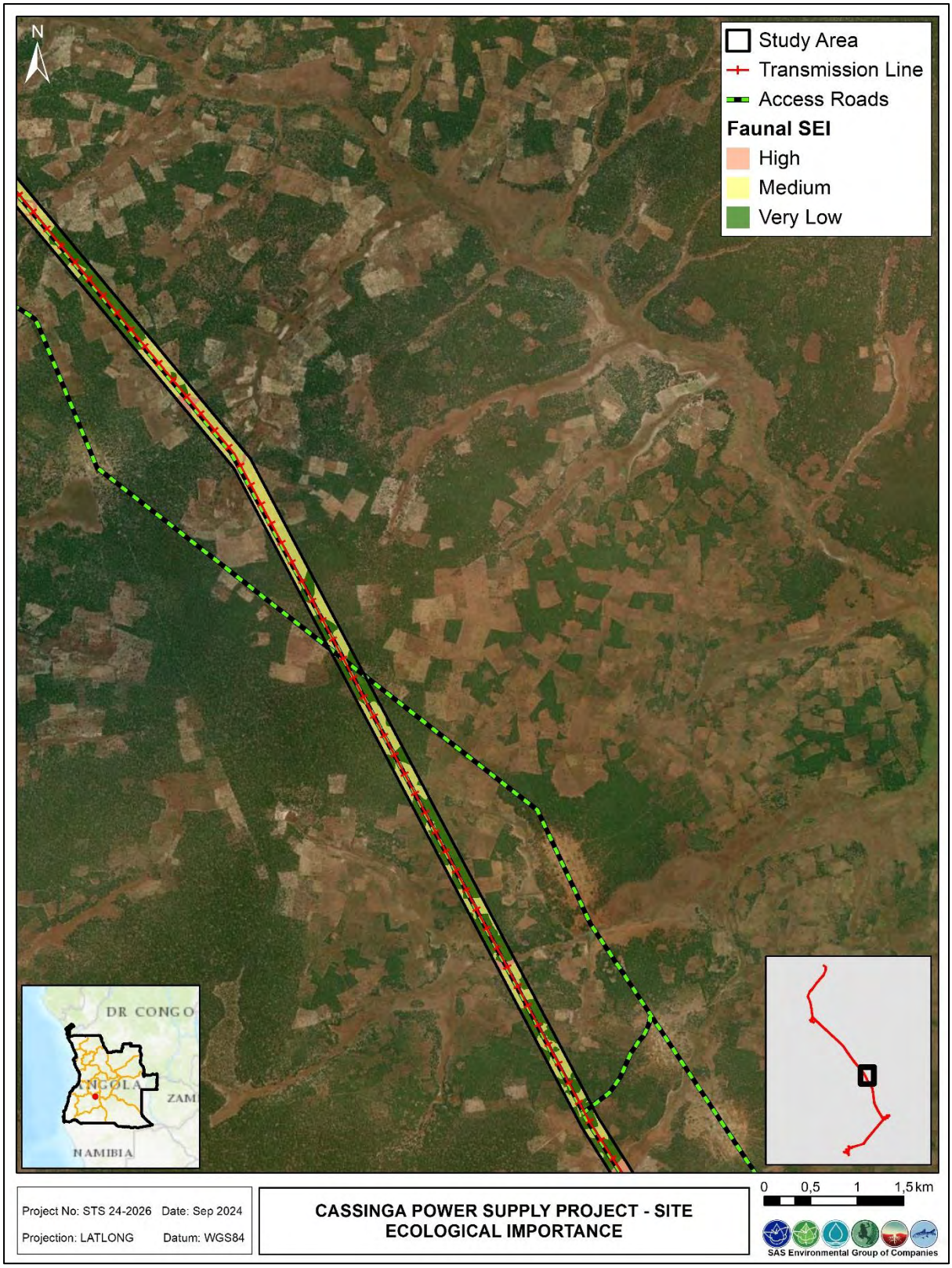


Figure 29. Site Ecological Importance regarding the faunal habitat within the study area.

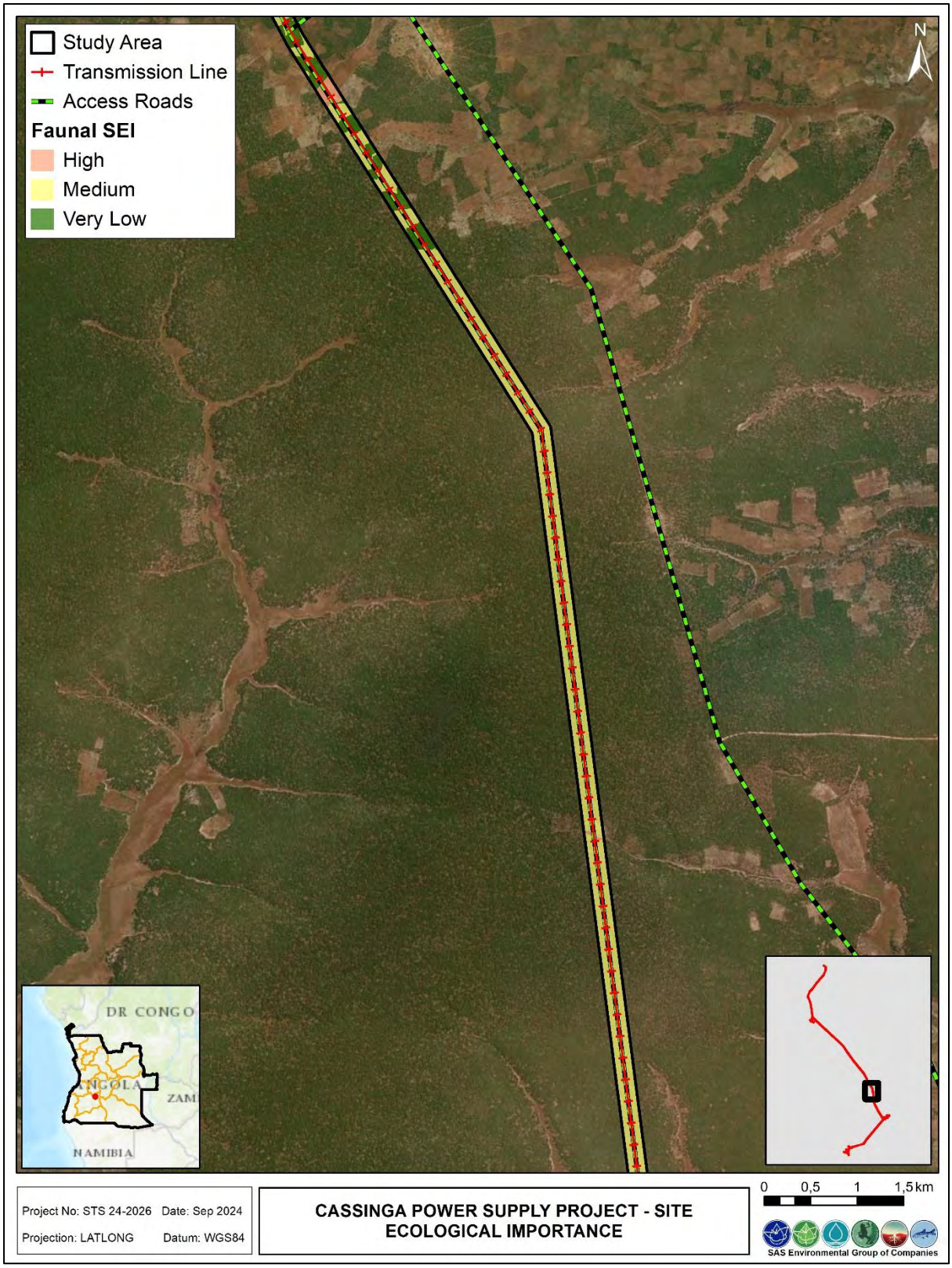


Figure 30. Site Ecological Importance regarding the faunal habitat within the study area.

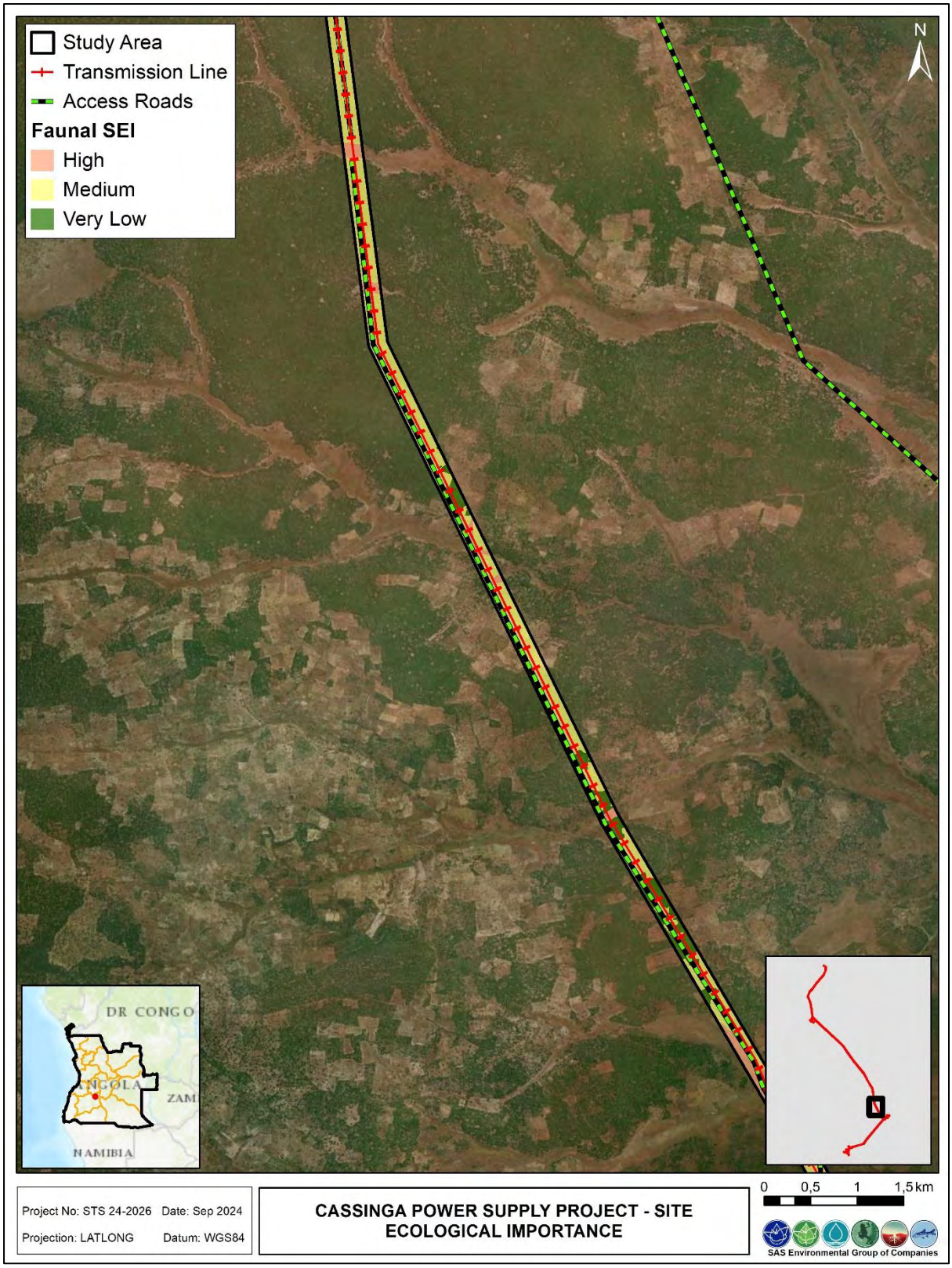


Figure 31. Site Ecological Importance regarding the faunal habitat within the study area.

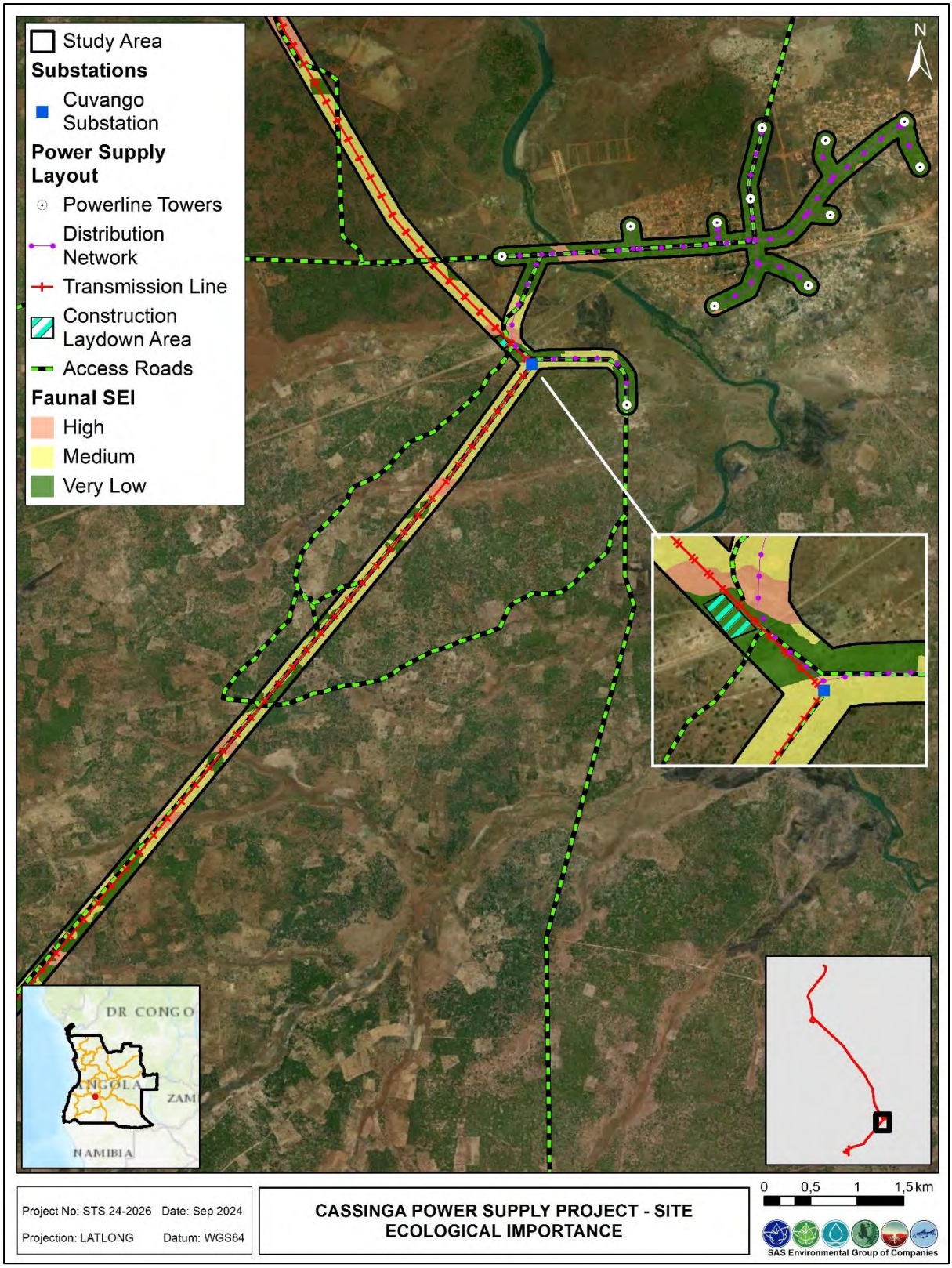


Figure 32. Site Ecological Importance regarding the faunal habitat within the study area.

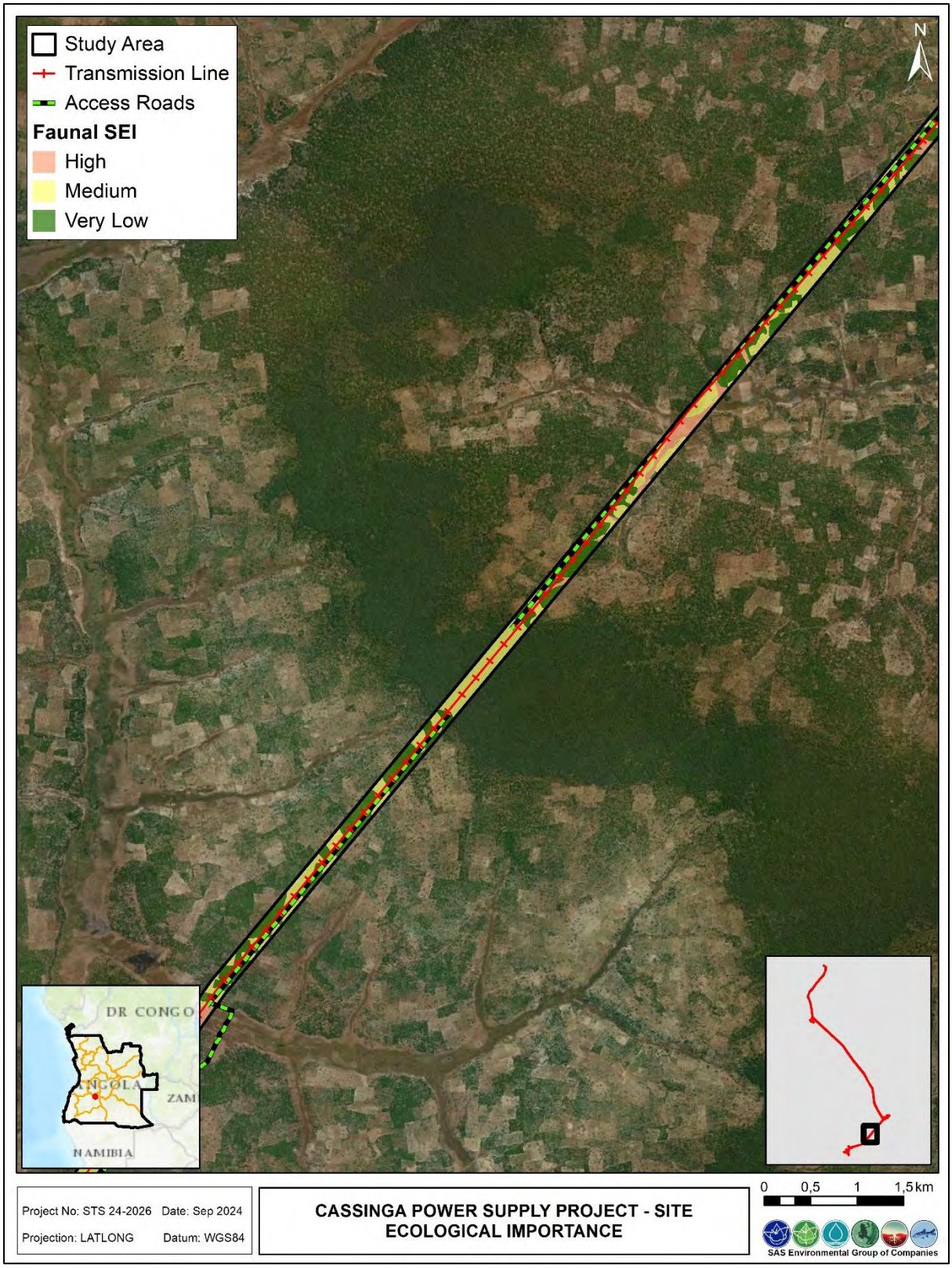


Figure 33. Site Ecological Importance regarding the faunal habitat within the study area.

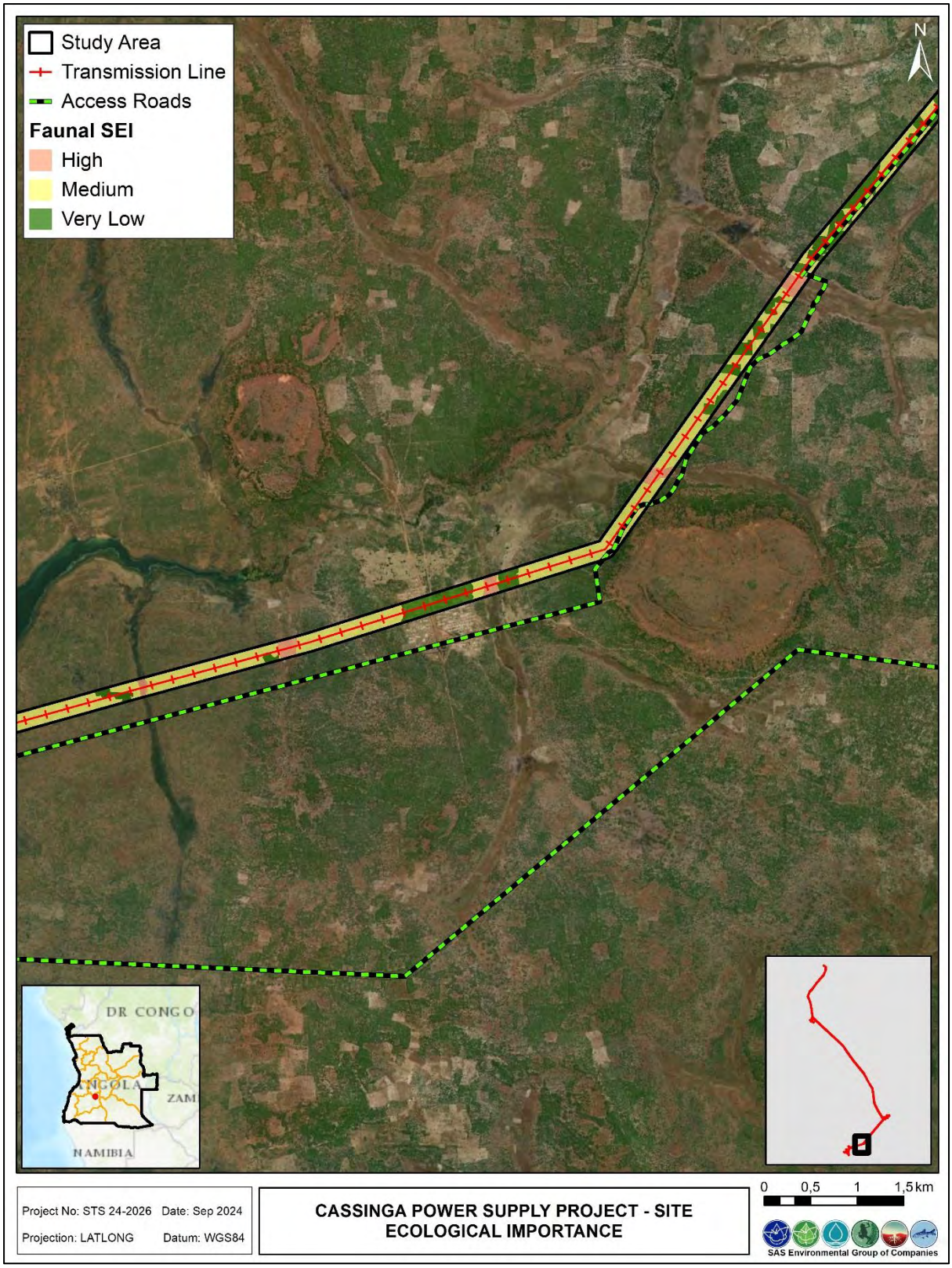


Figure 34. Site Ecological Importance regarding the faunal habitat within the study area.

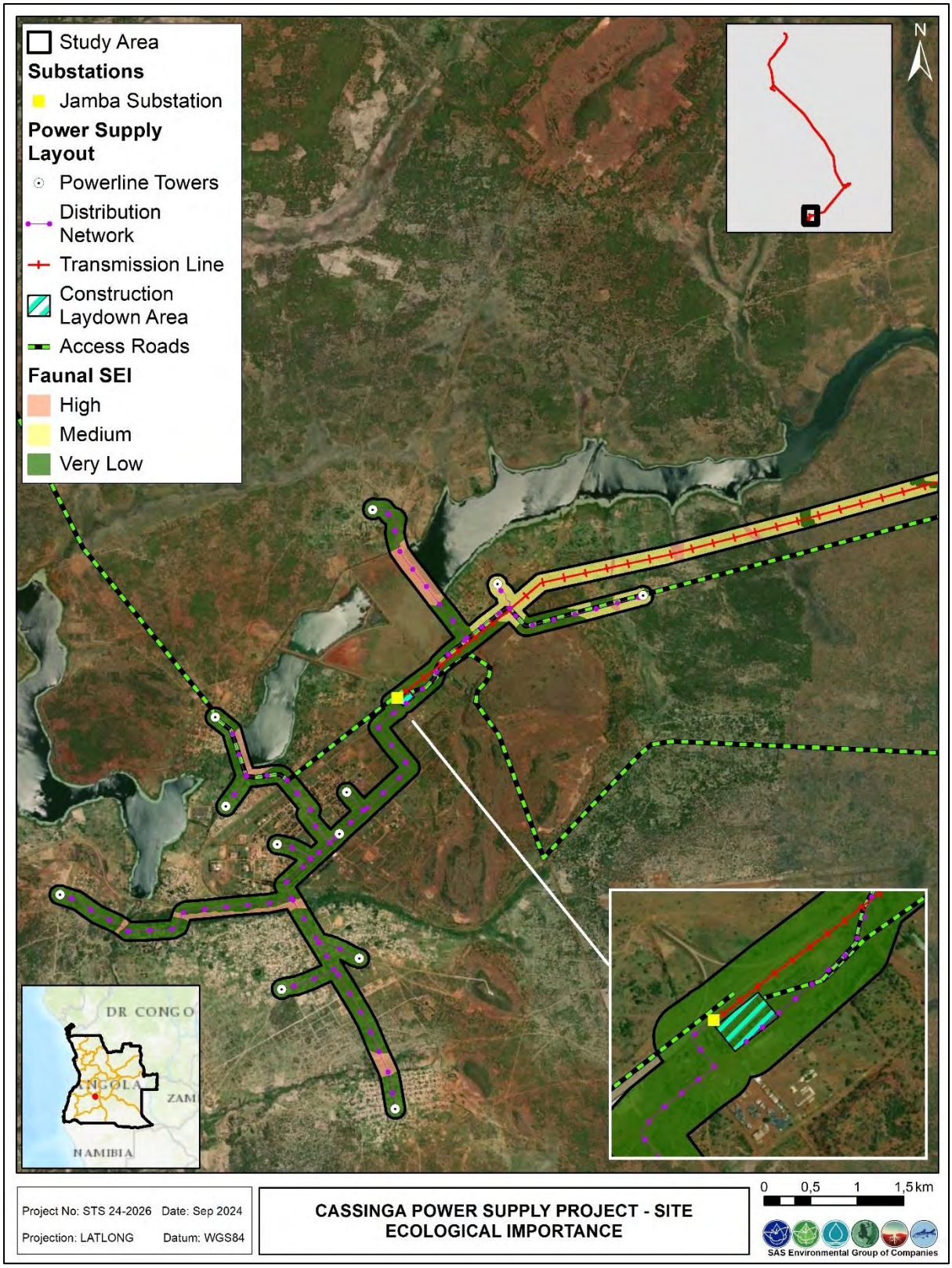


Figure 35. Site Ecological Importance regarding the faunal habitat within the study area.

7 IMPACT ASSESSMENT

The impact assessment was undertaken based on the assumption that the proposed development will take place in the preferred location, and that we assume that the rest of the development envelope will not be developed.

The sections below provide the significance of perceived impacts arising from the proposed tailings dam development within the study area. Refer to impact methodology in Appendix B.

An impact discussion and assessment of all potential planning, construction, and operational and maintenance phase impacts are provided in Section 6.2 and 6.3. All mitigatory measures required to minimise the perceived impacts are presented in Section 6.2.

The impact assessment in Tables 7 – 9 focus on the potential development areas provided by the proponent as depicted in Figure 2.

7.1 Identification Of Potential Impacts

The below table presents the perceived potential impacts that will impact on faunal habitat, species diversity and SCC as a result of the construction and operation of the proposed Cassinga Power Project, based on the following infrastructure:

- Overhead Powerline;
- Tower Footprints;
- Substations and associated infrastructure;
- Access roads:
  - Proposed new access roads;
  - Existing roads to be upgraded; and
- Laydown areas.

Table 11: Summary of the potential impacts to faunal habitat and species associated with the project.

Potential Impacts	Description of Impact
Construction Phase	
Loss of faunal habitat and species diversity	*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. *Development of new access roads will further enhance access to remoter areas which may lead to further wood harvesting and clearance of land for agricultural activities.
Loss of potential faunal SCC	*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 SCC.
Habitat fragmentation	*Vegetation clearance for the OHL and associated access roads will lead to further habitat fragmentation within the landscape, notably in the larger, intact areas of Miombo Woodland; and *Increased area accessibility may lead to further wood harvesting and agricultural land development leading to further fragmentation in the landscape.
Avifaunal and bat collisions with overhead lines	*Avifaunal species, notably medium to large species may collide with overhead powerlines, leading to increased incidents of avifaunal injuries and mortalities; and *Bats, notably larger fruit bat species may collide with overhead lines, leading to increased incidents of injuries and mortalities.
Operational Phase	
Loss of faunal habitat, species diversity and SCC	*Maintenance of the servitude resulting in further vegetation clearance; *Potential increased mortality rates due to human-wildlife conflict and/or collisions with operational vehicles; and *Potential erosion activities due to lack of sufficient vegetation cover.

Avifaunal and bat collisions with overhead lines	*Avifaunal species, notably medium to large species may collide with overhead powerlines, leading to increased incidents of avifaunal injuries and mortalities; and *Bats, notably larger fruit bat species may collide with overhead lines, leading to increased incidents of injuries and mortalities.
Decommissioning Phase	
Loss of faunal habitat, species diversity and SCC	*Loss of faunal species diversity from the footprint areas and potentially the adjacent habitats due to: • Species displacement including faunal SCC; • Potential hunting/snaring of fauna including faunal SCC; • Increased mortality rates due to human-wildlife conflict and/or collisions with decommissioning vehicles; and *Potential erosion activities due to lack of sufficient vegetation cover.
Consideration of Cumulative Impacts	
Habitat fragmentation	Vegetation clearance activities for the OHL will further add to current vegetation clearance activities taking place for subsistence agricultural activities in the region. The development of additional access roads may further accelerate the transformation of indigenous habitats into agricultural land to due to increased accessibility within the region. Further habitat fragmentation will also impact on species movement patterns and their dispersal abilities within the region.
Altered species diversity and occurrences	Continued loss of habitat and potential new access routes to previously difficult to reach areas may result in an increase in hunting / snaring activities. Vestiges of faunal populations that rely upon the relatively inaccessible areas through which the OHL traverses may now be subjected to increased levels of persecution.

7.2 Faunal Impact Assessment Results

The tables below indicate the perceived risks to the faunal ecology associated with the construction, operational and decommissioning phases of the proposed Cassinga OHL and associated infrastructure. The tables also provide the findings of the impact assessment undertaken with reference to the perceived impacts prior to the implementation of mitigation measures and following the implementation of mitigation measures. The mitigated results of the impact assessment have been calculated on the premise that all mitigation measures as stipulated in this report are adhered to and implemented. Should such actions not be adhered to, it is highly likely that post-mitigation impact scores will increase.

Tables 12 – 15 present the finding of the impact assessment for the Cassinga OHL.

Table 12. Impact assessment summary for the proposed Cassinga Power Project – Pre - Construction Phase.

Activity: Planning and finalization of footprints								
Project phase: Pre - Construction								
Impact Summary: Loss of Miombo Woodland Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Secondary Miombo Woodland Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Freshwater Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Transformed Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Medium term	Site	**Low**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of potential faunal SCC								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Medium term	Local	**Low**	Possible	**Low**	-	Medium
Impact Summary: Habitat Fragmentation								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Definite	**Low**	-	Medium
Impact Summary: Avifaunal Collisions with Overhead Powerlines – Miombo Woodland and Freshwater Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Major	Long term	Local	**High**	Definite	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium
Impact Summary: Avifaunal Collisions with Overhead Powerlines – Secondary Miombo Woodland and Transformed Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**High**	Possible	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium
Impact Summary: Bat Collisions with Overhead Powerlines – Miombo Woodland and Freshwater Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Major	Long term	Local	**High**	Definite	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium

Impact Summary: Bat Collisions with Overhead Powerlines – Secondary Miombo Woodland and Transformed Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**High**	Possible	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium

Management Measures:

- Project footprints are to be suitably planned and kept as small as possible, avoiding areas of increased sensitivity;
- As far as possible, no pylon footprints are to be placed within any of the freshwater habitats;
- 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 lengths needed for access should be constructed. Access road widths should, as far as possible be no wider than 5 meters;
- Where freshwater systems are to be crossed, exiting crossings must be used. No new crossings are to be developed;
- Vegetation clearance below the OHL is to be limited to only that which is needed, 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);
- Prior to the construction phase, micro-sighting of the pylon footprints, new access roads and laydown areas should be done;
- During micro-sighting of the footprints, if any raptors nests are observed, the locations need to be duly recorded. Should a nest be observed within the OHL route, and needs to be destroyed, this must be recorded accordingly;
- 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. As there are no known nest buffer recommendations at present for Bateleurs, a precautionary approach has been taken. 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 in a different locality until such a time that it is feasible to return to the area (post breeding);
- No snakes, small reptiles or arachnids are to be killed or harmed by staff during the construction phase. A staff awareness program should be developed prior to the construction phase to educate staff members, educating them not to kill snakes and to train suitable staff members in the correct handling techniques for snake removal;
- 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;
- Anti-perching / nesting devices should be installed of all pylons, substations and any structures which provide a suitable surface for perching or nesting;
- To minimize 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;
- 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; and
- 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.

Table 13. Impact assessment summary for the proposed Cassinga Power Project – Construction Phase

Activity: Site preparation - Clearance of vegetation for pylons, the OHL, laydown areas and access roads. Movement of construction vehicles and personnel.								
Project phase: Construction								
Impact Summary: Loss of Miombo Woodland Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Secondary Miombo Woodland Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Freshwater Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Transformed Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Medium term	Site	**Low**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of potential faunal SCC								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Medium term	Local	**Low**	Possible	**Low**	-	Medium
Impact Summary: Habitat Fragmentation								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Definite	**Low**	-	Medium
Impact Summary: Avifaunal Collisions with Overhead Powerlines – Miombo Woodland and Freshwater Habitats Freshwater Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Major	Long term	Local	**High**	Definite	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium
Impact Summary: Avifaunal Collisions with Overhead Powerlines – Secondary Miombo Woodland and Transformed Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**High**	Possible	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium
Impact Summary: Bat Collisions with Overhead Powerlines – Miombo Woodland and Freshwater Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Major	Long term	Local	**High**	Definite	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium

Impact Summary: Bat Collisions with Overhead Powerlines – Secondary Miombo Woodland and Transformed Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**High**	Possible	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium

Management Measures:

- Project footprints are to be kept as small as possible;
- As far as possible, no pylon footprints are to be placed within any of the freshwater habitats;
- 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;
- Where freshwater systems are to be crossed, exiting crossings must be used. No new crossings are to be developed;
- Vegetation clearance below the OHL is to be limited to only that which is needed, 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);
- No hunting/trapping of faunal species is to be allowed by construction personnel;
- No illicit fires on site are to be allowed. Where fires for cooking are needed, they are to be located in designated sites at the contractor camps and all, measures to ensure that runway fires do not occur must be taken;
- 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;
- All waste material should be cleared away from site and disposed of at a pre-determined disposal site away from sensitive habitats;
- Waste material or excavated soil are not to be disposed of in or adjacent to freshwater habitats;
- Should any raptors, notably *Terathopius ecaudatus* (Bateleur eagle), be found nesting in a large tree along /adjacent to the route, all activities in the vicinity are to be stopped until the fledgling has left the nest. 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);
- 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;
- 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;
- Anti-perching / nesting devices should be installed of all pylons, substations and any structures which provide a suitable surface for perching or nesting;
- To minimize 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;
- 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; and
- 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.

Table 14. Impact assessment summary for the proposed Cassinga Power Project – Operational Phase.

Activity: Infrastructure Maintenance –Vegetation cutting / clearance, limited earthworks, movement of vehicles and personnel								
Project phase: Construction								
Impact Summary: Loss of Miombo Woodland Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Medium term	Site	**Low**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Secondary Miombo Woodland Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Medium term	Site	**Low**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Freshwater Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Medium term	Site	**Low**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Transformed Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Medium term	Site	**Low**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of potential faunal SCC								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Medium term	Site	**Low**	Possible	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Habitat Fragmentation								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Long term	Site	**Low**	Definite	**Low**	-	Medium
Impact Summary: Avifaunal Collisions with Overhead Powerlines – Miombo Woodland and Freshwater Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Major	Long term	Local	**High**	Definite	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium
Impact Summary: Avifaunal Collisions with Overhead Powerlines – Secondary Miombo Woodland and Transformed Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**High**	Possible	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium
Impact Summary: Bat Collisions with Overhead Powerlines – Miombo Woodland and Freshwater Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Major	Long term	Local	**High**	Definite	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium

Impact Summary: Bat Collisions with Overhead Powerlines – Secondary Miombo Woodland and Transformed Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Long term	Local	**High**	Possible	**High**	-	Medium
After Management	Minor	Long term	Local	**Medium**	Possible	**Medium**	-	Medium

Management Measures:

- No additional clearing of vegetation beyond that which is needed for maintenance activities is to be undertaken;
- 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;
- Should access roads used during the construction phase no longer be needed, they should be decommissioned and rehabilitated accordingly;
- Old access roads and laydown areas which are no longer required should be decommissioned and rehabilitated;
- Vegetation clearance below the OHL is to be limited to only that which is needed, excessive vegetation clearance is to be avoided;
- No hunting/trapping of faunal species is to be allowed by construction personnel;
- No illicit fires on site are to be allowed;
- As far as possible, maintenance activities, notably for areas around freshwater habitats, must be planned for during the dry season to avoid excess water runoff., sedimentation and erosion;
- All waste material should be cleared away from site and disposed of at a pre-determined disposal site away from sensitive habitats;
- Waste material is not to be disposed of in or adjacent to freshwater habitats;
- 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;
- 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 has left the nest;
- Bird-flappers / diverters are to be replaced as and when needed should they become dislodged from the powerline. These devices should form part of the regular inspection activities undertaken for the OHL;
- Anti-perching / nesting devices should be inspected and repaired/replaced as and where needed;
- Ensure the insulated covering on the support / tension cables is intact to minimize risk of electrocution; and
- Inspect and maintain anti-perching/nesting devices fitted.

Table 15. Impact assessment summary for the proposed Cassinga Power Project – Decommissioning Phase

Activity: Site preparation - Clearance of vegetation for pylons, the OHL, laydown areas and access roads. Movement of decommissioning vehicles and personnel.								
Project phase: Construction								
Impact Summary: Loss of Miombo Woodland Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Secondary Miombo Woodland Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Freshwater Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of Transformed Habitat and faunal species diversity								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Minor	Medium term	Site	**Low**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Loss of potential faunal SCC								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Medium term	Local	**Low**	Possible	**Low**	-	Medium
Impact Summary: Habitat Fragmentation								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Definite	**Low**	-	Medium
Impact Summary: Avifaunal and Bat Collisions with Overhead Powerlines – Miombo Woodland and Freshwater Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Definite	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium
Impact Summary: Avifaunal and Bat Collisions with Overhead Powerlines – Secondary Miombo Woodland and Transformed Habitats								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	Moderate	Medium term	Local	**Medium**	Possible	**Medium**	-	Medium
After Management	Minor	Medium term	Site	**Low**	Possible	**Low**	-	Medium

Management Measures:

- Project footprints are to be kept as small as possible;
- Implementing a phased or gradual approach to decommissioning can allow wildlife time to adapt and relocate to adjacent areas;
- Existing roads are to be utilized as far as possible in order to access the OHL route;
- No hunting/trapping of faunal species is to be allowed by decommissioning personnel;
- No illicit fires on site are to be allowed. Where fires for cooking are needed, they are to be located in designated sites at the contractor camps and all, measures to ensure that runway fires do not occur must be taken;
- Decommissioning and rehabilitation 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;
- All waste material should be cleared away from site and disposed of at a pre-determined disposal site away from sensitive habitats;
- Waste material or excavated soil are not to be disposed of in or adjacent to freshwater habitats;
- Should any decommissioning activities be located near to known raptor nests, such activities are to only take place during none breeding periods to ensure nesting activities are not disturbed;
- No snakes, small reptiles or arachnids are to be killed or harmed by staff during the decommissioning 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; and
- Edge effects and AIP proliferation, which may affect adjacent or sensitive habitat, need to be strictly managed.

7.3 Impact Discussion

7.3.1 Impact on Faunal Habitat and Diversity

The proposed OHL and associated infrastructure will have varying degrees of impact on the receiving environment. The OHL traverses a mixed landscape, from areas of increased degradation, disturbance and fragmentation to areas of greater habitat integrity which are more intact and less fragmented (though such areas are in the minority). At present, clearing of land for crop cultivation and to a lesser extent wood harvesting has been the primary driver for habitat loss. Similarly, over the years active hunting and snaring of faunal species has resulted in a significantly reduced faunal diversity and abundance in the region, most notably in terms of mammal species. Whilst the upgrading of existing roads to better facilitate construction vehicles will result in habitat loss, such is deemed to be marginal and unlikely to significantly impact on available habitat for species at present. The development of new access roads is not extensive, and whilst it will result in habitat loss and partial habitat fragmentation, the proposed new access roads are located in areas where human and livestock movement are already prevalent, which has already had a notable impact on faunal species abundance and diversity in the study and adjacent areas.

Whilst direct vegetation loss from ground preparation activities may impact terrestrial species, volant species such as birds and bats face further collision risks due to the presence of the OHL, tensions cables etc. Collision risks cannot be wholly 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 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.

The proposed OHL is expected to have a medium impact significance prior to mitigation measures on faunal habitat and terrestrial bound species, decreasing to a low impact

significance following impact mitigation. Impacts to volant species are noted to be higher, with high impact significance levels expected prior to mitigation, reducing to medium impacts with mitigation measures implemented.

7.3.2 Impacts on Faunal SCC

Three faunal SCC were observed during the site assessment, namely *Terathopius ecaudatus* (Bateleur), *Trigonoceps occipitalis* (White-headed Vulture) and *Aonyx capensis* (African Clawless Otter). 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. A single *Trigonoceps occipitalis* (White-headed Vulture) 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.

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). As discussed in Section 7.3.1, these impacts can be reduced through the correct implementation of mitigation measures as stipulated in this report.

Although no active/inactive raptor nests, specifically those of *Terathopius ecaudatus* (Bateleur) were observed, there still remains the possibility that such may be encountered along the OHL route, as not all areas of the route could be accessed. Subsequently, it is recommended that as part of the final walkdown and micro sighting of pylons, should any such nests be encountered they are to be recorded. Where such nests are in the footprint areas of the OHL, it is recommended that the line, where possible, be shifted to avoid such nests. Should such not be possible, nests that are destroyed must be noted. Where nests are not in the footprint area, they are to be given a buffer of 500m (precautionary approach due to the lack of indicative data for nest buffers for this species), whilst no construction/maintenance activities are to take place during the active breeding season.

Vegetation clearance for the OHL, laydown areas or access roads is unlikely to have a significant impact on these species, or other potential SCC in the region, and provided that mitigation measures are implemented, impact significance can be reduced from medium (pre-mitigation) to low (post mitigation).

7.3.3 Cumulative Impacts

In terms of the faunal ecology, the cumulative impacts stemming from the Cassinga Power Project relate primarily to the impact on faunal habitat which is considered to be a valued environmental component, the continued loss of which degrades the overall ecological functioning of the ecosystem. The region through which the OHL traverses has already been subjected to extensive vegetation clearance activities for agricultural (crop planting) purposes. As such, further clearance for roads and pylon footprints within the intact Miombo Woodlands, and to a lesser extent Secondary Miombo Woodland habitats will further add to the regional loss of habitat. Current land uses and the expansion of agricultural lands has displaced many faunal species, forcing them into ever reducing tracts of remaining indigenous vegetation. These isolated populations are further impacted upon through hunting/snaring activities both by people and feral dogs. The proposed clearance activities and development of access roads may give further access to areas where access was previously difficult, potentially accelerating habitat loss due to increased wood harvesting activities and conversion of land to subsistence agriculture.

8 PERMIT REQUIREMENTS

At present no known permitting requirements pertaining specifically to faunal species is known. Furthermore, the only confirmed SCC is a far ranging avifaunal species which is not in need of rescue and relocation activities which may be subject to permit requirements.

9 BIODIVERSITY MANAGEMENT AND MONITORING ACTIONS

Biodiversity management and monitoring during the construction and operational phase of the OHL is important to ensure that all aspects of the receiving environment in terms of faunal species are taken into account, and that aspects are not overlooked. Whilst management aspects are used to define or highlight biodiversity goals / objectives, monitoring is required to assess the suitability and effectiveness of the management actions and if needed, highlight

shortcomings or areas of change which are needed in order better meet the overall management objectives.

The overall biodiversity management goal is to ensure that the construction and operation of the OHL has as low an impact as possible on the receiving environment, and in the case of this report, with specific reference to faunal species.

The table below details tasks / objectives for the project as well as monitoring activities and potential outcomes that should be implemented along with the mitigation measures already mentioned in Section 6 which are to be included in the Environmental and Social Management Plan (ESMP).

Table 16: Objectives and monitoring activities to be incorporated into the ESMP.

OBJECTIVE / TASK	SITE MANAGEMENT AND MONITORING ACTIVITIES	KEY PERFORMANCE INDICATOR (KPI)
Construction Phase: Ensure that project footprints earmarked for clearance of vegetation are clearly demarcated	• Using bunting/reflective tape, clearly demarcate all proposed laydown areas, pylon footprints and any new access roads where vegetation clearance will take place. • Ensure that vegetation clearance teams are well briefed on their tasks and understand that they are only to clear vegetation within the demarcated areas.	1. Footprint areas have been clearly demarcated. 2. Vegetation clearance teams have only cleared within the demarcated footprint areas.
Construction Phase: Ensure that footprint creep does not occur and that habitat beyond the demarcated areas is not impacted upon	• Weekly inspections of the project footprints are to take place to ensure that no footprint creep is taking place. • Where clearance is taking place beyond the demarcated footprints, ensure that those activities cease and that where necessary, rehabilitation measures are implemented.	1. Monthly report is compiled detailing any issues encountered on site and areas where unauthorised footprint extension has occurred. 2. Rehabilitation/rectification actions have implemented as needed.
Construction Phase: Cleanup laydown areas and construction footprints once activities therein are completed	• Ensure all waste material and construction equipment has been removed from the site/footprint area. • Implement suitable rehabilitation / revegetation activities to ensure that no bare soil areas remain post construction.	1. All waste and construction equipment has been removed. 2. Revegetation activities are taking place and plant cover is starting to re-establish in the disturbed areas within the first year.
Construction, Operational and Decommissioning Phase: Monitor for any erosion activities or significant sedimentation of the adjacent habitat taking place due to ground clearing activities	• Erosion monitoring of footprints is to take place on a monthly basis during the construction phase. • During the operational phase, time intervals between monitoring can be extended, taking place quarterly. • Decommissioning Phase should occur in a phased-out manner, ensuring rehabilitated areas are monitored until revegetation is complete to relinquish the site. • Erosion control measures implemented to reduce erosion and surface water runoff.	1. Monthly report detailing any erosion noted and localities where it is noted during the construction phase. 2. Quarterly reporting during the operational phase. 3. Quarterly reporting during the decommissioning phase or after a major rainstorm and/or floor. 4. Erosion management interventions have been implemented for identified areas of issue.
Construction and Operational Phase: Inspects the freshwater crossing points for avifaunal carcases (overhead line collisions) Monitor pylons for nest construction	• Inspect freshwater crossing points monthly during year 1 to ascertain the number of avifaunal collisions and effectiveness of the bird flappers. • Areas of high mortality incidences must be investigated in terms of increasing number of diverters or alternative device types dependant on species impacted. • Ad hoc inspections of pylons for construction of large raptor nests – remove old/inactive nests.	1. Monthly report indicating mortalities (species, numbers and locations) during year one. Engage specialists to ascertain acceptable mortality levels and determine if additional interventions are required. 2. Quarterly monitoring post year 1 (ad hoc observations also done by any maintenance staff). 3. Nests (old/inactive) posing a risk have been removed.
Operational Phase: Pylon footprint inspections are to be undertaken	• Footprint inceptions undertaken to assess revegetation progress on a monthly basis during the first year of operation. • Quarterly monitoring to take place from year two onwards in conjunction with the erosion monitoring. • Assess footprints for alien plant proliferation so timeous preventative measures can be taken.	4. Report submitted detailing vegetation regrowth in the disturbed areas including photographic evidence and locality data. 5. Erosion / alien plant control measures implemented based on site inspection outcomes.

10 CONCLUSION AND IMPACT STATEMENT

The study area comprises a mix of intact and degraded habitats, as well as areas where total habitat transformation has occurred. Mosaic land clearance for agricultural activities has in many instances left a patchy network of intact habitat, whilst old agricultural lands in mixed stages of ecological recovery (succession) are often located adjacent to current agricultural areas. There are though some areas traversed by the study area where relatively large and contiguous stands of Miombo Woodland are still present. Furthermore, the Freshwater habitats further from the villages/towns are predominantly intact, however some of the wetlands closer to human settlements have been impacted by agricultural practices.

Faunal diversity and abundance, particularly that of mammals was limited. This however can be expected in such area as there is likely to be hunting / snaring of mammal species for food. The vast majority of species encountered were insects and smaller avifaunal species, whilst reptiles and amphibians were not readily observed.

When considering the proposed OHL development, further habitat loss and fragmentation is unavoidable, though, these impacts can be minimised through sound planning and implementation of mitigation measures. Primarily, where the OHL traverses Miombo Woodland, vegetation clearance must be minimised. Furthermore, all freshwater habitats must be spanned as far as possible, avoiding pylon footprint placement within freshwater systems. Where not possible, the towers should be placed in the driest portions on the edge of the watercourses. Through sound planning, environmental management and implementation of mitigation measures, the impact significance associated with all activities and aspects of the project can be reduced to a low impact.

The objective of this study was to provide sufficient information on the faunal ecology of the area in order for the EAP and the relevant authorities to apply the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. It is the opinion of the specialist that whilst the Cassinga Power Project will lead to loss of habitat within the study area, the overall impact to fauna within the study area is expected to be limited, provided that mitigation measures as stipulated within this report are implemented.

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APPENDIX A: FAUNAL METHOD OF ASSESSMENT

It is important to note that due to the nature and habits of fauna, varied stages of life cycles, seasonal and temporal fluctuations along with other external factors, it is unlikely that all faunal species will have been recorded during the site assessment. The presence of anthropogenic activities within the study area will have an impact on faunal behaviour and in turn the rate of observations. Furthermore, the inability to access much of the study area further hampered species observation rates, requiring accessible proxy sites to be assessed which, due to their accessibility, may have had lower species diversity and abundance levels.

For SCC, the relevant databases were assessed, and only species considered to have a medium to high probability of occurrence were included in this report. Species whose known distribution areas do not coincide with the study area, or which have a low POC due to habitat unsuitability, were not included or discussed in this report. The exclusion of non-expectant or low POC species from this report in no way changes the data presented, the outcome of the sensitivity or impact assessments nor the overall conclusions drawn in the report.

Mammals

Mammal species were recorded during the field assessment with the use of visual identification by actively searching/listening for individuals or the presence of spoor, calls and dung. Specific attention was given to mammal SCC which may occur in the study area. Desktop analysis of the study area was used to further saturate field assessment data results. Where possible, transects were walked within representative habitats/proxy sites.

Avifauna

Field surveys were undertaken utilising direct observation and bird call identification techniques in order to identify avifaunal species. Specific attention was given to avifaunal SCC that may occur within the region. Areas of higher value to avifaunal species were determined through desktop analysis and increased time were spent in these areas where possible.

Reptiles

Reptiles were identified during the field survey. Suitable applicable habitat areas (rocky outcrops and fallen dead trees) were inspected and all reptiles encountered were identified. It is worth noting that reptiles are inherently secretive and shy and that it is difficult to observe all species during site assessments of limited duration. The data gathered during the assessment along with the habitat analysis provided an indication of which reptile species are likely to occur on the study area.

Amphibians

Identifying amphibian species is done by the use of direct visual identification along with call identification technique. Amphibian species flourish in and around wetland, riparian and moist grassland areas. It is unlikely that all amphibian species will have been recorded during the site assessment, due to their cryptic nature and habits, varied stages of life cycles and seasonal and temporal fluctuations within the environment.

Invertebrates

Insect species were visually observed and where possible photographs taken. It must be noted, however that due to the cryptic nature and habits of insects, varied stages of life cycles and seasonal and temporal fluctuations within the environment, it is unlikely that all insect species will have been recorded during the site assessment period. Specific attention was given to insect SCC which may be occur within the study area.

Suitable applicable habitat areas (rocky outcrops, sandy areas and fallen dead trees) where spiders and scorpions are likely to reside were further searched whilst on site. Rocks were overturned and inspected for signs of these species.

Faunal Species of Conservational Concern Assessment

The Probability of Occurrence (POC) for each faunal SCC is described:

- "**Confirmed'**: if observed during the survey;
- "**High**": if within the species' known distribution range and suitable habitat is available;
- "**Medium**": if either within the known distribution range of the species or if suitable habitat is present; or
- "**Low**": if the habitat is not suitable and falls outside the distribution range of the species.

The accuracy of the POC is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research.

Faunal Habitat Sensitivity

SEI is considered to be a function of the biodiversity importance (BI) of the receptor (e.g., species of conservation concern, the vegetation/fauna community or habitat type present on the site[2]) and its resilience to impacts (receptor resilience [RR]) as follows:

SEI = BI + RR

SEI can be derived from a simple matrix of BI and RR as follows:

Table A1: Matrix of CI and FI to determine BI.

Site Ecological Importance (SEI)		Biodiversity Importance				
		Very high	High	Medium	Low	Very low
Receptor Resilience	Very low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very high	Medium	Low	Very low	Very low	Very low

Interpretation of the SEI in the context of the proposed development is provided below.

Table A2: Guidelines for interpreting SEI in the context of the proposed development activities.

Site ecological importance	Interpretation in relation to proposed development activities
Very high	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e., last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
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.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

BI in turn is a function of conservation importance (CI) and the functional integrity (FI) of the receptor as follows:

[2] Note that the habitat type may be independent of the vegetation community and that it may even be artificial, e.g., excavated rock quarries that provide crucial breeding habitat for cliff-nesting species such as Bald Ibis.

BI = CI + FI

BI can be derived from a simple matrix of CI and FI as follows:

Table A3: Matrix of CI and FI to determine BI.

Biodiversity importance		Conservation importance				
		Very high	High	Medium	Low	Very low
Functional Integrity	Very high	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

Conservation importance (CI) is evaluated in accordance with recognised established internationally acceptable principles and criteria for the determination of biodiversity-related value, including the IUCN Red List of Species, Red List of Ecosystems and Key Biodiversity Areas (KBA; IUCN [2016]).

Conservation importance is defined here as:

> *'The importance of a site for supporting biodiversity features of conservation concern present, e.g., populations of IUCN threatened and Near Threatened species (CR, EN, VU and NT), Rare species, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes.'*

These criteria are defined as follows:

- IUCN threatened and Near Threatened species (CR, EN, VU and NT) are defined as either the global or national assessments of the risk of extinction as evaluated by a dedicated panel of species specialists according to the criteria of the International Union for The Conservation of Nature (www.iucnredlist.org). Where the global and national assessments differ for the same taxon, the national evaluation of status[3] should be used in calculating SEI unless the global assessment is both more recent and of a more threatened category. It is important to note that the specialist is required to have a firm understanding of the IUCN Red List Categories and Criteria (IUCN 2012) in order to appropriately apply these for the evaluation of SEI. This criterion can be assessed using confirmed occurrences of species or the suitability of the habitat to support these species. Rare species are those included on South Africa's National Red List as Rare or Critically Rare or Extremely Rare. These are highly restricted species that are currently not declining. However, should any development impact on a population of these species they will immediately qualify under one of the IUCN categories of threat. y Range-restricted species – the presence of terrestrial flora, vertebrate, and invertebrate fauna with a global population extent of occurrence (EOO) of 10 000 km^2 or less.
- Globally significant populations of congregatory species – a roughly estimated proportion (%) of the global population of a fauna species that congregate for breeding/feeding/hibernation/other reasons. y Significant areas of threatened vegetation types – this is a function of both the area (size) being considered in relation to the total extent of that vegetation type (i.e., proportion) and how threatened (CR, EN, VU) the vegetation types are.
- Natural processes – natural unmanaged areas with low levels of ecological disturbance have largely intact natural processes such as pollination, seed dispersal and migration, and thus have greater intrinsic conservation importance than those that are modified through ecological disturbance.

While most of the features that will be included in the CI will be provided by the screening tool, it is important to note that CI is evaluated at a much finer spatial scale and based on fieldwork data collection and comprehensive desktop analyses performed by the specialist during the EA process. As a minimum requirement, CI needs to be determined for each identified habitat within the project footprint, but best practice recommendation is that it should be determined for all habitats within the entire Project Area of Influence (PAOI)[4].

[3] http://speciesstatus.sanbi.org/. For mammals: https://www.ewt.org.za/wp-content/uploads/2020/04/2020-updated-2016-Red-List-of-Mammals-of-South- Africa-Lesotho-Swaziland-Summary-Listings.xlsx; for plants: http://redlist.sanbi.org.

[4] Because CI needs to be assigned to a receptor (e.g., the vegetation/fauna community or habitat type), it is customary to use the flora community delineation developed for a PAOI by a botanical specialist. However, such delineation is often too fine scaled to define fauna-

Fulfilling criteria to evaluate CI do not rely on a single specific threshold for each of the above defining characteristics but can act in combination or in isolation, providing a more robust evaluation of CI (Table A4). Furthermore, while CI is most likely to be assessed based on data collected during the fieldwork survey, it can also be an assessment of the suitability of the receptor to support populations conforming to the fulfilling criteria. As can be seen from the worked example below, each of these evaluations of the fulfilling criteria demand necessary justification.

Table A4: Conservation importance (CI) criteria.

Conservation importance	Fulfilling criteria
Very high	- Confirmed or highly likely occurrence of CR, EN, VU or Extremely Rare[5] or Critically Rare[6] species that have a global EOO of < 10 km^2. - Any area of natural habitat[7] of a CR ecosystem type or large area (> 0.1% of the total ecosystem type extent[8]) of natural habitat of EN ecosystem type. - Globally significant populations of congregatory species (> 10% of global population).
High	- Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km^2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. - Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type. - Presence of Rare species. - Globally significant populations of congregatory species (> 1% but < 10% of global population).
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. - Any area of natural habitat of threatened ecosystem type with status of VU. - Presence of range-restricted species. - > 50% of receptor contains natural habitat with potential to support SCC.
Low	- No confirmed or highly likely populations of SCC. - No confirmed or highly likely populations of range-restricted species. - < 50% of receptor contains natural habitat with limited potential to support SCC.
Very low	- No confirmed and highly unlikely populations of SCC. - No confirmed and highly unlikely populations of range-restricted species. - No natural habitat remaining.

Functional integrity (FI) of the receptor (e.g., the vegetation/fauna community or habitat type) is defined here as the receptors' current ability to maintain the structure and functions that define it, compared to its known or predicted state under ideal conditions. Simply stated, FI is:

> *'A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.'*

These criteria can be defined as:

specific habitats, which are generally more structural than phytosociological in nature. Where this is the case, the fauna specialist should merge two or more relevant floral communities to correlate with the specific fauna habitat type that is characteristic of a particular taxon assemblage. In certain cases, the faunal specialist will have to demarcate habitats that have not been classified by the botanical specialist; a pertinent example is the presence of cliffs, which are frequently important breeding habitat for some bird SCC.

[5] For butterflies, as per Armstrong *et al*. (2013).

[6] For plants, as per Raimondo *et al*. (2009).

[7] This excludes areas of transformed habitat within a defined ecosystem even if these are partially restored, e.g., Highveld grasslands that have been converted to maize fields and then abandoned so that some form of functional grassland is restored; this is not natural habitat as it does not and will not in the future have species composition representative of the original natural habitat.

[8] This can be calculated from the threatened ecosystem of South Africa shapefile available from the SANBI (current available version 2011: http://bgis.sanbi. org/Projects/Detail/49).

- Connectivity to other natural areas – connectivity, which can also be measured conversely as the degree of habitat fragmentation, refers to how connected habitat patches are to each other, which has a significant influence on numerous ecological processes, such as migration and dispersal opportunities of biota and therefore genetic exchange between populations. Connectivity to other similar habitats becomes more important as the remaining intact and functional area of a habitat decreases, mainly because population sizes decrease and are therefore at greater risk from ecological perturbations and inbreeding effects. The degree of connectivity between habitat patches varies greatly with the dispersal ability of the taxon or taxon group (e.g., fossorial reptiles) in question.
- Degree of current persistent negative ecological impacts – persistent negative impacts such as uncontrolled spread of alien and invasive flora effectively decreases both the remaining intact area and ecosystem functioning of a particular habitat. Persistent ecological disruptors must not include components that landowners are legally obliged to address or that should be addressed as norm for best practice. Wilful neglect of these legal obligations or the presence of invasive alien species that can practically be controlled through management actions should not negatively influence the FI score to a major extent.
- Remaining intact and functional area – the proportion of the receptor that supports natural habitat with intact ecological processes – small areas are less likely to withstand ecological degradation compared to large areas, and the latter are therefore better able to maintain structure and function allowing for intact ecological processes.

Ecological processes can be considered to be mostly intact and functional if the receptor area has low levels of current ecological disruptors, has good connectivity to other areas and is a relatively large area. As for CI, the fulfilling criteria to evaluate FI do not rely on a single specific threshold for each of the above defining characteristics but can act in combination or in isolation (Table A5) and will require justification by the specialist.

Table A5: Functional integrity (FI) criteria.

Functional integrity	Fulfilling criteria
Very high	- Very large (> 100 ha) intact area for any conservation status of ecosystem type or > 5 ha for CR ecosystem types. - High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. - No or minimal current negative ecological impacts with no signs of major past disturbance (e.g., ploughing).
High	- Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type or > 10 ha for EN ecosystem types. - Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. - Only minor current negative ecological impacts (e.g., few livestock utilising area) with no signs of major past disturbance (e.g., ploughing) and good rehabilitation potential.
Medium	- Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types. - 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 (e.g., established population of alien and invasive flora) and a few signs of minor past disturbance. Moderate rehabilitation potential.
Low	- Small (> 1 ha but < 5 ha) area. - Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. - Several minor and major current negative ecological impacts.
Very low	- Very small (< 1 ha) area. - No habitat connectivity except for flying species or flora with wind-dispersed seeds. - Several major current negative ecological impacts.

Ecological processes can be considered to be mostly intact and functional if the receptor area has low levels of current ecological disruptors, has good connectivity to other areas and is a relatively large area. As for CI, the fulfilling criteria to evaluate FI do not rely on a single specific threshold for each of the above defining characteristics but can act in combination or in isolation (Table 8.2) and will require justification by the specialist (see worked example below).

Receptor resilience (RR) is defined here as:

'The intrinsic capacity of the receptor to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention.'

The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor (Table A4) and will require justification by the specialist. The specialist needs to bear in mind that resilience will often be linked to a particular disturbance or impact, or even time of year, and needs to be described in relation to these factors. For example, large birds of prey have different levels of resilience to noise disturbance depending on whether they are breeding or not; these species would have low resilience to noise disturbance such as construction of a road adjacent to a nest site during the breeding season but a higher resilience to lodge construction in an area with limited breeding habitat outside of the breeding season.

Receptor resilience needs to be evaluated by the specialist and justification for each evaluation must be provided in the report (see worked example below). Finally, after the successful evaluation of both BI and RR as described above, it is possible to evaluate SEI from the final matrix as follows:

SEI should be described in the above manner for each impact receptor within the area of influence and clearly mapped in relation to the proposed development activities and infrastructure. Interpretation of SEI in the context of the proposed development activities (Table A1) must be provided by the specialist.

It is very important to note that SEI is specific to the proposed development activities and cannot be meaningfully compared between different proposed projects with different associated activities on the same spatial location. However, SEI for the same proposed development with multiple alternative layouts and/or locations may be compared within the same study.

Table A6: Resilience criteria.

Resilience	Fulfilling criteria
Very high	Habitat that can recover rapidly (~ less than 5 years) to restore > 75%[28] 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.
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.
Medium	Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed.
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.
Very low	Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring, or species that are unlikely to return to a site once the disturbance or impact has been removed.

International Finance Corporation Performance Standard 6

The IFC habitat categories are defined as follows:

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 Performance Standard applies to those areas of modified habitat that include significant biodiversity value, as determined by the risks and impacts identification process required in Performance Standard 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 are areas with high biodiversity value, including (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.

APPENDIX B: IMPACT ASSESSMENT METHODOLOGY

The project impact assessment method was supplied by SRK Consulting.

Impact assessment methodology

Potential impacts (direct, indirect, cumulative) will be assessed using information gathered during the baseline assessment in combination with previously collected desktop data and compared with the detailed project description.

Impact significance rating

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 4-1 and involves the following 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.
- 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 4-1: Method for rating 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	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*					
Impact characteristics	**Definition**		**Criteria**		
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

After determining the significance rating, practicable management measures are suggested for each specific impact. The impact description should indicate the significance rating prior to and following mitigation/optimisation. As explained above:

"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 is then re-assessed with assumed management measures in place ("after management"). Specialists also recommend and describe 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 4-2.

APPENDIX C: FAUNAL SCC

The tables below list the faunal Species of Conservation Concern considered for this project in accordance with Angolan legislation.

Table C1: Executive Decree No. 252/18 Red List of Animal Species of Angola (2018).

2. Categoria B: Espécies Ameaçadas de Extinção (AEx)

Classe		Nome Vulgar	Nome Científico	Ameaças Directas
Mamíferos	1	Malevo	*Lycaon pictus*	Caça furtiva de animais que consome
	2	Hiena-malhada	*Crocuta crocuta*	Caça furtiva de animais que consome
	3	Pretelo	*Pratelas crista*	Caça furtiva de animais que consome
	4	Leão	*Panthera leo*	Caça furtiva de animais que consome
	5	Cláta	*Acinonyx jubatus*	Caça furtiva de animais que consome
	6	Zebra de Montanha	*Equus zebra hartmannae*	Caça furtiva
	7	Gorila	*Gorilla gorilla*	Caça furtiva
	8	Pacaça (Búfalo vermelho)	*Syncerus caffer nanus*	Caça furtiva
	9	Cabra do monte comum	*Sylvicapra grimmia*	Caça furtiva
	10	Chimpanzé	*Pan troglodytes*	Caça furtiva
	11	Manatim africano	*Trichechus senegalensis*	Pesca ilegal e degradação do seu habitat
	12	Macaco de Bravza	*Cercopithecus stipulatus*	Caça furtiva
	13	Colobo	*Colobus angolensis*	Caça furtiva
	14	Palanca Negra Gigante	*Hippotragus niger variani*	Caça furtiva
	15	Raposa das areias	*Vulpes chama*	Caça furtiva de animais que consome
	16	Suricata	*Suricata suricata*	Caça furtiva
	17	Búfalo	*Syncerus caffer caffer*	Caça furtiva e Fragmentação do habitat
	18	Girafa de Angola	*Giraffa camelopardalis angolensis*	Caça furtiva
	19	Palmato (Macaco cão)	*Papio ursinus*	Caça furtiva e fragmentação do habitat

Classe		Nome Vulgar	Nome Científico	Ameaças Directas
Répteis		Tartaruga de Couro	*Dermochelys coriacea*	Destruição do ninhos e captura indirecta
Aves	1	Tordo-da-fumo	*Xenocopsychus ansorgei*	Endémica, fragmentação do habitat
	2	Cuinsonjolo	*Estrilda thomensis*	Endémica, fragmentação do habitat
	3	Garça de Garganta - Vermelha	*Egretta vinaceigula*	Desconhecido
	4	Grou Coroado	*Balearica regulorum*	Desconhecido
	5	Papagaio-cinzento	*Psittacus erithacus*	Caça furtiva P/ Domesticação
	6	Grou Carunculado	*Bugeranus carunculatus*	Desconhecidas
	7	Garça de Barriga - Vermelha	*Ardeola rufiventris*	Desconhecidas
Peixes	1	Raia Manta	*Manta birostris*	Pressão da Pesca ilegal
	2	Tubarão Azul	*Prionace glauca*	Pressão de Pesca ilegal
	3	Tubarão Tigre	*Galeocerdo cuvier*	Pressão de Pesca ilegal

3. Categoria C: Espécies Vulneráveis (Vul)

Classe		Nome Vulgar	Nome Cientifico	Ameaças Directas
Mamiferos	1	Babuino-cinzento	*Papio ursinus*	fragmentação do habitat
	2	Babuino amarelo	*Papio cynocephalus*	fragmentação do habitat
	3	Chacal de flancos raiados	*Canis adustus*	Caça furtiva de animais que consome
	4	Chacal de dorso preto	*Canis mesomelas*	Caça furtiva de animais que consome
	5	Raposa orelhuda	*Otocyon megalotis*	Caça furtiva de animais que consome
	6	Ratel	*Mellivora capensis*	Caça furtiva
	7	Lontra castanha	*Lutra maculicolis*	Caça furtiva
	8	Civeta	*Civettictis civetta*	Caça furtiva
	9	Gato bravo	*Felis silvestris*	Caça furtiva de animais que consome
	10	Serval	*Felis caracal*	Caça furtiva de animais que consome
	11	Caracal	*Felis caracal*	Caça furtiva de animais que consome
	12	Leopardo	*Panthera pardus*	Caça furtiva de animais que consome
	13	Pangolim Vulgar	*Manis temminckii*	Fragmentação do habitat
	14	Gimbo	*Orycterops afer*	Fragmentação do habitat
	15	Elefante de Savana	*Loxodonta africana africana*	Caça furtiva e fragmentação do habitat
	16	Elefante de Floresta	*Loxodonta africana cyclotis*	Caça furtiva e fragmentação do habitat
	17	Zebra de planicie	*Equus burchellii*	Caça furtiva
	18	Pangolim da Floresta	*Manis tetredactyla*	Caça furtiva

Classe		Nome Vulgar	Nome Científico	Ameaças Directas
Aves	1	Ollio de cantarilla de testa branca	*Platysteira albifrons*	Endémica, fragmentação do habitat
	2	Perdiz de Ditras cucurutas	*Pternistes griseostriatus*	Endémica, fragmentação do habitat
	3	Perdiz de Montanhas	*Pternistes swierstrai*	Endémica, fragmentação do habitat
	4	Ánabra de Cristo Vermelha	*Tauraco erythrolophus*	Endémica, fragmentação do habitat
	5	Rabo de Junco de Rabadilha vermelha	*Colius castanotus*	Endémica, fragmentação do habitat
	6	Tordito da Gabela	*Sheppardia gabela*	Endémica, fragmentação do habitat
	7	Tordo-de-Barras	*Xenocopsychus ansorgei*	Endémica, fragmentação do habitat
	8	Rouxinol de Pelzeln	*Macrosphenus pulitzeri*	Endémica, fragmentação do habitat
	9	Papa-moscas de Angola	*Melaenornis brunneus*	Endémica, fragmentação do habitat
	10	Alfaiate-de-papo de Gabela	*Prionops gabela*	Endémica, fragmentação do habitat
	11	Zombeteiro de Damaralandia	*Phoeniculus damarensis*	Endémica, Deserto do Namibe
	12	Bico de Serra vermelho	*Tockus damarensis*	Endémica, fragmentação do habitat
	13	Bico de Serra Monteiro's	*Tockus monteiri*	Endémica, Deserto do Namibe
	14	Calcovia Angolana	*Mirafra angolensis*	Endémica
	15		*Anthoscopus grayi*	Endémica, fragmentação do habitat
	16	Calcovia de bico Comprido	*Certhilauda benguelensis*	Endémica, fragmentação do habitat
	17	Unha longa de Lynnwood	*Macronyx grimwoodi*	Endémica, fragmentação do habitat
	18		*Parisoma carpi*	Endémica, fragmentação do habitat
	19	Cisticola de calvinus	*Phalacrotheca calvinus*	Endémica, fragmentação do habitat
	20			Endémica, fragmentação do habitat
	21		*Nesillas hartlaubi*	Endémica, fragmentação do habitat
	22		*Cisticola bayoni*	Endémica, fragmentação do habitat
	23	Bonis de savana	*Cisticola ayresii*	Endémica, fragmentação do habitat
	24		*Cisticola dorsti*	Endémica, fragmentação do habitat
	25	Papa-moscas de Bohm	*Muscicapa boehmi*	Endémica, fragmentação do habitat
	26	Papa-moscas fuliginoso	*Muscicapa infuscata*	Endémica, fragmentação do habitat
	27	Batis de Angola	*Batis minula*	Endémica, fragmentação do habitat
	28	Picanço Pardalote	*Lanioturdus torquatus*	Endémica, fragmentação do habitat
	29	Tecelão de Bocage	*Ploceus temporalis*	Endémica, fragmentação do habitat
	30	Cor de Cinza	*Bias musicus intercontinentalis*	Endémica, fragmentação do habitat
	31	Avestruz	*Struthio camelus*	Caça furtiva/Captura para domesticação

Classe		Nome Vulgar	Nome Científico	Ameaças Directas
Répteis	1	Tartaruga Oliva	*Lepidochelys olivacea*	Destruição do ninhos e captura indirecta
	2	Tartaruga cabeçuda	*Caretta caretta*	captura indirecta e poluição marinha
	3	Tartaruga Vede	*Chelonia mydas*	Destruição do ninhos e captura indirecta
	4	Tartaruga de Pente	*Eretmochelys imbricata*	captura indirecta e poluição marinha
	5	Tartaruga (Cágado) de dobradiças de Bell	*Kinixys belliana*	Degradação do habitat
	6	Crocodilo	*Crocodylus niloticus*	Caça furtiva de animais que consome
	7	Crocodilo de focinho ponteagudo africano	*Mecistops cataphractus*	Caça furtiva de animais que consome
	8	Cágado de lama Negra da África Oriental	*Pelusios subniger subniger*	Degradação do habitat
	9	Cágado de dobradiças serrilhadas	*Pelusios sinuatus*	Degradação de habitat
	10	Jibóia	*Boa sp.*	Caça furtiva e fragmentação do habitat
Insectos	1	Salalé (Termites)	*Macrotermes sublycalinus*	Exploração ou captura insustentáveis
	2	Zitsombe (larva)	*Rhynchophorus phoenicis*	Exploração ou captura insustentáveis
	3	Angola Sparklewing	*Umma fenana*	Espécie endémica
	4	Angola Jewel	*Chlorocypha crocea*	Espécie endémica

APPENDIX D: FAUNAL SPECIES LIST

Table D1: Mammals or signs thereof recorded or expected (*) within the study area.

Scientific Name	Common Name	Red List Status
Funisciurus congicus	*Congo Rope Squirrel*	LC
Lepus victoriae	African Savannah Hare	LC
Herpestes sanguineus	Common Slender Mongoose	LC
**Sylvicapra grimmia*	Common Duiker	LC
**Hystrix africaeaustralis*	Cape Porcupine	LC
*Subfamily Gerbillinae	Gerbils	LC
**Chlorocebus cynosuros*	Malbrouck Monkey	LC
**Fukomys mechowii*	Giant Molerat	LC
**Genetta maculata*	Rusty-spotted Genet	LC
Aonyx capensis	African Clawless Otter	NT

LC = Least Concer, NT – Near Threatened

Table D2: Potential bat species that may interact with the study area.

Scientific Name	Common Name	Red List Status
Taphozous mauritianus	Mauritian Tomb Bat	LC
Epomophorus crypturus	Peters's Epauletted Fruit Bat	LC
Rhinolophus fumigatus	Rüppell's Horseshoe Bat	LC
Nycteris hispida	Hairy Slit-faced Bat	LC
Epomophorus angolensis	Angolan Epauletted Fruit Bat	NT
Mops nigeriae	Nigerian Free-tailed Bat	LC
Miniopterus natalensis	Natal Long-fingered Bat	LC
Mimetillus moloneyi	Moloney's Flat-headed Bat	LC
Vansonia rueppellii	Rüppell's Pipistrelle	LC
Laephotis capensis	Cape Serotine	LC
Eidolon helvum	Straw-coloured Fruit Bat	NT

LC = Least Concern, NT – Near Threatened

Table D3: Avifaunal species recorded within the study area. Potential avifaunal species are indicated with an asterix (*).

Scientific Name	Common Name	Red List Status
Turdoides jardineii	Arrow-marked Babler	LC
Terathopius ecaudatus	Bateleur	EN
Cinnyris cupreus	Copper Sunbird	LC
Vidua funerea	Variable Indigobird	LC
Corvus albus	Pied Crow	LC
Cisticola natalensis	Croaking Cisticola	LC
Saxicola torquatus	African Stonechat	LC
Centropus superciliosus	White-browed Coucal	LC
Scopus umbretta	Hamerkop	LC
Prinia subflava	Tawny-flanked Prinia	LC
Emberiza flaviventris	Golden-breasted Bunting	LC
Euplectes ardens	Red-collared Widowbird	LC
Vidua macroura	Pin-tailed Whydah	LC
Cercotrichas barbata	Miombo Scrub-Robin	LC

Scientific Name	Common Name	Red List Status
Spilopelia senegalensis	Laughing Dove	LC
Uraeginthus angolensis	Blue Waxbil	LC
Dendropicos fuscescens	Cardinal Woodpecker	LC
Pycnonotus barbatus	Common Bulbul	LC
Milvus migrans	Black Kite	LC
Muscicapa striata	Spotted Flycatcher	LC
Pseudhirundo griseopyga	Gray-rumped Swallow	LC
Euplectes axillaris	Fan-tailed Widowbird	LC
Euplectes hartlaubi	Marsh Widowbird	LC
Spermestes cucullata	Bronze Mannikin	LC
Hirundo smithii	Wire-tailed Swallow	LC
Cecropis abyssinica	Lesser Striped Swallow	LC
Euplectes capensis	Yellow Bishop	LC
Circaetus cinereus	Brown Snake-Eagle	LC
Dicrurus adsimilis	Fork-tailed Drongo	LC
Melierax metabates	Dark Chanting-Goshawk	LC
Poicephalus meyeri	Meyer's Parrot	LC
Merops bullockoides	White-fronted Bee-Eater	LC
Indicator indicator	Greater Honeyguide	LC
Dryoscopus cubla	Black-backed Puffback	LC
Oriolus larvatus	Black-headed Oriole	LC
Zapornia flavirostra	Black Crake	LC
Tchagra sp	Tchagra	LC
Turtur afer	Blue-spotted Wood-Dove	LC
Lybius torquatus	Black-collared Barbet	LC
Apus affinis	Little Swift	LC
Melierax canorus	Pale Chanting-Goshawk	LC
Melaenornis pammelaina	Southern Black-Flycatcher	LC
Vanellus senegallus	Wattled Lapwing	LC
Lagonosticta	Firefinches	LC
Chalcomitra amethystina	Amethyst Sunbird	LC
Estrildidae	Waxbills and Allies	LC
Lagonosticta senegala	Red-billed Firefinch	LC
Merops pusillus	Little Bee-eater	LC
Alcedo semitorquata	Half-collared Kingfisher	LC
Circaetus pectoralis	Black-chested Snake-Eagle	LC
Ardea melanocephala	Black-headed Heron	LC
Terathopius ecaudatus	Bateleur	LC
Oenanthe familiaris	Familiar Chat	LC
Centropus superciliosus burchellii	Burchell's Coucal	LC
Rhinopomastus cyanomelas	Common Scimitarbill	LC
Campethera abingoni	Golden-tailed Woodpecker	LC
Indicator minor	Lesser Honeyguide	LC
Gymnoris superciliaris	Yellow-throated Bush Sparrow	LC
Passeriformes	Perching Birds	LC
Cinnyricinclus leucogaster	Violet-backed Starling	LC
Lagonosticta rubricata	African Firefinch	LC
Euplectes	Bishops and Widowbirds	LC

Scientific Name	Common Name	Red List Status
Lanius humeralis	Northern Fiscal	LC
Phylloscopus trochilus	Willow Warbler	LC
Polyboroides typus	African Harrier-Hawk	LC
Trigonoceps occipitalis	White-headed Vulture	CR
**Aquila rapax*	Tawny Eagle	VU
**Bucorvus leadbeateri*	Southern Ground Hornbill	VU
**Lybius torquatus*	Black-collared Barbet	LC
**Lissotis melanogaster*	Black-bellied Bustard	LC
**Buteo buteo*	Common Buzzard	LC
**Lophoceros pallidirostris*	Pale-billed Hornbill	LC
**Lophoceros nasutus*	African Grey Hornbill	LC
**Guttera verreauxi*	Western Crested Guineafowl	LC
**Anastomus lamelligerus*	African Openbill	LC
**Polyboroides typus*	African Harrier-Hawk	LC

LC = Least concerned, VU = Vulnerable, EN = Endangered

Table D4. Migratory Avifauna that may be associated with the study area.

Scientific name	Common name	Red List Status
Dendrocygna bicolor	Fulvous Whistling-duck	LC
Zapornia pusilla	Baillon's Crake	LC
Neotis denhami	Denham's Bustard	LC
Aquila nipalensis	Steppe Eagle	EN
Hieraaetus pennatus	Booted Eagle	LC
Circus aeruginosus	Western Marsh-harrier	LC
Milvus migrans	Black Kite	LC
Buteo buteo	Eurasian Buzzard	LC
Falco naumanni	Lesser Kestrel	LC
Falco vespertinus	Red-footed Falcon	VU

LC = Least concerned, EN = Endangered, VU = Vulnerable

Table D5. Reptiles recorded or expected (*) within the study area.

Scientific name	Common name	Red List Status
Boaedon fuliginosus	Brown House Snake	LC
Lygodactylus bradfieldi	Bradfield's Dwarf Gecko	LC
Gerrhosaurus auritus	Kalahari Plated Lizard)	LC
Trachylepis ansorgii	Skink	LC
Genus Gerrhosaurus	Lizard	LC
Genus Ichnotropis	Lizard	LC
Crocodylus niloticus	Nile Crocodile	LC
**Agama aculeata*	Ground Agama	LC
**Trachylepis spilogaster*	Kalahari Tree Skink	LC
**Crotaphopeltis hotamboeia*	Red-lipped Snake	LC
**Chamaeleo dilepis*	Flap-necked Chameleon	LC
**Psammophis subtaeniatus*	Stripe-bellied Sand Snake	LC
**Bitis arietans*	Puff Adder	LC

LC = Least Concern

Table D6. Amphibians recorded or expected (*) within the study area.

Scientific Name	Common Name	Red List Status
Sclerophrys pusilla	Eastern Flat-backed Toad	LC
Ptychadena taenioscelis	Small Ridged Frog	LC
Phrynobatrachus mababiensis	Mababe Puddle Frog	LC
Amnirana sp	Golden-backed Frogs	LC
**Sclerophrys gutturalis*	Guttural Toad	LC
**Hyperolius parallelus*	Angolan Reed Frog	LC
**Ptychadena anchietae*	Anchieta's Ridged Frog	LC
**Ptychadena oxyrhynchus*	Sharp-nosed Ridged Frog	LC
**Hyperolius benguellensis*	Benguella Reed Frog	LC
**Xenopus petersii*	Peters's Platanna	LC
**Tomopterna tuberculosa*	Rough Sand Frog	LC

LC = Least Concern

Table D7: Invertebrates recorded or expected (*) within the study area.

Scientific Name	Common Name	Red List Status
Insects		
Palpopleura portia	Portia Widow	LC
Precis octavia	Gaudy Commodore	LC
Palpopleura jucunda	Yellow-veined Widow	LC
Zizeeria knysna	African Grass Blue	LC
Neptis laeta	Albizia Sailer	LC
Hamanumida daedalus	Guinea-fowl Butterfly	LC
Apis mellifera	Western Honey Bee	NYBA
Mylothris agathina	Eastern Dotted Border	LC
Charaxes guderiana	Blue Spangled Charaxes	LC
Eurema brigitta	Broad-bordered Grass Yellow	LC
Tribe Platypleurini	Broadwing Cicadas	NYBA
Genus Catantops	Spur-throated Grasshoppers	NYBA
Nomadacris septemfasciata	Red Locust	NYBA
Cyligramma latona	Creamstriped Owl	LC
Zonocerus elegans	Elegant Grasshopper	NYBA
Leptotes sp	Common Blue	LC
Freyeria trochylus	Grass Jewel	LC
Pachylomera femoralis	Popeye Dung Beetle	NYBA
Trithemis pluvialis	Russet Dropwing	LC
Paltothyreus tarsatus	African Stink Ant	NYBA
Acrida sp	Slantface Grasshopper	NYBA
Danaus chrysippus	Plain Tiger Butterfly	LC
Brachythemis lacustris	Red Groundling	LC
Junonia natalica	Natal Pansy	LC
Ruspolias p	Coneheads	NYBA
Bicyclus sp	Bush Browns	LC
Melyris sp	Groove-wing Flower Beetles	NYBA
Trithemis furva	Navy Dropwing	LC
Ceriagrion glabrum	Common Citril	LC

Scientific Name	Common Name	Red List Status
Trachylepis sp	Afro-Malagasy Mabuyas	NYBA
Subfamily Myrmicinae	Myrmicine Ants	NYBA
Subfamily Geometrinae	Emerald Moths	NYBA
Toktokkus sp	Truetok Tokkies	NYBA
Leptotes sp	Common Blues	NYBA
Subfamily Cubitermitinae	Mushroom-shaped Mound-building Termites and Allies	NYBA
Dorylus sp	Driver Ants	NYBA
Lolaus silarus	Straight-line Sapphire	NYBA
Locris arithmetica	Spotted Red Spittle Bug	NYBA
Gerris swakopensis	Pond Skater	NYBA
Family Blaberidae	Giant Cockroaches	NYBA
Orthetrum chrysostigma	Epaulet Skimmer	NYBA
Junonia orithya	Blue Pansy	LC
Neptis laeta	Albizia Sailer	NYBA
Precis octavia	Gaudy Commodore	LC
Trithemis arteriosa	Red-veined Dropwing	LC
Ypthima asterope	Common Three-ring	LC
Euryphura concordia	Speckled Lilac Nymph	NYBA
Lolaus silarus	Straight-line Sapphire	NYBA
Crocothemis erythraea	Broad Scarlet	LC
Crocothemis sanguinolenta	Little Scarlet	LC
Synagris sp	Wasps	NYBA
Atractomorpha sp	Grasshoppers	NYBA
Arachnids		
Cyrtophora citricola	Tropical Tent-web Spider	NYBA
Superfamily Avicularioidea	Mygalomorph spiders	NYBA
Subfamily Lycosinae	Wolf Spiders	NYBA
Genus *Palystes*	Rain Spider	NYBA
Genus *Hippasa*	Funnel-web Wolf Spiders	NYBA
Family Clubionidae	Sac Spiders	

LC = Least Concern, NYBA = Not yet been assessed by the IUCN

APPENDIX E: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Chris Hooton	BTech Nature Conservation (Tshwane University of Technology)
Stephen van Staden	MSc Environmental Management (University of Johannesburg)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Terrestrial Services		
Postal address:	PO. Box 751779, Gardenview		
Postal code:	2047	Fax:	086 724 3132
Telephone:	011 616 7893		
Name / Contact person:	**Chris Hooton**		
E-mail:	chris@sasenvgroup.co.za		
Qualifications	BTech Nature Conservation (Tshwane University of Technology) National Diploma Nature Conservation (Tshwane University of Technology)		
Name / Contact person:	**Stephen van Staden**		
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Christopher Hooton, declare that -

- I act as the **independent specialist (reviewer)** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that June compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or June have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.



Specialist Signature

I, Stephen van Staden, declare that -

- I act as the **independent specialist (reviewer)** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTOPHER HOOTON

PERSONAL DETAILS

Position in Company	Senior Scientist, Member Biodiversity Specialist
Joined SAS Environmental Group of Companies	2013

EDUCATION

Qualifications

BTech Nature Conservation (Tshwane University of Technology)	2013
National Diploma Nature Conservation (Tshwane University of Technology)	2008

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Eastern Cape, Western Cape, Northern Cape, Free State
Africa - Zimbabwe, Sierra Leone, Zambia

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Floral Assessments
- Faunal Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

Freshwater Assessments

- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health Practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)
5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPr and WUL conditions

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans

- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

Appendix J: Noise

HCVAfrica
HIGH CONSERVATION VALUE



SPECIALIST STUDY: Noise Impact Assessment

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED CASSINGA ELECTRICAL SUPPLY PROJECT

April 2024

Executive Summary

The Project requires an environmental and social impact assessment (ESIA) to be conducted in compliance with Angolan legislation and regulations, and in conformance with international standards. HCV Africa was appointed via Geolab by SRK Consulting (South Africa) (Pty) Ltd. This report is the noise specialist report for the ESIA.

The 220/30kV overhead transmission line (OHL) will be from Jamba in the south of Angola to the Gove Dam where the hydraulic power station is situated. The OHL runs from Jamba to Kuvango, Dongo, Galangue, Chipindo, Kalima to the AH GOVE, and the main villages along this route. There are smaller Hamlets and /or Villages along this route. The most accessible Hamlets/Villages was between Village 12 (19 km north of Kuvango) and Village 7, situated along the EN120. The EN120 is a gravel road with traffic (motor-vehicles/light delivery vehicles and motor bikes with the odd truck) which used this route intermittently. This also resulted in peak noise levels on an intermittent basis. There were mills at some of the villages where generator power was used when maize was milled.

Construction vehicles will use the EN120 to transport building materials to and from the different sites, and noise surveys will be conducted at these villages to determine the prevailing ambient noise levels during the day. The villages can be classified as rural districts as there were no mechanical equipment in these villages except when there were transport and in the vicinity of mills.

Increased prevailing noise levels were experienced in the major Villages (Jamba, Kuvango, Chipindo and AH Gove) due to motorized traffic, generators, domestic-type noises, and localized noise sources. Traffic (motor-vehicles, trucks, and motor bikes), generators, domestic (barking dogs, animals, and people) contribute the most to the increased ambient noise levels.

There are large sections of the OHL where the route will follow along areas where the land is not occupied. This will result in the intermittent increase in the immediate vicinity of the construction phase of the OHL but will only increase the prevailing ambient noise level on a temporary basis. The people saw this project as an improvement and won't perceive the increased noise levels during the construction phase as negative. The location of the study area (small villages 1 to 14) and Jamba, Kuvango, Chipindo and Gove is illustrated in Figure 1. Communidade 1 could not be surveyed due to the access road to the Village which was inaccessible due to rainstorm the previous day. Permission to enter the Gove Power Plant at the Gove Dam could not be secured at the time of the environmental noise survey.



Figure 1: Cassinga OHL project area

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Glossary of Terminology

Acronym	Meaning
%	Percentage
amsl	average meters above sea level (a measure of elevation)
dB	Decibel – unit of measurement of noise
dB(A)	A-weighted decibels; filtered to represent response of human ear
dBL	Linear (unweighted) decibels
dB $L_{Aeq,1hr}$	The equivalent, time-averaged A-weighted noise level in decibels, in which the averaging period is 1 hour.
IFC	International Finance Corporation
LSA	Local Study Area
m	meters
mm	millimetres
mm/s	millimetres per second

1 INTRODUCTION

The Republic of Angola, through its Ministry of Energy and Water (MINEA), is launching the Cassinga Electrical Supply Project to bolster electricity supply in Huíla Province. The project entails the establishment of a new 220 kV Overhead Line (OHL) network spanning from Gove to Kuvango, with extensions to Chipindo and Jamba. Substations in Chipindo, Kuvango, and Jamba, each with a capacity of 220/30 kV - 20 MVA, will efficiently distribute power to these areas. Additionally, medium voltage overhead lines, low voltage networks, public lighting, and home connections will be installed in Chipindo, Kuvango, and Jamba. The aim is to create a reliable power supply system capable of meeting current needs and accommodating future expansions, including a potential 220 kV interconnection to Cuchi/Menongue. The project is estimated to meet a demand of 80 MW for the Cassinga Electrical Supply Project and an additional 10 MW for local communities, highlighting its importance in addressing regional power needs and supporting economic growth. Regulatory compliance is ensured through adherence to international standards like EN 50341-1 and EUROCODE 3 for metallic structures, ensuring safety, reliability, and efficiency in execution and operation.

The Project requires an environmental and social impact assessment (ESIA) to be conducted in compliance with Angolan legislation and regulations, and in conformance with international standards. HCV Africa was appointed via Geolab by SRK Consulting (South Africa) (Pty) Ltd.

This report is the noise specialist report for the ESIA.

2 DEVELOPMENT DESCRIPTION AND PROPOSED PROJECT INFRASTRUCTURE

The Project is located South of the centre of Angola, namely, in the provinces of Huila and Huambo (Figure 2-1). The Project powerline extends for about 170 km, crossing three municipalities (Municípios) which include Jamba, Kuvango, and Chipindo.

The main works will be carried out largely in Huila Province near the Gove Hydro Dam (Huambo) and extend for 135 km with an OHL 220 kV to Kuvango, 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 Kuvango 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 associated with the electrification of villages at Chipindo, Kuvango and Jamba will be constructed (Figure 2-1).



Figure 2-1: Location of the proposed 220 kV OHL and the towns it will supply with electricity.

2.1 Proposed infrastructure

The Project involves the construction of three (3) new substations at Jamba, Kuvango and Chipindo and the establishment of a new 220kV overhead power line (OHL) from Gove to Chipindo, Kuvango and Jamba. This will allow the electrification of Chipindo, Kuvango and Jamba. The Project will include a 30 kV Medium Voltage OHL network to the new substations and a Low Voltage network to supply electricity to 1 000 homes in each of the three villages.

2.1.1 Transmission lines and towers

The structures proposed to be used for most of the 220 kV OHL are metallic towers type Y, adequate to the angle of the OHL. These towers are approximately 50 m in height and a total footprint area of 80 m x 50 m is required for each tower. The average span between two towers is 400 m.

2.1.2 New substations

The three new 220/30 kV – 20 MVA substations will be constructed at Chipindo, Kuvango and Jamba.

2.1.3 Overhead line infrastructure

The OHL infrastructure will be constructed in two stages where the first stage will be from The Gove – Chipindo and Kuvango and Stage 2 will be from Kuvango to Jamba.

2.1.4 Electrification of community homes and public lighting

The electrification of Chipindo, Kuvango and Jamba will consist out of medium and low voltage network to supply grid electricity to approximately 1 000 homes in each village. The medium voltage 30kV OHL (MV network) – yellow lines and transformation stations – red triangle in the villages is illustrated in Figure 2-2 – Chipindo, Figure 2-3 – Kuvango and Figure 2-4 – Jamba.

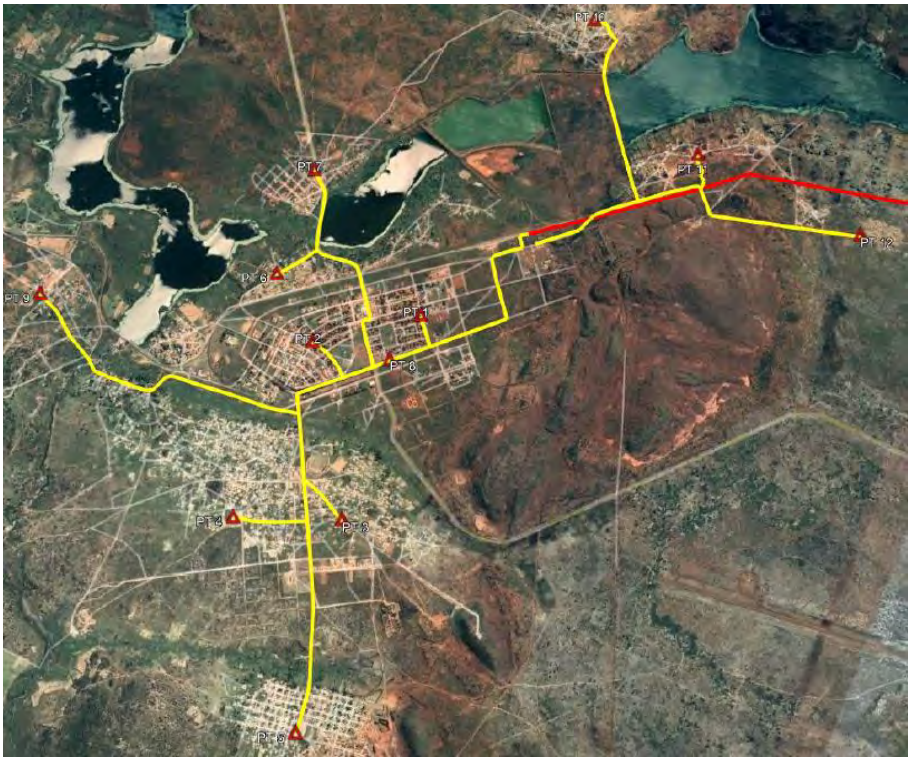


Figure 2-2: MV network and transformation Station sites - Jamba



Figure 2-3 - MV network and transformation Station sites - Kuvango

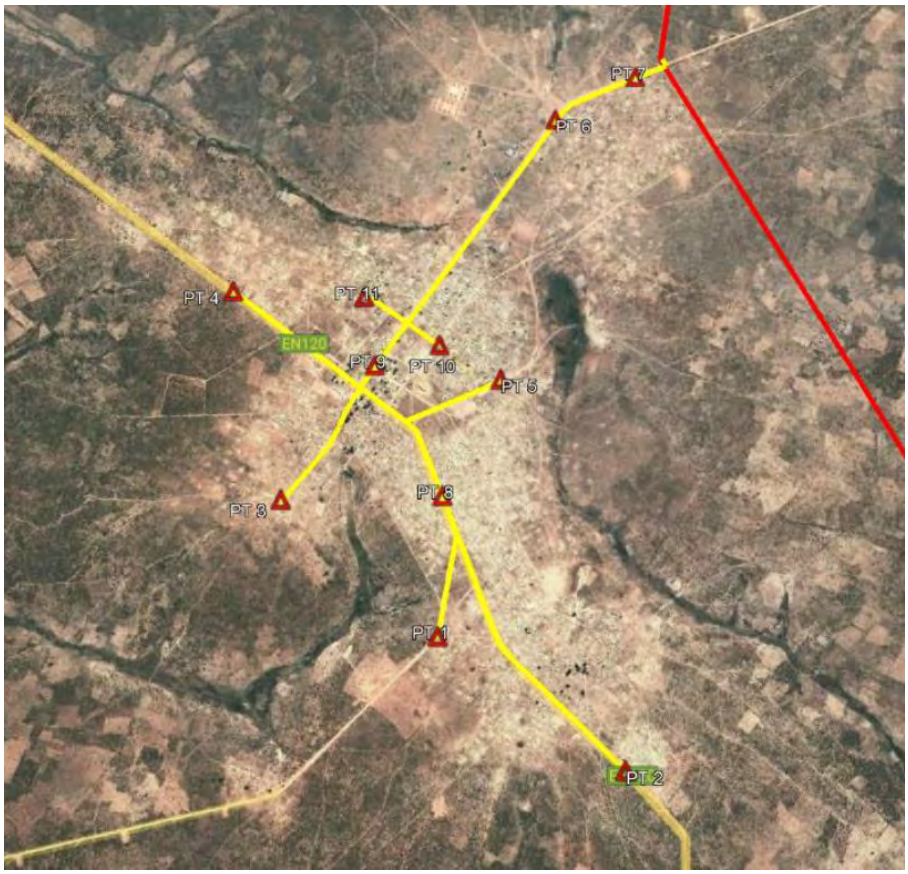


Figure 2-4 - MV network and transformation Station sites - Chipindo

3 PROJECT PHASES

3.1 Construction phase

Construction phase will consist of earthmoving activities at the footprint of the towers, substations, access roads and OHL servitudes, foundations, temporary lay down areas, and construction camps.

3.2 Operational phase

The operational phase will consist of energisation of the substations and OHL network distribution of electricity across the project area and regular routine maintenance of infrastructure (1 - 2 times per year).

3.3 Closure and rehabilitation phase

Removal of camp sites after construction and rehabilitation of these area to be done , removal of towers, sub-stations and footprint areas revegetated.

4 PROJECT WASTES AND EMISSIONS

4.1 Noise

Noise emissions associated with the Project are anticipated during both the construction, operation, and closure/rehabilitation phases. The levels and impact of these emissions will vary depending on the specific activities and the proximity of work site footprint areas to local communities.

Table 4-1: Anticipated noise sources during the Project

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.
	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.
Closure/ rehabilitation	Removal of infrastructure	Intermittent noise from machinery contribute to the prevailing ambient noise level.
	Preparation of footprint areas	Intermittent noise from earthmoving machinery during the demolishing activities.

	Revegetated	Machinery noise during the intermittent revegetated process.

5 LEGAL, POLICY AND OTHER REQUIREMENTS

5.1 Introduction

The National Assembly of Angola approved the new Constitution the Republic of Angola on 5 February 2010, to replace the 1992 Constitution. The Constitution provides the basis for the Environmental Framework Law through Article 39. This Article 39 (Environmental Rights) provides 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 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.

3. Acts that endanger or damage conservation of the environment shall be punishable by law.

Angolan legislation is issued at the national level through:

- Laws, which are issued by the National Assembly;
- Presidential Decrees, which are issued by the President's office; and
- Regulations (executive decrees), joint executive decrees and resolutions, which are normally issued by a ministry or ministries.

Note that other legislative, regulatory, and administrative requirements may pertain to the proposed projects, which will be elaborated on in the ESIA as relevant. The summary provided below is intended to highlight key environmental legislation and obligations only.

5.2 Institutional framework[1]

5.2.1 Ministry of Environment (MINAMB)

Presidential Decree No. 45/18 of February 2018 approved the new organizational structure of the Ministry of Environment (*Ministério do Ambiente,* MINAMB). MINAMB is responsible for the development and coordination of the country's environmental policy and for implementing the National Programme of Environmental Management (*Programa Nacional de Gestão Ambiental*, PNGA). MINAMB is responsible for the implementation of the Environment Framework Law No. 5/98, for approving EIAs under Decree No. 51/04 on Environmental Impact Assessment and issuing Environmental Licenses in terms of Decree No. 59/07 on Environmental Licensing, and all associated Regulations.

Depending on the type of project to be developed, the EIA report should also be approved by the appropriate line ministry, in this case will be the Ministry of Agriculture. 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.

5.2.2 EIA procedural framework in Angola

The Angolan EIA Procedure is presented in Figure 5-1.

[1] Where the legal section refers to EIA as defined in the Angolan statutes, it would imply "ESIA" which will be developed for the Project.

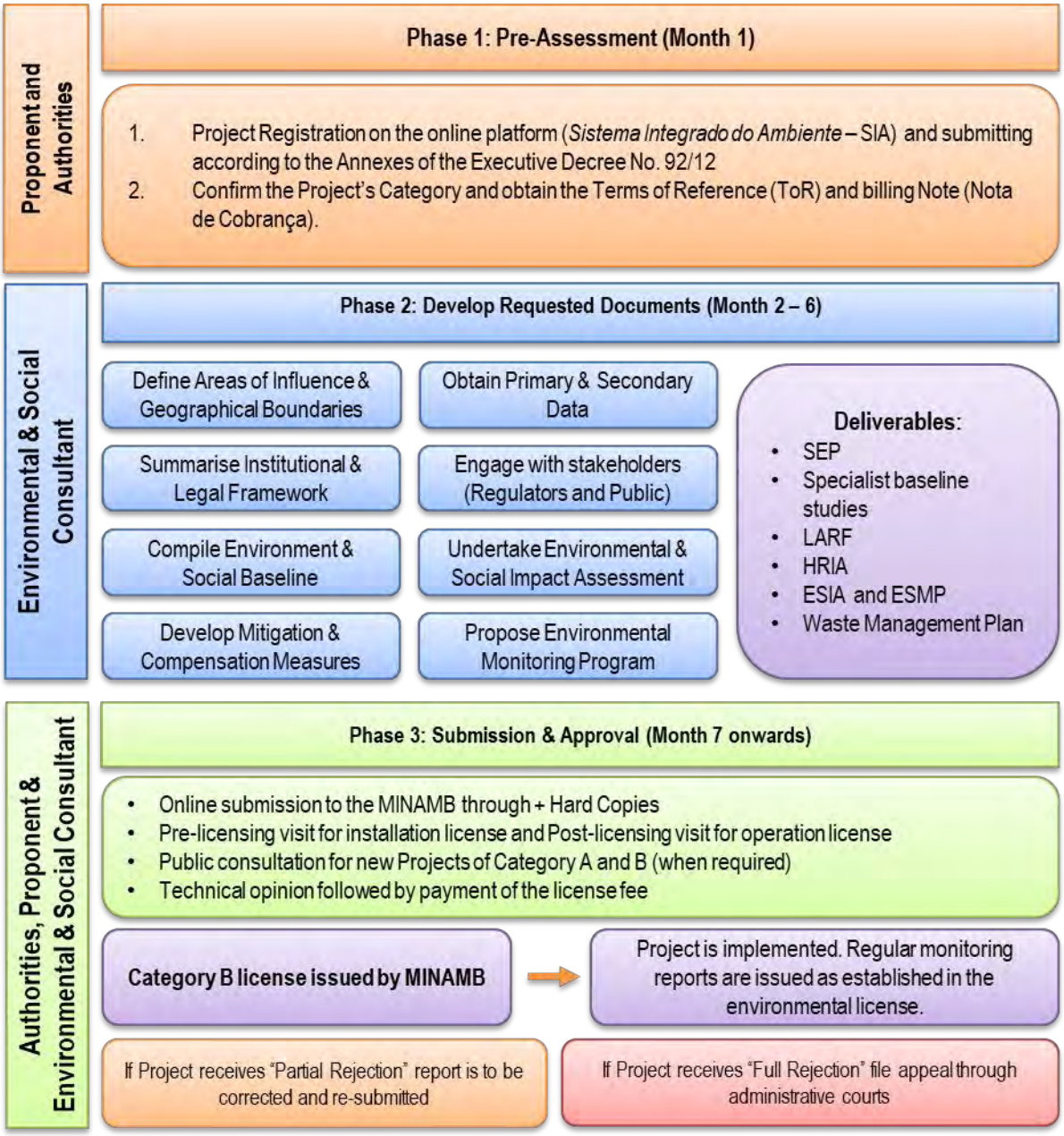


Figure 5-1: ESIA Procedural framework in Angola

5.3 International guidelines and standards

International standards most commonly refer to and meet the requirements of the International Finance Corporation Performance Standards (IFC PS); other key standards include the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) and Organisation for Economic Co-operation and Development (OECD) Common Approaches. Of these the IFC PSs (and associated guidance notes) provide guidance on identification of impacts and the related risks, mitigation to conduct a proponent/developer's business in a sustainable manner.

Over time, IFC PS developed into an environmental and social risk management framework used internationally by financial institutions. The Equator Principles (EPs) are based on the IFC PS and have been widely adopted by funding institutes as a benchmark. Guidelines which also includes requirements for robust stakeholder consultation and disclosure.

The IFC published a wide range of industry specific guidelines for Environmental, Health and Safety (EHS) management; as well as 'Good Practice Notes'. The guidelines/notes relevant to the proposed Project will be focused on during the impact assessment phase and the guidelines of these standards will be incorporated in the specific management plan components in the Environmental and Social Management Plan (ESMP).

5.3.1 Environmental noise guidelines

Due to a lack of recommended environmental noise levels for new developments it was decided to make use of the IFC Environmental Health and Safety (EHS) Guidelines (IFC 2007) (Ref 2). 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 5-1. 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.

Table 5-1: 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	

5.3.2 Ground vibration

It is unknown whether the project would involve any blasting. It was retained in the assessment for completeness' sake. The assessment of the ground vibration levels as per United States of Bureau - Mine Standards, BMRI 8507 were used.

Blast induced ground vibrations, both surface waves (those travelling just under the earth's surface, analogous to water waves) and body waves (those travelling through the ground), naturally attenuate with increased distance from the blast site due to material damping and geometric spreading. Body waves attenuate more rapidly than the surface waves resulting in the surface waves being more dominant at greater distances. The vibration intensity perceived or measured at the closest receptors around the Project Site would therefore be dominated by surface waves. The rate at which ground vibrations attenuate from the blast source depends on a variety of conditions, including the type and condition of the bedrock being blasted, depth and composition of the earth covering deposits (soil), and the general topography.

The effect of vibrations on structures is related to both the amplitude and the dominant frequency of the vibration, as well as the type and configuration of the structure. The peak particle velocity (PPV) is the most commonly-used measure of the intensity of the ground vibration due to blasts. Two of the most important variables that affect the PPV from a blast are; the distance from the source and the maximum explosive charge weight per delay period. Table 5-2 provides a listing of effects related to increasing levels of ground vibration intensities that are used to assess the impacts of vibration.

Table 5-2: Effects from varying intensities of ground vibration

Ground Vibration Intensity, mm/s	Ground Vibration Effect
0.3 – 0.5	Becomes perceptible to humans
12.5	USBM recommended limit to prevent damage to weakest of building materials in well-built wood-frame structures (e.g., plaster-on-lath).
19.1	Recommended limit to prevent damage to drywall/sheetrock construction.
50.0	Recommended limit for construction blasting and quarry blasting at high frequencies.
75 - 125	Hairline cracks may start developing in plaster.
300 - 600	Micro-cracks may start developing in rock.

Peak ground vibration limits generally established for blasting sites to prevent damage to adjacent facilities or structures generally range from 12.5 mm/s to 50.0 mm/s, depending on the dominant frequency of the ground vibration.

This assessment assumes that most of the houses in the nearby villages are of traditional construction type and may have suffered from previous degrees of deterioration. They are therefore more sensitive to blast vibrations than structures using modern materials and technology (e.g. block-built) and a recommended maximum ground vibration limit of 12.5mm/s is recommended.

At the time of this assessment, limited information was available regarding the proposed surface blasting parameters ***if any, as this project make provision for a pick and shovel method of removing the material***, including the proposed weight of charge per interval.

5.3.3 Air-pressure levels

Blast induced air vibration effects are primarily influenced by the prevailing weather conditions at the time of the blast and less so by the factors influencing ground vibrations. Air –pressure levels are only expected to occur within and off the project area when blasting takes place at the surface. The assessment of the ground vibration levels as per United States of Bureau - Mine Standards, BMRI 8507 were used.

Air-pressure levels in excess of 140.0 dBL are necessary to cause glass or window damage, such as the cracking of a poorly set plate glass window. Windows are typically the first material to show signs of distress from excessive air vibrations as they are the least able to withstand high external air pressures. Air-pressure limits commonly used for ground vibration levels where blasting can be expected to occur over many years typically fall in the range of 120.0 to 134.0 dBL measured at the nearest sensitive receptor. A list of effects from increasing levels of air vibration intensities is provided in Table 5-3.

Table 5-3: Effects from varying intensities of air pressure levels

Air Vibration Intensity, dBL	Effect
95	Equivalent to a wind gust at 5 km/hr.
110	Equivalent to a wind gust at 11 km/hr.
120	USBM cautionary limit set for quarries and open pit mines.
133	Recommended limit for large scale surface mine blasting. Equivalent to a wind gust of 43 km/hr.
140	May result in window breakage.
171	General window breakage.

6 SPECIALIST TERMS OF REFERENCE AND METHODOLOGY

Environmental noise (activities during preparation of the footprint areas) and ground vibrations which include air pressure levels (should blasting be required) will be the main issues and field of investigation for this specialist impact assessment.

Blasting will only be required when large boulders will have to be dislodged and reduced to smaller size material.

6.1 Methodology

6.1.1 Noise data collection

The field data collection took place over a period of three days from 18 March 2024 to 20 March 2024. The noise survey was done in terms of the "*Guia Prático para Medicoes de Ruldo Ambiente*" (Practical guide to Environmental Noise Measurements) which is based on the Portuguese Norm NP ISO 1996 and with the requirements of the IFC Environmental, Health, and Safety (EHS) Guidelines General Environmental Health Standards Guidelines: Environmental Noise Management, 2007. The measuring points are illustrated in Figure 2-1 (southern section), Figure 6-2 (middle section), Figure 6-3 (northern section) and Figure 6-4 (northern section).

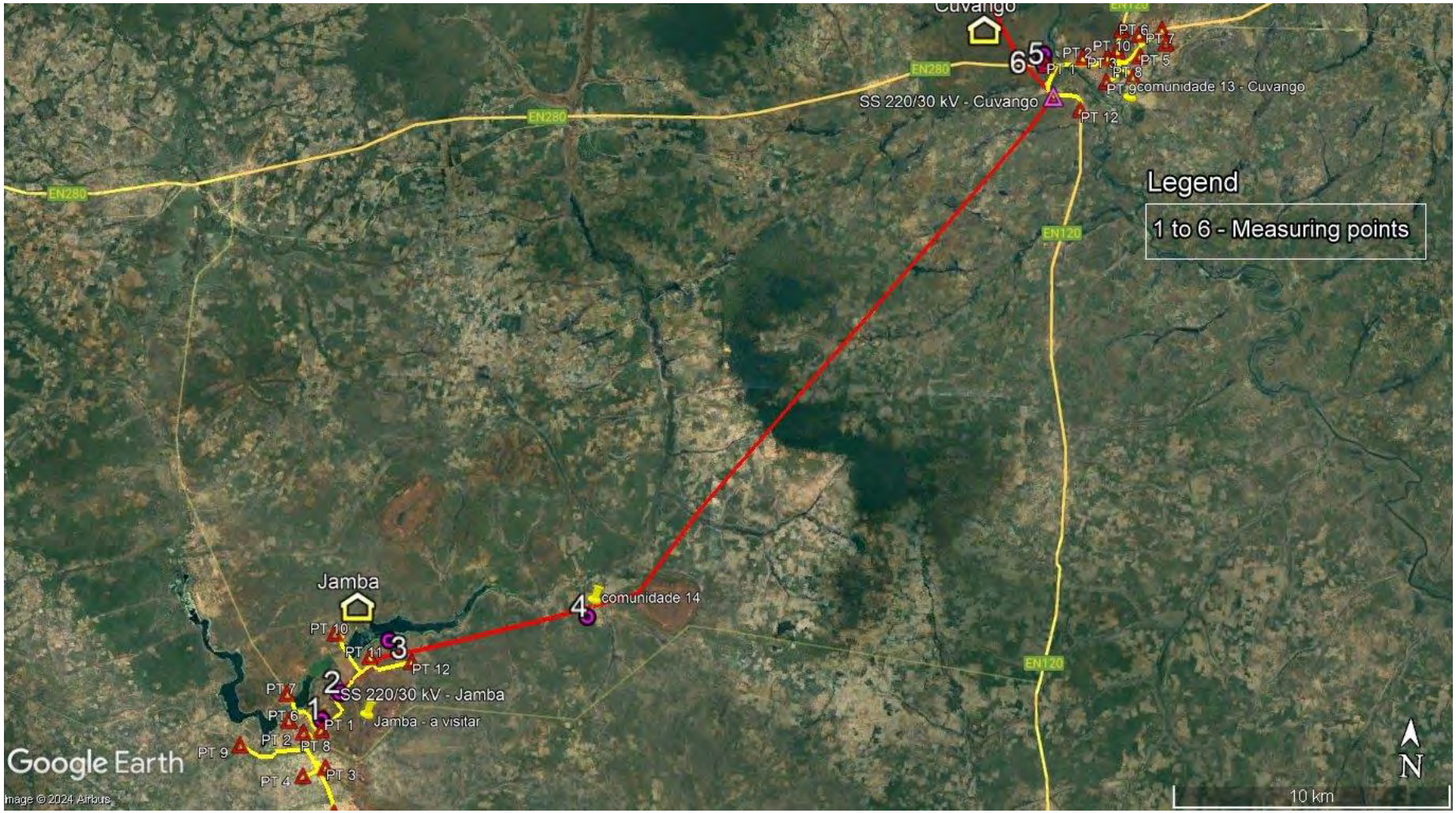


Figure 6-1: Noise monitoring points – southern section

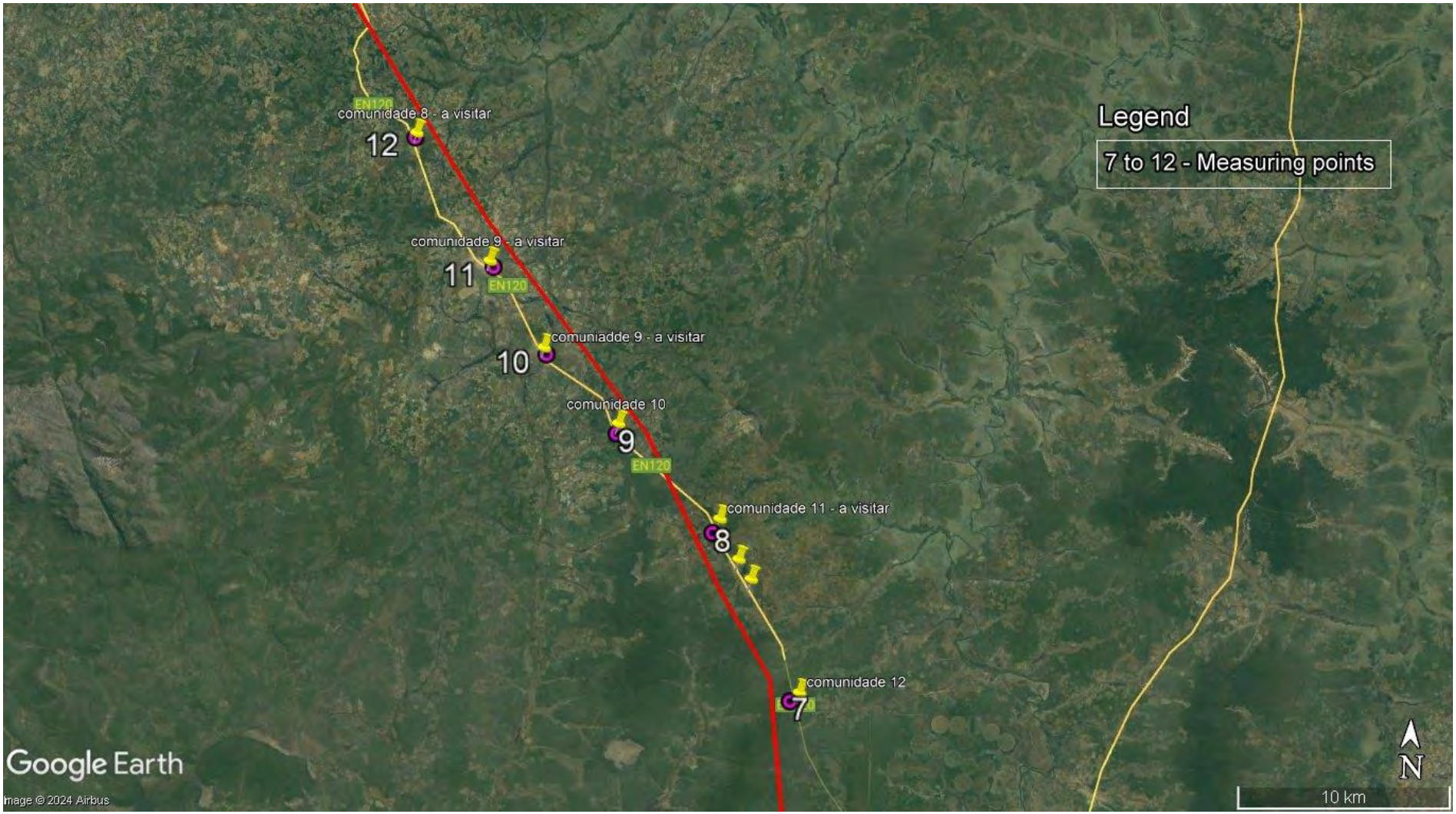


Figure 6-2: Noise monitoring points – Middle section



Figure 6-3: Noise monitoring points – Northern section



Figure 6-4: Noise monitoring points Northern section

The geographical location and information of each measuring point is illustrated in Table 6-1.

Table 6-1: Geographical information of the measuring points

Measuring point	Latitude	Longitude	Remarks
1	14° 41.340'S	16° 2.019'E	Jamba Village.
2	14° 40.812'S	16° 2.367'E	Jamba Village.
3	14° 39.753'S	16° 3.308'E	Jamba Village.
4	14° 39.160'S	16° 7.280'E	Communidade 14 to the east of Jamba.
5	14° 28.008'S	16° 16.114'E	Kuvango Village.
6	14° 27.816'S	16° 16.107'E	Kuvango Village.
7	14° 17.069'S	16° 12.433'E	Communidade 12 some 971m from EN120
8	14° 12.885'S	16° 10.251'E	Communidade 11 – some 1 005 from EN120.
9	14° 10.451'S	16° 7.642'E	Along the EN120.
10	14° 8.500'S	16° 5.722'E	Along the EN120.
11	14° 6.320'S	16° 4.241'E	Along the EN120.
12	14° 3.074'S	16° 2.045'E	Along the EN120.
13	13° 59.000'S	16° 0.899'E	Along the EN120.
14	13° 58.871'S	16° 0.723'E	Along the EN120.
15	13° 56.789'S	16° 0.723'E	No noise survey due to inaccessibility of village.
16	13° 54.849'S	15° 54.643'E	Communidade 5.
17	13° 52.979'S	15° 51.158'E	No noise survey due to inaccessibility of village.
18	13° 48.972'S	15° 47.445'E	Chipindo Village.
18A	13° 49.024'S	15° 47.338'E	Chipindo Village.
18B	13° 49.028'S	15° 47.364'E	Chipindo Village.
19	13° 48.006'S	15° 47.755'E	Chipindo Village.
20	13° 48.081'S	15° 47.951'E	Chipindo Village.
21	13° 40.755'S	15° 47.759'E	No noise survey due to inaccessibility of village.
22	13° 27.426'S	15° 51.650'E	Permission not granted to access the site.

The distances between the main OHL and the abutting residential areas (the nearest point from the OHL activities, Transformation site (TS) to the noise receptors in meters) are given in Table 6-2 (Jamba), Table 6-3 (Kuvango) and Table 6-4 (Chipindo).

Table 6-2: Distances between the noise receptors and OHL and Transformation site - Jamba

Jamba			
Noise receptor	**Co-ordinates of NSAs**		**Distance in meters**
	Latitude	Longitude	
Jamba North to OHL	14° 41.072'S	16° 2.059'E	749
Jamba Middle to OHL	14° 41.528'S	16° 1.686'E	1869
Jamba Substation to Noise Sensitive Area (NSA)	14° 41.296'S	16° 1.995'E	1028
TS1	14° 41.293'S	16° 2.045'E	30
TS2	14° 41.608'S	16° 1.629'E	30
TS3	14° 42.269'S	16° 2.104'E	30
TS4	14° 42.450'S	16° 1.669'E	30
TS5	14° 43.138'S	16° 2.305'E	30

TS6	14° 41.385'S	16° 1.341'E	35
TS7	14° 40.875'S	16° 1.290'E	35
TS8	14° 41.540'S	16° 1.986'E	38
TS9	14° 41.905'S	16° 0.370'E	38
TS10	14° 39.674'S	16° 2.179'E	25
TS11	14° 40.083'S	16° 2.908'E	50
TS12	14° 40.169'S	16° 3.753'E	40

Table 6-3: Distances between the noise receptors and OHL and Transformation site - Kuvango

Kuvango			
Noise receptor	**Co-ordinates of NSAs**		**Distance in meters**
	Latitude	Longitude	
Kuvango East	14° 27.988'S	16° 16.609'E	1771
Kuvango Middle	14° 27.989'S	16° 17.571'E	2685
Kuvango Substation to NSA	14° 28.258'S	16° 16.957'E	1432
TS1	14° 28.033'S	16° 16.129'E	75
TS2	14° 27.944'S	16° 16.924'E	30
TS3	14° 27.840'S	16° 17.380'E	30
TS4	14° 27.287'S	16° 17.632'E	45
TS5	14° 27.806'S	16° 18.039'E	30
TS6	14° 27.358'S	16° 18.018'E	30
TS7	14° 27.534'S	16° 18.563'E	30
TS8	14° 28.220'S	16° 17.924'E	30
TS9	14° 28.336'S	16° 17.384'E	30
TS10	14° 27.743'S	16° 17.606'E	50
TS11	14° 27.242'S	16° 18.470'E	30
TS12	14° 28.911'S	16° 16.853'E	30

Table 6-4: Distances between the noise receptors and OHL and Transformation site - Chipindo

Chipindo			
Noise receptor	**Co-ordinates of NSA**		**Distance in meters**
	Latitude	Longitude	
Chipindo East	13° 47.989'S	15° 47.778'E	50
Chipindo Middle	13° 48.821'S	15° 47.674'E	1275
Chipindo Substation to NSA	13° 48.018'S	15° 47.750'E	75
TS1	13° 49.749'S	15° 47.686'E	30
TS2	13° 49.914'S	15° 48.267'E	40
TS3	13° 49.507'S	15° 47.123'E	35
TS4	13° 48.951'S	15° 46.820'E	30
TS5	13° 49.011'S	15° 47.623'E	30
TS6	13° 48.260'S	15° 47.578'E	40
TS7	13° 48.017'S	15° 47.734'E	70
TS8	13° 48.956'S	15° 47.437'E	30
TS9	13° 49.067'S	15° 47.291'E	30
TS10	13° 48.954'S	15° 47.435'E	30
TS11	13° 48.867'S	15° 47.190'E	40

The location of the OHL, Substation, Transformation station and MV 30kV OHL is illustrated in Figure 6-5 (Jamba), Figure 6-6 (Kuvango) and Figure 6-7 (Chipindo).

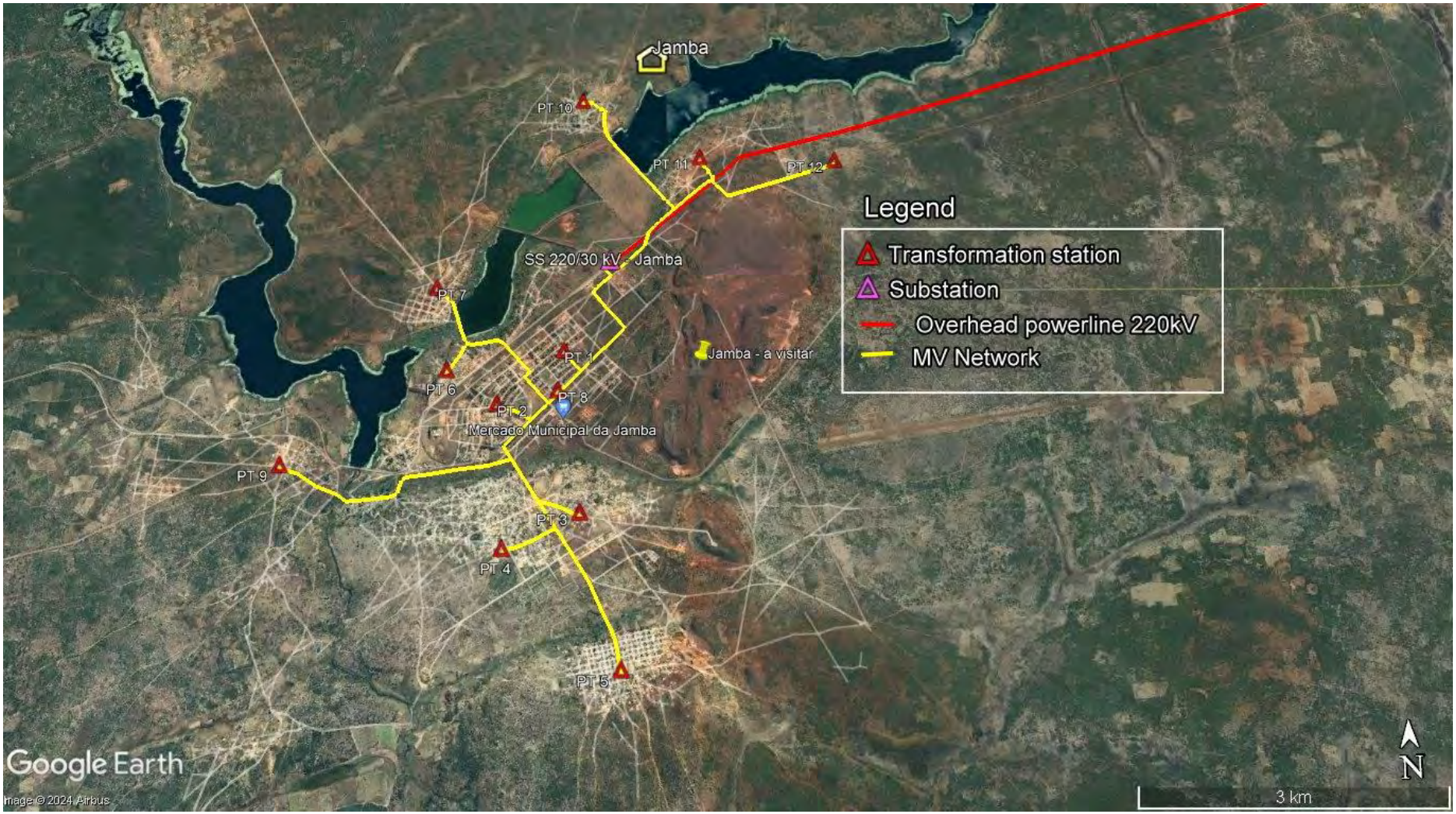


Figure 6-5: Location of the OHL, Substation, Transformation station and MV 30kV OHL at Jamba

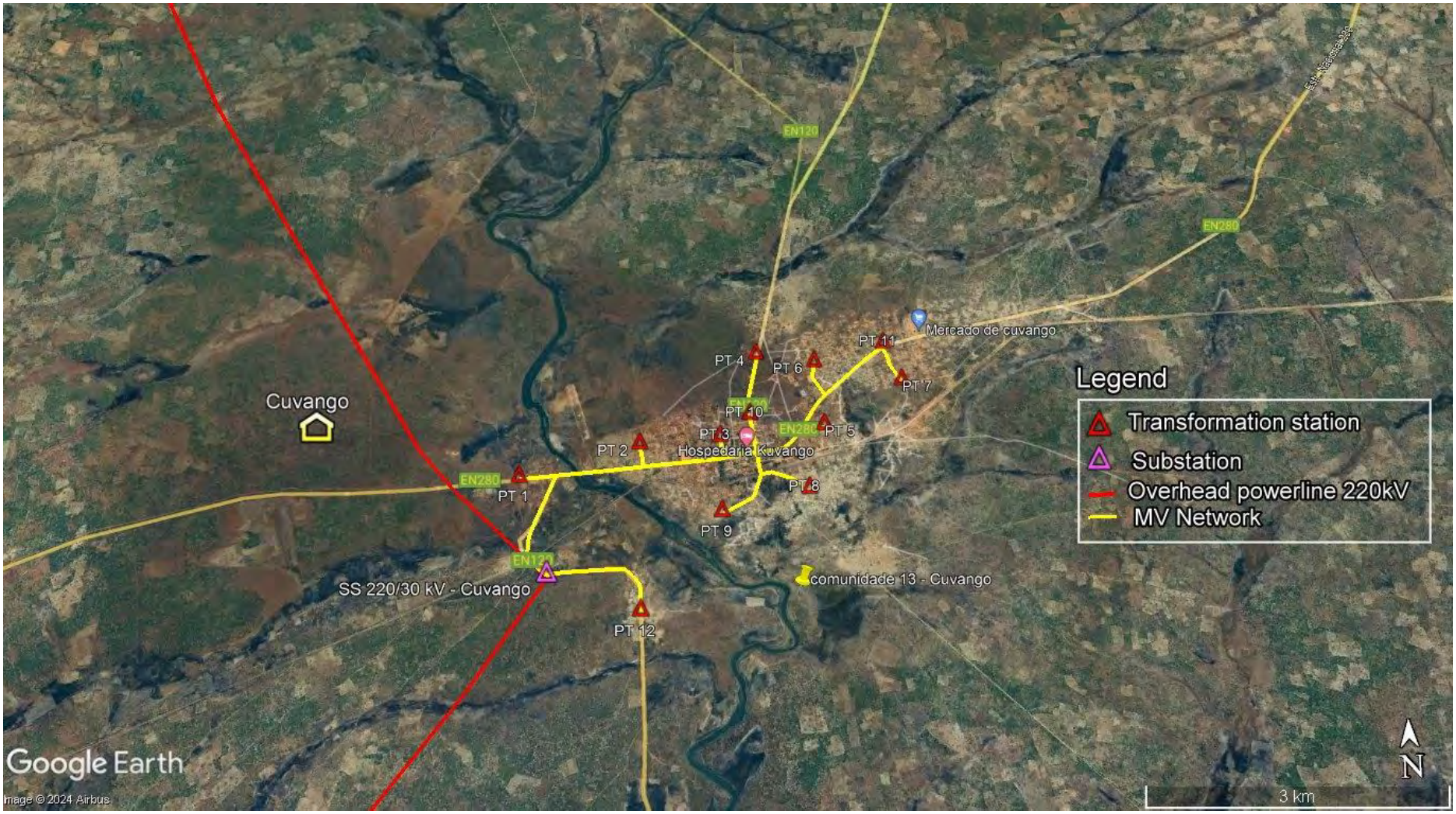


Figure 6-6: Location of the OHL, Substation, Transformation station and MV 30kV OHL at Kuvango

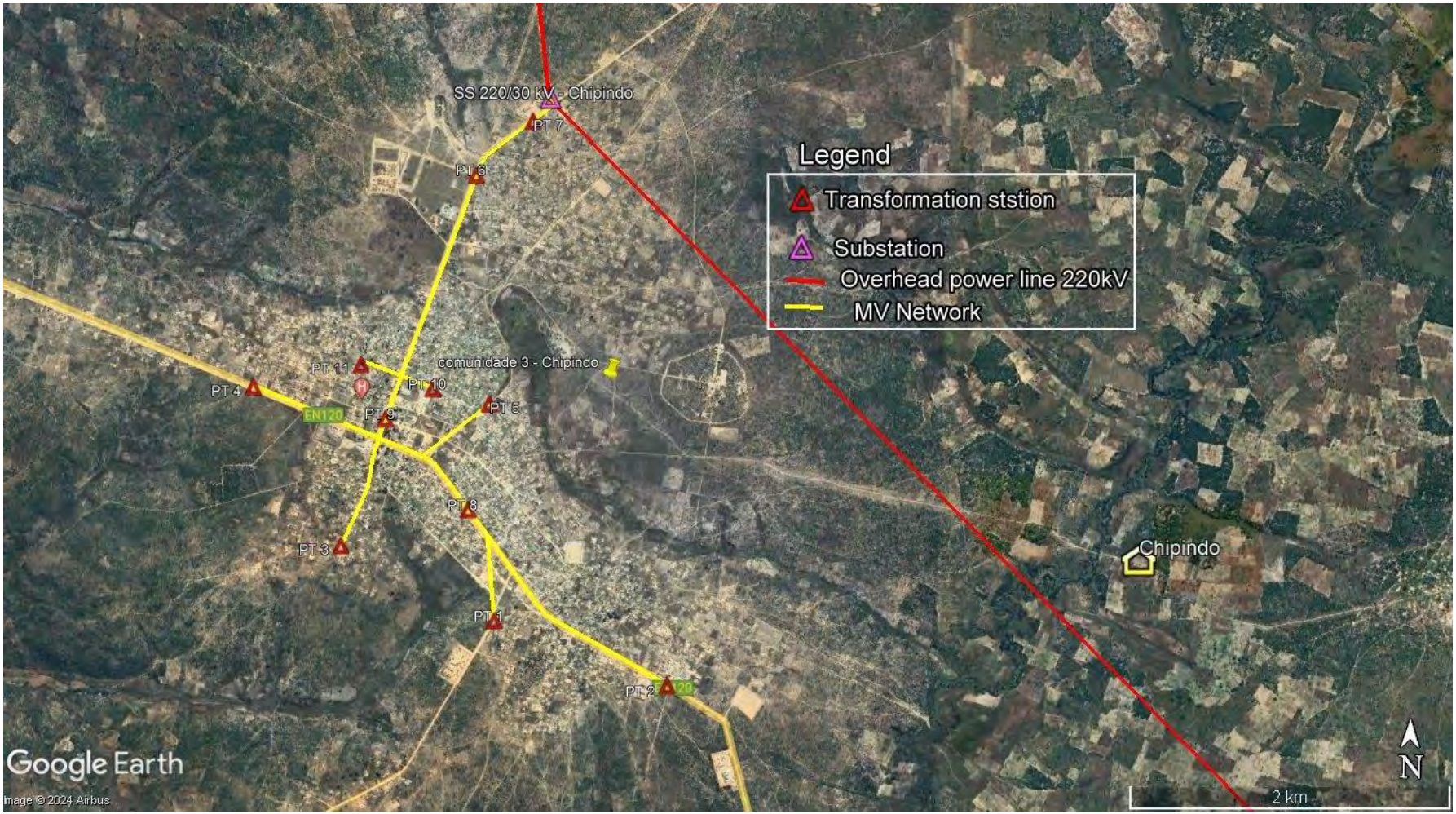


Figure 6-7: Location of the OHL, Substation, Transformation station and MV 30kV OHL at Chipindo

6.1.2 Environmental noise sampling

A Larson Davis 831 integrated Class 1 noise level meter was used to do the noise survey at the different measuring points as illustrated in Figures 6-1 to 6-4. 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). The certificates are attached as Appendix A.

The measuring procedure was at follows during the noise survey period:

- The instrument was calibrated before and after a series of noise readings;
- The wind shield was always used;
- The height of the instrument was 1,3m from the ground level at each measuring point;
- The instrument was placed at least 3.5m away from reflective surfaces;
- Field study notes were gathered at each of the measuring points; and
- The wind direction, temperature and wind speed were measured at each of the measuring points.

It was not necessary to measure the ground vibration levels as there were no ground vibration activities present in the vicinity of the measuring points. The only vibration levels currently at some of the measuring points were from vehicle movement.

6.1.3 Environmental noise results

The noise survey was conducted in the vicinity of the main feeder road (EN120) and in the vicinity of residential properties along the route between Jamba to Chipindo. At Jamba, Kuvango, and Chipindo, the noise survey was conducted in the vicinity of residential properties, internal roads and the EN roads. 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 illustrated in Table 6-5. The L90 value is a statistical value which is an indication of the ambient noise level.

The temperature was between 31.5°C to 33.5°C with a north easterly wind of 0.8m/s to 3.9m/s at measuring points (MPs) 1 to 4, easterly wind of 0.8m/s to 1.8m/s at MPs 5 to MP 11, south easterly wind of 0.7m/s to 2.4m/s at MPs 16 to 20.

Table 6-5: Measured environmental 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

Measuring point	Location	L_{Aeq}	L_{Max}	L_{Min}	L90	Remarks	Distance from OHL - meters
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

7 BASELINE CONDITIONS

7.1 Noise receptors

The prevailing ambient noise levels were created by subsistence farming activities, intermittent traffic along the main road (EN120), roads in villages. The residential areas consist of single housing units, cluster houses and villages with formal and informal gravel roads. The residents in the far lying villages are already exposed to motorized traffic such as motor-vehicles and motorcycles whereas the residents in the vicinity of the main road and feeder road are exposed to motor-vehicles, heavy duty vehicles and motorcycle noises. The height above mean sea level (AMSL) at the villages differs throughout the study area due to the undulating conditions within the study area.

7.2 Climatic information of study area

Jamba has a tropical savannah climate. It is warm every month with a wet and dry season. Average annual temperature for Jamba is 25° C and the prevailing wind is an East northeast (ENE) wind. The prevailing wind direction in Chipindo is westerly, south-westerly, and south south-westerly and the average annual temperature is 26.5° C. The average annual temperature for Kuvango is 25.7° C and the wind direction is an easterly, east south-easterly (ESE) wind.

7.3 Topography of the study area

7.3.1 Elevation profiles

The topography of an area under development will play a major role in how sound from a source will be propagated. Topographical features such as hills, valleys, elevation levels may create natural barriers between the OHL project and the residential areas in each of the three villages where electricity will be provided. The elevation profiles are illustrated in Figures 7-1 to 7-3 illustrate the different elevation profiles respectively. The elevation profiles appear somewhat exaggerated due to the scale and the landscape is however undulating with a protrusion where the substation(s) in each village will be situated.

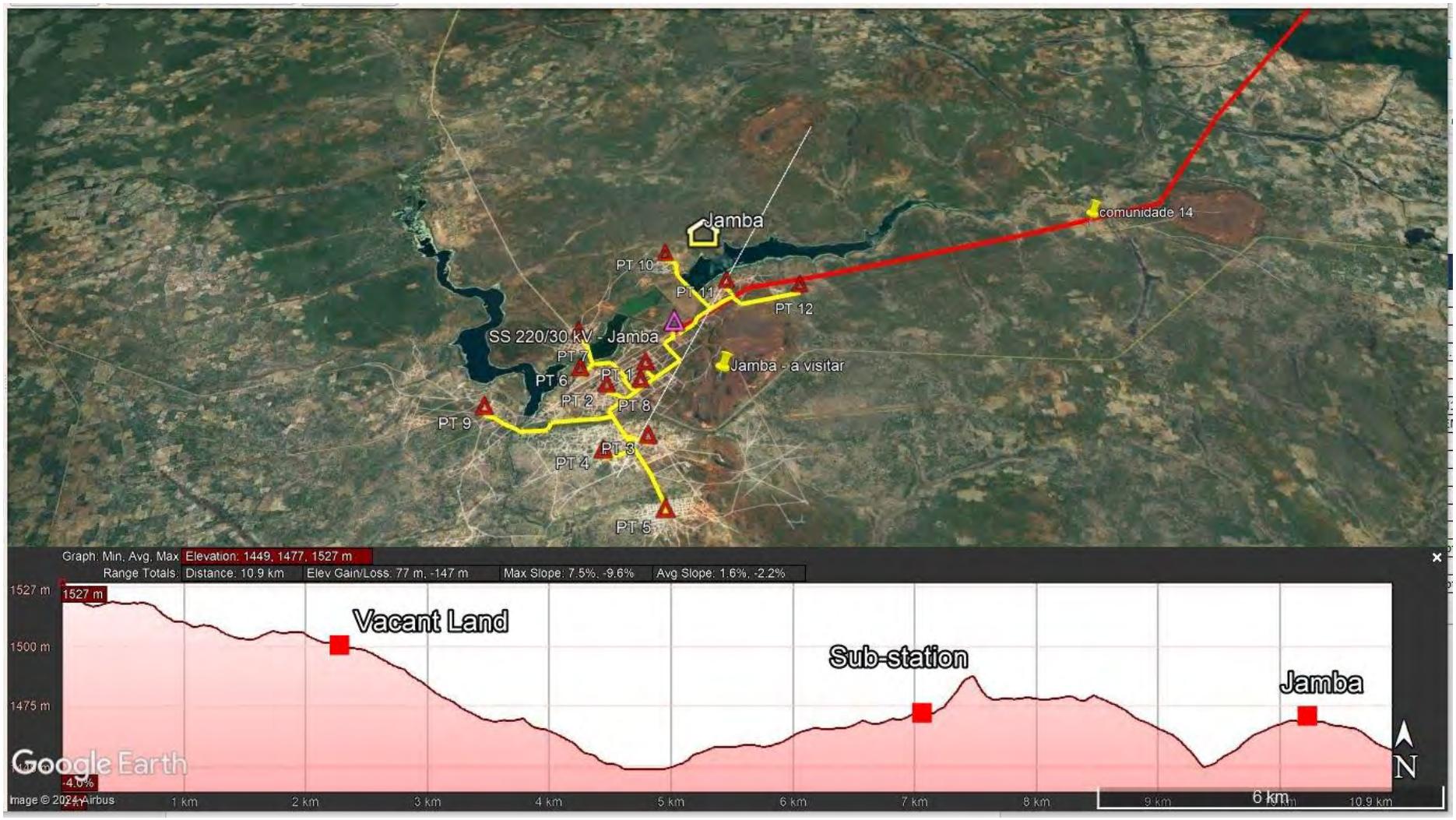


Figure 7-1: Elevation profile between Northeasterly and South-westerly side of the Jamba project area

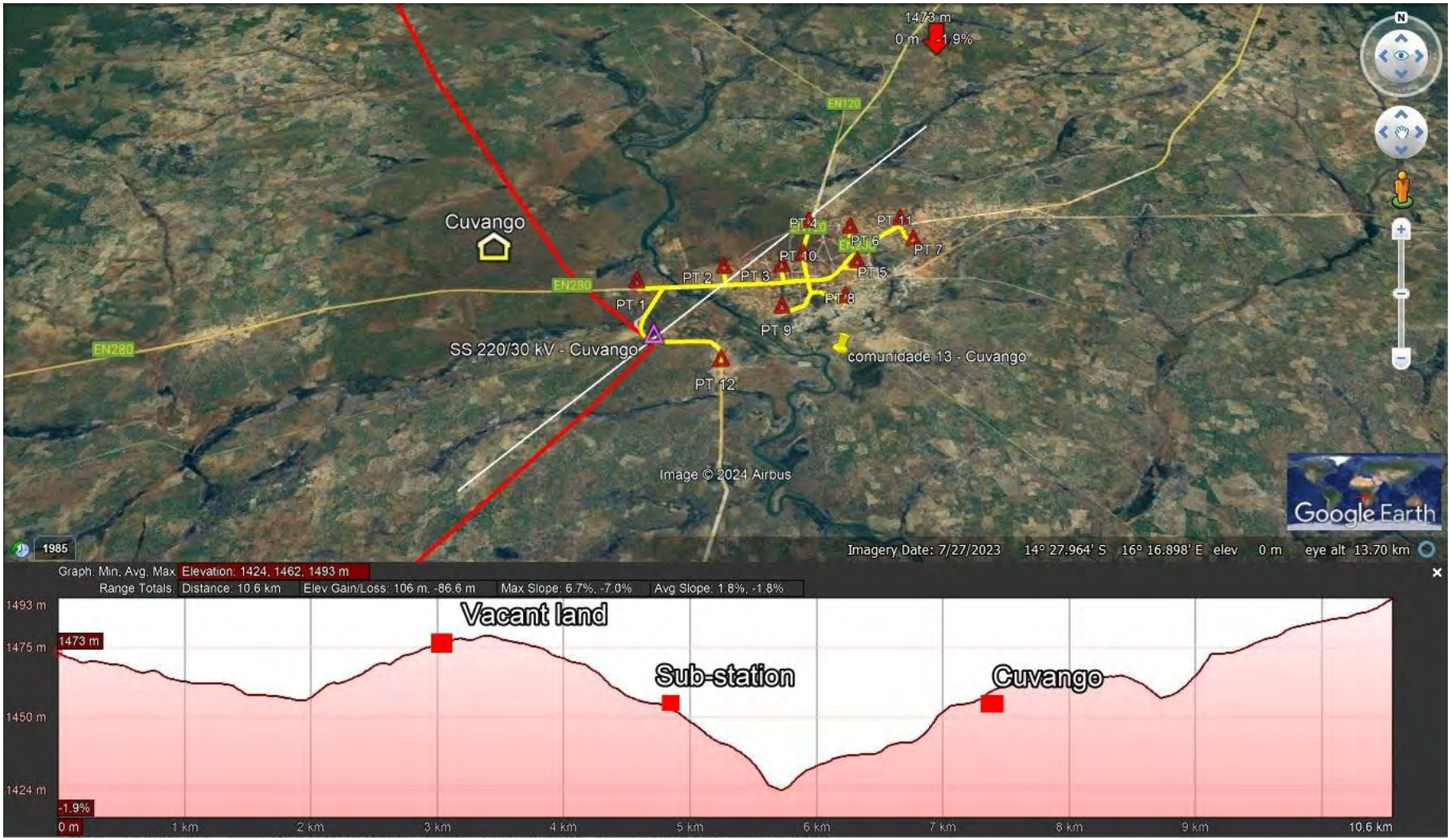


Figure 7-2: Elevation profile between Northeasterly and Southwesterly side of the Kuvango project area

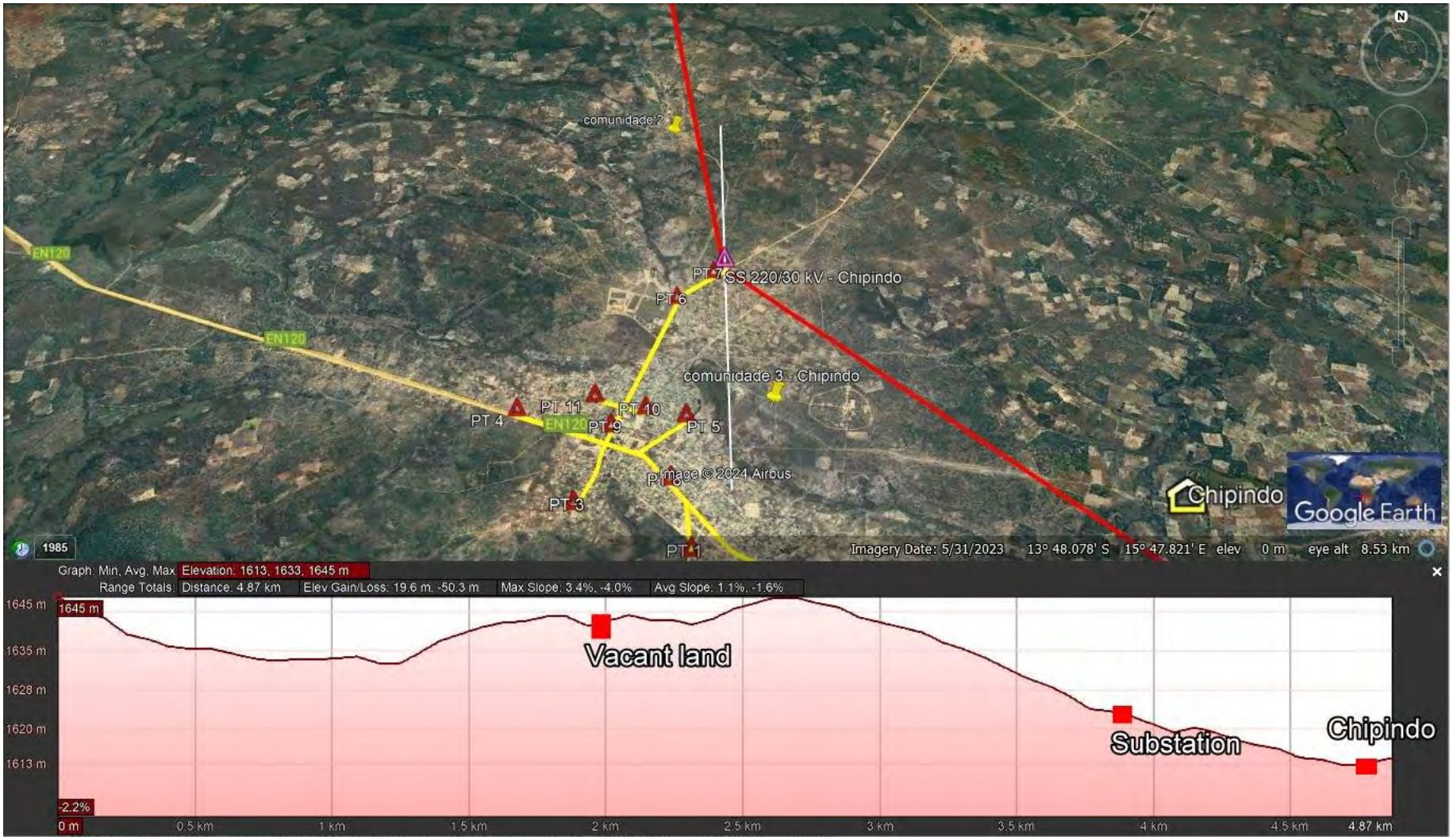


Figure 7-3: Elevation profile between North and South of the Chipindo project area

8 ENVIRONMENTAL NOISE INTRUSION CALCULATIONS

8.1 Environmental noise

Each noise measurement was taken over a representative period to ensure that all the possible variations in noise generation in the area, i.e. possible noise sources are included in the measurement value (IFC, 2007).

The following formula was used to calculate the noise levels at the different noise receptors during the construction and operational phases of the project:

Lp = Lw - 20log R - α

where, Lp is the sound level at a distance from the source in dBA;
Lw is the sound level at the source in dBA;
R is the distance from the source; α is the noise reduction factor of 3dB for air density, ground conditions will be allowed for.

The abovementioned noise impact formula and the Interactive Noise Calculator (ISO 9613) was used to determine the noise levels during the different phases of the project. The noise levels as calculated at the different noise receptors was in a logarithmic manner to determine the potential noise intrusion levels at the specific village.

The potential noise increase from the OHL, substation, and transformation stations project at the villages was determined by using the following formula:

Δ*L*Req,T = *L*Req,T (post) - *L*Req,T (pre)

where, *L*Req,T (post) – noise level after completion of the phase – projected or calculated noise levels;
*L*Req,T (pre) – noise level before the proposed project – ambient noise levels.

The criteria for assessing the magnitude of the potential noise impact are illustrated In Table 8-1.

Table 8-1: The criteria of the magnitude of the noise Intrusion levels

Increase Δ-dBA	Assessment of impact magnitude	Color code
0 <Δ≤ 1	Not audible	
1 <Δ≤ 3	Very Low	
3 <Δ≤ 5	Low	
5 <Δ≤ 10	Medium	
10 <Δ≤ 15	High	
15 <Δ	Very High	

8.2 Environmental noise intrusion levels

The calculated noise intrusion levels during the construction phase, which will take place during daytime periods only, are illustrated in Table 8-2 (Jamba), Table 8-3 (Kuvango), Table 8-4 (Chipindo) and during the operational phase in Table 8-5 (Jamba), Table 8-6 (Kuvango) and Table 8-7 (Chipindo).

Table 8-2: Noise Intrusion levels (dBA) for the Construction phase - Jamba

Noise receptors	Clearing and grubbing of the footprint areas	Construction activities at footprint areas	Construction of the infra-structure	Civil construction activities	Construction of access roads	Cumulative noise levels	Cumulative noise levels daytime	Noise intrusion levels
Jamba North to OHL	26.0	21.0	25.5	27.0	31.0	34.2	40.6	0.0
Jamba Middle to OHL	18.1	13.1	17.6	19.1	23.1	26.3	39.7	0.0
Jamba Substation to NSA	23.3	18.3	18.3	18.3	18.3	26.8	39.7	0.0
TS1	39.0	39.0	33.5	33.0	29.0	43.2	44.7	3.7
TS2	39.0	39.0	33.5	33.0	29.0	43.2	44.7	3.7
TS3	39.0	39.0	33.5	33.0	29.0	43.2	44.7	3.7
TS4	39.0	39.0	33.5	33.0	29.0	43.2	44.7	3.7
TS5	39.0	39.0	33.5	33.0	29.0	43.2	44.7	3.7
TS6	37.6	37.6	32.1	31.6	27.6	41.8	43.8	2.3
TS7	37.6	37.6	32.1	31.6	27.6	41.8	43.8	2.3
TS8	36.9	36.9	31.4	30.9	26.9	41.1	43.4	1.6
TS9	36.9	36.9	31.4	30.9	26.9	41.1	43.4	1.6
TS10	40.5	40.5	35.0	34.5	30.5	44.7	45.9	2.3
TS11	34.5	34.5	29.0	28.5	24.5	38.7	42.1	0.0
TS12	36.5	36.5	31.0	30.5	26.5	40.7	43.1	1.2

Table 8-3: Noise Intrusion levels (dBA)for the Construction phase - Kuvango

Noise receptors	Clearing and grubbing of the footprint areas	Construction activities at footprint areas	Construction of the infra-structure	Civil construction activities	Construction of access roads	Cumulative noise levels	Cumulative noise levels daytime	Noise intrusion levels
Kuvango North to OHL	18.5	13.5	18.0	19.5	23.5	26.8	42.1	0.0
Kuvango Middle to OHL	14.9	9.9	14.4	15.9	19.9	23.2	42.1	0.0
Kuvango Substation to NSA	20.4	15.4	15.4	15.4	15.4	24.0	42.1	0.0
TS1	31.0	31.0	25.5	25.0	21.0	35.2	42.8	0.0
TS2	39.0	39.0	33.5	33.0	29.0	43	45.6	1.2
TS3	39.0	39.0	33.5	33.0	29.0	43	45.6	1.2
TS4	35.4	35.4	29.9	29.4	25.4	40	44.0	0.0
TS5	39.0	39.0	33.5	33.0	29.0	43.2	45.6	1.2
TS6	39.0	39.0	33.5	33.0	29.0	43.2	45.6	1.2
TS7	39.0	39.0	33.5	33.0	29.0	43.2	45.6	1.2
TS8	39.0	39.0	33.5	33.0	29.0	43.2	45.6	1.2
TS9	39.0	39.0	33.5	33.0	29.0	43.2	45.6	1.2
TS10	34.5	34.5	29.0	28.5	24.5	38.7	43.7	0.0
TS11	39.0	39.0	33.5	33.0	29.0	43.2	45.6	1.2
TS12	39.0	39.0	33.5	33.0	29.0	43.2	45.6	1.2

Table 8-4: Noise Intrusion levels (dBA)for the Construction phase - Chipindo

Noise receptors	Clearing and grubbing of the footprint areas	Construction activities at footprint areas	Construction of the infra-structure	Civil construction activities	Construction of access roads	Cumulative noise levels	Cumulative noise levels daytime	Noise intrusion levels
Chipindo North to OHL	49.5	44.5	49.0	50.5	54.5	57.7	57.9	14.1
Chipindo Middle to OHL	21.4	16.4	20.9	22.4	26.4	29.6	43.8	0.0
Chipindo Substation to NSA	46.0	41.0	41.0	41.0	41.0	49.5	50.5	5.9
TS1	39.0	39.0	33.5	33.0	29.0	43.2	46.4	0.0
TS2	36.5	36.5	31.0	30.5	26.5	40.7	45.4	0.0
TS3	37.6	37.6	32.1	31.6	27.6	41.8	45.8	0.0
TS4	39.0	39.0	33.5	33.0	29.0	43.2	46.4	0.0
TS5	39.0	39.0	33.5	33.0	29.0	43.2	46.4	0.0
TS6	39.0	39.0	33.5	33.0	29.0	43.2	46.4	0.0
TS7	31.6	31.6	26.1	25.6	21.6	35.8	44.3	0.0
TS8	39.0	39.0	33.5	33.0	29.0	43.2	46.4	0.0
TS9	39.0	39.0	33.5	33.0	29.0	43.2	46.4	0.0
TS10	39.0	39.0	33.5	33.0	29.0	43.2	46.4	0.0
TS11	36.5	36.5	31.0	30.5	26.5	40.7	45.4	0.0
TS12	39.0	39.0	33.5	33.0	29.0	43.2	46.4	0.0

Noise intrusion levels during the operational phase are illustrated in Tables 8-5, 8-6, 8-7. This is based on the noise from the OHL, sub-station, and transmission station and the maintenance activities in the residential area in the vicinity of the transmission station.

Table 8-5: Noise Intrusion levels for the Operational phase in dBA - Jamba

Position	OHL	Substation	Transformation station	Maintenance activities	Cumulative noise level OHL and NSA	Cumulative noise levels SS and NSA	Cumulative noise level TS and NSA	Cumulative noise level maintenance and NSA	Cumulative noise levels	Noise intrusion level
TS1	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	**1.3**
TS2	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	**1.3**
TS3	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	**1.3**
TS4	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	**1.3**
TS5	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	**1.3**
TS6	32.6	37.6	27.6	27.6	32.6	37.6	27.6	27.7	39.4	**0.0**
TS7	32.6	37.6	27.6	27.6	32.6	37.6	27.6	27.7	39.4	**0.0**
TS8	31.9	36.9	26.9	26.9	31.9	36.9	26.9	27.0	38.7	**0.0**
TS9	31.9	36.9	26.9	26.9	31.9	36.9	26.9	27.0	38.7	**0.0**
TS10	35.5	40.5	30.5	30.5	35.5	40.5	30.5	30.6	42.4	**2.9**
TS11	29.5	34.5	24.5	24.5	29.5	34.5	24.5	24.7	36.4	**0.0**
TS12	31.5	36.5	26.5	26.5	31.5	36.5	26.5	26.6	38.3	**0.0**

Table 8-6: Noise Intrusion levels for the Operational phase in dBA - Kuvango

Position	OHL	Substation	Transformation station	Maintenance activities	Cumulative noise level OHL and NSA	Cumulative noise levels SS and NSA	Cumulative noise level TS and NSA	Cumulative noise level maintenance and NSA	Cumulative noise levels	Noise intrusion level
TS1	26.0	31.0	21.0	21.0	26.0	31.0	21.0	21.1	32.8	0.0
TS2	34.0	39.0	29.0	29.0	34.0	39.0	21.0	29.0	40.5	0.0
TS3	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	0.0
TS4	30.4	35.4	25.4	25.4	30.4	35.4	25.4	25.5	37.2	0.0
TS5	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	0.0
TS6	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	0.0
TS7	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	0.0
TS8	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	0.0
TS9	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	0.0
TS10	29.5	34.5	24.5	24.5	29.5	34.5	24.5	24.6	36.3	0.0
TS11	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	0.0
TS12	34.0	39.0	29.0	29.0	34.0	39.0	29.0	29.0	40.8	0.0

Table 8-7: Noise Intrusion levels for the Operational phase in dBA - Chipindo

Position	OHL	Substation	Transformation station	Maintenance activities	Cumulative noise level OHL and NSA	Cumulative noise levels SS and NSA	Cumulative noise level TS and NSA	Cumulative noise level maintenance and NSA	Cumulative noise levels	Noise intrusion level
TS1	34.0	39.0	29.0	29.0	35.3	40.3	30.3	35.6	42.7	0.0
TS2	31.5	36.5	26.5	26.5	31.5	38.6	30.3	35.2	41.1	0.0
TS3	32.6	37.6	27.6	27.6	34.4	39.4	29.4	35.3	41.9	0.0
TS4	34.0	39.0	29.0	29.0	35.3	40.3	30.3	35.6	42.7	0.0
TS5	34.0	39.0	29.0	29.0	35.3	40.3	30.3	35.6	42.7	0.0
TS6	34.0	39.0	29.0	29.0	35.3	40.3	30.3	35.6	42.7	0.0
TS7	26.6	31.6	21.6	21.6	31.3	36.3	26.3	34.7	39.6	0.0
TS8	34.0	39.0	29.0	29.0	35.3	40.3	30.3	35.6	42.7	0.0
TS9	34.0	39.0	29.0	29.0	35.3	40.3	30.3	35.6	42.7	0.0
TS10	34.0	39.0	29.0	29.0	35.3	40.3	30.3	35.6	42.7	0.0
TS11	31.5	36.5	26.5	26.5	33.6	38.6	28.6	35.2	41.3	0.0
TS12	34.0	39.0	29.0	29.0	34.0	40.3	30.3	35.6	42.5	0.0

The calculated noise intrusion levels at the villages where there will be no electrification and only the OHL in the vicinity of the villages are illustrated in Table 8-8.

Table 8-8: Calculated noise levels (dBA) from the OHL line at the villages

Village	Distance in meters	Calculated noise level	Cumulative noise level	Noise intrusion level
Com 13	290	14.3	45.9	**0.0**
Com 12	980	3.7	38.0	**0.0**
Com 11	885	4.6	38.0	**0.0**
Com10	1053	3.1	38.3	**0.0**
Com9	1480	0.1	42.2	**0.0**
Com9	1079	2.8	42.4	**0.0**
Com8	819	5.2	45.1	**0.0**
Com 7 - north	1526	-0.2	49.5	**0.0**
Com7 - south	1533	-0.2	49.5	**0.0**
Com5	700	6.6	49.0	**0.0**

The noise intrusion levels during the decommissioning phase are given in Tables 8-9 (Jamba), Table 8-10 (Kuvango) and Table 8-11 Chipindo.

Table 8-9: Noise intrusion levels (dBA) during the decommissioning phase - Jamba

Noise receptors	Removal of structures	Removal of debris and groundworks	Planting of grass and natural vegetation	Cumulative Levels	Cumulative noise level - Daytime	Intrusion noise level - daytime
Jamba North to OHL	26.0	21.0	21.0	28.1	39.8	0.0
Jamba Middle to OHL	18.1	13.1	13.1	20.2	39.6	0.0
Jamba Substation to NSA	23.3	18.3	18.3	25.4	39.7	0.0
TS1	34.0	29.0	29.0	36.1	41.1	0.0
TS2	34.0	29.0	29.0	36.1	41.1	0.0
TS3	34.0	29.0	29.0	36.1	41.1	0.0
TS4	34.0	29.0	29.0	36.1	41.1	0.0
TS5	34.0	29.0	29.0	36.1	41.1	0.0
TS6	32.6	27.6	27.6	34.7	40.8	0.0
TS7	32.6	27.6	27.6	34.7	40.8	0.0
TS8	31.9	26.9	26.9	34.0	40.6	0.0
TS9	31.9	26.9	26.9	34.0	40.6	0.0
TS10	35.5	30.5	30.5	37.7	41.7	0.0
TS11	29.5	24.5	24.5	31.6	40.2	0.0
TS12	31.5	26.5	26.5	33.6	40.5	0.0

Table 8-10: Noise intrusion levels (dBA) during the Decommissioning Phase - Kuvango

Noise receptors	Removal of structures	Removal of debris and groundworks	Planting of grass and natural vegetation	Cumulative Levels	Cumulative noise level - Daytime	Intrusion noise level - daytime
Kuvango Middle to OHL	14.9	9.9	9.9	17.0	42.0	0.0
Kuvango Substation to NSA	20.4	15.4	15.4	22.5	42.0	0.0
TS1	46.0	41.0	41.0	48.1	49.1	0.0
TS2	34.0	29.0	29.0	36	43.0	0.0
TS3	34.0	29.0	29.0	36	43.0	0.0
TS4	30.4	25.4	25.4	33	42.5	0.0
TS5	34.0	29.0	29.0	36.1	43.0	0.0
TS6	34.0	29.0	29.0	36.1	43.0	0.0
TS7	34.0	29.0	29.0	36.1	43.0	0.0
TS8	34.0	29.0	29.0	36.1	43.0	0.0
TS9	34.0	29.0	29.0	36.1	43.0	0.0
TS10	29.5	24.5	24.5	31.6	42.4	0.0
TS11	34.0	29.0	29.0	36.1	43.0	0.0
TS12	34.0	29.0	29.0	36.1	43.0	0.0

Table 8-11: Noise intrusion levels (dBA) during the Decommissioning Phase - Chipindo

Noise receptors	Removal of structures	Removal of debris and groundworks	Planting of grass and natural vegetation	Cumulative Levels	Cumulative noise level - Daytime	Intrusion noise level - daytime
Chipindo North to OHL	49.5	44.5	44.5	51.6	52.3	8.0
Chipindo Middle to OHL	21.4	16.4	16.4	23.5	43.6	0.0
Chipindo Substation to NSA	46.0	41.0	41.0	48.1	49.4	0.0
TS1	34.0	29.0	29.0	36	44.3	0.0
TS2	31.5	26.5	26.5	34	44.0	0.0
TS3	32.6	27.6	27.6	35	44.1	0.0
TS4	34.0	29.0	29.0	36.1	44.3	0.0
TS5	34.0	29.0	29.0	36.1	44.3	0.0
TS6	34.0	29.0	29.0	36.1	44.3	0.0
TS7	26.6	21.6	21.6	28.7	43.7	0.0
TS8	34.0	29.0	29.0	36.1	44.3	0.0
TS9	34.0	29.0	29.0	36.1	44.3	0.0

Noise receptors	Removal of structures	Removal of debris and groundworks	Planting of grass and natural vegetation	Cumulative Levels	Cumulative noise level - Daytime	Intrusion noise level - daytime
TS10	34.0	29.0	29.0	36.1	44.3	0.0
TS11	31.5	31.5	26.5	35.1	44.2	0.0
TS12	34.0	34.0	29.0	37.6	44.6	0.0

8.3 Ground vibration and air pressure levels

Ground vibration will be created when blasting activities may be required to dislodge large boulders during the construction phase of the project and the following formulas were used to calculate the ground vibration levels and over-air pressure levels based on typical mass of charge per delay of 50kg of site-mixed slurry explosives respectively. The ICI Handbook of Blasting Tables (ICI, 1971) provides the following formula for calculating ground-borne vibration.

8.3.1 Ground vibration Levels

The ground vibration levels during blasting at a distance from the blasting area will be calculated using the following equation from the ICI Blasting Handbook

$$V = k.\left(\frac{R}{\sqrt{W}}\right)^{b}$$

Where *V* is the peak particle velocity (mm/s)

R is the distance from the blast to the monitoring point (m)

W is the explosive charge weight per delay (kg)

The Australian Standard 2187.2-2006 (Standards Australia, 2006) will be used in the absence of site-specific constants for *k* and *b* in the above formula.

k 1140

b -1.6

8.3.2 Air Overpressure Levels/Air vibration

The level of air overpressure during blasting at a distance from the blasting area will be calculated using the following equation from the ICI Blasting Handbook:

$$P[dBZ]5\% = 165.3 - 24\log 10\left(\frac{D}{\sqrt[3]{W}}\right)$$

Where *P* is the 95th percentile peak pressure (dBZ);

D is the distance from the blast (m); and

W is the charge per mass delay (kg).

The following criteria based on international standards in Table 8-12 are designed to ensure adequate protection of sensitive land uses whilst permitting the operations to be conducted in a practical manner. The criteria are presented as 95 percentile limits for human comfort in occupied buildings and avoiding risk of cosmetic and structural damage to buildings from long-term effects of vibration. Lower limits are set for the night-time period. Night-time blasting will, however, not be allowed, and only daytime blasting will be conducted. No distinction is made between minor and moderate significance because of the nature of impacts resulting from blasting and the response of receptors. Critical impacts from air blast are identified where air blast noise from blasting exceeds 140.0 dBL, generally accepted as the safe threshold for hearing.

Table 8-12: Criteria for the evaluation of air blast vibration and ground vibration

Period	**Air blast dB(L)**				**Vibration PPV mm/s**			
	Not significant	**Minor/Moderate**	**Major**	**Critical**	**Not significant**	**Minor/Moderate**	**Major**	**Critical**
Daytime	<115	>115-125	>125-140	>140	<2	>2-5	>5-10	>10
Night-time	<105	>105-115	>115-140	>140	<1	>1-2	>2-5	>5

The calculation of the ground and air pressure levels were done with 50kg mixed slurry explosives per delay. This was done to identify the ground vibration and air pressure levels, which can be expected when blasting is required. The distance from the blasting activities, depth of the blast and the geology of the study area play a role in the ground vibration and air pressure levels at the residential abutting regions during each blast.

8.3.3 Ground vibration and air pressure levels

Calculations were made and the calculated ground vibration levels and air-pressure levels are illustrated in Table 8-13. The calculations were based on the distance of the OHL pylons and the residential areas.

Table 8-13: Ground vibration and air-pressure levels for a 50kg and 100kg site mix slurry explosives per delay

Noise receptor	Distance in meters	Calculated air pressure levels (dBL) at the receptor with 50kg site mixed slurry explosives per delay at blasting site	Calculated air pressure levels (dBL) at the receptor with 50kg site mixed slurry explosives per delay at blasting site.	Calculated air pressure levels (dBL) at the receptor with 100kg site mixed slurry explosives per delay at blasting site	Calculated air pressure levels (dBL) at the receptor with 100kg site mixed slurry explosives per delay at blasting site
Jamba	1 280	0.28	104.3	0.48	106.7
Jamba	600	0.94	112.2	1.63	114.6
Kuvango	580	0.99	112.6	1.72	115.0
Kuvango	820	0.57	109.0	0.99	111.4
Com 12	980	0.43	107.1	0.74	109.5
Com 11	885	0.50	108.2	0.87	110.6
Com10	1053	0.38	106.4	0.66	108.8
Com9	1480	0.22	102.8	0.38	105.2
Com9	1079	0.37	106.1	0.64	108.5
Com8	819	0.57	109.0	0.99	111.4
Com 7 North	1526	0.21	102.5	0.37	104.9
Com7 South	1533	0.21	102.4	0.36	104.8
Com6	1450	0.23	103.0	0.40	105.4
Com5	700	0.73	110.6	1.27	113.0
Com4	2500	0.10	97.3	0.17	99.7
Chipindo	1975	0.14	99.8	0.24	102.2
Chipindo	1956	0.14	99.9	0.25	102.3

9 IMPACT ASSESSMENT APPROACH

The ESIA (including its specialist studies) for the Cassinga Project will be conducted in compliance with Angolan legislation, the IFC standards and other applicable international standards. The integrated ESIA process is illustrated in Figure 9-1.

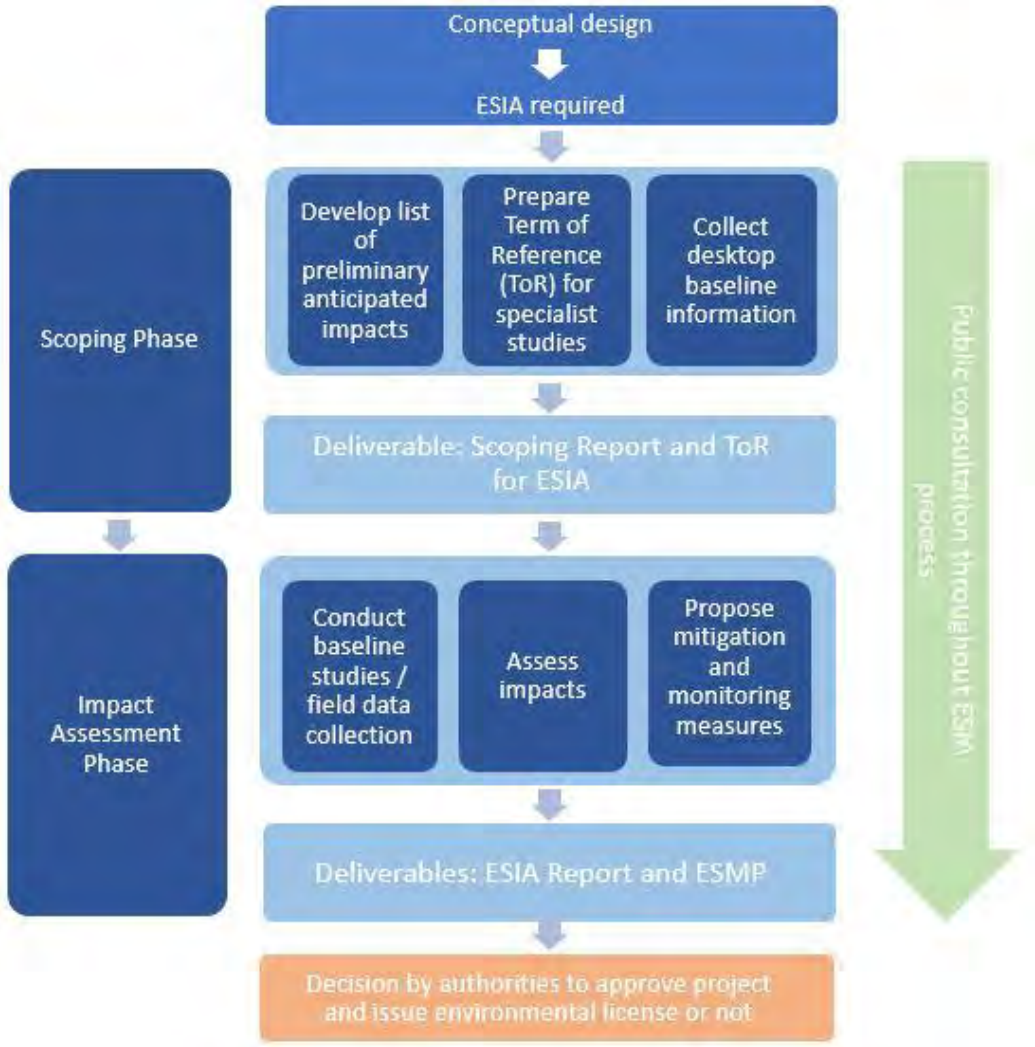


Figure 9–1: The integrated ESIA process

9.1 Impact assessment methodology

Impacts are assessed using information gathered during the baseline assessment in combination with previously collected desktop data and compared with the detailed project description.

The significance of the identified impacts is determined using the approach outlined in Table 9-1. This incorporates two aspects for assessing the potential significance (i.e. incidence and severity of impacts). The impacts will be classified and described for (a) impacts before mitigation is applied and (b) after mitigation has been applied (these are known as the residual impacts).

The impact significance rating system is presented in Table 9-1 and involves the following 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.
- 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 9-1: Method for rating 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	Medium	High
		Short term	Low	Medium	Medium
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

9.2 Confidence of prediction

Per definition, impact assessment remains uncertain due to availability of information, the dynamic nature of the social and biophysical environments, and the predictive nature of assessment methods.

In cases where there are concerns about the prediction confidence of a specific environmental and social aspect, these will be discussed in the impact assessment. At times, when low confidence prediction is evident, the ESIA specialists will make subjective assessments considering the information at hand at the time of the assessment and their professional experience and opinion. In such uncertain cases, the ESIA specialists will make their

recommendations based on the precautionary principle and possibly recommend the collection of additional data and regular monitoring to improve data availability and thus informed decision-making.

9.3 Formulation of mitigation measures

In line with good international industry practice (GIIP), a mitigation hierarchy is applied:

- Avoid: (e.g., move to a more suitable site or use different technology);
- Minimise: by applying mitigation (e.g., by, amending the layout of the project or using alternative technology);
- Rehabilitate/restore: (e.g., measures to improve ecosystems where impacts could not be avoided nor minimised); and
- Offset / compensate: (e.g., measures to compensate for residual adverse impacts where avoid-minimise-rehabilitate cannot be applied). Offsets for biodiversity can be complex and costly but are used where other steps cannot be used. For physical and economic resettlement, there are legislative / regulatory processes and international standards that details requirements (e.g., compensation rates for loss of crops, land access: and livelihood and housing restoration guidelines).

10 IMPACT ASSESSMENT

10.1 Project Phases

The following activities during the Construction Phase were used to determine the potential noise intrusion levels at the Villages:

10.1.1 Construction Phase

- Clearing and grubbing of the footprint areas at the OHL, Substation, Pylons, and Transformation Stations;
- Blasting (if required) ;
- Construction activities at OHL and infrastructure – Construction of the different sections of the electrification process; and
- Civil construction activities – Construction of internal/access roads, construction camps every 80km, infrastructure, and buildings.

10.1.2 Operational Phase

The electrification activities which may contribute to a noise increase during the operational phase of the project is listed:

- Substation activities such as fans and transformers;
- Transformation stations; and
- Maintenance activities.

10.1.3 Decommissioning Phase

The rehabilitation of disturbed areas where the pylons, poles, and sub-stations were constructed may increase the noise level on a temporary basis and is as follow:

- Removal of all structures – demolition of all structures at the different footprint areas;

- Rehabilitation of disturbed areas – restore the different footprint areas to its natural form; and
- Planting of vegetation – planting of natural grass at the disturbed areas.

10.2 Construction phase

The different aspects of the construction phase are dealt with in Tables 10-1 to 10-4.

Table 10-1: Clearing and grubbing of the electrification footprint areas.

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 phase								
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: Ensure that all machinery with noise sources exceeding 80.0dBA are adequately acoustically screened off. Noise complaints must be assessed within 8hours after receipt of a noise complaint								
After management	Minor	Medium term	Site	Low	Unlikely	Low	-	Medium

Table 10-2: Blasting

Activity: Blasting at OHL, Substation, Pylons, and Transformation Stations footprints – if required								
Project phase: Construction phase								
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 a blast - if required								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
Before management	Moderate-	Medium term	Local	Medium	Possible	Medium	-	Medium
Management measures: 1. No blasting to be conducted within 500m from any residential area. 2. Safe blasting techniques to be in place during a blast. 3. Blast design to be conducted before a blast. 4. Ground vibration and/or air pressure levels to be monitored.								
After management	Minor	Medium term	Local	Low	Unlikely	Low	-	Medium

Table 10-3: Construction activities at OHL and infrastructure

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 phase								
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	Local	Medium	Possible	Medium	-	Medium
Management measures: Ensure that all machinery with noise sources exceeding 80.0dBA are adequately acoustically screened off. Noise complaints must be assessed within 8hours after receipt of a noise complaint								
After management	Minor	Medium term	Local	Low	Unlikely	Low	-	Medium

Table 10-4: Civil construction activities of internal roads, infrastructure, and buildings

Activity: Civil construction activities – Construction of internal roads, infrastructure, and buildings.								
Project phase: Construction phase								
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	Local	Medium	Possible	Medium	-	Medium
Management measures: Ensure that all machinery with noise sources exceeding 80.0dBA are adequately acoustically screened off. Noise complaints must be assessed within 8hours after receipt of a noise complaint								
After management	Minor	Medium term	Local	Low	Unlikely	Low	-	Medium

10.3 Operational phase

The different aspects of the operational phase are presented in Tables 10-5 to 10-7.

Table 10-5: Transformer and noise from fans at substation

Activity: Noise from transformers, cooling fans and other noise sources.								
Project phase: Operational phase								
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	Local	Medium	Possible	Medium	-	Medium
Management measures: Ensure that all machinery with noise sources exceeding 80.0dBA are adequately acoustically screened off. Noise complaints must be assessed within 8hours after receipt of a noise complaint								
After management	Minor	Medium term	Local	Low	Unlikely	Low	-	Medium

Table 10-6: Transformation stations at Jamba, Kuvango and Chipindo

Activity: Transformers at the poles make a noise which is intrusive.								
Project phase: Operational phase								
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: Ensure that transformers with noise sources exceeding 50.0dBA are adequately acoustically screened off. Noise complaints must be assessed within 8hours after receipt of a noise complaint								
After management	Minor	Medium term	Site	Low	Unlikely	Low	-	Medium

Table 10-7: Maintenance activities

Activity: Maintenance activities at the OHL, Substations and Transform stations (12 at each Village).								
Project phase: Operational phase								
Impact summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during the maintenance activities.								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
Before management	Moderate-	Medium term	Site	Medium	Possible	Medium	-	Medium
Management measures: Ensure that all machinery with noise sources exceeding 50dBA to 80.0dBA are adequately acoustically screened off. Noise complaints must be assessed within 8hours after receipt of a noise complaint								
After management	Minor	Medium term	Site	Low	Unlikely	Low	-	Medium

10.4 Decommissioning phase

The different aspects of the decommissioning phase are presented in Tables 10-8 to 10-10.

Table 10-8:Removal of all structures – demolition of all structures at the different footprint areas

Activity: Removal of all structures – demolition of all structures at the different footprint areas.								
Project phase: Decommissioning phase								
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: Ensure that all machinery with noise sources exceeding 80.0dBA are adequately acoustically screened off. Noise complaints must be assessed within 8hours after receipt of a noise complaint								
After management	Minor	Medium term	Site	Low	Unlikely	Low	-	Medium

Table 10-9: Rehabilitation of disturbed areas – restore the different footprint areas to is natural form.

Activity: Rehabilitation of disturbed areas – restore the different footprint areas to is natural form.								
Project phase: Decommissioning phase								
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: Ensure that transformers with noise sources exceeding 50.0dBA are adequately acoustically screened off. Noise complaints must be assessed within 8hours after receipt of a noise complaint								
After management	Minor	Medium term	Site	Low	Unlikely	Low	-	Medium

Table 10-10: Planting of grass and natural vegetation

Activity: Revegetation activities at the OHL, Substations and Transformer stations (12 at each Village).								
Project phase: Decommissioning phase								
Impact summary: Increase in the noise levels at the residential areas in that the prevailing ambient noise levels are exceeded during the maintenance activities.								
	Magnitude	Duration	Scale	Consequence	Probability	Significance	+/-	Confidence
Before management	Moderate-	Medium term	Site	Medium	Possible	Medium	-	Medium
Management measures: Ensure that all machinery with noise sources exceeding 50dBA to 80.0dBA are adequately acoustically screened off. Noise complaints must be assessed within 8hours after receipt of a noise complaint								
After management	Minor	Medium term	Site	Low	Unlikely	Low	-	Medium

10.5 Cumulative Impacts

The cumulative impacts of the different activities during the Construction phase, Operational phase, Decommissioning phase, are illustrated in Tables 10-1 to 10-10 respectively.

10.5.1 Construction phase

The cumulative impact will be less than 1.0dBA except at Chipindo Village where the OHL will run through a section of the Village. Should the final route alignment of the OHL be within 300m of a household, the alignment must be adjusted so that the alignment is outside a 300m buffer of such household(s). The construction phase will only take place during the daytime periods when the prevailing ambient noise levels will be higher at the abutting residential areas. The ground vibration and/or air pressure levels will be insignificant when site slurry mixtures of 50kg/100kg explosives are used in areas where the distance is more than 500m from the blasting area to the residential areas.

10.5.2 Operational phase

The cumulative impact at the abutting residential areas will be low with a noise intrusion level of 1.3dBA at TS1 to TS4 and an increase of 2.9dBA at TS10 which is low.

10.5.3 Decommissioning phase

The cumulative impact will be less than 1.0dBA which according to the matrix will not be audible. The decommissioning phase will only take place during the daytime periods when the prevailing ambient noise levels will be higher at the abutting residential areas.

11 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) AS APPLICABLE TO ENVIRONMENTAL NOISE AND GROUND VIBRATION

The Project is comprised of three components:

- Construction phase where the sites will be prepared for the construction of the OHL infrastructure;
- Operational phase where power will be distributed to three Villages been Jamba, Kuvango and Chipindo with a OHL from Gove to Jamba; and
- Project management of the distribution of electricity in a rural area with emphasis on environmental noise impacts on the villages in the vicinity of the project area.

11.1 Major environmental impacts related to environmental noise

- Potential positive impacts – The introduction of electricity to areas where there was no electricity will have a positive impact as people can now use electricity to enrich their daily living environment.
- Potential negative impacts – Residents in the vicinity of the project area may suffer from sleep disturbance due to increased environmental noise.

11.2 Enhancement and mitigation measures

The negative impacts may occur during the project's operational phase if the recommended mitigatory measures are not in place before the commissioning of the electrification of the three Villages. Engineering design will have to be conducted during the project implementation assessment, and the Angolan Environmental Law and the Health and Safety Guidelines by the World Bank's IFC will have to be adhered to always.

Aspects such as increase in the prevailing ambient noise levels (+3dB above the prevailing ambient noise levels may be allowed) and increase in the ground vibration levels above the threshold level of 12.5mm/s for poorly constructed buildings and 25mm/s for modern type buildings will be assessed.

Mitigation measures will have to be enforced as the distances between the villages and the OHL and the substation and transformation stations differ. Distance between the different electrification aspects and the villages and the projected noise and vibration levels will trigger what the specific mitigatory measures will have to be so that the threshold values at the villages will not be exceeded.

The Noise and Vibration Environmental Social Management Plant for Environmental and Vibration is illustrated in Table 11-1.

Table 11–1: Environmental Noise and Ground Vibration ESMP

Project phase	Potential impact	Detailed actions	Responsible person/ entity	Monitoring mechanism	Indicator / performance criteria
Construction phase	Increase in the prevailing ambient noise levels – 3dB above the prevailing ambient noise level – see Table 3.2	The following are the Environmental, Health and Safety Guidelines of the IFC of the World Bank, which should be taken into consideration during the construction phase of the project: • Selecting equipment with lower sound power levels; • Installing silencers for fans; • Installing suitable mufflers on engine exhausts and compressor components; • Installing acoustic enclosures for equipment causing radiating noise; • Installing vibration isolation for mechanical equipment - care; • Re-locate noise sources to areas which are less noise sensitive, to take advantage of distance and natural shielding; • Taking advantage during the design stage of natural topography as a noise buffer; • Develop a mechanism to record and respond to complaints; • Construction activities to be done during daytime only.	The Project engineer	Noise monitoring to be conducted when noise complaints are received. Noise monitoring to be done with a Class 1 Noise Level Meter. Calibration of the instrument to be done at an accredited laboratory on an annual basis. Noise monitoring to be done in terms of the requirements of the Health and Safety Requirements of the IFC, World Bank.	The prevailing ambient noise levels may not be exceeded by more than 3.0dBA at the boundary of the different electrification footprint areas.
Operational phase	Increase in the prevailing ambient noise levels – 3dB above the prevailing ambient noise level	• Inventory of structural damage to buildings within a radius of 500m of the pits to be done and kept on record;	Environmental section of the Contractor.	• Environmental noise monitoring to be conducted when complaints area received.	The prevailing ambient noise levels may not be exceeded by more than 3.0dBA at the electrification footprint areas.

	which may result in sleeping loss for residents in the vicinity of the OHL operations. Structural damage to residential properties during blasting.	• Ground vibration and air pressure levels to be done each time a blast will be done; • Feed back to the Chief Engineer once the prevailing ambient noise level is exceeded by more than 3.0dBA (OHL project related noise only); • Records of environmental noise and ground vibration to be kept for a period of three (3) years; • Acoustic mitigatory measures to be implemented at noise sources more than 85.0dBA or when the ambient noise level is exceeded by more than 3.0dBA; • Only at site mixed slurry explosives per delay of less than 100kg per delay to be used to break-up large boulders; • Develop a mechanism to record and respond to complaints.		• Noise monitoring to be done with a Class 1 Noise Level Meter. • Calibration of the instrument to be done at an accredited laboratory on an annual basis. • Noise monitoring to be done in terms of the requirements of the Health and Safety Requirements of the IFC, World Bank.	The threshold value of 12.5mm/s for poorly constructed buildings and 25mm/s for modern type buildings not to be exceeded at the residential areas.
Decommissioning phase		• Demolition activities and maintenance activities to be done during daytime periods only.	Environmental section of the Contractor.	Noise monitoring to be conducted when complaints area received. Noise monitoring to be done with a Class 1 Noise Level Meter. Calibration of the instrument to be done at an accredited laboratory on an annual basis. Noise monitoring to be done in terms of the	The prevailing ambient noise levels may not be exceeded by more than 3.0dBA at the residential areas.

				requirements of the Health and Safety Requirements of the IFC, World Bank.	

12 MONITORING PLAN

The noise monitoring plan for the OHL operations is given in Table 12-1

Table 12-1: Noise monitoring plan

	Management Plan								
	Objective	**Detailed Mitigation measures**	**Procedures**	**Monitoring Mechanism**	**Target / Performance indicator**	**Responsibility**	**Start**	**End**	**Cost**
Land use change - change of traditional land use to special.	Minimise noise impacts and promote and establish sustainable environmental noise levels.	• Final Project infra structure, and access areas will be clearly indicated in final construction plans provided to contractors/employees. The plans will consider environmental noise constraints. • Access roads (etc.) will be planned to avoid sensitive areas. Environmental noise monitoring to be conducted in the case of noise complaints Procedures on noise monitoring to be adhered to. • The noise mitigatory measures for the Construction, Operational and	Prevention of excessive noise and vibration levels	As per monitoring mechanism in Table 9-2.	The prevailing ambient noise levels may not be exceeded by more than 3.0dBA at the boundary of the different project areas. The threshold value of 12.5mm/s for poorly constructed buildings and 25mm/s for modern type buildings not to be exceeded at the residential areas.	Environmental Department	Construction	Decommissioning phases	

		Decommissioning phases to be adhered to.							

13 STUDY LIMITATIONS / ASSUMPTIONS

The noise calculations were made on the assumption that the following equipment and/or mine machinery will be used during the operational phase of the project:

Table 13-1: Electrification operations inventory

Quantity	Location	Type: Name and Feature	Capacity
1	Public domain	OHL	220/30kV electricity
3	Villages	Jamba, Kuvango, and Chipindo	
36	Transformation Stations	Jamba, Kuvango, and Chipindo	
3	Substations	Jamba, Kuvango, and Chipindo	

There were no details provided of the processing plant (height and Enclosures) and the loading activities at the siding and a conceptual lay-out of the siding and processing plant will have to be provided.

14 CONCLUSION

The Cassinga OHL and associated infrastructure project will consist out of the construction of three (3) new substations at Jamba and the establishment of a new 220kV overhead power line from Gove to Chipindo, Chipindo to Kuvango and Kuvango and Jamba. This will be the electrification of Chipindo, Kuvango and Jamba Villages. The Project will include a 30 kV Medium Voltage OHL network to the new substations and a Low Voltage network to supply electricity to 1 000 homes in each of the three villages.

The introduction of electricity to the villages may result in the prevailing ambient noise levels at and in the vicinity of the villages increasing, but such noise will be insignificant at the abutting noise receptors.

The noise levels at the Villages abutting the EN120 were during the first set of noise readings in the vicinity of the feeder roads were between 38.1dBA 45.5dBA and intermittent traffic, a mill, animals and/or domestic activities contributed to the prevailing ambient noise levels. In Jamba, Kuvango and Chipindo the prevailing noise levels were 37.6dBA to 52.4dBA. This noise level illustrates that the people in the Jamba, Kuvango and Chipindo villages are already exposed to noise from motor vehicles, heavy-duty vehicles, and motorcycles.

The proposed Cassinga OHL project will comply with the requirements of the WHO Health, Angolan laws and the IFC Safety Requirements provide that the noise mitigatory measures are in place and that the management plans be implemented during the construction, operational and decommissioning phases of the project.



BJB van der Merwe – MSc UJ
Environmental noise and vibration specialist

15 REFERENCES

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Appendix A

Calibration certificate

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Co. Reg. No: 2012/123238/07 VAT NO: 4300255876 BEE Status: Level 4
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CERTIFICATE OF CALIBRATION

CERTIFICATE NUMBER	2023-AS-0482
ORGANISATION	DB ACOUSTICS CC
ORGANISATION ADDRESS	P.O. BOX 1219, ALLANSNECK, 1737
CALIBRATION OF	INTEGRATING SOUND LEVEL METER complete with built-in ⅓ OCTAVE/OCTAVE FILTER and ½" MICROPHONE
MANUFACTURERS	LARSON DAVIS and PCB
MODEL NUMBERS	LXT1, PRM LXT1 and 377B 02
SERIAL NUMBERS	0006037, 069946 and 316345
DATE OF CALIBRATION	05 – 06 APRIL 2023
RECOMMENDED DUE DATE	APRIL 2024
PAGE NUMBER	PAGE **1** OF **5**

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W.S. SIBANYONI (CALIBRATION TECHNICIAN)	M. NAUDÉ (SANAS TECHNICAL SIGNATORY)	**11 APRIL 2023**

Director: Marianka Naudé

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CERTIFICATE OF CALIBRATION

CERTIFICATE NUMBER	2024-AS-0004
ORGANISATION	DB ACOUSTICS CC
ORGANISATION ADDRESS	P.O. BOX 1219, ALLANSNECK, 1737
CALIBRATION OF	ACOUSTIC CALIBRATOR
MANUFACTURER	LARSON DAVIS
MODEL NUMBER	CAL 200
SERIAL NUMBER	9855
DATE OF CALIBRATION	11 JANUARY 2024
RECOMMENDED DUE DATE	JANUARY 2025
PAGE NUMBER	PAGE 1 OF 3

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Calibrated by:	Authorized/Checked by:	Date of Issue:
W.S. SIBANYONI (CALIBRATION TECHNICIAN)	M. NAUDÉ (SANAS TECHNICAL SIGNATORY)	15 JANUARY 2024

Director: Marianka Naudé (082 727 3312)

Appendix B

HCV Africa profile

Experience excellence and tailored solutions with HCV Africa.

At HCV Africa, we embody a collective of independent, seasoned environmental scientists and social specialists united by a steadfast commitment. Our mission is clear: to provide outstanding consulting services across Africa and in growing economies throughout Asia and the Middle East.

Drawing upon our extensive international expertise across key sectors (such as mining, oil and gas, renewable energy, agri-business, heavy industry, and large-scale civil infrastructure), we specialise in developing sustainable solutions through carefully tailored consulting services.

Our deep understanding of various international norms and experienced insights into African business environments, supported by long-standing partnerships with local consulting firms and experienced experts, enables us to efficiently translate complex global knowledge into practical, locally tailored solutions for our clients.

Explore our comprehensive range of environmental management services, which include:

- Applying the relevant international standards such as IFC/World Bank Standards and Equator Principles in Environmental and Social Impact Assessments (ESIA).
- Skilful navigation of legal processes, dispute resolution, directives, and rectification of environmental and water issues.
- Develop and meticulously implement environmental and social management plans/programs.
- Assurance of capital investments through thorough environmental and social audits and due diligence.
- Strategic design and seamless execution of environmental and social management systems.
- Conducting thorough environmental, social and health risk assessments.
- Specialised studies and assessments of ecosystem services.
- Design and implementation of robust environmental, social and health monitoring plans.
- Efficient management of environmental and water legal administrative functions.
- Provision of expert opinions and advisory services.

Embark on a journey with HCV Africa, and let us work together to shape a sustainable future.

For further insights, we encourage you to visit our website: www.hcvafrica.com

Appendix C

Specialist CV

CURRICULUM VITAE

Surname:	Van der Merwe
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Address :	43 6th Street, Linden
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Qualifications

- MSc Environmental Management – University of Johannesburg;
- BSc Honours in Geography and Environmental Management – University of Johannesburg;
- National Diploma in Public Health - Cape Town Technikon;
- National Higher Diploma in Environmental Health - Witwatersrand Technikon;
- National Certificate in Noise Pollution - Technikon SA;
- National Certificate in Air Pollution - Technikon SA;
- National Certificate in Water Pollution - Technikon SA;
- Management Development Diploma - Damelin Management School;
- Advanced Business Management Diploma - Rand Afrikaans University.

Membership

- Member South African Acoustics Institute - SAAI.
- Member of National Association of Clean Air - NACA.
- Member of the International Association of Impact Assessment - IAIASA.
- Member of the South African Association of Geographers - SAAG.

Experience

- Environmental noise impact assessments mining, roads, wind farms, emergency generator plants – EIA & EMP.
- Noise attenuation at places of entertainment.
- Design and implementation of sound attenuators.
- Noise projections and contouring.
- Advisory capacity regarding noise related cases to Local authorities: - Sandton, Roodepoort, Randburg, Krugersdorp, Alberton, Centurion, Vereeniging.

Environmental Impact Assessments – Noise

The following are noise impact assessments where dBAcoustics was involved with during the Environmental Impact Assessment process (Noise):

- Various mine projects in Mozambique, Ethiopia, Democratic Republic of Congo, Tanzania, Zambia, Sierra Leone;
- Kelvin Power Station, Edenvale, Johannesburg
- Coal gasification plant in Theunissen and Lephalale;
- Wind farms in Caledon and Wolseley, Western Cape;
- SANRAL Roads in Mokopane, Zeerust, Howick, Transkei, Nelspruit, Trichardt; Volksrust; George. Heidelberg Gauteng.
- Baseline noise monitoring for mines in Northwest Province (Royal Bafokeng mines, Sibanye mines), Glisa mine - Belfast, Modikwa mine – Limpopo, Thabametsi mine – Lephalale, Khumba mine and Khumani mine – Kathu Northern Cape, Venetia mine – Limpopo;

EIA and EMP (last two years):

- Der Brochen mine, Steelpoort;
- Mokgalakwena Platinum mine expansion - Mobopane;
- Matai mine – Rustenburg;
- Vanggatfontein Colliery – Delmas;
- Musina copper mine- Musina;
- Turfvlakte coal mine – Lephalale;
- Lephalale railway yard – Lephalale;
- Mine Booysensdal North & South – Steelpoort;
- N2 Road (Butterworth) - Eastern Cape;
- National roads – Kroonstad, Mpumalanga, Kowie (KZN);
- Middelburg South Coal mine – Mpumalanga;
- Nuco mines – Rustenburg;
- Setlabotsha mine – Standerton;
- Phalaborwa mining Company – Phalaborwa;
- Paling mine – Postmasburg;
- nKomati Mine - Komatipoort;
- Nkwe Mine (Eerstegeluk) – Steelpoort;
- Naledi Geluk Mine – Steelpoort;
- Petra diamond mine – Kroonstad;
- Modikwa mine – Steelpoort;
- Bronkhorstspruit siding – Bronkhorst Spruit;
- Thabazimbi siding - Thabazimbi;
- Eloff Coal mine – Delmas;
- Rietkuil Vakhoni underground mine – Town Ga-Nala.

Projects in Africa over the last two years

Country	Project name	Type	Environmental company
Ethiopia	IPC Dira Dawa	Environmental Noise	Golder associates
Sultanate of Oman	Salalah Ammonia plant establishment	Environmental Noise	Five Oceans environmental Services, Oman
Zambia	Frontier Copper Mine	Environmental Noise	Golder associates
Zambia	Maamba power Station	Environmental noise	Maamba Collieries, Zambia
Nigeria	Upgrade of gas plant	Environmental noise	Royal Haskoning, Netherlands
Lesotho	PV Plant	Environmental noise	Royal Haskoning South Africa
Malawi	Malingunde project	Environmental noise	Dhamana Consulting, Australia
Democratic Republic of Congo	Kinsevere mine – Expansion project	Environmental Noise	Golder Associates
Democratic Republic of Congo	Comide mine expansion	Environmental Noise	Golder associates
Democratic Republic of Congo	Metalkol mine – Expansion project	Environmental Noise	Golder Associates
Democratic Republic of Congo	Kipushi mine – Expansion project	Environmental Noise	Golder Associates

Appendix K: SEIA

Socio-Economic Impact Assessment for the Cassinga Power Supply Project ESIA

Report Prepared for

Pak Yatirim

Report Number 595657/SEIA



Report Prepared by

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December 2024

Socio-Economic Impact Assessment for the Cassinga Power Supply Project ESIA

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Executive Summary

A Socio-Economic Impact Assessment (SEIA) was conducted for the proposed Cassinga Power Supply Project in the Huíla Province of Angola. The SEIA process included a desktop review of the socio-economic baseline of the project-affected area, including the municipalities of Chipindo, Cuvango and Jamba. Various sources were consulted, such as the latest statistical data of the Angolan census. A site visit was undertaken, during which initial meetings were held with the administrations of these local municipalities. Primary data was also collected through household surveys in villages that are envisaged to benefit from connections to the new powerline.

Surveys were concentrated in rural areas to gather relevant data on communities along the OHL route. Sixteen villages were surveyed, including visits to social facilities, sacred sites, and water lines. KIIs with local leaders (*sobas*) provided additional data, such as household numbers in each village.

Findings indicated similar social baselines across rural areas of Huíla, with most villagers engaged in subsistence farming, informal commerce, beekeeping, artisanal gold mining, and river fishing. The primary income source is selling field produce, with monthly household incomes ranging from AKZ 38 000 to AKZ 180 000. Additional income sources in municipal centres include civil service jobs and government subsidies. Crop cultivation methods are rudimentary, with staple crops like maize and beans, and other vegetables such as sweet potatoes, cassava, and yams.

Land for housing and agriculture is mostly inherited or granted by traditional authorities, though formal land ownership is limited. Infrastructure and services are inadequate, with no electricity except in municipal centres where thermal generators provide limited power. Most families use wood and charcoal for cooking and solar panels for lighting. Water sources include hand-dug wells and streams, with some municipal centres having government-provided water connections. Education facilities are basic, often using church spaces as classrooms. Public transport is absent, with private motorbikes and walking as the primary means of transportation.

Health issues are significant, with malaria, bronchitis, diarrhoea, and cholera affecting children, while adults suffer from typhoid fever, rheumatism, hypertension, and diabetes. Certain activities, such as herding and vehicle driving, are male-dominated, and important household decisions are typically made by men. School attendance is generally equal among boys and girls, though girls are more likely to drop out due to motherhood. Farming responsibilities are shared between men and women.

Vulnerable groups include people with disabilities, women, the elderly, youth, migrants/internally displaced people who moved to the project area during or after the war, war veterans, mostly elderly, war maimed (disabled) persons, mostly elderly, Artisanal and Small-scale Gold Miners (ASGM) in the project area, community members without security of tenure, physically or economically displaced PAPs, unemployed persons in municipal centres, individuals/groups that are economically or socially marginalised due to their historical pasts, or political or social beliefs, and the non-Bantu San ethnic group, traditional hunter-gatherers at risk of socio-cultural extinction. Some San households occasionally reside in areas within Jamba and Cuvango municipalities, but they are not located in or close to the project area. The current living conditions of the villages are expected to remain unchanged without investments in infrastructure, services, and employment opportunities.

Socio-economic impacts have been identified, assessed and rated pre- and post-mitigation using SRK's impact assessment methodology and are summarised in **Table ES-1** below.

Table ES-1: Summary of socio-economic impacts

№	Impact	Construction phase	Operational phase	Significance ratings	
				Pre-mitigation	Post-mitigation
1.	Reduced income-earning opportunities due to a loss of, or access to, farming and livestock grazing land	✓	✓	High	Medium
2.	Increased food insecurity due to loss of farming or grazing land or access to such land	✓	✓	High	Medium
3.	Reduced income-earning opportunities for artisanal miners due to loss of available artisanal mining areas	✓	✓	Medium	Medium
4.	Disruption of access in and between communities and sites used by Khoi San people	✓	✓	Medium	Low
5.	Altered sense of place of community members and Khoi San people due to the presence of the powerlines and substations	✓	✓	High	Medium
6.	Undercompensating economically displaced PAHs/PAPs	✓	✓	High	Medium
7.	Undercompensating physically displaced PAH/PAPs	✓	✓	High	Medium
8.	Increased gender marginalisation and vulnerability resulting from compensations to mostly male household heads	✓	✓	High	Medium
9.	Reduced community and Khoi San ecosystem services as a result of construction activities	✓	✓	High	Medium
10.	Cultural heritage disturbance due to disruption of access to graves and culturally significant sites	✓	✓	Medium	Low
11.	Discrimination or inadvertent exclusion of indigenous peoples (San)	✓	✓	Medium	Low
12.	Improved household incomes and livelihoods as a result of temporary employment opportunities	✓		Medium +	Medium +
13.	Increased gender marginalisation and vulnerability as a result of temporary employment opportunities	✓		Medium	Medium
14.	Increase in social pathologies as a result of migrant worker influx and increased spending power	✓		High	Medium
15.	Increase in the local economy as a result of increased income and spending by temporary workers/contractors	✓		Low +	Medium +
16.	Increased safety hazards and accidents to community members, Khoi San people and livestock during construction	✓		Medium	Medium
17.	Safety hazards and accidents to people and livestock during operations		✓	High	Medium
18.	Nuisance impacts due to air, water and noise pollution	✓		Medium	Medium

№	Impact	Construction phase	Operational phase	Significance ratings	
				Pre-mitigation	Post-mitigation
19.	Increased vulnerability of villagers due to harassment or tension between construction and security workers, and community members	✓		High	Medium
20.	Increased vulnerability of artisanal miners due to abuse by security, law enforcement and/or local police	✓	✓	High	Medium
21.	Improved safety resulting from removal of Unexploded Ordnances (UXOs)	*Pre-construction*	*Pre-construction*	Medium +	Medium +
22.	Safety risks to personnel and community members during UXO removal process	*Pre-construction*	*Pre-construction*	Medium	Low
23.	Improved access to electricity		✓	High +	High +
24.	Downstream economic development		✓	High +	High +

All impacts can be mitigated to such an extent that their impact levels are reduced to tolerable levels. Management and mitigation measures have been suggested as appropriate, and include those listed below. Special mitigation measures required for vulnerable groups are highlighted:

Land use and farming mitigations:

- Adapt project design to avoid impacts on farming or grazing land.
- Provide alternative land of equivalent or better quality if avoidance is not possible.
- Rehabilitate impacted farmland to pre-construction conditions or provide replacement land.
- Consult with local authorities to identify and avoid farmland before site establishment.
- Limit construction activities to demarcated areas, avoiding farming and grazing land.
- Immediately address construction impacts on farmland (soil compaction, spills, water contamination).

Stakeholder engagement and grievance mechanism:

- Implement the IFC PS1-compliant Stakeholder Engagement Plan (SEP) with a grievance mechanism.
- Engage stakeholders to ensure awareness of project components and land use.
- Ensure grievance mechanisms are accessible to all, including vulnerable groups.
- Use visuals and simple text in Umbundu, Nganguela, !Kung (if consultation with San is required) and Portuguese for communication.

Displacement and livelihood restoration:

- Compile and implement an IFC PS5-compliant Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP).
- Avoid physical and economic displacement; if unavoidable, limit and mitigate.
- Monitor valuation and compensation processes to ensure fairness and transparency.
- Provide education on financial literacy and sustainable farming practices with cash compensation.

Community and cultural considerations:

- Ensure replacement land is of the same or better capacity and distance as the affected land.
- Identify and protect medicinal plants and unmarked graves before site establishment.
- Develop a Chance Find Procedure for the discovery of graves.
- Ensure access to graves and natural resource areas is maintained or rerouted safely.

- Consult separately with San and other indigenous groups respecting their cultural needs and languages, if required.

Employment and local benefits:

- Provide employment opportunities for local, unskilled, and semi-skilled labour.
- Establish a mobile labour desk for fair job application opportunities.
- Implement a preferential recruitment policy for local employees.
- Include financial literacy and sexual health awareness in workplace inductions and toolbox talks.

Health, safety, and security:

- Implement and monitor a Community Health, Safety, and Security (CHSS) plan.
- Restrict vehicle movement to existing roads and enforce speed limits.
- Ensure security personnel are screened, trained, and follow a strict code of conduct.
- Publicise, implement, and evaluate the grievance mechanism for reporting community safety concerns.

Environmental and biodiversity mitigations:

- Limit vegetation clearing to the absolute minimum.
- Prevent and manage hydrocarbon spills as per the Environmental and Social Management Plan (ESMP).
- Establish conservation corridors and safe access routes to natural resource-use areas.
- Allow villagers to harvest natural resources before site clearing activities.

Finally, the need for ongoing stakeholder engagement using the SEP that was prepared as part of this project is outlined. This report should be read in conjunction with the Human Rights Impact Assessment, Land Acquisition and Resettlement Framework and the CHSS should be read in conjunction with this report. The implementation of the requisite plans will ensure that the negative environmental and social impacts of the project are reduced and that the benefit of the project is felt in the areas that will now, for the first time, receive reliable electricity.

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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

AAB	Agricultural and Aquaculture Businesses (INE, 2023) (INE, 2022)
ACADIR	*Associãcao de Conservacão do Ambiente e Desenvolvimento Integrado Rural* / Association for Environmental Conservation and Integrated Rural Development
AoI	Area of Influence
ASM	Artisanal and Small-scale Mining
CASI	*Centros de Acção Social Integrada* / Integrated Social Action Centres
CFM	*Caminho de Ferro de Moçâmedes* / Moçâmedes Railway
CHSS	Community Health, Safety and Security
CRC	Convention on the Rights of the Child
CRPD	Convention on the Rights of Persons with Disabilities
ECA	*Escolas de Campo de Agricultores* / Farmer Field Schools
EDA	*Estações de Desenvolvimento Agrícola* / Agricultural Development Stations
EHS	Environmental, Health and Safety
EKN	*Exportkreditnämnden* / Swedish Export Credit Agency
ENDE	*Empresa Nacional de Electricidade de Angola*
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GIIP	Good International Industry Practice
GRI	Global Reporting Initiative
H&S	Health and Safety
Ha	hectare
ICCPR	International Covenant on Civil and Political Rights
ICERD	International Convention on the Elimination of All Forms of Racial Discrimination
ICESCR	International Covenant on Economic, Social and Cultural Rights
IDA	*Instituto de Desenvolvimento Agrário* / Agrarian Development Institute
IFC	International Finance Corporation

ILO	International Labour Organization
INE	*Instituto Nacional de Estatísticas* / National Institute of Statistics
kV	kiloVolt
LARF	Land Acquisition and Resettlement Framework
LRP	Livelihood Restoration Plan
LV	Low Voltage
MASFAMU	*Ministério da Acção Social, Família e Promoção da Mulher* / Ministry of Social Protection, Family and Promotion of Women
MBAKITA	*Missão de Beneficência Agro-pecuária do Kubango, Inclusão, Tecnologia e Ambiente* / Mission of Agricultural and Livestock Beneficence of Kubango, Inclusion, Technology, and Environment
MINEA	*Ministério da Energia e Águas* / Ministry of Energy and Water
MINAMB	*Ministério do Ambiente* / Ministry of Environment
MINFIN	*Ministério das Finanças de Angola* / Ministry of Finance of Angola
MPI-M	Multidimensional Poverty Index by Municipality
MV	Medium Voltage
NDP	National Development Plan
NGO	Non-governmental Organisation
NPSA	*Política Nacional da Acção Social* / National Policy on Social Action
OCADEC	*Organizacao Crista de Apoio ao Desenvolvimento Comunitario* / Christian Organisation for Community Development Support
OECD	Organisation for Economic Co-operation and Development
OHL	Overhead Line
OHS	Occupational Health and Safety
PAC	Project Affected Community
PAH	Project Affected Household
PAP	Project Affected Party
PEDR	*Programa de Extensão de Desenvolvimento* / Rural Development Extension Programme

PIDLCP	*Programa Integrado de Desenvolvimento Local e Combate à Pobreza* / Local Development and Combating Poverty Programme
PIIM	*Programa Integrado de Intervenção Municipal* / Integrated Municipal Intervention Programme
PS	Performance Standard
RAPP	*Recenseamento Agropecuário e Pescas* / Agro-Livestock and Fisheries Census
RNT	Rede Nacional de Transporte de Electricidade
SDG	Sustainable Development Goals
SEIA	Socio-economic Impact Assessment
SEK	Svensk Exportkredit
SEP	Stakeholder Engagement Plan
SMME	Small, Medium and Micro-sized Enterprises
UN	United Nations
UNGP	UN Guiding Principles on Business and Human Rights
UNHCR	United Nations High Commission for Refugees

1 Introduction

SRK Consulting (South Africa) (Pty) Ltd (SRK) has been appointed by Pak Yatirim (Pak) to conduct an Environmental and Social Impact Assessment (ESIA) for the proposed Cassinga Power Supply Project (the Project). Geolab Engenharia & Serviços (Geolab) is SRK's in-country partner in Angola. The ESIA is to meet local legislative requirements as well as lender requirements. Therefore, the ESIA includes various specialist studies and plans to support the ESIA and to ensure that the Project meets relevant Good International Industry Practices (GIIP).

This report, the Socio-Economic Impact Assessment (SEIA), has been prepared as part of the ESIA for the project. It should be read in conjunction with the Human Rights Impact Assessment (HRIA), the Stakeholder Engagement Plan (SEP), the Land Acquisition Framework (LARF), and the Community Health, Safety and Security (CHSS) Plan prepared for the project.

1.1 Background

The Republic of Angola, through its Ministry of Energy and Water (*Ministério da Energia e Águas* – MINEA), is embarking on a significant enhancement of its electrical infrastructure through the Project which aims to boost electric power supply across various communities within the Province of Huíla. The Project is structured around establishing a new 220 kV Overhead Line (OHL) network, extending from Gove Hydro Plant to Cuvango which branches out to Chipindo and Jamba. This project includes the construction of new substations in the municipalities of Chipindo, Cuvango, and Jamba, each equipped with a capacity of 220/30 kV – 20 MVA to efficiently distribute the power generated to these municipalities which are located in the Huíla Province in south-west Angola. The Project further includes the construction of 30 kV medium voltage (MV) overhead lines for distribution, along with the necessary low voltage (LV) network to supply 1 000 connections in each of the three villages, including public lighting, within the communities of Chipindo, Cuvango, and Jamba.

The overarching goal is to create a robust and reliable electric power supply system that caters to the current demands and is scalable to accommodate future expansions, including the prospective OHL 220 kV interconnection to Cuchi/Menongue. An estimated power demand of 80 MW has been calculated for the Cassinga Project, with an additional 10 MW anticipated for local community demands. This project is critical in addressing the electricity needs of the region to foster economic growth, improve the quality of life of its residents, and to meet the growing energy demands of the region.

1.2 Location

The Project is located south of the centre of Angola, namely, in the Provinces of Huíla and Huambo (**Figure 1-1**). The OHL extends for about 170 km, crossing six municipalities (*Municípios*) which include Jamba, Cuvango, Dongo, Galangue, Chipindo and Kalima.

The OHL will start near the Gove Hydro Dam in the Huambo Province, but the main works will be carried out largely in the Huíla Province. From Gove, the 220 kV OHL will extend to Chipindo, then Cuvango, and finally Jamba where new 220/30 kV substations will be built in each of these municipalities' seats[1]. In addition, the infrastructure associated with the electrification of villages at Chipindo, Cuvango and Jamba will be constructed, such as the aforementioned MV and LV distribution

[1] The name of the main town, commune or seat of the municipality, is the same as the name of the administrative division of the municipality which is geographically larger and contains numerous villages or smaller communes. For instance, the *communes* of Jamba, Dongo, and Tchamutete (formerly, Cassinga) are located in the *municipality* of Jamba.

powerlines. The project will comprise two stages, namely Stage 1, a 135 km section between Gove, Chipindo and Cuvango, and Stage 2, a 35 km section between Cuvango and Jamba.

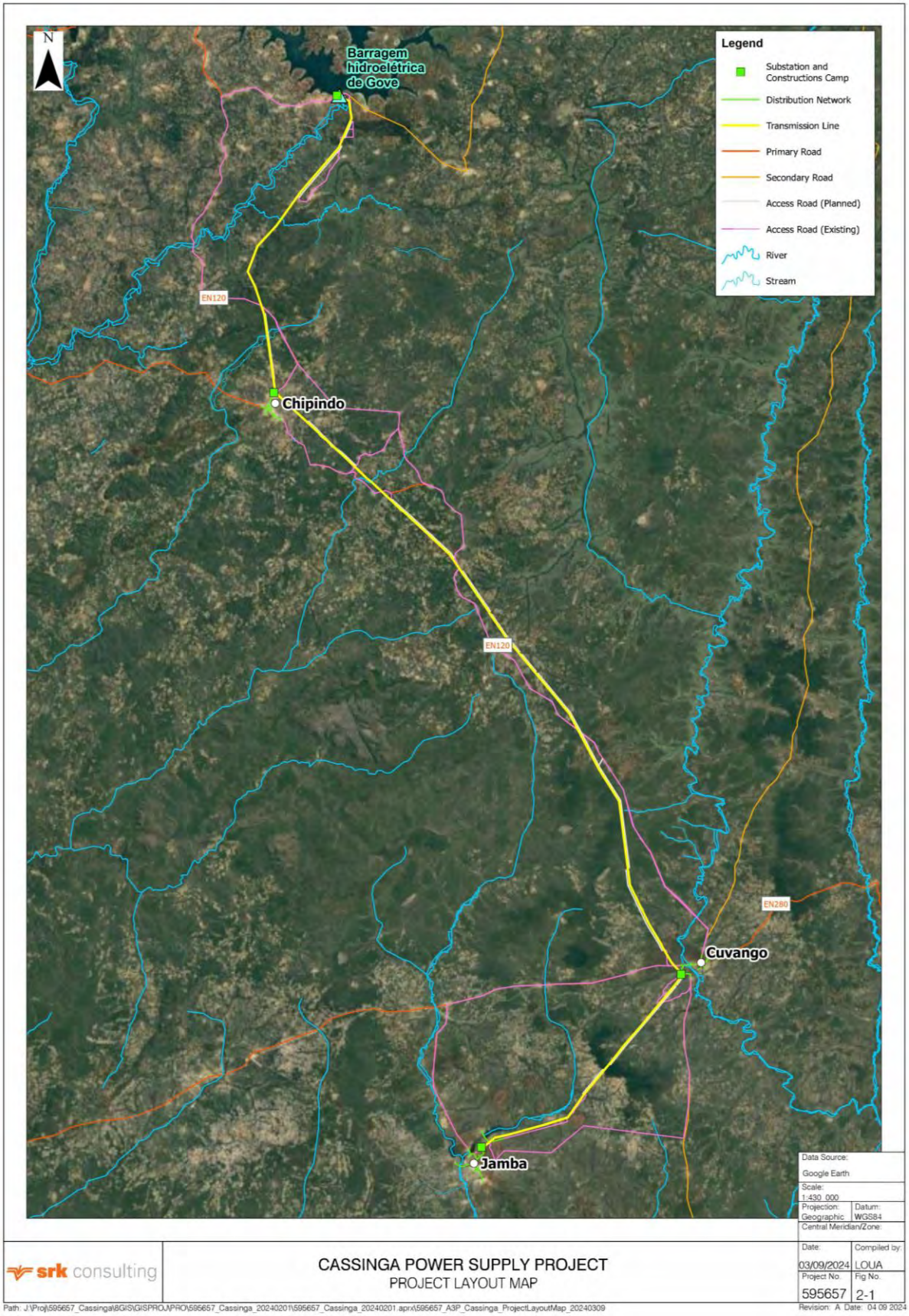


Figure 1-1: Location of the proposed 220 kV OHL, distribution network at the towns it will supply with electricity, existing and planned access roads, and construction camps.

2 Project description

2.1.1 Project infrastructure

In terms of regulatory compliance, the project aligns with the *ET-E-008-Ed. A Technical Specification for Metallic Structures for Lines and Substations*, adhering to international standards such as EN 50341-1, EUROCODE 3, and various others on steel quality, galvanising, and construction norms. This ensures the required levels of safety, reliability and efficiency in the project's execution and operation.

Transmission lines and towers

Transmission line conductors are strung on in-line suspension towers and bend (strain) towers. The structures proposed to be used for the majority of the 220 kV OHL are metallic-type (MT) Y towers, adequate to the angle of the OHL (**Figure 2-1**). These towers are approximately 50 m in height and a total footprint area of 80 m x 50 m is required for each tower. The average span between two towers is 400 m.

The cross-rope suspension tower is typically used along the straight section of the servitude, while the self-supporting angle towers and inline strain towers are used where there is a bend in the powerline alignment. Angle towers are cumbersome and more steel-intensive than suspension towers, making them more visually intrusive and expensive to construct. Therefore, transmission line routes are planned with as few bends as possible.

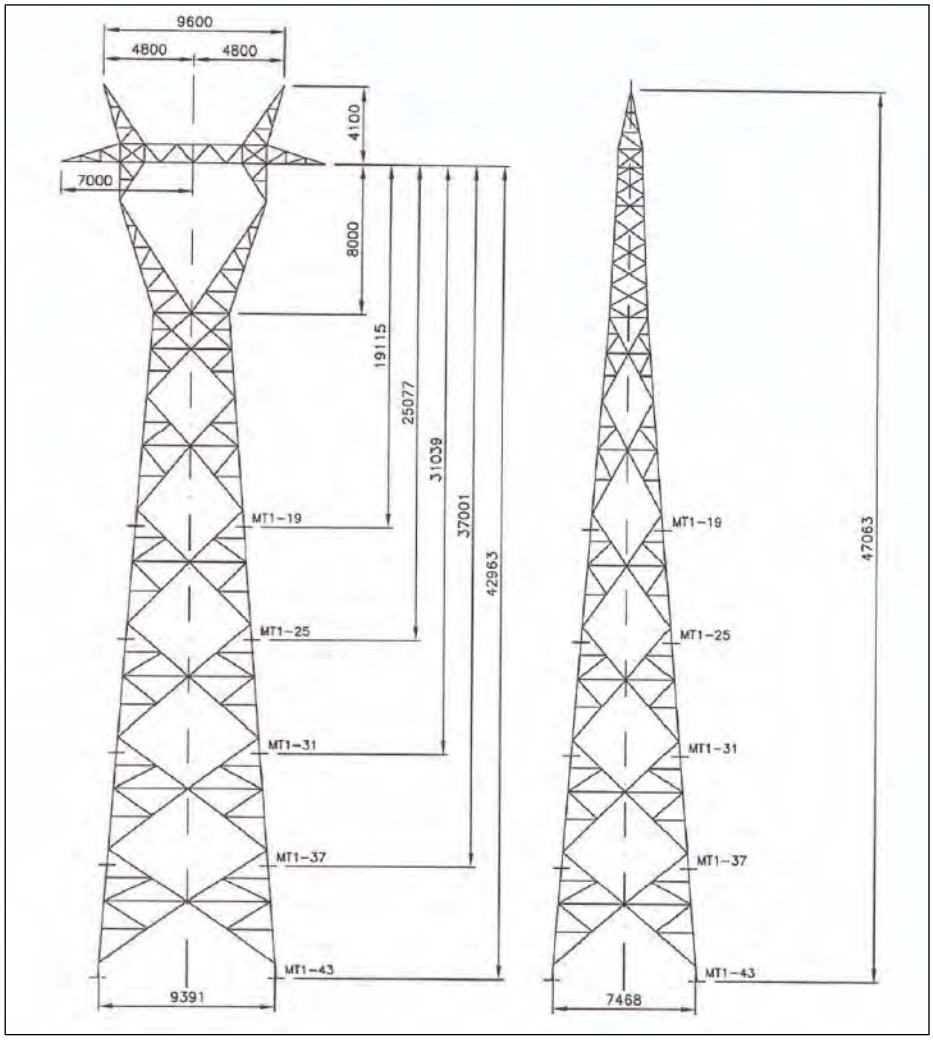


Figure 2-1: Example of an MT-type tower.

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. The design of the Chipindo, Cuvango and Jamba 220/30 kV substations will be in accordance with MINEA Technical Specifications and International Electrotechnical Commission standards. The construction of the new substations will be in accordance with the plan and single line schemes that will be presented at a later stage, based on relevant guideline schemes. At the 220 kV level, the single busbar configuration was implemented, and the width of each 220 kV Bay Line is 15 m. **Table 2-1** presents the requirements needed to implement the new substations at the proposed locations of Chipindo, Cuvango and Jamba. **Figure 2-2** presents the draft layout for the 220/30 kV – 20 MVA substation.

Table 2-1: Technical specifications for the substations

Component	Specifications	Quantity (each location)
Design and 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

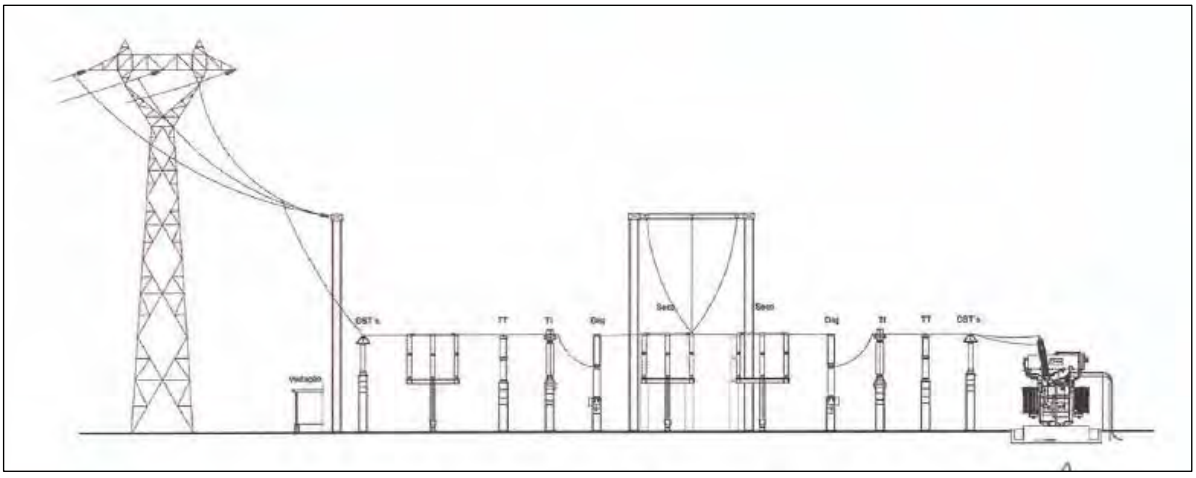


Figure 2-2: Draft layout for the 220/30 kV – 20 MVA substation.

OHL 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, with the requirements of the OHL infrastructure presented in **Table 2-2**.

Table 2-2: OHL design requirements

Component	Description	Quantity (for Gove - Chipindo - Cuvango)	Quantity (for Cuvango - Jamba)
Route Study and Survey	Topographic and geotechnical assessment	1 set	1 set
Project Design	Mechanical and electrical calculations and 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 and Access Roads	To facilitate construction and maintenance	135 km	35 km
Conductor Cable	"YEW" cable 479 mm^2	135 km	35 km
OPGW Cable	With 24 optical fibres	135 km	35 km
Commissioning and Final Tests	Ensuring operational reliability	1 set	1 set

*Additional information on the specific project components of the 135 km and the 35 km stages is provided in **Appendix A**.*

Electrification of community homes and public lighting

The electrification of Chipindo, Cuvango and Jamba requires several infrastructure components, which are detailed in **Table 2-3**. The installation of these components within each community will establish a medium and low-voltage network to supply grid electricity to approximately 1 000 homes in each community, including public lighting.

Table 2-3: Electrification component details

Component	Description	Specifications	Quantity (for each community)
MV Network 30 kV	To interconnect power transformation stations	Conductor ACSR 110 mm², various concrete poles	Approximately 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 mm², Luminaires 150 W - VS	As per design
Home Connections	To supply electricity to homes	Single-phase/three-phase home connections provided with LXS 2x16 mm cable and LXS 4x16 mm, including assembly and prepaid counting system or ready board installed in residence	Approximately 1 000 homes

Medium voltage 30 kV OHL

The project consists in the construction of a 30 kV network from the substations to be built at the 30 kV outlets, to the communes of Jamba and Cuvango. This infrastructure will be established along the existing access roads, based on concrete poles and comprise a cable ACSR 110 mm^2 conductor, single circuit and pennant conductors (**Table 2-4**). An example of a 30 kV OHL is shown in **Figure 2-3**.

Table 2-4: 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

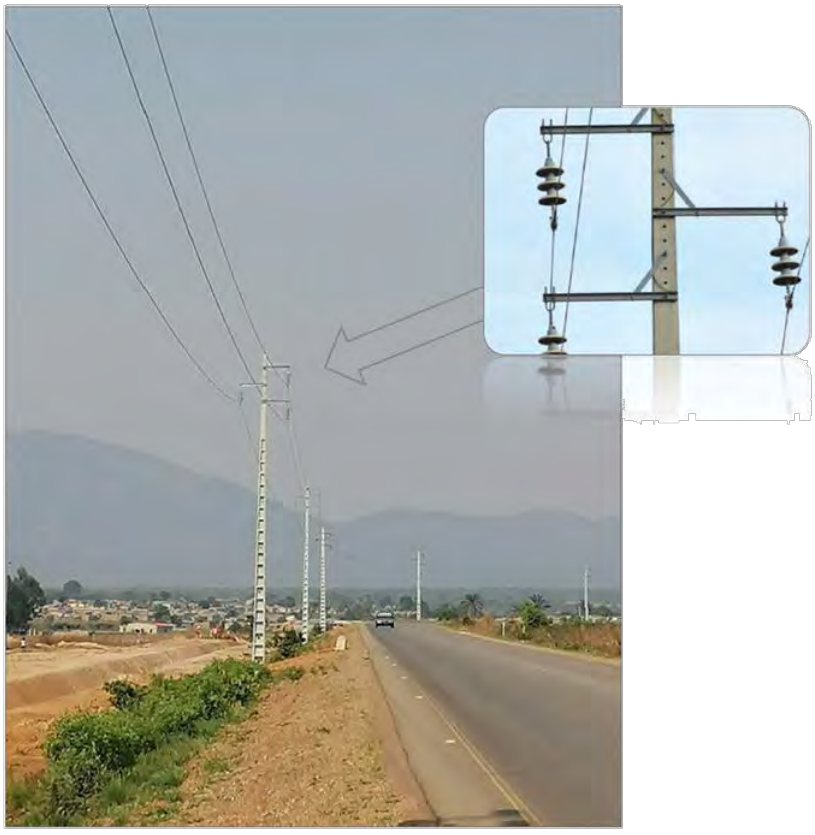


Figure 2-3: Example of a Medium Voltage 30 kV OHL and insulators in the insert

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 2-5** and a representative diagram is shown in **Figure 2-4**.

Table 2-5: 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

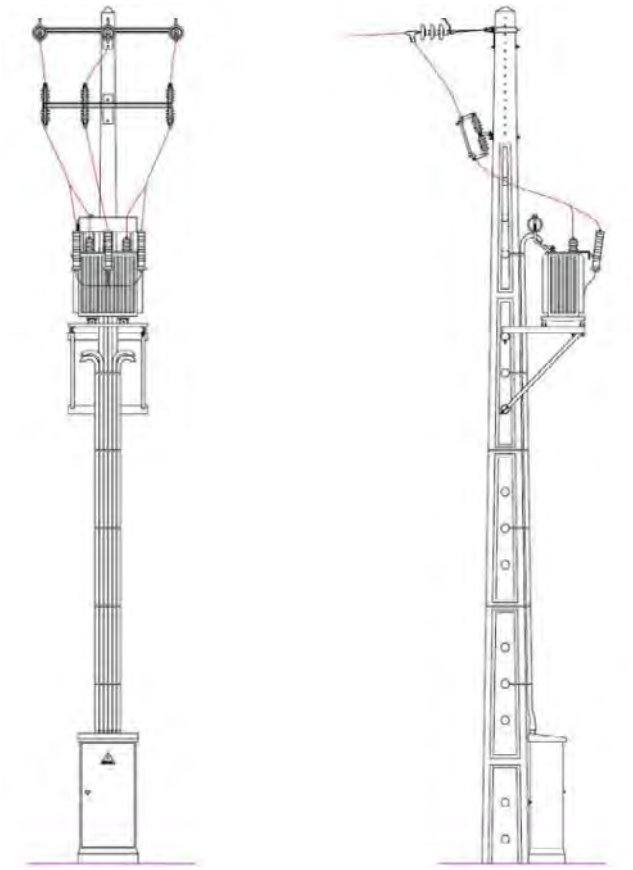


Figure 2-4: Example of a typical transformer station.

Electrification of Chipindo, Cuvango and Jamba

In order to electrify the town of Chipindo, Cuvango and Jamba from the new 220/30 kV substations, the following scope will be considered:

- **Chipindo:** 30 kV MV OHL network, with approximately 10 km to connect the new 220/30 kV substation to eleven (11) power transformation (PT) stations (**Figure 2-5**) for home connections and public lighting.
- **Cuvango:** 30 kV MV OHL network, with approximately 13 km to connect the new 220/30 kV substation to interconnect twelve (12) PT stations (**Figure 2-6**) for home connections and public lighting.
- **Jamba:** 30 kV MV OHL network, with approximately 17.5 km to connect the new 220/30 kV substation to interconnect twelve (12) PT stations (**Figure 2-7**) for home connections and public lighting.
- Construction of LV network to supply grid electricity to around 1 000 homes, including public lighting in each of Chipindo, Cuvango and Jamba.

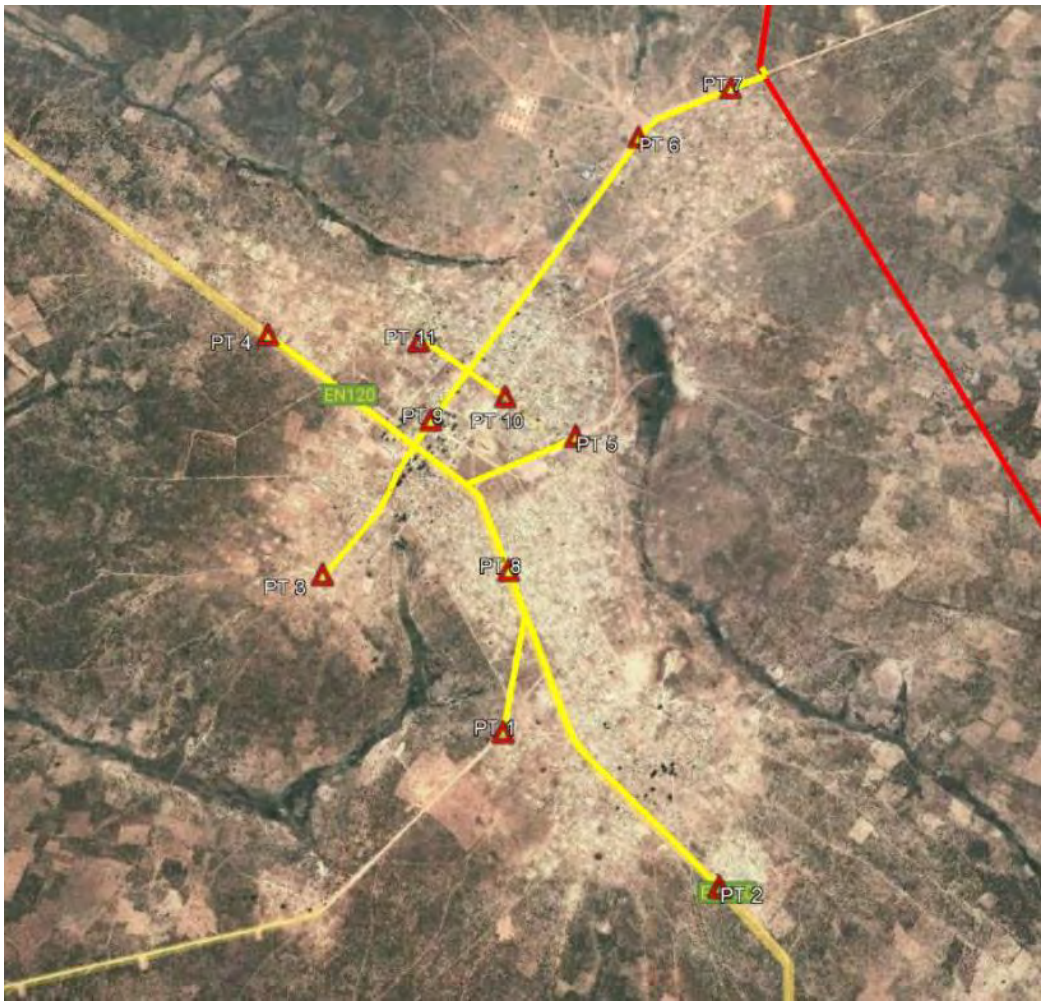


Figure 2-5: Proposed MV network and transformation station sites in Chipindo.



Figure 2-6: Proposed MV network and transformation station sites in Cuvango.

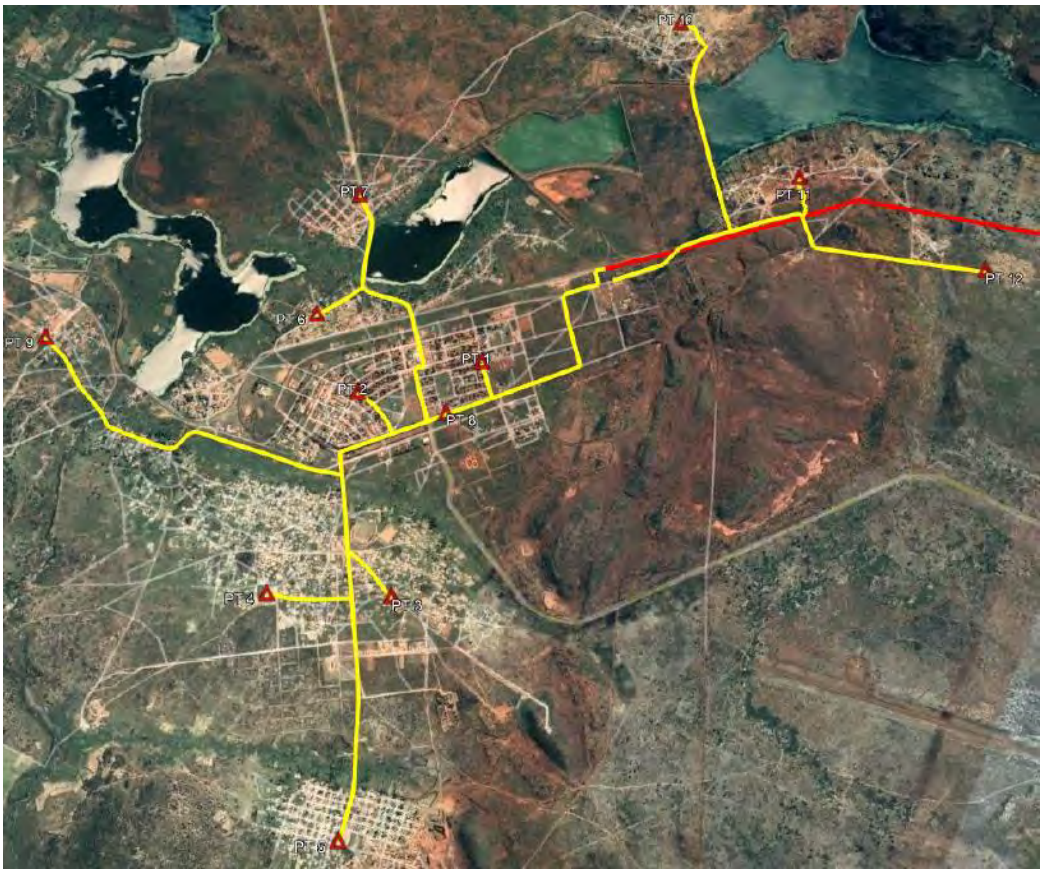


Figure 2-7: Proposed MV network and transformation station sites in Jamba.

2.1.2 Project design guidelines

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

National requirements

The 2004 Land Law specifies in Article 27 that there is a designated right of way, consisting of a 30 m strip on both sides of the transmission line, creating a total corridor width of 60 m. The recommendation from MINEA for projects of this nature is to keep houses and structures out of this 60 m corridor where possible. 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 2-6** below.

Table 2-6: National minimum clearance requirements

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

International guidelines

The International Finance Corporation's Environmental, Health and Safety (IFC 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 EHS Guidelines, projects are required to comply with the more stringent requirements. Should less strict standards be deemed appropriate due to unique project conditions, a comprehensive justification for any alternative approaches must be provided. The General EHS Guidelines offer insights into broad EHS issues that could be relevant to various projects.

Furthermore, sector-specific EHS Guidelines have been established to address the unique challenges of different industries. For this Project, the applicable sector-specific guidelines will be incorporated into the ESIA process. Of relevance to the Project and the ESIA are the *IFC EHS Guidelines for Electric Power Transmission and Distribution*. These Guidelines indicate that *"Rights-of-way 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 overhead distribution power lines up to 35 kV, 12 to 24 m corridors (6 to 12 m on each side) are recommended"*. It is therefore recommended that the total corridor width adopt the most stringent requirement, which is a total of 100 metres (i.e., 50 m strip on either side of the OHL).

2.1.3 Project phases

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. 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 the clearing of trees and shrubs for servitudes and substation platforms, the construction of access paths and the establishment of temporary construction camps and laydown areas for materials and equipment.

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, the installation of the towers and 220 kV OHL network stretching approximately 170 km, and the establishment of the MV 30 kV OHLs for electricity distribution. The LV network, public lighting and home connections within the communities of Chipindo, Cuvango, and Jamba will also be established.

Construction activities will involve earthmoving for substation platforms, setting up 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 adverse environmental and social impacts.

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 biodiversity management plan which forms part of the Environmental and Social Management Plan (ESMP).

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). Furthermore, strain structures require more extensive foundations for support than in-line suspension structures. 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 m x 40 m for compact cross-rope suspension towers.

Foundations will 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 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 generally 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.

Access roads and OHL servitude route

The Project will mainly follow existing roads, especially the Gove – Chipindo – Cuvango route as there is limited space for an access path between the existing roads and working sites. If clearing of access paths is required, it is anticipated that approximately 50 m will be required for every 2 km of OHL route. In order to reduce potential impacts associated with the construction of new access paths, existing roads will be used as far as possible where available and new access paths will be constructed by means of ‘two-tracks’ over the vegetation where possible to avoid permanent removal of the existing vegetation. Maintenance of some paths may be required for ongoing maintenance during operations and will be undertaken in accordance with the specifications of the ESMP. Other paths not required for ongoing maintenance will be rehabilitated concurrently.

Service roads for construction purposes will be sitting along 95% of the OHL route. The OHL route will have to be cleared of trees and shrubs to allow construction teams access. The OHL servitude will be maintained for the Project. Service roads will also be constructed by means of ‘two-tracks’ over the vegetation where possible to avoid permanent removal of the existing vegetation.

Temporary laydown and assembly areas

An area of approximately 5 000 m^2 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 approximately at 400 m intervals and need to be cleared of vegetation. The exact siting of the temporary laydown and assembly areas must take cognisance of any no-go and sensitive areas identified through the ESIA process. All temporary laydown and assembly areas will be rehabilitated concurrently after use.

Construction camps

This construction of the powerline will require the establishment of construction camps at appropriate locations along the route. Construction camps will be sited at the Contractor's discretion according to their construction schedule and needs. It is estimated that a campsite will be built approximately every 80 km and will be required to house up to 100 people. The exact siting of the construction camps may require negotiation with the relevant landowners, and must take cognisance of any no-go and sensitive areas identified through the ESIA process. Once construction activities have been concluded, the construction camp will be closed off and the area rehabilitated concurrently.

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 (three years), provided construction proceeds as scheduled. It is proposed that the Contractor will commence construction in the first quarter of 2025.

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 the power supply.

During the lifespan of the OHL, ongoing maintenance will be performed with line inspections undertaken on an average of one to two 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.

The operation phase will also focus on maintaining high safety standards to protect both the workforce and the local communities, alongside continuous environmental monitoring to ensure compliance with national regulations and international standards and guidelines. 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.

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.

2.1.4 Project alternatives

Consideration of alternatives[2] is one of the most critical elements of the ESIA process. Its role is to provide a framework for sound decision-making based on the principles of sustainable development. The range of categories of alternatives should always be considered along with the “no go” alternative.

Location alternatives

The initial OHL route alignment and substation locations were proposed by RNT (Rede Nacional de Transporte de Electricidade), informed by high-level environmental and socio-economic screening through a desktop analysis and field survey. These investigations aimed to avoid sensitive environmental and social features and to prioritise the selection of sites that were previously disturbed, such as the substation at Jamba which was formerly a thermal power station. It is not anticipated that the Project infrastructure (i.e., OHL, substations and community electrification networks) will change substantially. However minor adjustments to the final route alignment will be informed by the findings of the ESIA and associated specialist studies.



Figure 2-8: Views of the former power station at Jamba, showing substantial disturbance of the site’s footprint. These pictures were taken during a reconnaissance site visit in February 2024, as walks along the road adjacent to the site.

No-go alternative

Currently, the Huíla Province has little access to the national electricity grid particularly for the municipalities of Chipindo, Cuvango and Jamba. A no-go alternative would result in ongoing challenges relating to power supply and distribution. Currently, blackouts are common in the region

[2] The different categories of alternatives that can be identified may include activity alternatives, location alternatives, process alternatives, demand alternatives, scheduling alternatives, input alternatives, routing alternatives, site layout alternatives, scale alternatives and design alternatives.

with little possibility for socio-economic development. The expansion of industry and mining in the region relies on reliable electricity supply.

2.1.5 Project resource needs

Workforce requirements

Employment opportunities will vary across the different phases of the Project. The construction phase will offer numerous temporary positions through contractors and sub-contractors, while the operational phase will require a stable workforce. Labour will be sourced from Angola (59%) and from third-party sources (41%), which are yet to be determined. **Table 2-7** details the potential staffing requirements for the construction and operational phases of the Project.

Table 2-7: Potential employment opportunities

Employee type	Description
Construction	
Civil engineers	Professionals who design the powerline path, oversee construction activities, and ensure structures meet specifications and safety standards.
Electrical engineers	Specialists in designing the electrical aspects of the powerline, ensuring efficient power transmission and compliance with technical standards.
Environmental consultants	Experts assessing and mitigating environmental impacts of construction activities, ensuring compliance with environmental regulations.
Construction workers	Skilled labourers involved in the physical construction of the powerline, including excavation, tower erection, and cable installation.
Health and Safety Officers	Individuals responsible for implementing safety protocols, conducting safety training, and ensuring a safe working environment for all personnel.
Logistics coordinators	Coordinators responsible for the procurement, delivery, and management of materials and equipment necessary for construction activities.
Project managers	Oversee the entire construction process, ensuring projects are completed on time, within budget, and to specified quality standards.
Surveyors	Conduct land surveys to establish exact geographical positions for construction, ensuring the powerline follows the planned route accurately.
Operation	
Electrical technicians	Technicians responsible for the maintenance and repair of the powerline, ensuring optimal performance and addressing any issues that arise.
System operators	Operators who monitor and control the flow of electricity through the powerline, ensuring reliable power supply and coordinating maintenance and emergency responses.
Environmental monitoring staff	Staff dedicated to ongoing monitoring of the powerline's impact on the environment, ensuring compliance with environmental regulations and mitigating any adverse effects.
Security personnel	Security staff responsible for the physical security of substations and powerline infrastructure, preventing unauthorised access and vandalism.
Customer service representatives	Representatives handling inquiries and complaints from the public and stakeholders, providing information about powerline operations and addressing concerns.
Network engineers	Engineers focused on the integration of the powerline with the existing grid, optimising power distribution and planning for future network expansions.

Employee type	Description
Maintenance managers	Managers overseeing the scheduling, execution, and documentation of maintenance activities to ensure the long-term reliability of the powerline.

Water consumption

Water is essential not only for the construction phase but also for operational maintenance and environmental management. Currently, it has not yet been established how much water will be required or where it will be sourced from. **Table 2-8** presents possible uses of supplied water for the construction and operational phases of the Project.

Table 2-8: Anticipated water requirements

Phase	Purpose	Anticipated water requirements
Construction	Dust suppression	Regular application on exposed soils and roads to minimise dust emissions.
	Concrete mixing	Water for mixing concrete for foundations and structural components.
	Compaction	Water for soil compaction at foundation sites and road construction.
	Sanitation	Water for sanitation facilities for construction workforce and in camps.
	Vegetation management	Water for the establishment and maintenance of vegetation for erosion control and landscape restoration.
Operation	Cooling systems (if applicable)	Continuous water supply for any water-based cooling systems for substation equipment.
	Maintenance cleaning	Water for routine cleaning of equipment and infrastructure to maintain safety and efficiency.
	Vegetation management	Water for maintaining landscaped areas around substations and OHL routes to control dust and preserve barrier vegetation.

Energy consumption

During the construction and operational phases of the Project, energy consumption will differ between phases and will need to be sourced. This electricity will be supplied either through diesel generators or, where possible, direct connections to the local grid. **Table 2-9** presents an overview of the anticipated uses of electricity.

Table 2-9: Anticipated energy uses

Phase	Component	Description
Construction	Heavy machinery operation	Relies predominantly on diesel fuel for the operation of earthmoving equipment, cranes, and transportation vehicles.
	Temporary power solutions	Electricity needed for lighting, operating tools, and providing accommodation at construction camps, supplied through diesel generators or local grid connections where possible.
Operation	Power supply demand	Total estimated demand of 90 MW, with 80 MW for the project's core objectives and an additional 10 MW for local communities, covering residential, commercial, and industrial needs.

Phase	Component	Description
	Maintenance and operations	Energy consumed by maintenance vehicles, diagnostic equipment, and operational centres, emphasising the need for efficient energy management throughout the project's lifecycle.

2.1.6 Supply chain

Building materials and equipment needs

The Project will require a wide range of building materials and equipment. These materials and equipment will be sourced for various components of the Project, including the construction of substations, the erection of OHL infrastructure, and the electrification of communities. **Table 2-10** provides an overview of building materials and equipment that will be sourced.

Table 2-10: Materials and equipment required

Project component	Material/equipment
Construction materials	
Substation construction	• Concrete: For foundations, structural components, and grounding. • Gravel: For use in flooring, drainage, and as part of the grounding system. • Structural steel: For support structures, framework, and equipment mounts.
OHL infrastructure	• Aluminium conductors: Aluminium or aluminium-alloy conductors, possibly reinforced with steel, for the main OHL cables. • Steel for towers and poles: Galvanised steel for the construction of transmission towers and support poles. • Concrete: For the foundations of towers and poles.
Electrification of communities	• Copper or aluminium cables: For MV and LV distribution networks. • Distribution transformers: Incorporating steel, copper, and insulating materials. • Pre-paid consumer meter box: Single-phase prepayment counters. • Public lighting materials: Including poles (steel or aluminium), fixtures, and lamps.
General construction needs	• Insulation materials: For electrical insulation and safety. • Galvanised steel: For guard wires, including Optical Ground Wire (OPGW) cables. • Ceramic or composite insulators: For isolating electrical conductors from physical structures in substations and along the OHL.
Equipment requirements	
Construction equipment	• Earthmoving equipment: Bulldozers, excavators, and graders for site preparation and excavation. • Cranes: Mobile cranes for lifting and placing heavy items such as transformers, poles, and tower components. • Wire pulling equipment: Wire pulling machine, brake machine, rope for conductor pulling, wire cutting machine, rope for conductor pulling. • Concrete mixers and pumps: For preparing and transporting concrete to foundations and structural components. • Welding machines: For assembling and repairing steel structures and components. • Drilling rigs: For creating foundations, especially for towers and poles.

Project component	Material/equipment
	• Compaction equipment: Vibratory rollers and plate compactors for soil compaction. • Transport vehicles: Trucks for delivering materials, equipment, and personnel to site locations. • Utility vehicles: For on-site transportation and miscellaneous tasks. • Generators: Portable generators for power supply during construction before the grid connection is established.
Operation equipment	• Diagnostic and testing equipment: For initial and ongoing testing of electrical components and systems. • Maintenance tools: A range of hand and power tools for routine and corrective maintenance tasks. • Safety equipment: For ensuring the safety of personnel during maintenance and operation, including personal protective equipment (PPE), insulating gloves, and grounding equipment. • Substation control systems: Including SCADA (Supervisory Control and Data Acquisition) systems for monitoring and controlling substation operations, CCTV, HVAC equipment, intrusion system, switchyard power socket box. • Emergency response equipment: Fire extinguishers, spill kits, and first aid supplies for handling potential emergencies at substations and along the OHL, fire detection. • Diesel generator: 150 KVA and 60 KVA. • Outdoor lightning.
Specialised electrical equipment	• Line protection and transformer protection bays for monitoring and protecting the network and transformers from faults: Surge arrester, circuit breaker, voltage transformer, current transformer, earth transformer, switch gear. • Power transformers: For voltage transformation at substations. • Earthing transformers: To provide a neutral point for earthing and enhance safety. • MV board SF6 insulated switchgear: For MV switching and protection. • Auxiliary power transformers: To supply power for auxiliary systems within substations. • Cables.

Sourcing of materials and labour

Before the commencement of construction, Project representatives will engage with local administrations to secure agreements for the management of raw water resources. These resources will be supplied to the project site via tanker trucks, ensuring a consistent supply independent of regional characteristics or project specifics. For drinking water, the project will provide its workforce with bottled water during working hours, avoiding any extraction from pits or natural deposits to preserve local water resources.

The procurement of essential materials for the Project, such as transmission towers, conductor cables, iron fittings, and other specialised components, will be managed internationally. These materials will be transported from their origin points to Angola, arriving at the Port of Luanda, from where they will be trucked to the project sites across the Huíla and Huambo Provinces. Conversely, materials required for civil works, including cement and aggregates, will be sourced locally to support the regional economy and reduce transportation-related carbon emissions.

Installation tasks on-site will be undertaken directly by the employed workforce, ensuring quality and adherence to project standards without the need for subcontractors. This encompasses a wide range of activities from vegetation clearing and the laying of foundations to the intricate mechanical and electrical installations necessary for the project's success. Local labour will be prioritised as far as possible, and the project will employ local subcontractors depending on the skill level of the local workforce required for project technical requirements. Local subcontractors will be employed for all non-technical field roles, specifically catering and security services to support operational needs.

Transportation and logistics

The transportation and logistics strategy for the Project emphasises efficiency, safety, environmental considerations, and support for the local economy. **Table 2-11** provides a high-level overview of the transportation and logistical considerations for the Project.

Table 2-11: Transportation and logistical considerations

Component	Description
Material transportation	International components (transmission towers, conductor cables, iron fittings) shipped to Port of Luanda, then trucked to project sites. Local materials (cement, aggregates) transported directly from local suppliers to sites, supporting local economy and reducing long-haul transport emissions.
Personnel movement	Organised transportation for personnel from local accommodation centres to project sites, using buses or suitable vehicles, to ensure safety and reduce environmental impact.
Logistics management	A dedicated team coordinates procurement, shipment tracking, and delivery, employing advanced systems for real-time monitoring and communication to address logistical challenges and align with the project timeline.

2.1.7 Project wastes and emissions

Waste generation and disposal

The Project will generate various types of waste during its construction, operation, and decommissioning phases. The management of this waste is crucial to minimising environmental impacts and comply with both national and international environmental standards. **Table 2-12** outlines the types of waste that the Project is expected to generate.

Table 2-12: Anticipated wastes generated during the project

Phase	Type of waste	Waste description	Management strategies
Construction	Construction and demolition waste	Includes concrete rubble, metal scraps, timber, packaging materials, and excess construction materials.	Recycle or reuse materials on site. Metal scraps sent to local recycling facilities. Soil and rubble used for landscaping or backfilling.
	Hazardous waste	Includes oils, lubricants, and paints from machinery and equipment, as well as batteries and electronic waste.	Collected separately and disposed of or treated at licensed facilities to prevent environmental contamination.
	Domestic waste	Generated from temporary construction camps, including food waste,	Minimise through reduction and recycling initiatives, with remainder disposed of at licensed municipal waste facilities.

Phase	Type of waste	Waste description	Management strategies
		packaging, and other general refuse.	
Operation	Maintenance waste	Includes used oils, filters, and worn-out parts from machinery and vehicles.	Managed according to strict disposal protocols to prevent environmental contamination.
	Domestic waste	Arising from operational staff and possibly from the maintenance of permanent facilities.	Managed through reduction, reuse, and recycling strategies, with residual waste disposed of at approved municipal sites.
Decommissioning	Construction and demolition waste	Similar waste types as in the construction phase, due to the dismantling of infrastructure.	Focus on recycling and repurposing materials wherever possible. Metal components of structures recycled, concrete and other inert materials used in land rehabilitation or projects.

Wastewater generation

The generation and management of wastewater during both the construction and operational phases of the Project require thorough planning and implementation of best practices to ensure compliance with environmental standards and sustainability objectives. **Table 2-13** provides an overview of anticipated wastewater generation sources and proposed strategies to mitigate these.

Table 2-13: Anticipated wastewater sources and mitigation strategies.

Phase	Source of wastewater	Anticipated wastewater type	Mitigation strategies
Construction	Construction camps	Domestic wastewater from kitchens, sanitation, and laundry	• Installation of temporary treatment facilities. • Proper disposal and treatment of domestic wastewater.
	Equipment and vehicle maintenance	Wastewater with grease, oil, and other contaminants	• Use of oil/water separators. • Proper disposal of contaminated wastewater.
	Concrete mixing and construction processes	Wastewater with suspended solids and materials	• Sediment control measures. • Reuse of water where possible. • Proper management and disposal.
Operation	Substation maintenance	General cleaning and maintenance wastewater	• Collection and treatment systems for wastewater. • Recycling of water for maintenance processes where feasible.
	Cooling systems for electrical equipment	Cooling water discharge	• Design cooling systems to minimise water usage. • Incorporate water recycling systems. • Treatment of discharge water to meet environmental standards.

Air emissions

Air emissions associated with the Project will also 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 2-14** provides an overview of the anticipated air emissions during the different phases of the Projects as well as possible mitigation strategies.

Table 2-14: Anticipated air emissions and mitigation strategies

Phase	Source of Air Emissions	Emissions Description	Mitigation Strategies
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.	Use water sprays to settle dust, cover stockpiles, and implement silt fences.
	Exhaust emissions from vehicles and equipment	Operation of construction machinery, vehicles, and generators produces exhaust gases, including carbon monoxide (CO), nitrogen oxides (NOx), sulphur dioxide (SO_2), and volatile organic compounds (VOCs).	Use low-emission vehicles and machinery, schedule regular maintenance to reduce emissions.
	Construction materials	Certain materials used in construction emit VOCs during handling and application, such as paints, solvents, and adhesives.	Use low-VOC products and ensure proper ventilation during application.
Operation	Substation equipment	Electrical equipment, such as transformers and switchgear, can emit small quantities of Sulphur Hexafluoride (SF6) gas due to leakage. SF6 has a high global warming potential, despite being low in volume.	Regularly inspect and maintain equipment to prevent leaks, use alternatives to SF6 where feasible.
	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.	Implement preventive maintenance schedules for vehicles and generators, use electric or hybrid models.

Noise

Noise emissions associated with the Project are anticipated during both the construction and operation phases. The levels and impact of these emissions will vary depending on the specific activities and the proximity of work sites to local communities. **Table 2-15** outlines the anticipated noise sources

during the Project. Baseline noise measurements and mitigation measures to reduce noise levels will be recommended in the ESIA.

Table 2-15: 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.
	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.

2.1.8 Physical and economic displacement

The OHL route alignment (medium and high voltage) and substation locations was informed by a high-level environmental and socio-economic screening through desktop analysis and field surveys to avoid sensitive environmental and social features, including physical displacement. Initial field investigations during the reconnaissance site visit undertaken in February 2024, indicated that there is little need for physical resettlement in the areas to be affected by the Project. Taking into account the low population density that resides in the Project's direct Area of Influence (AoI), physical displacement is expected to be almost completely avoidable by adjusting the route of the OHL, should it be required. As part of the ESIA and detailed engineering design works, Pak will continue to optimise the pathway for the OHL with the goal of avoiding physical resettlement, through:

- An analysis of existing structures in the Project's direct AoI using field surveys, Geographic Information Systems (GIS) tools and a cartographic survey (orthophoto maps), to detail any Project adjustments to minimise resettlement.
- Stakeholder engagement with municipalities, community leaders and rural families along the pathway of the transmission line.

Regarding economic displacement, i.e., loss of income sources or means of livelihood, the following needs are anticipated:

- Temporary loss of crops associated mainly with the OHL corridor and temporary working areas of the tower sites.
- Permanent loss of seasonal crops and fruit trees associated mainly with the permanent tower footprints.
- Total deforestation caused by the construction of the project, including the deforestation within the OHL corridor and the deforestation within the temporary working areas of the tower sites.

Based on a reconnaissance survey conducted in February/March 2024, it appears that a number of pylons may be placed inside maize fields, which will result in economic displacement. Consideration must also be given to the fact that some crops, such as cassava, can take approximately one year to

be ready for harvest. Although these plants may not be fully mature, farmers will need to be compensated for their loss.

3 Methodology

3.1 Objectives

The aim of an SEIA is generally to develop an understanding of the current socio-economic environment, assess the potential impact of the project on the socio-economic environment, and propose mitigation measures for negative impacts and enhancement measures for positive impacts.

The key objectives of this SEIA are to:

- Show the connection between **legislation**, **standards** or **policies** and the socio-economic impacts of the project;
- **Define** the AoI of the project;
- **Describe** the current socio-economic conditions of the AoI and the region so that there is a baseline against which impacts can be identified and measured;
- **Identify**, **describe** and **rate** the positive, negative, direct, indirect, and cumulative socio-economic impacts that the proposed development could have during project phases; and
- Propose measures to **mitigate** negative impacts, **enhance** positive impacts/benefits, and **monitor** their implementation.

3.2 Approach

The SEIA was conducted by undertaking desktop research of publicly available literature, statistics, reports and other information. Primary data was collected by surveying a sample of households in the project AoI, and through key informant (KII) interviews with a sample of key stakeholders.

3.2.1 Desktop studies and literature review

Secondary data sources were reviewed to secure information on the demographics, employment sectors and economy of the area in general. Data was obtained from theNational Institute of Statistics / *Instituto Nacional de Estatística* (INE), governments of the Huíla Province and municipalities of the Project Affected Communities (PACs), and Non-Governmental Organisations (NGOs).

3.2.2 Site reconnaissance visit

A site reconnaissance visit was undertaken between 26 and 29 February 2024 by two SRK and two Geolab consultants, who were accompanied by one representative of Pak and two from RNT. The objectives of the site visit were to:

- Undertake consultations with the local municipal authorities of Jamba, Cuvango and Chipindo, as well as PRODEL-EP (the state electricity generation agency, *Empresa Pública de Produção de Electricidade*) representatives at Gove Dam, to present the project, inform them of the imminent ESIA process, household surveys and specialist fieldwork, as shown in **Figure 3-1**. Representatives of the national police and local companies were also present in the municipal authority meetings. During these meetings the project was presented and background information documents (BIDs) in Portuguese were provided to participants. 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.
- Identify the main environmental and socio-economic aspects to be considered in specialised studies.
- Identify the issues that will influence logistical planning and the mobilisation of specialists for fieldwork.
- Receive initial comments on the project and obtain key information, such as the whereabouts of indigenous peoples.



Figure 3-1: SRK, Geolab, RNT and Pak team at meetings with (clockwise from top-right) Jamba, Cuvango, and Chipindo municipal administrations, and PRODEL.

3.2.3 Primary data collection

Geolab collected primary data between 18 and 21 March 2024. 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 KIIs. Data collected during the site visit focused on:

- New data on the socio-economic living conditions of the affected villages within the ZoI.
- Ground-truthing existing data and determining the quality and coverage of this data.
- Undertaking site observations in areas where there is a need to have a deeper understanding of current baseline conditions.

The following activities were conducted to collect primary data (Geolab, 2024):

- Formal meetings with the municipal and communal administration and traditional leaders (*sobas* or *regedores*). During these meetings the project was presented and background information documents (BIDs) in Portuguese were provided to participants.
- Villages or towns to be surveyed or visited were selected using a map of the proposed powerline overlayed onto the known locations of villages. The sizes of the villages and their accessibility were also considered:
- Interviews of *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, as shown in **Figure 3-2**. The aim was to survey at least four households per village, based on the location of the communities, accessibility and time available. Paper questionnaires were undertaken. The following themes were covered in the questionnaires:
  - Demographics
  - Water, sanitation and energy
  - Land tenure and use
  - Nutrition

  - Health
  - Access to public services
  - Cultural heritage sites
  - Gravesites
- 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.
- The engagements not only aimed to gather basic socio-economic information, but it also provided an opportunity to build trust and establish relationships with the communities, which should continue throughout the life of the project.

Table 3-1 below 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.

Table 3-1: Number and dates of surveys undertaken in Jamba, Cuvango and Chipinido

Municipality	Community	No. of household surveys	No. of soba 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	
	Ngokue	4	1	
	Cavinga*	2	1	
Chipindo	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.*



Figure 3-2: Household survey being carried out in Cacola (top-left) and Lucunga A (top-right) villages, Jamba; Km 50 (2nd row, left) and Tchicunho (2nd row, right), Ngokue (3rd row, left) villages, Cuvango; and Oko village, Chipindo (3rd row, right and bottom (Geolab, 2024).

3.3 Impact assessment methodology

"Social change processes" are differentiated from "social impacts" as described in the sub-sections below.

3.3.1 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, et al., 2001). Social change processes are dynamic, interactive, and non-linear (Rossouw & 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
- **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 3-3**. These themes have been used as a guide in developing and contextualising the social change processes (and impacts) in **Section 6**.

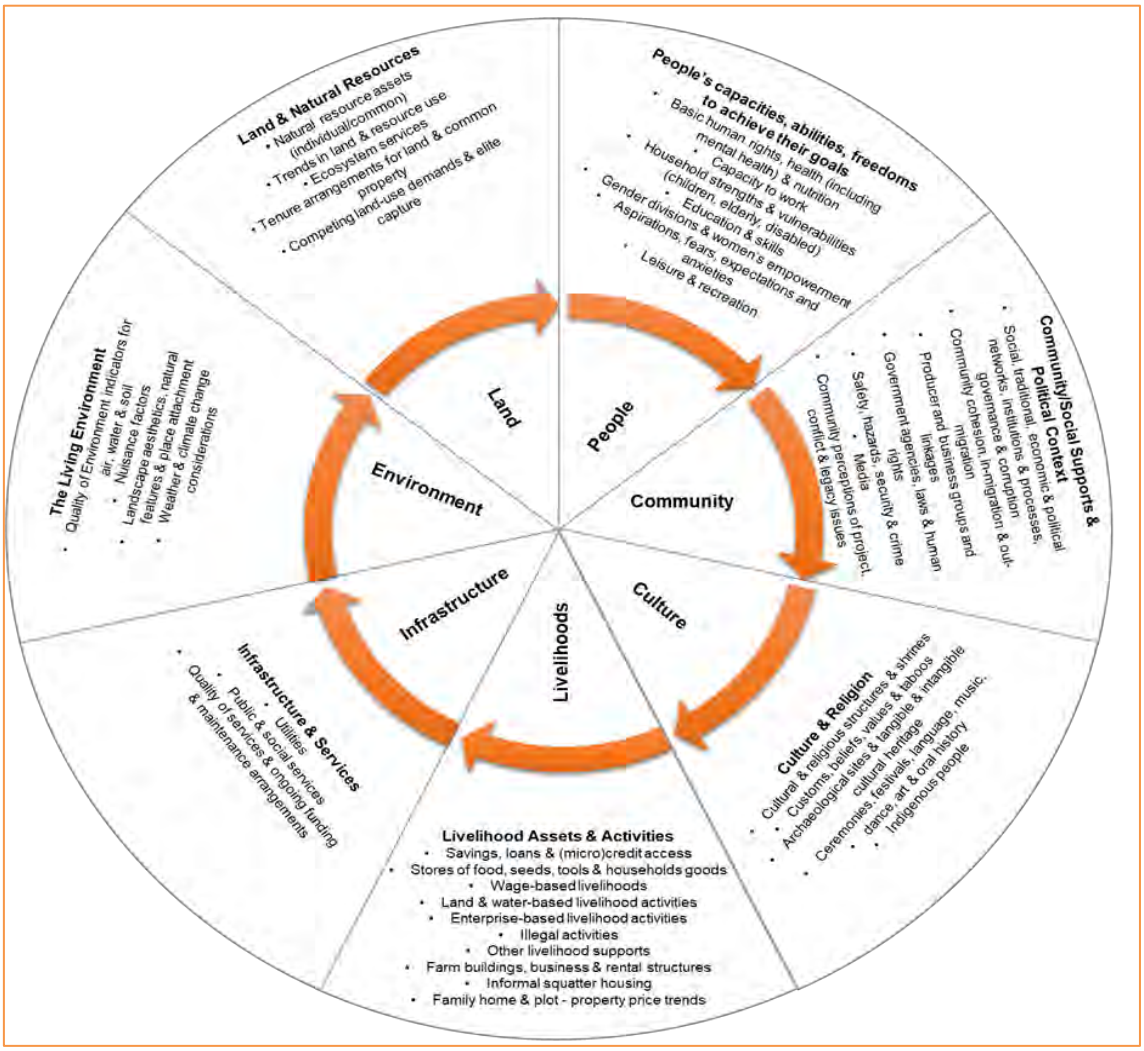


Figure 3-3: Social change processes (Smyth & Vanclay, 2017)

3.3.2 Social 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, et al., 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 in this report.

3.3.3 Impact significance rating

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 3-2 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 3-2: 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

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**
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
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 negative impact and "+" 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 not in place.

Management recommendations and post-management significance

Practicable **management measures** are 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 is then re-assessed **with** assumed management measures in place ("**after management**"). Appropriate **monitoring** and review programs are also recommended and described to track the efficacy of management measures.

Social impacts occur within the context of human behaviour, cultures, traditions, perceptions, histories, economic situations, and political and religious beliefs. Therefore, the mitigation measures recommended often repeat or overlap. Social impacts also result from the cumulative effect of the context in which they occur, and this is addressed in **Section 0**.

3.4 Assumptions, limitations and exclusions

The following assumptions, limitations exclusions apply to the 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).
- Since villages were challenging to access due to poor road conditions and the time to conduct the household surveys was limited to four days, a limited number of household questionnaires was completed.

4 Applicable legal framework and standards

This section presents the legal and governance framework applicable to socio-economic matters in Angola, the study area and the project.

4.1 Legislation, lender requirements and corporate standards

Table 4-1 in this section provides a high-level overview of constitutional rights, key legislation and policies related to the intersection between socio-economic impact assessment and the energy sector in Angola. The key international conventions and treaties applicable to Angola are briefly described as well.

In **Section 4.2**, lender requirements are described. Finally, **Section 4.3** outlines the corporate policies and standards of Pak Yatirim.

Table 4-1: Legislation and guidelines considered in assessing the socio-economic impacts of the proposed project

Legislation and guidelines	Description	Application to project
Constitution of Angola (Republic of Angola, 2010) / *Constituicao da Republica de Angola*	The Constitution of Angola 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 organisation of the government and the rule of law in Angola. Chapter II of the Constitution provides for individual and collective fundamental rights, freedoms and guarantees. The principles of the Articles summarised below are considered in the socio-economic impact assessment of the proposed project: • **30 Right to life:** Human life is inviolable. • **31 Right to personal integrity:** The moral, intellectual and physical integrity of individuals is inviolable, and respect and the human person and human dignity are protected. • **32 Right to identity and privacy:** Everyone's right to personal identity, civil capacity, nationality, a good name and reputation, likeness, free speech, and privacy in personal and family life are recognised. • **33 Inviolability of the home:** The home is inviolable or sacred. • **35 Family, marriage and filiation:** The family is based on marriage or a *de facto* union between a man and a woman, is the basic nucleus of social organisation and enjoys special protection by the state. Men and women are equal within the family, in society and before the state, enjoy the same rights and are responsible for the same duties. All children, despite filiation, are equal before the law and are not discriminated against. Families, the state and society prioritise the protection of children's rights through balanced upbringing, health care, education and living conditions. The state, family and society, promote balanced development of young people, and create conditions to fulfil their political, economic, social and cultural rights. It fosters youth organisations established for economic, cultural, artistic, recreational, environmental, scientific, and educational, purposes.	The potential of the project to violate, influence, or improve the enjoyment of these rights are considered when identifying its socio-economic impacts. These rights are also considered in the Human Rights Risk Assessment compiled by SRK for the same project. It should be noted that, although the Constitution is comprehensive in its coverage of fundamental human rights, there are still some shortcomings in its universal achievement in the country (OHCHR, 2008; da Silveira, 2014).

Legislation and guidelines	Description	Application to project
	• **36 Right to physical freedom and personal security:** Everyone has the right to physical freedom, individual security, physical and mental integrity, and protection and control over their own body without violence, torture, cruel, inhumane or degrading treatment and punishment. • **37 Right to property, requisitions and expropriations:** The right to private property and its transmission is guaranteed for everyone under the terms of the Constitution and law. The state respects and protects the property rights in rem of private individuals, corporate bodies and local communities. Temporary civil requisition and expropriation for public use shall only be permitted upon prompt payment of just compensation under the terms of the Constitution and law. • **38 Right to free economic initiative:** Private enterprise, free business and cooperative initiatives can be undertaken under the terms of the Constitution and law. The law promotes, regulates and protects the economic activities and investments of private, national or foreign individuals and corporate bodies to enable their contribution to the country's development. It defends the economic and technological emancipation and interests of the Angolan people and of workers. • **39 Environmental rights:** Everyone can live in a healthy, unpolluted environment and must defend and preserve it. The location of economic activities and the development and use of all natural resources happen sustainably to respect the rights of future generations. • **41 Freedom of conscience, religion and worship:** Freedom of conscience, religion and worship is inviolable. • **42 Intellectual property:** Intellectual, artistic, political, scientific and communication activities can be expressed without censorship or licence.	

Legislation and guidelines	Description	Application to project
	• **43 Freedom of cultural and scientific creation:** The freedom to invent, produce and publicise scientific, literary and artistic works are not restricted and are protected by copyright law. • **46 Freedom of residence, movement and emigration:** Any Angolan citizen may freely establish their residence, move and settle anywhere in the country. • **48 Freedom of association:** All citizens can freely associate with one another without requiring administrative authorisation, as long as it is democratic and under the terms of the law. No-one can be obliged or coerced to belong to or remain a member of an association. Associations or groupings whose purposes or activities incite and practice violence, promote tribalism, racism, dictatorship, fascism, xenophobia, or militarisation are prohibited. • **49 Freedom of professional and business association:** All professionals and self-employed workers can belong to a professional association that defend their rights and interests and regulates the profession's ethics. • **50 Trade union freedoms:** Workers may create trade union organisations to defend their collective and individual interests and conduct social dialogue. • **51 Right to strike and prohibition of lock-outs:** Workers have the right to strike, lock-outs are prohibited, and employers may not forbid workers to access their workplaces to influence the outcome of labour conflicts. • **52 Participation in public life:** Every citizen can participate in political life and the direction of public affairs.	
Presidential Decree No. 117/2020 of 22 April on General Regulation on Environmental Impact	The 2020 Decree establishes the rules and procedures regulating environmental impact assessments (EIAs) of public and private projects and the environmental licensing procedures for activities that, by their	The socio-economic aspects of the project, as required, are included in this report or cross-referenced to the main EIA report. Social impacts are assessed as detailed in **Section 6**. The

Legislation and guidelines	Description	Application to project
Assessment and Environmental Licensing Procedures	nature, location or dimension, are likely to cause significant environmental **and social impacts**. It specifies the activities that are required during the EIA process, as well as the contents of the EIA report. Apart from the technical project and environmental aspects, the EIA report must also include the following details: • A thorough analysis of the baseline conditions before development, including the interactions within and between the socio-economic and non-human environment; • A definition of the project AoI, considering the human population in which the project is located; • All government plans and programmes proposed and being implemented in the project AoI, and the project's compatibility with them; • Any other information that may be relevant to the project, such as international protocols; • A description of possible social changes caused by the project; • A systematic identification and assessment of the socio-economic impacts generated in each project phase (design, construction, operation and decommissioning), including the identification and prediction of the magnitude and scale of impacts, detailing: – Positive and negative, direct and indirect, immediate, medium, long-term, temporary and permanent impacts; – The degree to which the impacts are reversible; – Cumulative and synergistic properties of impacts; and – The distribution of the social burden and benefits. • Measures required to mitigate, monitoring and audit negative impacts and effects of the project; and • Any opinions and criticisms resulting from public consultations.	impacts identified, assessed, and for which mitigation and monitoring measures are described, are detailed in **Section 6**. Something to note in the monitoring of project impacts is that, due to the lack of available resources and professional capacity, the MINAMB might be somewhat constrained in conducting monitoring activities as required for projects. To mitigate this, several monitoring activities are carried out by project implementers themselves, or in collaboration with Angolan institutes, such as the Natural History Museum and the Agostinho Neto University's Faculty of Sciences (DBSA, 2021). This emphasises that mitigation, monitoring and auditing requirements recommended in the SEIA should be practicable and measurable as far as possible.
Public Consultation Regulations approved by Executive Decree No. 87/12 of 24 February / *Regulamento de Consulta Pública*	Projects such as this one must be subjected to a public consultation process after the project's EIA report has been received by the competent authority. The public consultation process comprises the:	A stakeholder engagement process is being undertaken as part of this project. The first engagements took place in February 2024 with municipal administrators. Subsequent engagements will take place with a wider audience of interested and affected parties in the AoI in March 2024 and will happen as part of the primary data

Legislation and guidelines	Description	Application to project
	• Release of a non-technical summary (NTS) of the EIA report to interested and affected parties. The consultation must be disclosed in a daily newspaper and other relevant social media. • Consideration of comments relating to the proposed project; and • Compilation of a report within eight days of the completion of the consultation period. This public consultation process must take place over a period of five to ten days and the costs must be borne by the developer. The public consultation process or hearing is chaired by the National Directorate for the Prevention and Assessment of Environmental Impacts (*Direcção Nacional de Prevenção e Avaliação de Impactes Ambientais* [DNPAIA]) on behalf of the Ministry (or the designated alternate) and comprises a Board with a President, Secretary, and a Rapporteur. The questions and opinions presented during the public consultation are answered and taken into consideration in the decision-making process to be performed by DNPAIA.	collection undertaken for this report. A third round of engagements will take place once the outcomes of all specialist studies are available and the ESIA report is complete.
Decree No. 1/10 of 13 January on Environmental Audits, gazetted in January 2010	Activities that take place without the necessary social mitigation are subject to auditing. The Decree explains the types of audits that may be conducted, and that they can be conducted by authorised public or private bodies. The costs of the audits are carried out by the entity being audited.	Environmental audits of the project will include social impact mitigation.
Basic Law on Social Protection (Law 7/04 of October 15, 2004) / *Lei n. 7/04 – Estabelece a Lei de Bases da Protecção Social*	The Basic Law on Social Protection establishes a legal framework for social protection. Its purpose is to ensure that the well-being of Angolan citizens is protected through social security, health care, pensions, and other social benefits. It focuses on vulnerable groups such as the elderly, disabled individuals, children, and those living in poverty. The law seeks to protect individuals and families from the economic risks associated with old age, sickness, disability, unemployment, and other situations of need. It also aims to promote social inclusion and overall quality of life, to reduce poverty and inequality, and by providing a basic level of social protection to all citizens.	The socio-economic impacts identified and assessed as part of the project should take cognisance of what this Act aims to achieve, and why. Since it puts structures in place to improve the current socio-economic baseline situation (assessed in **Section 5**), the project's impacts need to be mitigated or enhanced to such an extent that it does not jeopardise what the Act is trying to achieve – especially for vulnerable groups.

Legislation and guidelines	Description	Application to project
	This social protection is financed through tax in an act of national solidarity. The well-being of people, families and the community, is achieved through social promotion and regional development. This Law gives effect to some of the Constitutional rights summarised above.	
Presidential Decree No. 37/21 approving the National Policy on Social Action (NPSA) / *Decreto Presidencial n. 37/21 – Política Nacional da Acção Social*	The Decree approves and establishes the theoretical and methodological bases for the NPSA. It establishes the State's responsibility for the guidance, management, financing and control of the NPSA. The purpose of the NPSA is to guide the government's efforts to address social challenges and promote social development. It aims to improve the quality of life of Angolans, particularly the most vulnerable groups such as children, women, elderly, people with disabilities, and those living in poverty. The NPSA focuses on enhancing social protection, access to basic services, and social inclusion. It also emphasises the importance of community participation and collaboration among various stakeholders to achieve its objectives.	The socio-economic impacts of the project will be identified and assessed against the backdrop of the aims of this Decree and the NPSA so that its positive impacts can be optimised so as not to jeopardise what the NPSA is attempting to accomplish.
Land Use Planning and Urban Development Act (Law of Territorial Planning and Urbanisation), No. 3/04 of 25 June 2004 / *Lei do Orderamento do Territorio e do Urbanismo*	The Act adopts a concept of integrated planning. It includes socio-economic aspects and attempts to create synergy between urban and rural areas. It calls for the establishment of a decentralised system to coordinate land use planning. The Act was established in response to outdated and ineffective land use planning and urban management legislation. Existing laws on territory, town planning, and urban issues are fragmented and do not align with current scientific and technological standards. Rapid urbanization, particularly in coastal areas due to war and migration, has worsened urban management issues, resulting in overcrowded and deteriorating cities. The lack of integrated and coordinated plans has further compounded problems, leading to inefficient urban development and growth.	Any issues regarding land acquisition associated with this project should take into consideration that the implementation of legislation can take time. Laws and policies might be established but the reality might be that some land uses and tenure rights might not yet be in line with them. This aspect is considered in this report.
Land Law, No. 9/04 of 9 November 2004 / *Lei da Terras*	The Land Law regards land as the property of the state and describes it as a:	Since the State holds all ownership of land, any further engagements regarding land acquisition or lease should take note thereof. This will also be important in mitigating the impacts of

Legislation and guidelines	Description	Application to project
	• Shelter and home for the inhabitants of Angola, implying the existence of an appropriate urban planning system; • Source of natural resources; and • Support for economic, agricultural and industrial activities. It also contains a number of aspects that are important to foster sustainable development, and optimal use of soil and natural resources. It presents two land classifications, namely urban land (areas for the construction of buildings) and rural land (areas for agriculture, raising livestock, forestry and mining). The government decides on the establishment of land areas to be used for roads, inland borders, airports and ports, and military bases.	involuntary physical or economic displacement, where the sourcing of replacement land might be required.
Local Municipalities Act, No. 39/11 of December 2011 of 1999 / *Lei das Autoridades Locais*	The Act establishes that local governments are responsible for the promotion of development, basic sanitation, environmental protection and land management.	Any aspects related to land acquisition or leasing for use by Project Affected Parties (i.e., those who might be affected by involuntary physical or economic displacement as a result of the project) must be managed in close collaboration with the affected local municipalities.
Cultural Assets Law No. 14/05 of 11 October 2005	This law establishes the basic protection and enhancement policy and regime for the protection of cultural heritage, understand, and establishing the Angolan cultural identity.	Although a Heritage Impact Assessment is conducted as part of the ESIA of this project, the cultural, heritage and spiritual aspects of the AoI is considered in this SEIA, since these aspects are intrinsically linked to the socio-economic situation of the area.
New General Labour Law (NGLL), Law No. 12/23 of 27 December 2023 / *Nova Lei Geral do Trabalho*	The NGLL replaces the General Labour Law, Law No. 7/15 of 15 June 2015. It recently came into force, on 26 March 2024. It introduced several significant changes and new features to the labour landscape in Angola. The changes and additions aim to modernise and regulate labour relations in Angola, addressing various aspects of employment contracts, disciplinary procedures, work conditions, and employee rights and protections.	Labour laws will apply to all phases of the project in some way, but most notably in the construction phase. The confluence of the need for labour by the proponent as well as the need for employment by potential labourers and their families are duly considered in this SEIA as it could have both negative and positive consequences.
Occupational Health and Safety (OHS) Laws:	These decrees establish principles and regulations to promote health, safety and workplace conditions, occupational health and safety	The presence of the project will likely require labour from local communities. There might also be an influx of construction workers and job-seekers to the study area. Potential OHS impacts

Legislation and guidelines	Description	Application to project
• Decree No. 31/94 of 5 August 1994 • Decree No. 31/95 of 5 November 1995 • Executive Decree No. 128/04 of 23 November 2004 • Decree No. 53/05 of 5 August 2005	systems, and the legal regime relating to occupational accidents and diseases.	on workers in the area might therefore also be regarded as impacts on the communities in the AoI.
Energy Supply Legislation: • Decree No. 40/04, 2 July 2004 • Decree No. 41/04, 2 July 2004 • Decree No. 39/04, 2 July 2004	These decrees govern the licensing of installations to use electric energy networks in buildings, the production, transport, and distribution of electric energy, and the statute of the technician responsible for electrical installations. These regulations collectively define the legal framework for the proper handling and operation of electrical energy installations.	Compliance with these regulations is crucial for the successful implementation and operation of the Project, since it directly involves the transmission and distribution of electrical energy. Although the socio-economic impact of an increase in the available infrastructure to supply energy is mostly positive, stakeholders in the AoI will need to understand what the legal requirements, timelines, and larger project objectives are, since all households and other potential users of electricity (e.g., businesses) will not necessarily be connected as part of this particular project.
Long-Term Development Strategy – Angola 2050 (*Estratégia de Desenvolvimento de Longo Prazo* — Angola 2050, ELP-2050)Strategy to Combat Poverty (2003)	These strategies provide details on current obstacles to development in Angola, such as low human development, a weak economy, inadequate health and education services, and regional inequality. They were developed as part of an ongoing process of reconstruction and national development. The strategies contain plans to eliminate or improve the conditions that Angolan citizens live in. It considers the possible growth of various sectors and the main activities to realise this growth. They make provision for stakeholder engagement to allow the vulnerable to participate actively in the socio-economic development process.	The project is in line with the strategy as it will indirectly, and in the long term, contribute to the improvement of the economy, social services and human development.
Key international conventions and treaties		
• Human and gender rights instruments	Angola has ratified or acceded to various international covenants, conventions and protocols on human rights, including the:	Angola has not signed, ratified or acceded to the following conventions:

Legislation and guidelines	Description	Application to project
• United Nations Human Rights: Office of the High Commissioner • African Union: African Charters	• International Covenant on Economic, Social and Cultural Rights (ICESCR) – Optional Protocol to the ICESCR (signed, not ratified) • International Covenant on Civil and Political Rights (ICCPR) – Optional Protocol to ICCPR – Second Optional Protocol to the ICCPR, aiming at the abolition of the death penalty • Convention on the Elimination of All Forms of Discrimination Against Women – Optional Protocol to the Convention on the Elimination of All Forms of Discrimination against Women • Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment – Optional Protocol to the Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (signed, not ratified) • Convention on the Rights of Persons with Disabilities (CRPD) – Optional Protocol to the CRPD • Convention on the Rights of the Child (CRC) – Optional Protocol to the CRC on the involvement of children in armed conflict – Optional Protocol to the CRC on the sale of children, child prostitution and child pornography • International Convention on the Elimination of All Forms of Racial Discrimination • International Convention for the Protection of all Persons from Enforced Disappearance (signed, not ratified) • African Charter on Human and Peoples' Rights (1992) – Protocol to the African Charter on Human and Peoples' on the Rights of Women in Africa (2007) • African Charter on the Rights and Welfare of the Child	• Optional Protocol to the CRC on a communications procedure • International Convention on the Protection of the Rights of All Migrant Workers and Members of their Families The Human Rights Committee considered a 2013 report on how Angola implements the provisions of the ICCPR (UN, 2013). The Committee expressed concerns about various human rights issues in Angola, including restrictions on freedom of expression, association, and peaceful assembly, as well as reports of excessive use of force by security forces. In 2022, there were still ongoing challenges with the enforcement of human rights instruments in Angola according to Amnesty International and Human Rights Watch (Amnesty International, 2023; Human Rights Watch, 2021). These include violations of the right to adequate housing, freedom of expression and assembly, freedom from arbitrary arrest and detention, fair trial, lack of accountability for past human rights abuses, concerns about the independence of the judiciary, and challenges faced by civil society organisations and human rights defenders in the country. These aspects are considered in further detail in the HRIA.
Labour	Angola has ratified various labour-related International Labour Organization (ILO) Conventions, such as:	

Legislation and guidelines	Description	Application to project
	• 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) • Tripartite Consultation (International Labour Standards) Convention, 1976 (No. 144) • Labour Inspection Convention, 1947 (No. 81) • Discrimination (Employment and Occupation) Convention, 1960 (No. 111) • Equal Remuneration Convention, 1951 (No. 100) • Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87) • Right to Organise and Collective Bargaining Convention, 1949 (No. 98)	
Armed conflict and refugees	• 1st Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field (1984) • 2nd Geneva Convention for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea (1984) • 3rd Geneva Convention relative to the Treatment of Prisoners of War (1984) • 4th Geneva Convention relative to the Protection of Civilian Persons in Time of War (1984) • Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts (Protocol I) of 8 June 1977 (1984) • Convention Governing the Specific Aspects of Refugee Problems in Africa (United Nations High Commissioner for Refugees [UNHCR]) (1981) • Convention and Protocol Relating to the Status of Refugees (UNHCR) (1981)	

4.2 Lender requirements

The Swedish export credit system consists of SEK's financing and EKN's guarantees. These two entities' views on the socio-economic impacts of their projects and the management thereof are summarised in the sub-sections below:

4.2.1 Svensk Exportkredit (SEK)

International guidelines of the Organisation for Economic Co-operation and Development (OECD), the United Nations (UN) and the Equator Principles guide SEK's sustainability efforts. Currently, the social topics that SEK prioritises include labour conditions and human rights. The following information is extracted from SEK's webpage on Governance and reporting (SEK, 2023)

Sustainability governance

As a Swedish state-owned company, SEK must set a positive example for sustainable business, which primarily means that they:

- integrate priority sustainability topics into their business strategy through targets;
- are transparent on material risks and opportunities and maintain an active dialogue with stakeholders;
- cooperate with other companies and relevant organisations; and
- comply with international guidelines on sustainability.

SEK's work with sustainability topics is integrated into its corporate governance. SEK is to promote compliance with international guidelines within the area of sustainable business relating to the environment, anti-corruption, human rights, labour conditions and business ethics.

Where relevant when making credit assessments, SEK is to comply with international frameworks, such as the OECD's Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence or the Equator Principles. SEK is also to take into account the OECD's Principles and Guidelines to Promote Sustainable Lending in the Provision of Official Export Credits to Low Income Countries.

Sustainability risk

Various risks can arise in connection with lending. Although these are primarily credit risks, they can also include sustainability risks. Sustainability risk is defined as a risk class by SEK, so their business decisions take into account how their surroundings are impacted by ethics, corruption, the environment and climate, human rights and labour conditions.

Sustainability risks are identified, examined and managed on counterparty, country and business levels. How these risks are expected to impact surroundings is also considered. SEK expects the companies that are granted loans to adhere to the compliance of laws and international guidelines concerning sustainability.

In cases of heightened sustainability risk, a detailed sustainability review is performed, and measures could be required in order to mitigate environmental and social risks. The requirements that SEK sets are based on national and international regulations and guidelines within the areas of environment and climate, anti-corruption, human rights including labour conditions and business ethics including tax.

Policy documents

SEK has a Sustainable finance policy stating that they must act responsibly, minimise the risk of negative impact and leverage opportunities to generate sustainable value. They must promote

reduced climate and environmental impact, active work with anti-corruption, respect for human rights and good and decent labour conditions, which include a safe and secure work environment, good business ethics and acting responsibly in the tax area. Their Code of Conduct guides their colleagues in terms of ethical behaviour within the company and in their interactions with external parties.

International sustainable business guidelines

International guidelines show the way for SEK's sustainability efforts, the following of which govern their operations: The Equator Principles, the globally recognised framework for assessing and managing environmental and societal risks in conjunction with financing projects. They report their efforts to meet the Equator Principles, as well as the projects financed by them that are classified under the Equator Principles as potentially high-risk.

The ten principles in the UN Global Compact are also used as guidance. As a member of the Global Compact, SEK annually compiles a Communication on Progress showing how they work with sustainability initiatives that are included in the Global Compact. They adhere to the UN's framework for business and human rights, the UN Convention on the Rights of the Child, the OECD Guidelines for Multinational Enterprises, the OECD's guidelines for managing social and environmental considerations when granting export credits and the OECD's Principles and Guidelines to Promote Sustainable Lending in the Provision of Official Export Credits to Low Income Countries.

The UN Sustainable Development Goals

SEK promotes the UN Sustainable Development Goals (SDGs). SEK contributes to meeting the UN SDGs both through financing and as an employer. SEK has been active in green financing since 2015, and is expanding its sustainable finance offering. SEK's focus is to integrate sustainability risks in the risk framework to reduce potentially negative impacts on the UN SDGs that certain financial activity could generate.

4.2.2 Swedish Export Credit Agency (*Exportkreditnämnden*, EKN)

Human rights

EKN assesses the risk of negative impacts on human rights by focusing on the operations or project where the product is to be used (end-user). The following information was extracted from EKN's webpage on Human rights (EKN, 2024).

A human rights review is part of EKN's business risk assessment which is used to reduce financial and human rights risks.

EKN's assessment of human rights impacts places particular emphasis on the rights that are linked to a given activity's local impacts. These include, for example, working conditions, the effect on health and safety in the surrounding area, resettlement, indigenous peoples, vulnerable groups and cultural heritage.

EKN assesses human rights as follows:

1. When guarantee applications are received, EKN performs a screening to identify transactions with a significant risk of negative impact on human rights The screening takes into consideration, *inter alia*, the sector and the country applicable.
2. When there is any indication of a material risk of negative impact, the application is subjected to a human rights assessment. The review is adapted based on the risks that are identified and the design of the financing. If necessary, EKN can request supplementary information from the borrower concerning how risks to human rights are managed.

3. EKN uses the IFC's Performance Standards (PSs), the World Bank's EHS Guidelines and the UN Guiding Principles on Business and Human Rights (UNGPs) to evaluate whether the risk of negative impact on human rights is managed adequately. EKN also uses the UN Guiding Principles on Business and Human Rights in its assessment of how risks are to be prioritised and what opportunities EKN has to mitigate these risks.

An HRIA has been prepared for this project.

EKN's approach to sustainable and responsible business

The following information provides an overview of how EKN approaches sustainability in new projects. The information was adapted from their Q&A webpage on the same topic (EKN, 2024).

For transactions with a risk of negative impacts, EKN requests information about the buyer company and an ESIA if the transaction involves a new project. If necessary, EKN may contact local stakeholder organisations and obtain information from external sources and experts.

For large projects, EKN visits the site to ensure that the environmental and social impact of the project is consistent with the information that has been provided. EKN may include reporting requirements as a condition of the guarantee.

4.3 Pak Yatirim corporate policies

Pak Yatirim has a Sustainability Policy in place (Pak Yatirim, 2024). The project's socio-economic impacts are assessed not only against GIIP and legislative requirements, but also take into account the requirements of Pak's own Sustainability Policy. The policy notes that Pak is dedicated to stakeholders, including the communities in which they work by:

- Recognising the social impact and considering the welfare of local communities where their projects are executed.
- Integrating sustainability considerations, such as human rights, health and safety, stakeholder engagement, and corporate social responsibility into their decision-making processes.
- Achieving long-term sustainable outcomes within the communities that their projects are located.
- Providing exceptional project experiences for stakeholders throughout their projects' supply chains.

Pak's sustainability framework involves a social pillar that focuses on how its actions and business relationships affect people. The company believes in respecting human rights, which is a core value of their company and is committed to upholding these rights by following the principle of "enhancing life for all". Discrimination based on race, nationality, gender, age, religion, disability, and marital status is not tolerated, and employees play their roles in a way that respects human dignity. This is also reflected in the "Diversity and Inclusion" sub-pillar of the policy. Pak opposes any violation of human rights and strives to prevent offensive communication. The companyis against child and forced labour and aligns with the United Nations Universal Declaration of Human Rights and the United Nations Convention on the Rights of the Child.

5 Community profile and social baseline

The following information was extracted from the *Socio-economic Baseline and Stakeholder Consultation* report drafted by Geolab for the Project, in May 2024 (Geolab, 2024).

There are 14 municipalities in the Huíla Province. Each municipality is then subdivided into communes. The municipalities affected by the project are highlighted in **Table 5-1 bold text** below, which shows the names of the other municipalities and communes within them, to provide context to the reader.

Table 5-1: Municipalities and communes of Huíla Province

Province	Municipalities	Communes
Huíla	Lubango	Lubango, Arimba, Huila, Quilenda, Hoque
	Cacula	Cacula, Vite-Vivar, Tchituto, Chicuaqueia
	Chibia	Chibia, Capunda Cavilongo, Jau, Quihita
	Caconda	Caconda, Gungui, Uaba, Cusse
	Caluquembe	Caluquembe, Calépi, N'gola
	Quilengues	Quilengues, Impulo, Dinde
	Cuvango	**Cuvango**, Vicungo, **Galangue**
	Quipungo	Quipungo, Cainda, Chicungo, Tchiconco, Ombo
	Matala	Matala, Mulondo, Capelongo, Micosse
	Chicomba	Chicomba, Quê, Kutenda (ex-Chitenda), Libongue
	Jamba	**Jamba, Dongo, Tchamutete (ex-Cassinga)**
	Chipindo	**Chipindo**, Bambi, Bunjei
	Gambos	Gambos, Chimbemba
	Humpata	Humpata, Palanca, Bata-bata, Kaholo, Neves

Each communal administration has a further governance structure that oversees the villages/villages in each commune. Traditional authorities are located at three hierarchical levels, which officially translate today into the *regedor* (or *soba grande*), the *soba* and the *sekulusecúlo* (Pacheco, 2022). The *soba* is the chief in the villages (see **Figure 5-2**). 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. This local governance structure is shown in **Figure 5-1**. Information on the villages/communities affected by the project and as provided by the sobas, is discussed in **Section 5.19**.

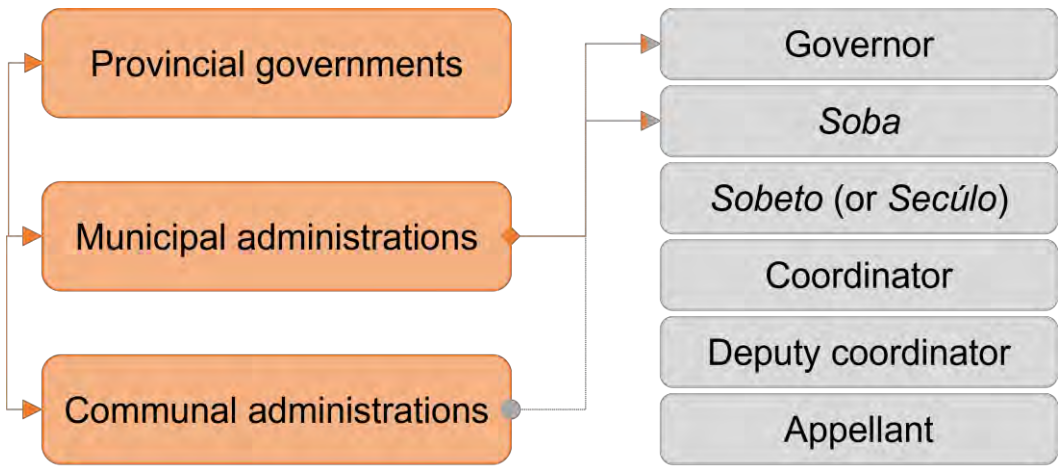


Figure 5-1: Diagram of the local government structure.



Figure 5-2: Sobas exiting Cuvango town.

The locations within the Huíla Province of the three project-affected municipalities of Chipindo, Cuvango and Jamba, are shown in **Figure 5-3**. Note that the map only shows the administrative areas to provide a visual context to the readers of how the municipalities (red line) and communes (dotted line) are demarcated, but this does not mean that all the communes within those municipalities are actually affected by the project. For instance, in the south of Jamba, the village of "Kassinga" is shown, but the battery limits of the OHL do not reach into that area – it ends in Jamba.

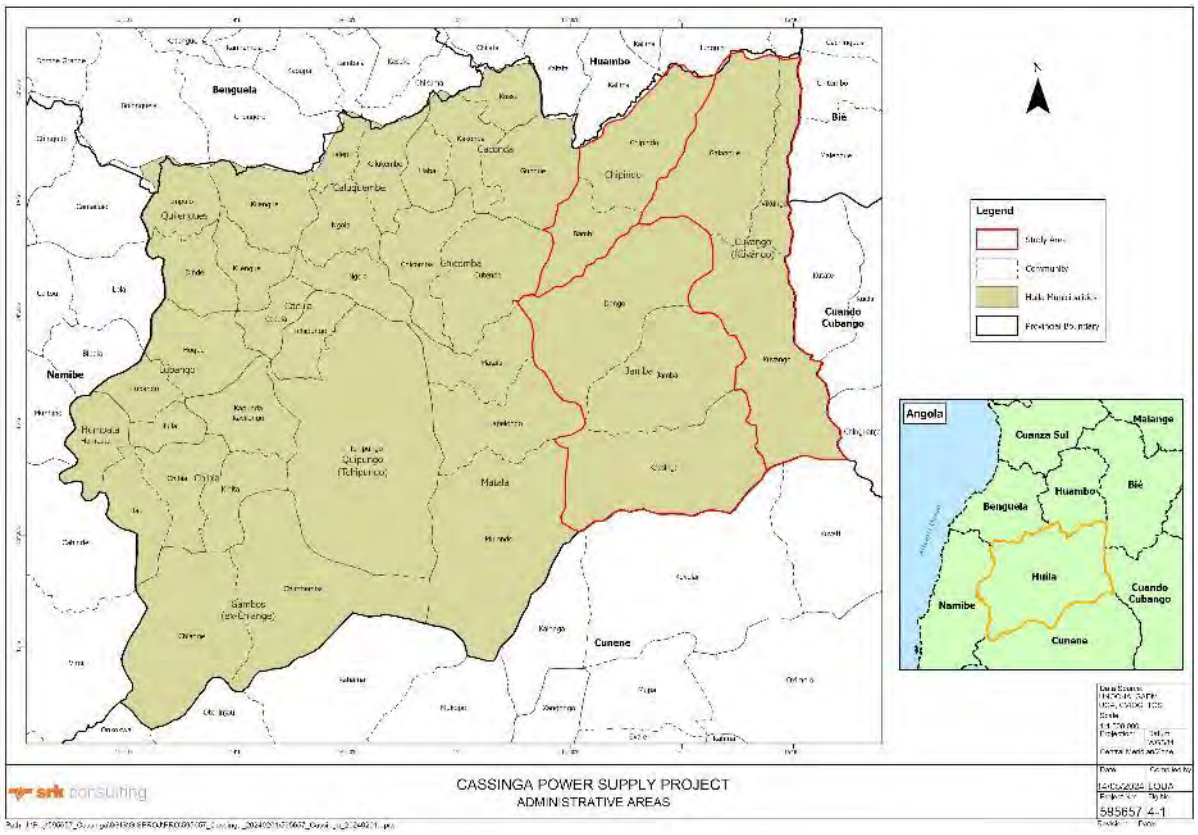


Figure 5-3: Map of the municipalities and communes of Huíla Province, with the affected municipalities outlined in red.

This section takes a detailed look at the socio-economic aspects relating mainly to the Province of Huíla, highlighting the municipalities and communes affected by the project, as shown in **Table 5-1**

above. The relevant social, cultural and economic aspects characterising the communities are also provided.

5.1 Population

The civil war in Angola led to an exodus of people from rural areas to the cities, with strong repercussions on the country's demographic structure, creating huge population clusters and disaggregated urban growth.

In 2020, Angola's population was estimated at 33 million, with almost two-thirds (66 per cent) of the population under age 25. The fertility rate is 6.2 children per woman and the population growth rate is 3.2%. With this growth rate, Angola's population is estimated to double in twenty years. Therefore, the National Development Plan (2020-2022) targets investments in education, health, employment and the participation of adolescents and young people. These efforts will provide important socio-economic opportunities that will contribute to the fulfilment of the Sustainable Development Goals (SDGs) (UNFPA, 2020)

The population of Huíla Province was 2 497 422 at the time of the 2014 census, representing 9.7% of the country's population, as shown in **Figure 5-4** below.

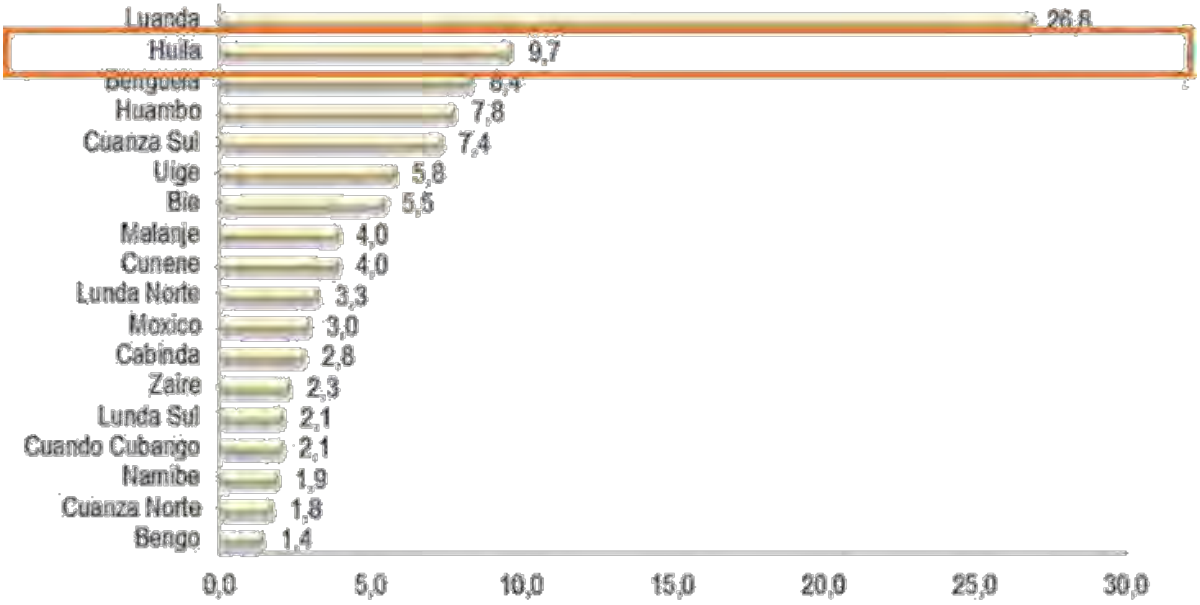


Figure 5-4: Percentage distribution of population by Province (INE, 2016)

Around 33% of the population of Huíla Province live in urban areas and 67% in rural areas, as shown in **Table 5-2**, making it a predominately rural population, with little variation between the number of men vs women living in urban vs rural areas.

Table 5-2: Population distribution by area of residence and sex (INE, 2016)

Province	Total		Men		Women	
	No.	%	No.	%	No.	%
Urban	817 039	32.7	390 816	32.9	426 223	32.5
Rural	1 680 383	67.3	795 773	67.1	884 610	67.5
Huíla	**2 497 422**	**100**	**1 186 589**	**100**	**1 310 833**	**100**

The project-affected municipalities are some of the least populous in the Huíla Province. Cuvango and Chipindo have fewer than 100 000 inhabitants and Jamba has 105 090, whereas the largest municipality, Lubango, has 776 249 inhabitants, representing approximately a third (31%) of the

Province's population. **Figure 5-5** below shows a breakdown of the populations of the various municipalities in Huíla.

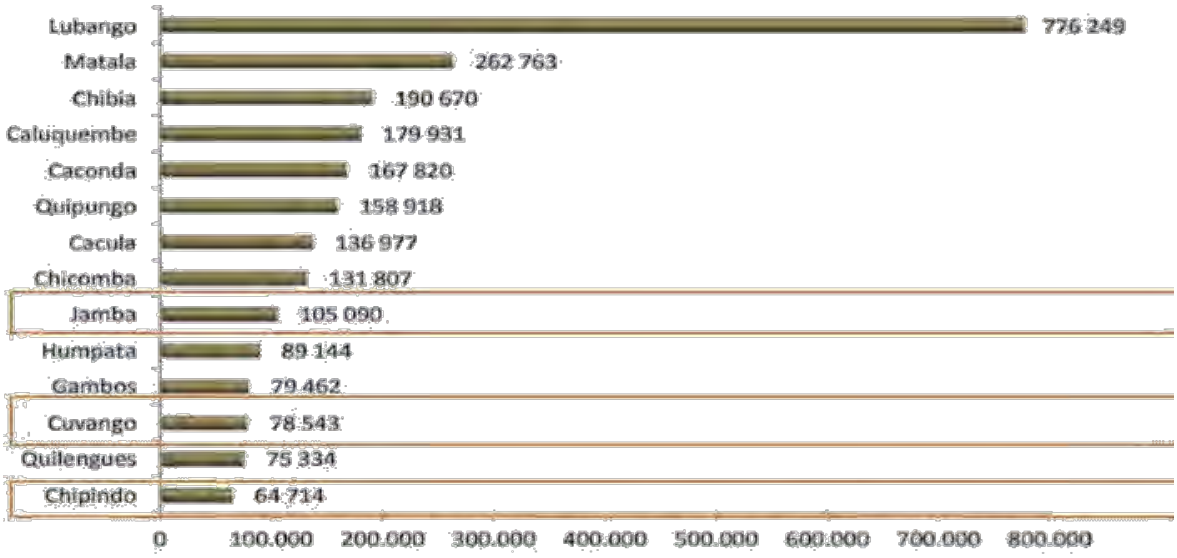


Figure 5-5: Distribution of the resident population by municipality (INE, 2016).

The populations of Chipindo, Cuvango, and Jamba are shown in **Table 5-3**, along with the gender distribution and the percentage of Huila it makes up.

Table 5-3: Affected municipality population distribution by gender (INE, 2016)

Municipality	Total	% of Huíla	Men	% of Huíla	Women	% of Huíla
Chipindo	64 714	3%	30 933	3%	33 780	3%
Cuvango	78 543	4%	37 766	4%	40 777	4%
Jamba	105 090	3%	50 003	3%	55 087	3%

5.2 Age structure

The age structure of the Angolan population is characterised by a young population, with the average age of the population being around 21. The labour force (aged 15-64) accounts for around 50% (12 980 098 inhabitants) of the country's population. The total resident population aged 0-14 is 12 196 496 inhabitants (47%) and the remaining 3% is the aged 65 or over, representing a total of 612 430 inhabitants (INE, 2016).

As shown in **Figure 5-6**, there are more women than men in Angola, or, 52%, corresponding to a total of 13 289 983 inhabitants. The male population is 12 499 041, representing 48%of the total population, with an average ratio of 94 men for every 100 women.

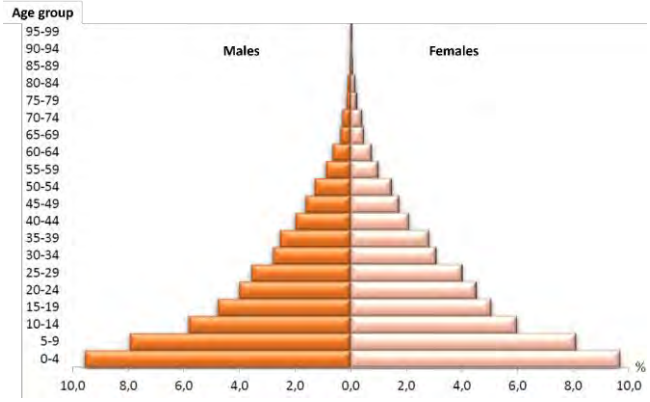


Figure 5-6: Age structure of Angola's population (INE, 2016).

With regard to the population of Huíla, **Figure 5-7** below shows that the percentage of the population aged between 0 and 14 is above the national average for all but one of its municipalities. In Chipindo, 54.2% are aged 0-14, in Cuvango, that number is 50.2% and in Jamba, it's slightly less, at 48.4%.

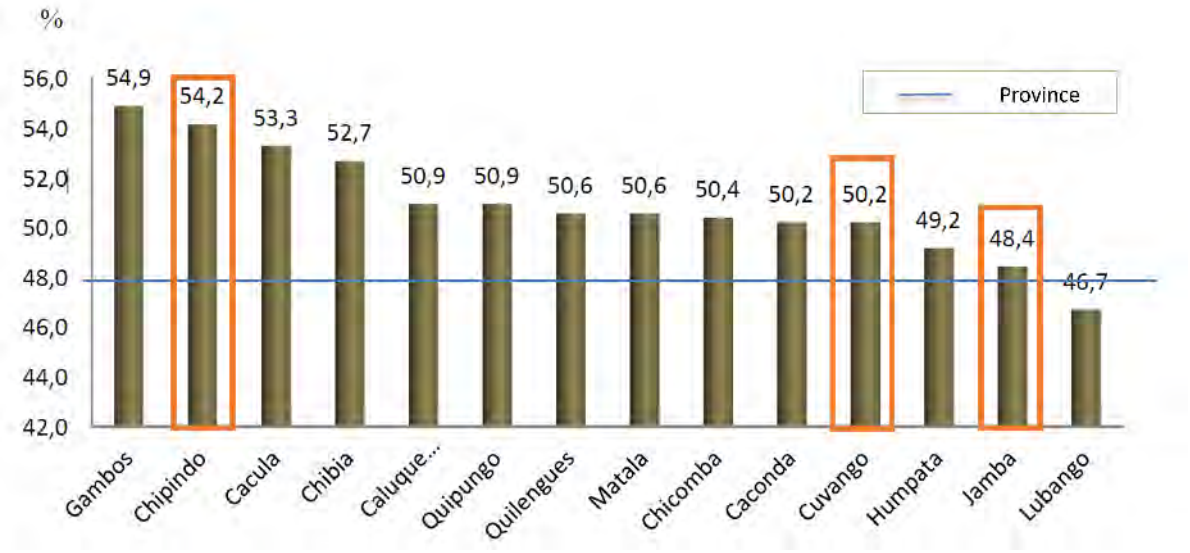


Figure 5-7: Population aged 0-14 by municipality for Huíla (INE, 2016).

The population aged 65 and over is less than 3% of the population of Huíla Province. The municipality with the highest proportion of elderly people is Chibia at only 4.1%. The population aged 65 and over for Jamba, Cuvango and Chipindo are highlighted in **Figure 5-8** below, making up 3.3%, 3%, and 3% respectively.

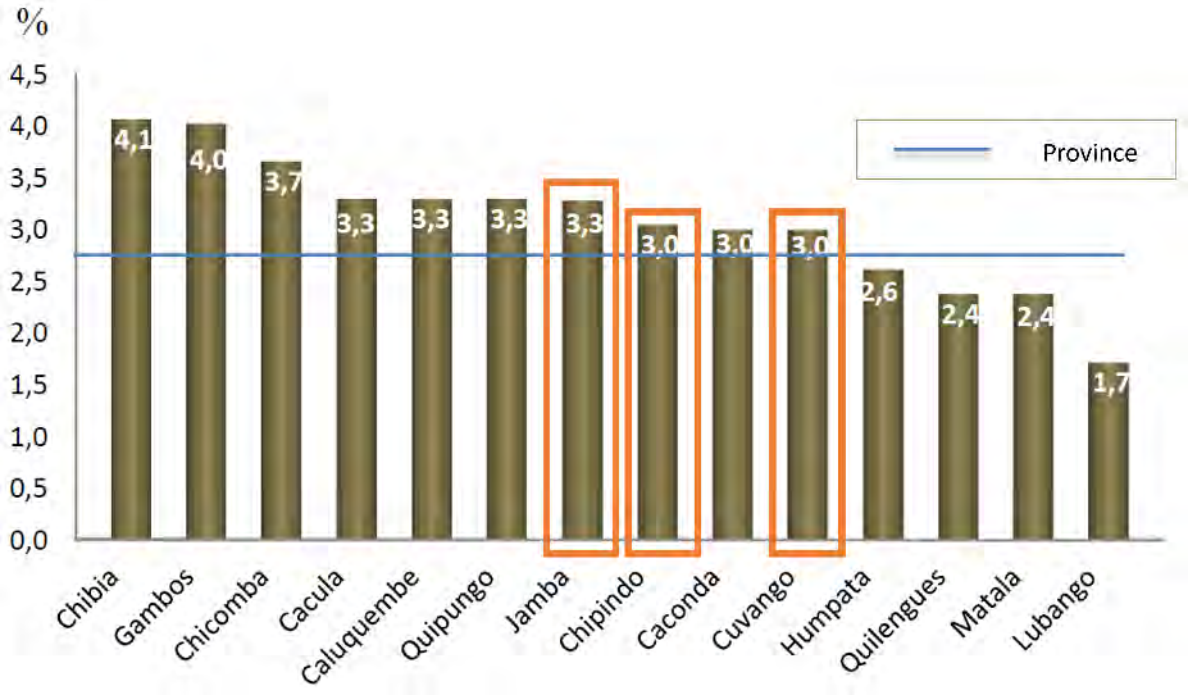


Figure 5-8: Population aged 65 and over by municipality for Huíla (INE, 2016).

The longevity index is a ratio between the population aged 75 and over, to the total population aged 65 and over. In 2014 this index was 37.6 for Huíla. Jamba has the lowest index (34.4), while Gambos has the highest index (43.7), which means that a large part of its elderly population is over 75. Chipindo and Cuvango have fewer persons over 75, with ratios of 37.6 and 34.9, respectively, as shown in **Figure 5-9** below.

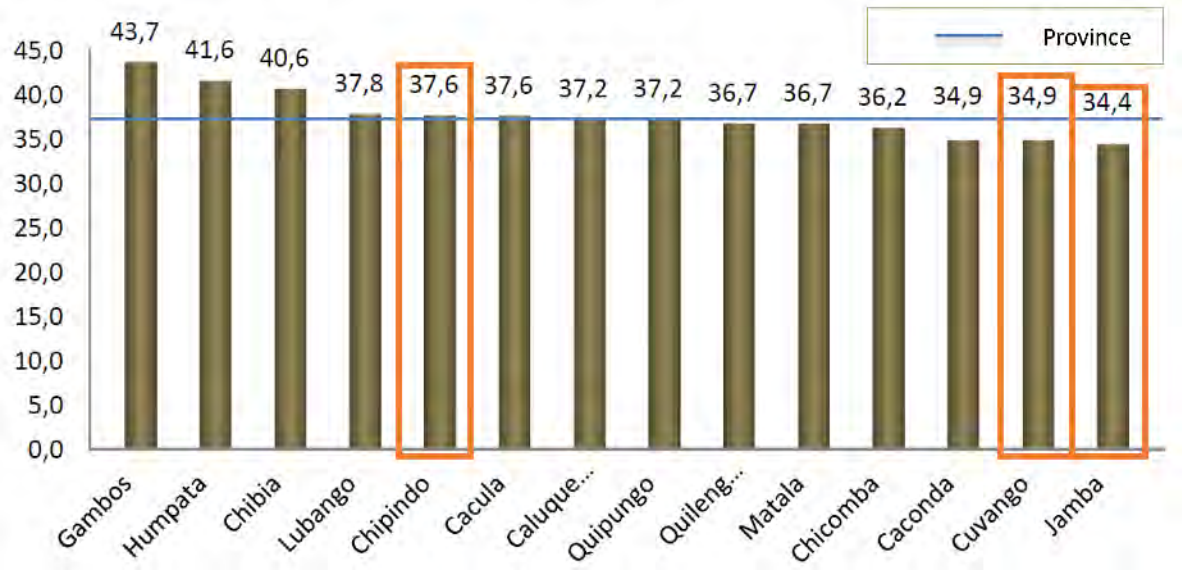


Figure 5-9: Longevity index by municipality for Huíla (INE, 2016).

5.3 Household size

In Huíla Province, 20% of households are made up of more than seven (7) or more members and 8.3% are made up of just one person. The average number of people per household in the Province is 4.8. Of the three project-affected municipalities, Chipindo has the highest average number of people per household. The average number of households in Chipindo ranges between 4.8 and 5.2, in Cuvango it ranges between 4.7 and 4.8, and in Jamba it ranges between 4.4 and 4.7.

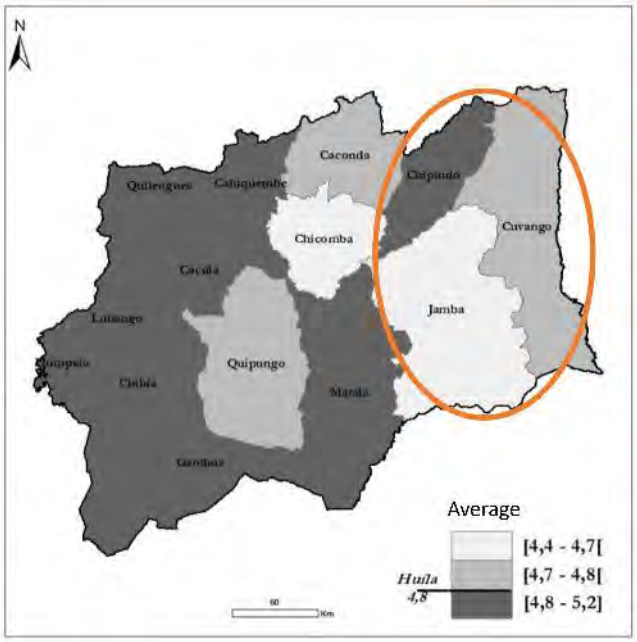


Figure 5-10: Average household size by municipality.

5.4 Ethnicities and languages

Central southern Angola is home to a number of ethnolinguistic groups, including Ovimbundu, Ocindonga, Owambo, Nyaneka-Humbe, Ovingangela and Herero. In the southern region, Umbundu is the most widely spoken language, followed by Nhaneca, Herero, Kwanyama and Cindonga.

In Huíla Province, Portuguese is spoken by more than half the population (54%), with a greater predominance in urban areas, where 85% of the population speaks Portuguese. However, in rural areas only 39% speak Portuguese. Umbundo is the second most spoken language at 32%, followed by Nyaneka and Muhumbi, spoken by approximately 24% and 11%, respectively (as shown in **Figure 5-11**).

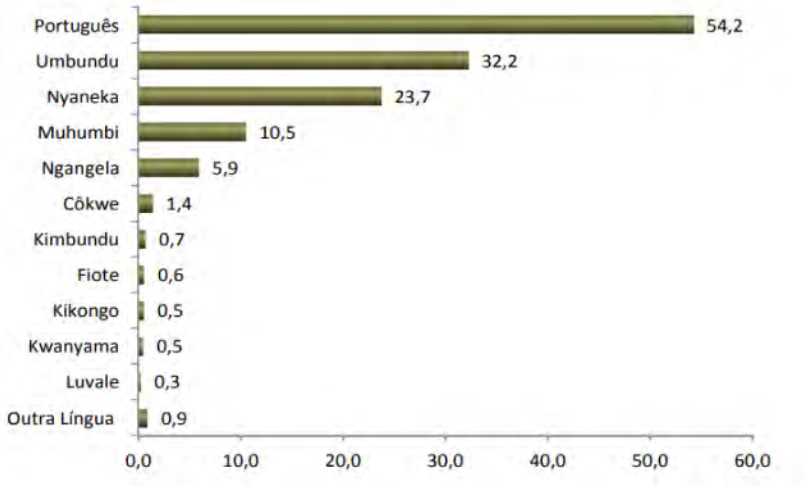


Figure 5-11: Most spoken languages in Huíla Province (INE, 2016).

The most widely spoken languages in the municipalities affected by this project are Nganguela (Cuvango and Jamba) and Umbundo (Chipindo) (as shown in **Figure 5-12**), according to the 2014 census.

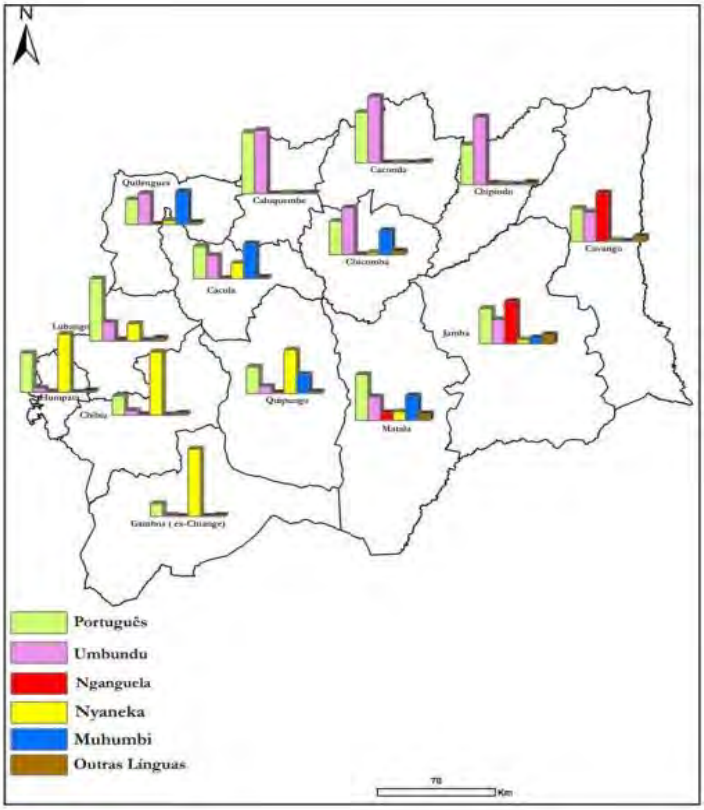


Figure 5-12: Most spoken languages by municipality (INE, 2016).

5.5 Education

Despite the difficulties in implementing the international and national agenda, in the 2018-2021 period, data from the Office of Studies, Planning and Statistics of the Angolan Ministry of Education show an increase in the net enrolment rate in primary education from 74.2% (in 2017) to 76.1% (in the 2018-2021 period), with completion rates also increasing from 50.2% (in 2017) to 62.12%, thus showing that primary education, before the COVID-19 pandemic, was evolving quite positively. In addition, infrastructure has also improved and grown, with the number of classrooms increasing nationally (from 25,617 to 35,645) (GOA & UNPD, 2022).

In 2014, the literacy rate at the national level was 66%, with urban areas being almost twice as high as rural areas: 79% against 41% respectively, as shown in **Table 5-4** (INE, 2016).

Table 5-4: Angolan population aged 15 and older that can read and write by residence area

Country and area of residence	Population of 15 years and older	Population that can read and write	Literacy rate
Urban	8 706 580	6 908 680	79.4%
Rural	4 885 947	2 006 945	41.1%
Angola	13 592 528	8 915 628	65.6%

Significant asymmetry is also observed between genders, where 80% of men are literate, compared to 53% of women. An age and gender- breakdown of literacy rates are provided in **Figure 5-13**. It shows that women are generally less literate than men, but these rates are improving, as shown among those aged between 15-24.

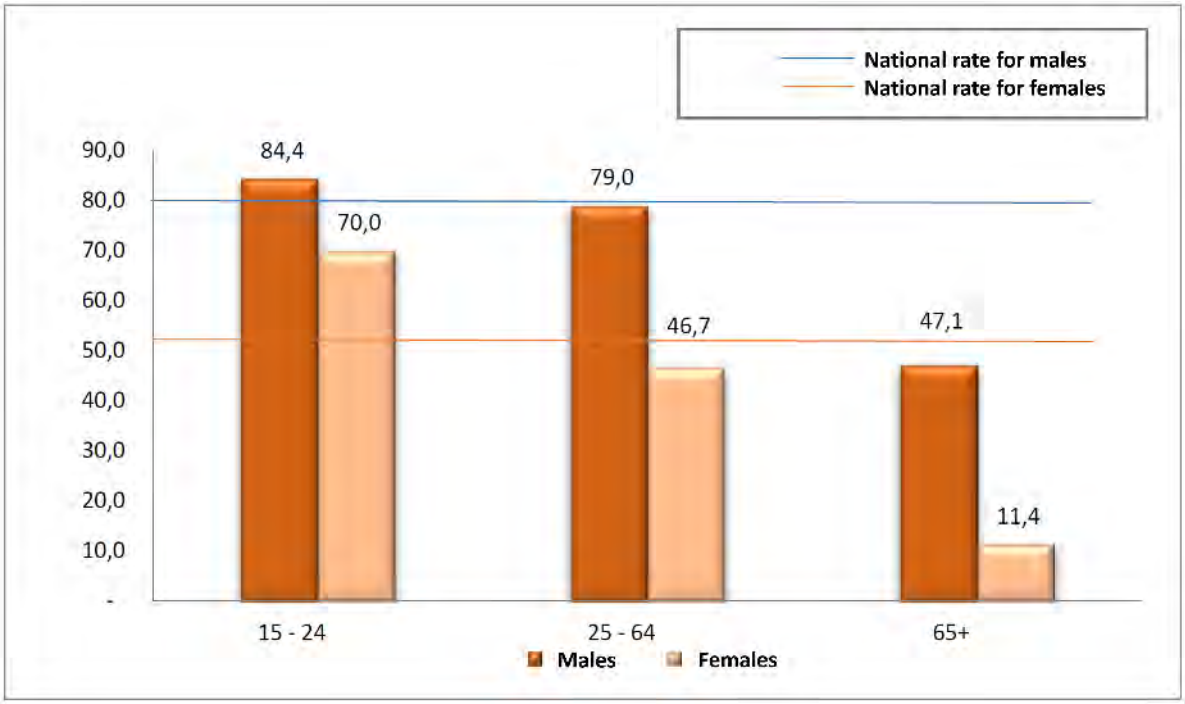


Figure 5-13: Literacy rate in the population aged 15 or over, by age group and gender (INE, 2016).

The literacy rate in Huíla Province is 51%; 80% in urban areas and 36% in rural areas (**Table 5-5**). In terms of gender, 64% of men can read and write, compared to 40% of women. The discrepancy

between male and female literacy rates becomes more apparent when comparing rural and urban literacy rates, where only 24% of women are literate in rural areas, compared to 72% in urban areas.

Table 5-5: Literacy rate by area of residence, by sex (INE, 2016)

Province and area of residence	Can read and write (%)		
	Total	Men	Women
Urban	79.5	88.2	71.7
Rural	36.3	51.4	24.1
Huíla	**50.9**	**64.3**	**39.8**

The municipalities of Chipindo, Cuvango and Jamba have literacy rates of 47%, 41% and 37%, respectively, as shown in **Figure 5-14**Figure 5-14.

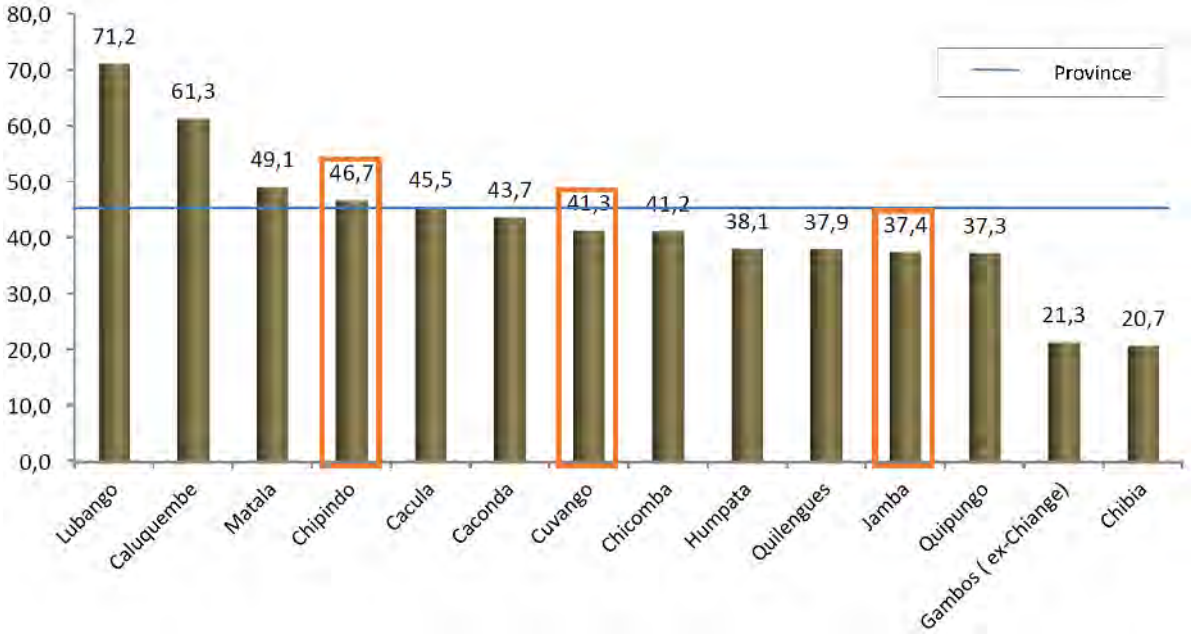


Figure 5-14: Literacy rate by municipality (INE, 2016).

The Agro-Livestock and Fisheries Census (RAPP 2019-2020) *Report on the Results of the Village Census* published by the INE, indicated that 36% of villages say they have at least one primary school in their village, and 64% say they have none. The Province of Bengo has the highest coverage of schools in its villages (58%), while Lunda Norte, has the lowest coverage (21%). On average, the population needs to walk three hours to reach the primary school closest to their village.

The municipality of Huíla is above the national average in terms of school coverage, with 40.8%, as shown in **Figure 5-15**.

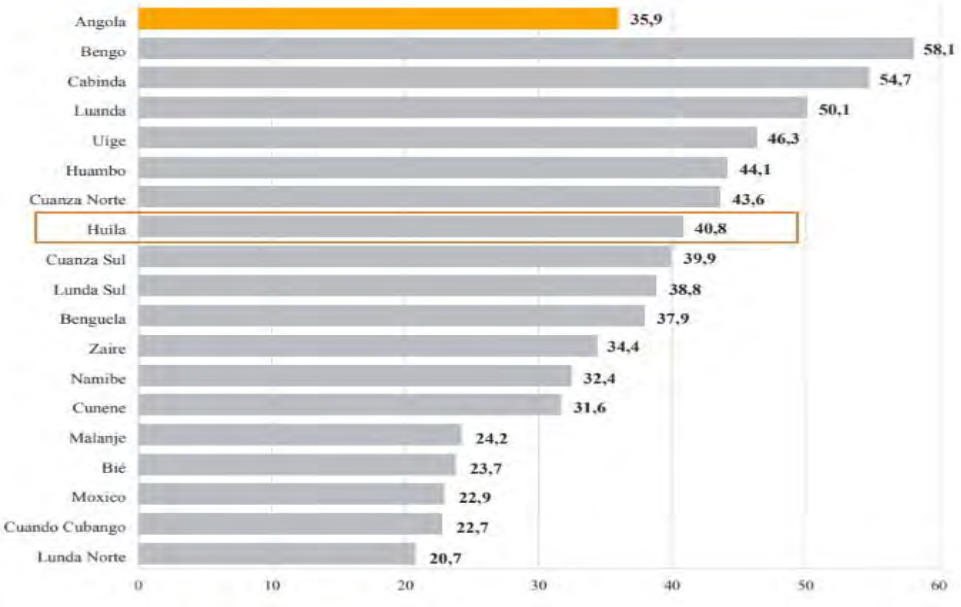


Figure 5-15: Villages with primary schools, by Province.

5.5.1 Municipality of Jamba

According to data from the Jamba Municipal Directorate of Education, Science, Technology and Innovation, there are 1 080 children outside the education system in the municipality, but there is at least one primary school in every village, as outlined in **Table 5-6** below. In Angola, according to Law no. 17/16 of October 7, preschool education includes kindergartens, children's centres (three to four years old) and a beginners' class (which starts at five years old); primary education comprises grades 1 to 6, for a duration of six years); secondary education comprises a first (grades 7 to 9) and second cycle (grades 10 to 11); Technical Secondary Education (grades 10 to 12); and Young Adult School (EJA, *Escola de Jovens Adultos*) for adult literacy.

Table 5-6: General data on the Education Sector in the Municipality of Jamba (AMJ, 2024)

Number of students enrolled by education subsystem						
Pre-school	**Primary school**	**EJA**	**Secondary school (1st cycle)**	**Secondary school (2nd cycle)**	**Technical secondary education**	**Total**
4 909	26 522	1 386	2 542	344	475	**36 178**
Number of schools by education subsystem						
Pre-school	**Primary schools**	**Secondary schools (1st cycle)**	**Secondary schools (2nd cycle)**	**Teacher training school**	**Technical secondary education**	**Total**
2	55	2	1	0	1	**61**
Number of schools with access to school meals as part of the *Fight Against Poverty* programme						
Initiation		**Primary Education**			**Cycle I**	
--		5			--	
Number of schools with access to school meals by *Grupo Carrinho Comércio Lda*.						
Initiation		**Primary Education**			**Cycle I**	
--		15			--	

5.5.2 Municipality of Cuvango

The Municipality of Cuvango has 117 schools, 16 of which are permanently built and 101 of which are built by the community. For the current academic year (2023/2024), 21 768 pupils are enrolled in the various education subsystems, with a total of 746 teachers (AMC, 2023).



Figure 5-16: A primary school in the municipal seat (town) of Cuvango.

5.5.3 Municipality of Chipindo

At Chipindo, the student body for the current academic year is distributed as follows:

- 4 789 pupils enrolled in pre-school education
- 20 143 pupils enrolled in primary school;
- 2 199 students enrolled in the first cycle of secondary education;
- 602 students enrolled in the second cycle of secondary education; and
- 890 pupils enrolled in adult education.



Figure 5-17: Secondary school in Chipindo.

5.6 Health

The health sector at the national level has serious weaknesses in terms of both infrastructure and human resources. The National Health Policy points out that the weakness associated with human resources is mainly due to the existing imbalance in their distribution across the country, the small, specialised workforce, and scarcity. This gap is compensated for by professionals recruited through international cooperation. According to UNDP data (2018 Statistical Update), there are 1.4 doctors (2007-2017 data) for every 10 000 inhabitants and only eight beds (2007-2014 data) for the same number of inhabitants, classifying Angola as a country of average human development. Although the state of health of the Angolan population is considered to be of average human development, the sector has been improving with average life expectancy increasing from 51.9 years in 2013 to 55.8 years in 2016. Mortality rates have also been falling, but are still considered high. According to 2016

data, the mortality rate is 54.6 children per 1 000 live births and 203 women and 277 men per 1 000 people. The maternal mortality rate (2015 data) is 477 per 100 000 live births (UNDP, 2018).

According to the 2017-2022 NDP, malaria represents a major public health problem and is the leading cause of death in Angola. HIV/AIDS is the second cause of morbidity and mortality in key groups. Angola is part of the group of 30 countries with the highest burden of tuberculosis and it is the third leading cause of mortality in the country, aggravated by the increase in cases of HIV-associated tuberculosis and poor access to diagnostic and care services for tuberculosis cases, with high abandonment rates and low treatment success. Among neglected diseases, leprosy is the leading cause of permanent physical disability among infectious diseases. Human African Trypanosomiasis (HAT), or sleeping sickness, as well as other neglected diseases (onchocerciasis, schistosomiasis, filariasis, and dracunculiasis, among others) are still a public health problem today, threatening the well-being of populations and the consequent socio-economic development in endemic Provinces, as these illnesses cause a variety of debilitating symptoms such as blindness, chronic ill-health and disability. Chronic non-communicable diseases (such as diabetes mellitus, cardiovascular and cerebrovascular diseases, kidney disease and cancer) have increased exponentially, and the population still has little knowledge of these diseases and their risk factors. In recent years, the country has experienced emergency public health situations, with epidemic outbreaks of cholera, yellow fever and dengue fever.

The results of the 2015-2016 Multiple Indicator and Health Survey (IIMS), regarding the prevalence of malaria in children under the age of five, show that Huíla Province has one of the lowest percentages (2%) as shown in **Figure 5-18**, compared to other Provinces such as Moxico Province, which has the highest percentages of both malaria prevalence (40%) and anaemia prevalence (22%).

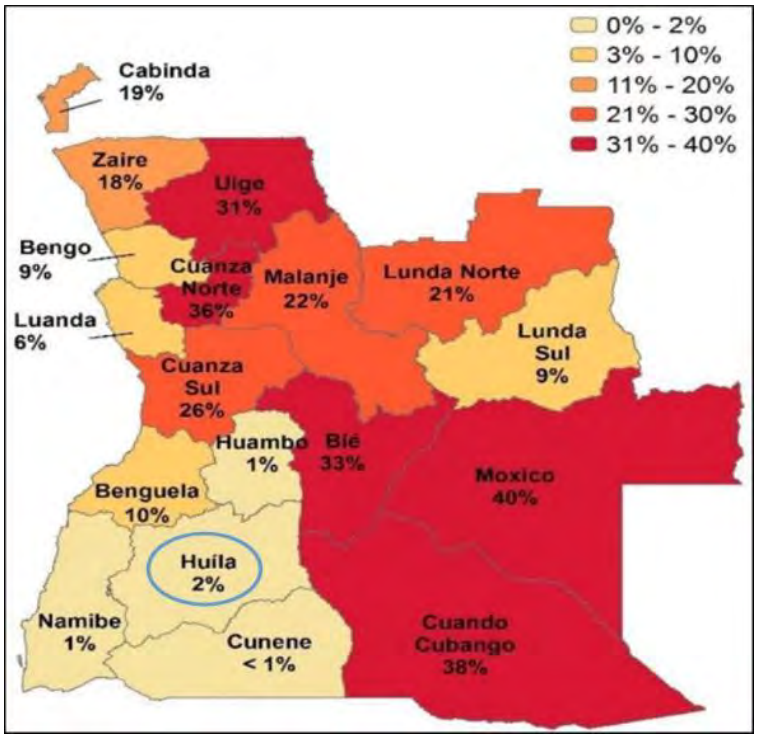


Figure 5-18: Prevalence of malaria in children by Province (INE, 2017).

Angola is implementing the Long-Term Development Strategy, “Angola 2025”. In terms of National Health Policy, it is implementing the National Health Development Plan for the period 2012 to 2025. Data from the Agro-Livestock and Fisheries Census (RAPP 2019-2020), in its Report on the Results of the Village Census published by the INE, show that health services are still not present in the majority of villages, health being a factor that contributes to human development and an essential

indicator of the population's well-being. Of the 23 832 villages surveyed in the country, only 14% (corresponding to 3 230 villages) say they have a health unit (hospital, centre or medical post), and 86% say they do not have a health unit, or 20 602 villages. The highest relative coverage is found in the Province of Lunda Sul (28%) and the lowest coverage is found in Bié (around 9%). Huíla Province has less than 11% coverage.

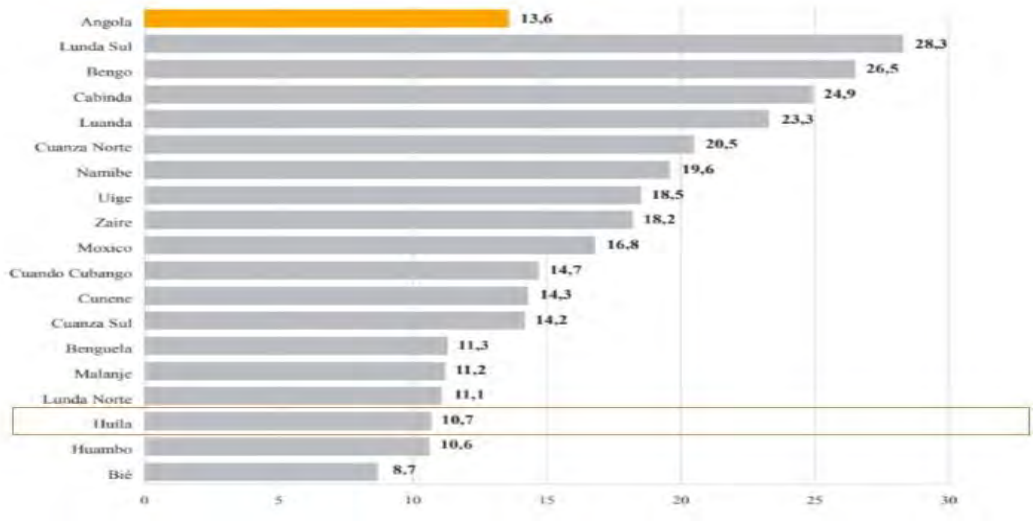


Figure 5-19: Villages with a health centre, by Province (%) (INE, 2022).

5.6.1 Municipality of Jamba

In the Municipality of Jamba, most health units are concentrated in the communal centres. The table below shows general data for the sector.

Table 5-7: Health units (AMJ, 2024)

Indicator	Hospital	Health centre	Mother and child centre	Health centre	Total
Number of existing sanitary units	1	3	1	14	**19**
Number of beds	100	31	22	0	**153**
Health centres with laboratories	1	0	0	0	**1**
Number of units with an operating theatre	1	0	0	0	**1**
Number of units with a blood bank	1	0	0	0	**1**
Units with fixed vaccination posts	1	3	1	9	**14**
Number of health centres with a complete package and essential medicines	1	3	1	11	**16**
Number of advanced/mobile team sessions held for people without access to a health centre	4	3	2	5	**14**
Number of morgues in operation	1	0	0	0	**1**

5.6.2 Municipality of Cuvango

According to data from the Municipality's characterisation report, the sector controls 30 health units, 10 doctors, 124 technical staff and 39 administrative staff. The sector recently received 13 nursing technicians. The number of staff working in these health units is still considered insufficient to meet the demands of the population.

The most common diseases among the population are malaria, acute diarrhoeal diseases, respiratory diseases and malnutrition, especially among children.



Figure 5-20: Cuvango Municipal Hospital.

5.6.3 Municipality of Chipindo

Chipindo has seven (7) sanitary units, six (6) of which are permanently built and one (1) made of adobe (clay) (as shown in **Table 5-8**).

Table 5-8: Hospital network in the municipality of Chipindo (CMA, 2024)

Name of health unit	Estimated population	Location	Year built	Type of construction	Beds
Municipal hospital	25 031	Head office	2013/2007	Permanent	84
Bambi health centre	18 319	Commune	2005/2006	Permanent	13
Bunjei health centre	15 141	Sector	2004	Permanent	5
Buloteque health centre	6 231	Sector	2011/2012	Permanent	4
Chiyoya health centre	6 357	Sector	2006	Adobe (clay)	2
Ndovala health centre	5 111	Sector	2011	Permanent	4
Capembe health centre	6 352	Sector	2012/2013	Permanent	4

Malaria is the most common illness among patients seen at the Chipindo municipal hospital's emergency department, which has 11 doctors, 73 nurses and 19 diagnostic technicians.



Figure 5-21: Chipindo Municipal Hospital.

5.7 Water supply and distribution network

In Angola, just over half of the households (53%) have access to appropriate water sources for drinking, 67% of which are in urban areas and 32% in rural areas. In urban areas, 22% of households have piped water inside the house or in the yard (appropriate water sources) and 21% get drinking water from a tanker truck, cart with a small tank or three-wheeled motorbike (inappropriate water sources). On the other hand, 39% of households in rural areas get drinking water from a lake, pond, stream or irrigation canal (non-appropriate water sources). Between 2008-2009 and 2015-2016, household access to sources of water suitable for drinking increased by 12 percentage points (from 42% to 54%). This increase was mainly in urban areas (INE, 2017).

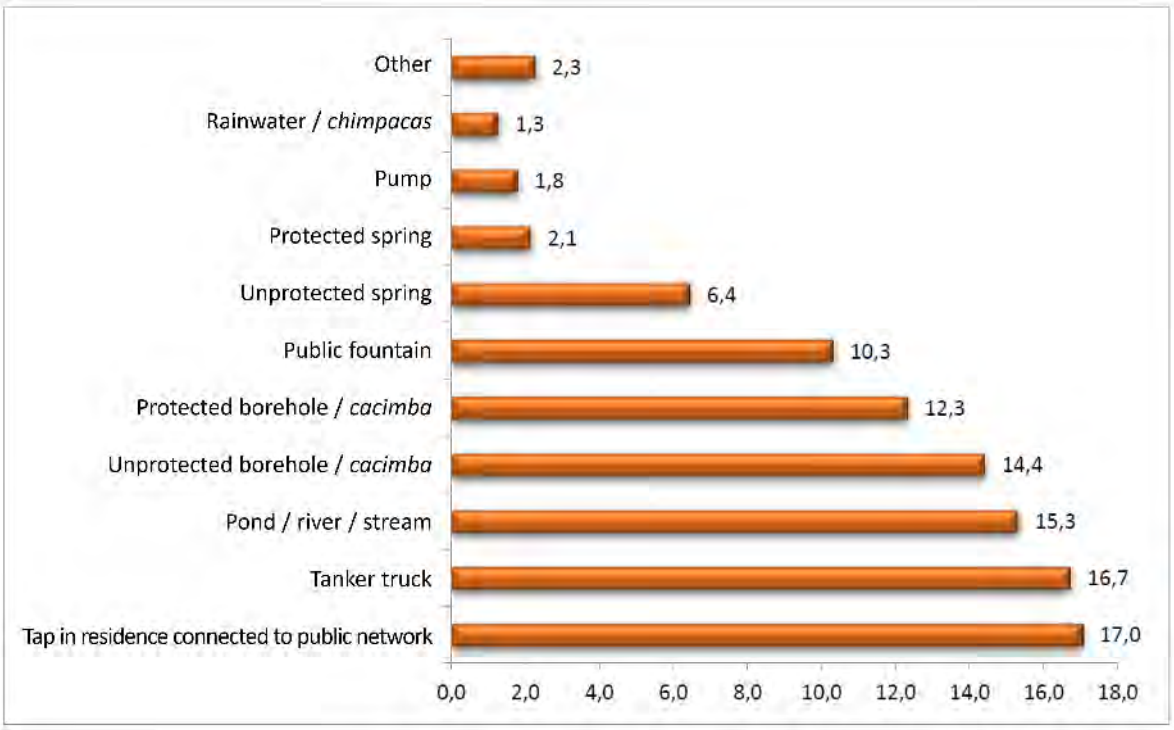


Figure 5-22: Sources of household drinking water supply in Angola (INE, 2016).

In Huíla Province, according to the results of the 2014 Census, only 35.5% of households have access to appropriate sources of drinking water.

Table 5-9: Households with access to suitable drinking water by area of residence (INE, 2016)

Province and area of residence	No.	%
Urban	114 526	70.4
Rural	68 321	19.4
Huíla	**182 847**	**35.5**

There are significant differences in access to suitable drinking water between the municipalities. The municipality of Lubango has the highest figure compared to the other municipalities, with 62% of households having access to water suitable for drinking. The municipality of Cacula has the lowest figure at 11.9%. The municipalities of Chipindo (33.7%), Jamba (25.7%) and Cuvango (24.1%) are below the provincial average in terms of the use of appropriate water sources.

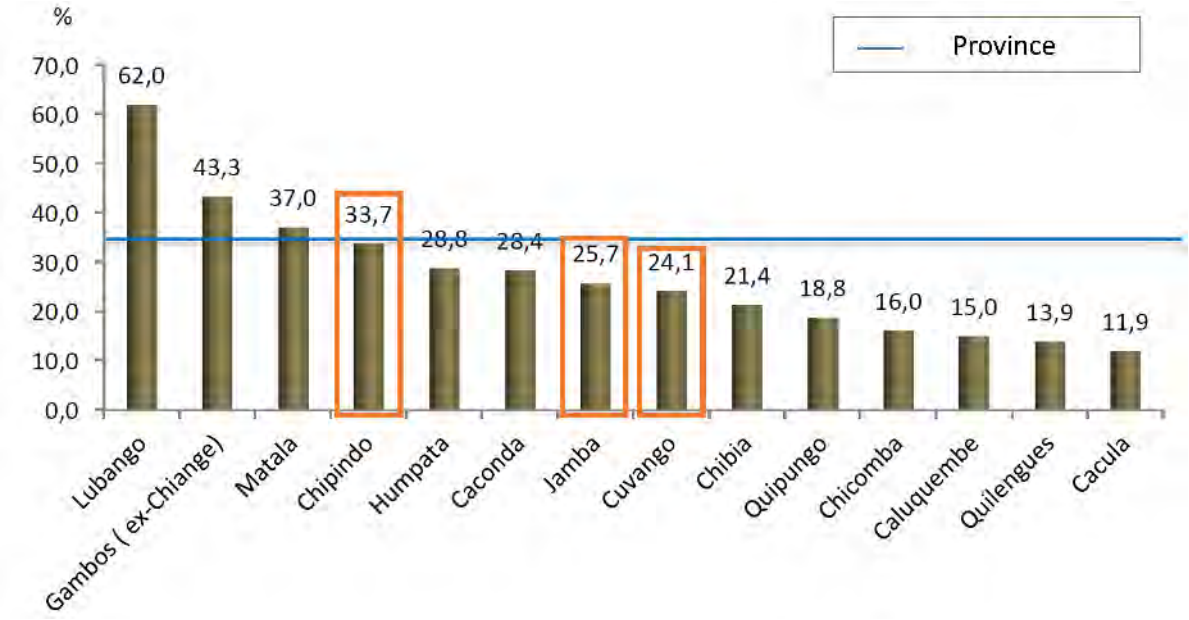


Figure 5-23: Households using appropriate sources of drinking water by municipality (INE, 2016).

5.7.1 Municipality of Jamba

In the seat of the municipality of Jamba, i.e., in the Jamba commune, the households have water connections under the government's "Water for All" project, as shown in **Table 5-10**.

Table 5-10: General data on the water sector in the municipality of Jamba (AMJ, 2024)

Commune	No. of household connections	Drinking water production capacity (m^3/day)	No. of water points	No. of fountains	No. of water supply systems	No. of small water systems	No. of people benefited
Jamba	3 532	850	25	42	3	25	35 023
Cassinga	--	--	10	3	0	1	30 573
Dongo	24	20	14	14	0	1	23 950

5.7.2 Municipality of Cuvango

The municipality has one water collection station built in the colonial period and rehabilitated in 2010. This system is made up of a catchment on the Cubango River, a pumping pipeline, a 200 m^3 distribution reservoir and an approximate length of 5 500 metres of pipeline, with 263 connections in

the form of backyard taps. In addition, there are 15 water points and two small water systems, an example of which is shown in **Figure 5-24**.



Figure 5-24: One of the water supply points in the municipality.

5.8 Electricity supply and distribution network

According to the 2018-2022 NDP, electricity is one of the biggest challenges in terms of infrastructure development, with repercussions on competitiveness, diversification and economic growth, as well as improving the provision of essential services and citizens' quality of life. Angola's Long-Term Development Strategy (2025) sets out one of the visions for energy: "to ensure an efficient and integrated contribution from all the energy sources that make up Angola's energy matrix, for the sustainable development of the country and its energy self-sufficiency, promoting a growing intervention of energies supported by renewable natural resources".

In 2014, only 32% of households had access to grid-connected electricity (INE, 2016).

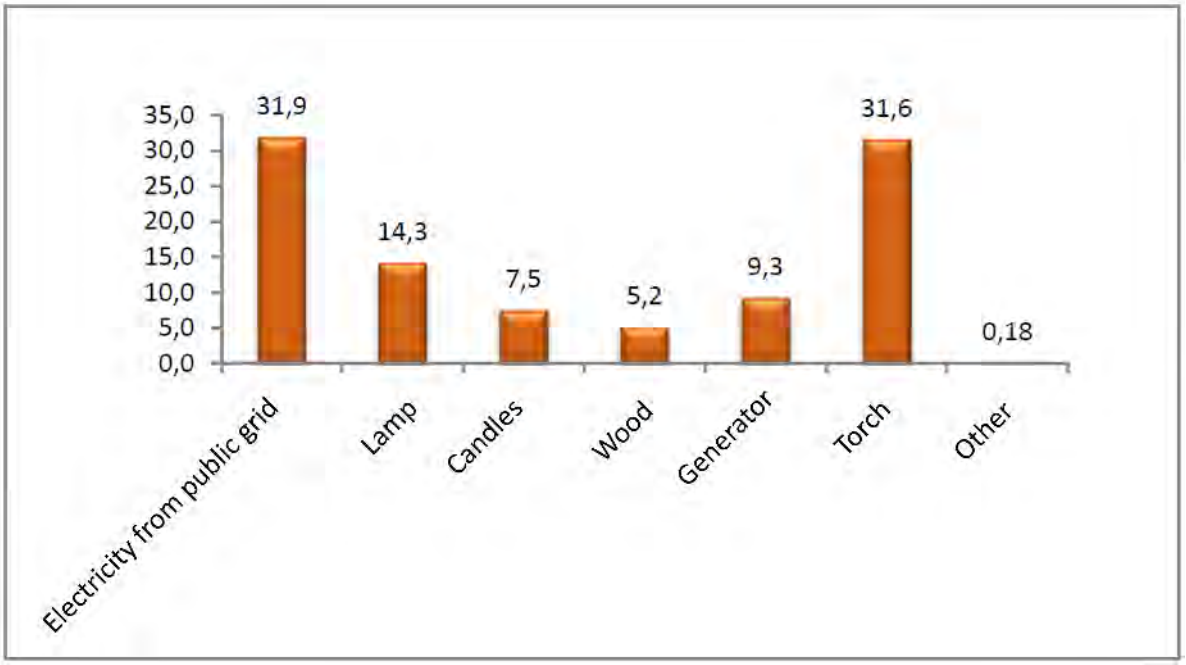


Figure 5-25: Proportion of households by type of lighting in Angola (INE, 2016).

Only around 42% of Angolans have access to electricity, of which 37.8% are connected to the national grid. The Provinces in the interior of the country have the lowest levels of access, such as Bié with 8% and Moxico with 10%. The highest rates are found on the country's coast, with Luanda having an access rate of 66% and Cabinda with 52%. The most electrified areas are in the coastal north of the

country, especially near the capital (ASAER & ALER, 2022). In 2014, only 16% of households in Huíla Province had access to electricity from the public grid, as shown in **Figure 5-26**.

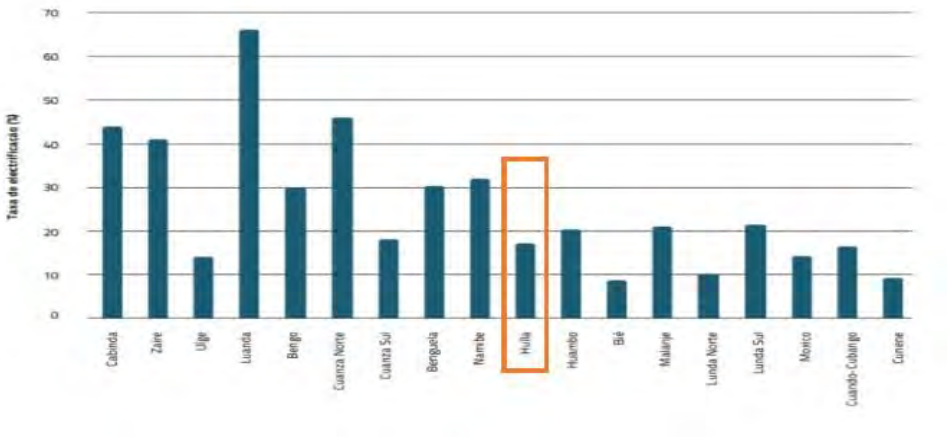


Figure 5-26: Provincial electrification rates in Angola (ENDE, 2022).

The Angolan electricity sector has been restructuring and increasing its production capacity, with three options currently being used to produce electricity: hydro, thermal and new renewables. The growth of the country's economy and population, combined with an electrification effort, investments in energy production and reinforcement of existing power stations, has resulted in a sharp increase in supply and demand for electricity. In 2021, the total installed capacity for electricity production was 5 880.19 MW, of which 3 676.12 MW was hydroelectric, 2 169.07 MW thermal and 35 MW hybrid (solar and diesel) as shown in **Figure 5-27** (ASAER & ALER, 2022).

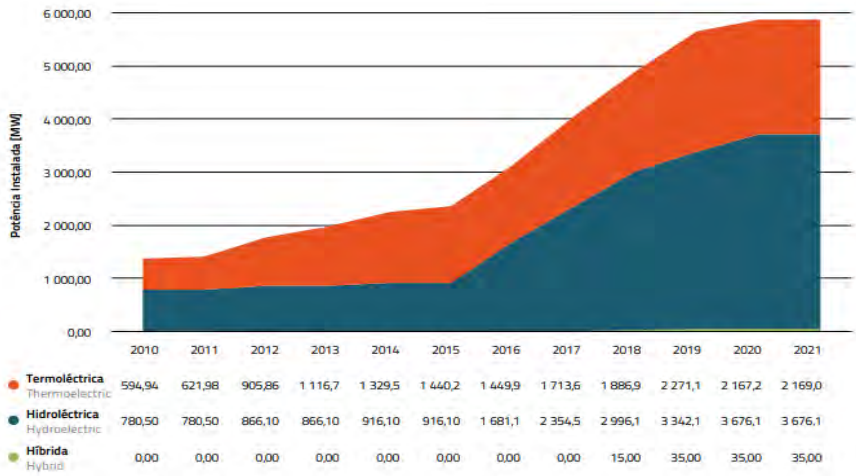


Figure 5-27: Installed electricity production capacity by source (PRODEL, 2022).

In 2014, only 16 per cent of households in Huíla province had access to electricity from the public grid and 50 per cent have access to energy by using torches (**Figure 5-28**) (INE, 2016).

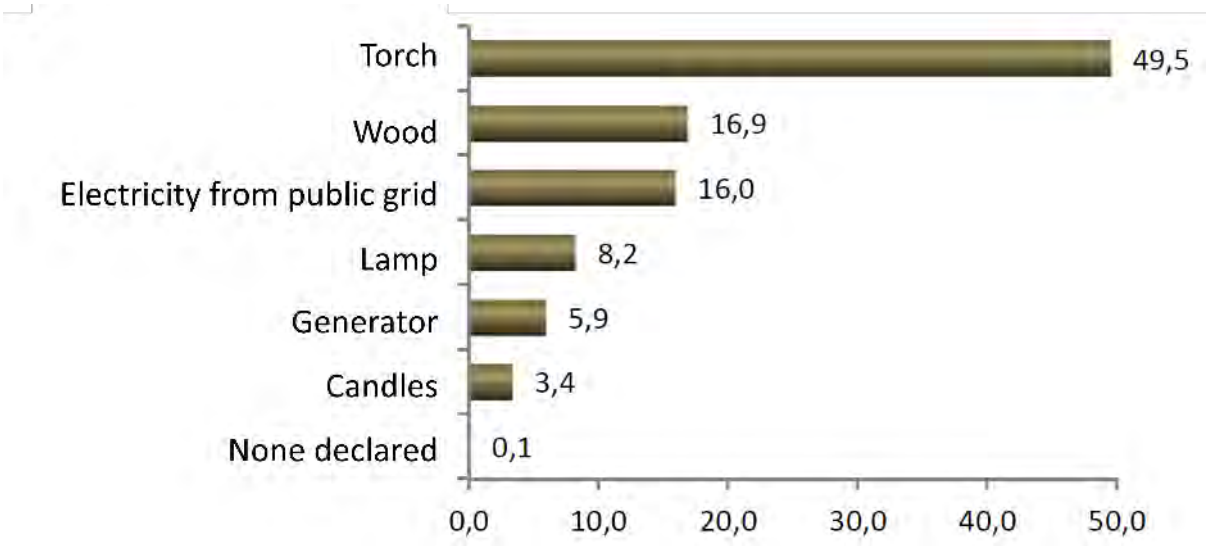


Figure 5-28: Household distribution of main type of lighting in the Huíla Province.

Table 5-11: Households by area of residence, municipalities and communes, by type of lighting (INE, 2016)

Province, area of residence, municipalities and communes	No of households	Type of lighting						
		Grid electricity	Lamp	Candle	Firewood	Generator	Torch	Other
Province	**514 412**	**82 144**	**42 345**	**17 346**	**86 876**	**30 530**	**254 660**	**512**
Urban	**162 735**	**75 655**	**16 689**	**13 444**	**1 889**	**19 506**	**35 353**	**199**
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	**351 678**	**6 489**	**25 656**	**3 902**	**84 987**	**11 024**	**219 307**	**314**
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

In the Province of Huíla, the Matala Dam was established in 1959 in the Municipality of Matala on the Cunene River. It currently has a power generation capacity of approximately 100 MW, which supplies electricity not only to the Province of Huíla but also to the Province of Namibe.



Figure 5-29: Matala Dam.

5.8.1 Municipality of Cuvango

There is currently a distribution network in the Cuvango commune with 528 kVA and 500 kVA generator sets. A 1 250 kVA monoblock has been installed next to it to raise the voltage from 400 V to 15 kV to supply the medium-voltage (MV) network. Three 250 kVA rural-type transformer substations (PTs) were supplied and installed along a 2 355 m distribution line.

5.8.2 Municipality of Jamba

General electrification information for the municipality was obtained and is summarised in **Table 5-12** below.

Table 5-12: General sector data (AMJ, 2024)

No. of existing thermal power stations	No. of electrical stations	No. of MV networks	No. of LV networks	No. of PTs	No. of household connections (through contract)	Total number of beneficiaries
1		2	3	5	801	4 445
No. of low-voltage post-paid customers	**No. of medium voltage customers**	**Installed capacity of private power stations MW**	**Electrification rate %***	**No. of customers**	**% minimum electrification rate****	**% coverage rate in rural areas**
772	---	2.5 MW	34.40%	772	65%	0
No. of mini-hydro plants	**No. of solar power plants**	**No. of diesel power plants**				
		1				

** Area in Jamba village already electrified*

*** Amount needed to electrify the entire municipality (according to the Energy and Water Director of Jamba Administration)*

5.9 Waste management

In Huíla Province, only 8.3% of households dispose of waste in appropriate places. Waste is deposited in the open by 72.5% of households living in urban areas and 93.1% of those living in rural areas. Only 11% of households living in urban areas dispose of waste in bins (INE, 2016), as shown in **Table 5-13** and **Figure 5-30**.

Table 5-13: Households that dispose of waste in appropriate places by area of residence (INE, 2016)

Province of residence	No.	%
Huila	42 452	8.3
Urban	30 604	18.8
Rural	11 848	3.4

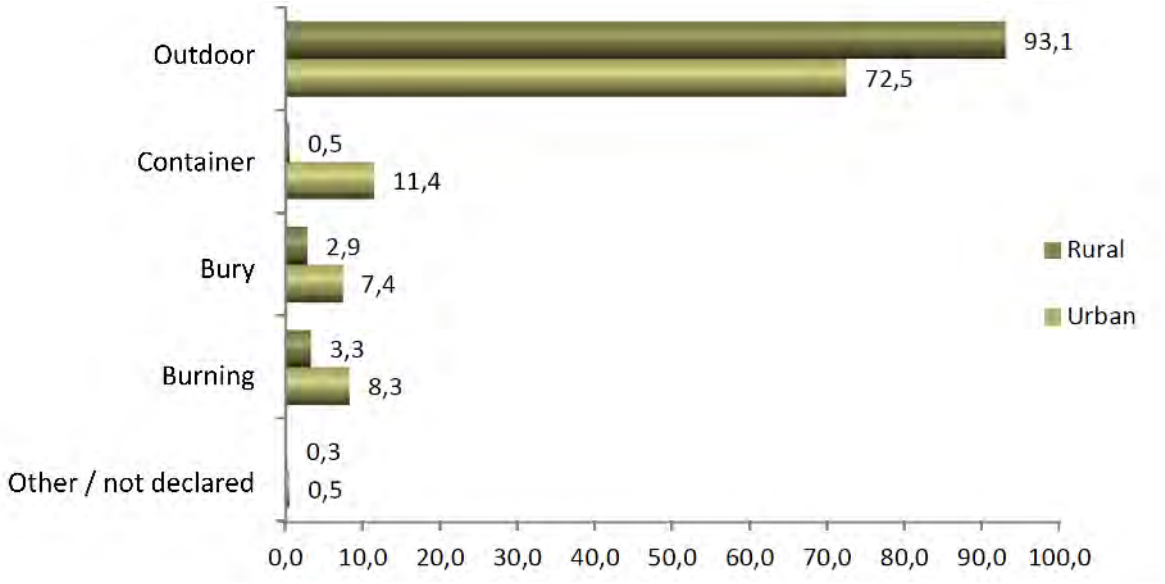


Figure 5-30: Households, by main waste disposal site and area of residence, Huíla Province (INE, 2016).

In all of the Province's municipalities, the major concerns about solid waste and wastewater management are related to the lack of landfill sites, good coverage of waste containers and waste recycling systems, which are a source of pollution and the multiplication of vectors of transmissible diseases.

In the municipalities that cover the project area, there are no private public cleaning companies, as is the case in other municipalities in the country. In these municipalities, waste management is the responsibility of the Municipal Directorates of Community Services and Environment, as shown in **Figure 5-31**.



Figure 5-31: Public cleaning workers in Cuvango headquarters.

5.10 Sanitation

The conditions of sanitation facilities can contribute to the transmission of diseases such as cholera, typhoid fever and others, so the use of appropriate, non-shared sanitation facilities is important. At national level, around a third of households (32%) have some form of appropriate, non-shared sanitation facility and the proportion is higher in urban areas (46%) than in rural areas (11%). On the other hand, 15% of households use shared facilities and this is more frequent in urban areas (23% in urban areas and 3% in rural areas). More than half of households have unsuitable facilities (5%), and this percentage is almost three times higher in rural areas than in urban areas (86% and 32% respectively) (INE, 2017).

At provincial level, 26.4% of households use an appropriate place to defecate. However, this figure is only 7.1% in rural areas, compared to 68.1% in urban areas, as shown in **Table 5-14** (INE, 2016).

Table 5-14: Households that use appropriate places to defecate, by area of residence

Province and area of residence	No.	%
Urban	110 751	68.1%
Rural	25 070	7.1%
Huíla	135 822	26.4%

There are different realities between municipalities regarding the use of appropriate sanitation facilities. Between 11.7% and 26.4% in Chipindo, and between 2.1% and 11.7% of Jamba and Cuvango's households use appropriate sanitation facilities as shown in **Figure 5-32**.

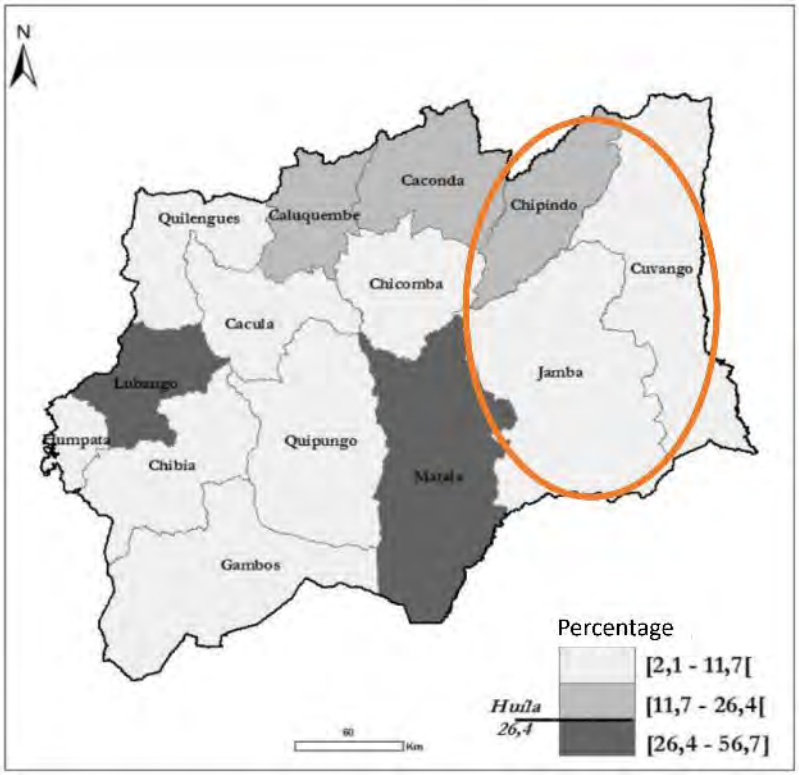


Figure 5-32: Households using appropriate sanitation facilities, by municipality (INE, 2016).

5.11 Housing

In Angola, the majority of occupied family homes in 2014 were of the conventional type, at around 74%, followed by the *cubata* type (huts), at around 22% (INE, 2016), as shown in **Figure 5-33**.

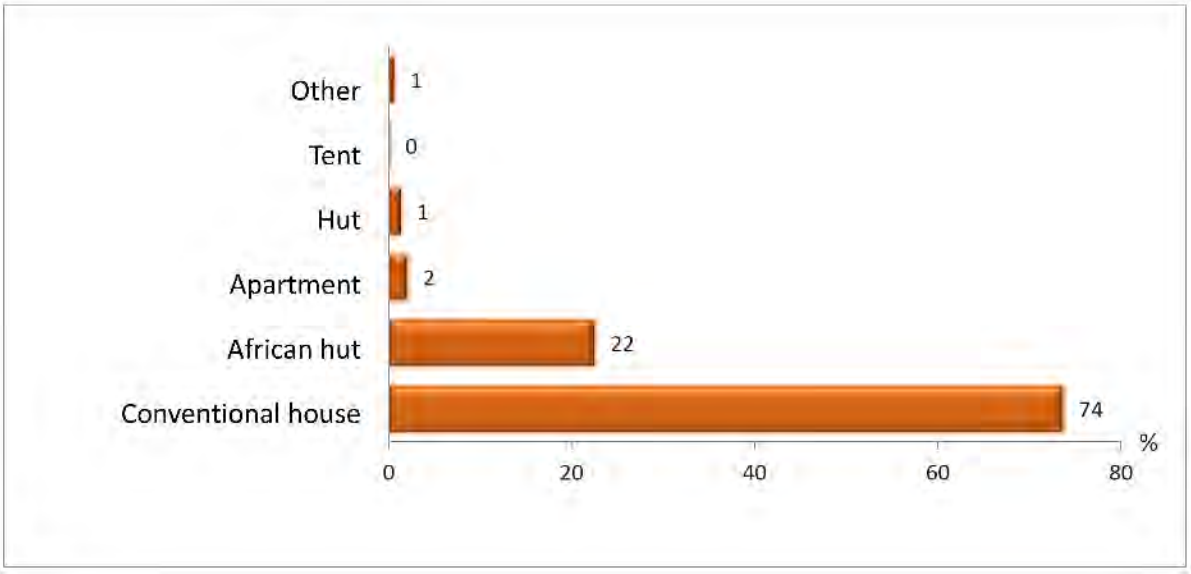


Figure 5-33: Households by type of dwelling, 2014 (INE, 2016).

In 2014, the majority of occupied family homes in Huíla Province were of the *cubata* type, at around 56.6%, followed by conventional houses (42.2%) and flats (0.5%), as shown in **Figure 5-34**.

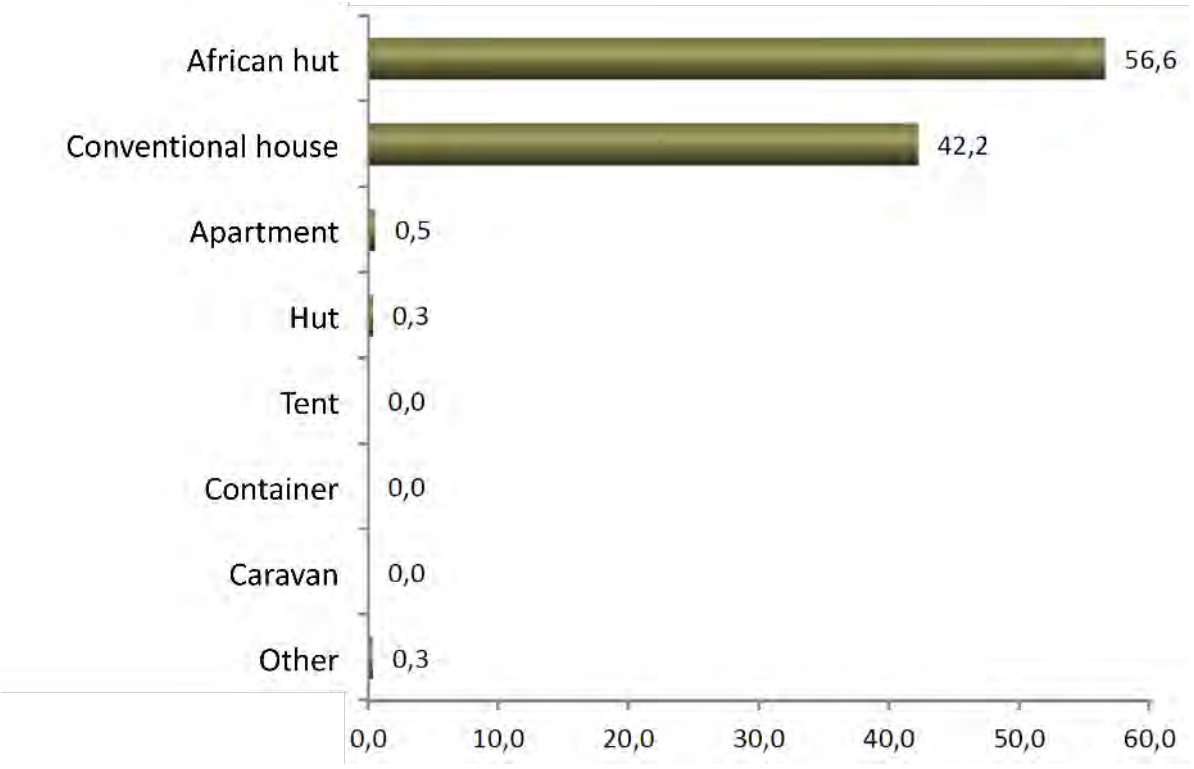


Figure 5-34: Households by type of dwelling in Huíla Province, 2014 (INE, 2016).

Examples of typical houses in the project area are house is shown in **Figure 5-35**.



Figure 5-35: An example of a one-room house in Ngokue, Cuvango(left), and a house with a sand and cement wall (right), taken in Bairro 1º de Maio, Chipindo.

5.12 Heritage and culture

The Huíla Provincial Directorate of Culture has inventoried 180 monuments and historical sites, as well as 121 *Ombalas* (soba villages) that need to be classified. These include monuments and sites of civil, military, religious and funerary interest, historical sites, landscapes and natural areas. Some points of interest have attracted many domestic and foreign tourists, such as the Caconda Catholic Mission, the Huíla commune Catholic Mission, the building housing the Huíla Provincial Directorate of Culture, the Christ the King statue, the Chapel of Our Lady of the Mount, the National Assembly centre building, the Huíla Regional Museum and the Jau Catholic Mission (in the Chibia municipality).

The Province has natural, cultural and socio-economic resources that, in essence, constitute high tourism potential, which could be geared towards rural areas or cultural and urban leisure tourism, with the city of Lubango standing out in this field, as a UNESCO World Heritage Site (Ramos, 2023)

In the project area, in the municipality of Cuvango, there is the Catholic Mission of Cuvango (*Imaculada Conceição*), recently classified (Executive Decree No. 87/24, of April 29th 2024) as a Historical Cultural Heritage Site.

5.12.1 Cuvango Catholic Mission (*Imaculada Conceição*)

The Church of the Catholic Mission of Cuvango (*Imaculada Conceição*), is also known as the “Mission of Vila da Ponte” because of the bridge that stands next to it. It has also been called “the Mission of Cascata” because of the waterfall around it that feeds the Cubango River. The mission was built in 1964, under the orders of its first priest, Martinho Van Koolwjk, a Dutch national belonging to the Congregation of Spiritan missionaries (AMC, 2023).

It is one of the largest in the country when it comes to Catholic missions. Its layout is unique in that similar churches can only be found in Holland (see **Figure 5-36**) (AMC, 2023). The location of the Cuvango Catholic Mission relative to the project area is shown in **Figure 5-37**.



Figure 5-36: Front and interior views of the Mission (AMC, 2023).

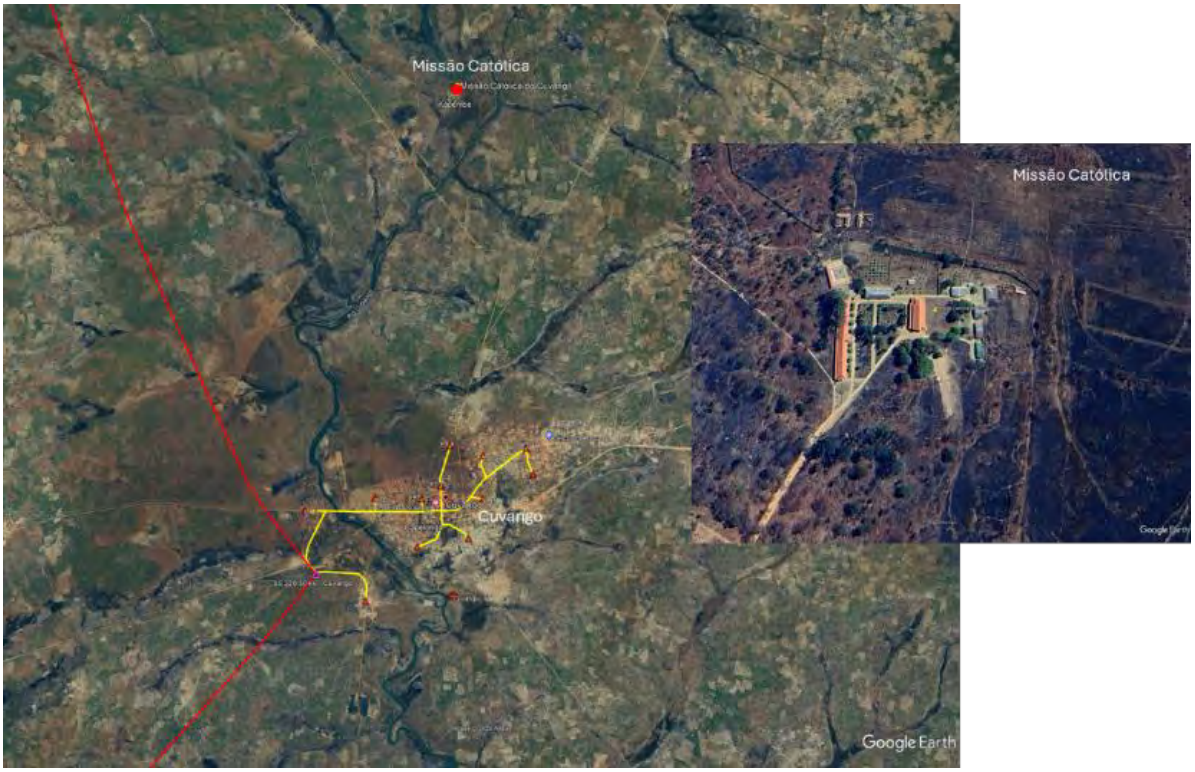


Figure 5-37: Location of Cuvango Catholic Mission Cultural Heritage site relative to the project area.

According to data from the Cuvango Municipal Directorate of Education and Culture, other historic buildings and sites in the municipality have also been proposed for recognition as National Historical and Cultural Heritage, namely the Padre Ernesto Lecont historical monument and the town parish (*Paróquia da Vila*).

5.12.2 Father Ernesto Lecont historical monument

According to historical data, Lecont landed in Angola in 1884 to evangelise the peoples of the south, including the Ngagela people. The monument shown in **Figure 5-38** was built in honour of this Catholic missionary, Father Ernesto Lecont, in December 1889, who faced an assassination attempt instigated by Mwene Thyawako, who had him tied to a tree (*mulembeira*) and later executed. It is a monument built in colonial times to honour the memory, deeds and good name of this figure, who contributed to the evangelisation of the municipality's indigenous community.



Figure 5-38: Front of the Fr Ernesto Lecont Monument.

5.12.3 *Paróquia da Vila* (Town Parish)

The *Paróquia da Vila* is also on the list of Cuvango's historical and cultural monuments to be classified. Founded in 1940 by the Spiritan Missionaries, the church was built from scratch using raw bricks produced locally, i.e. in the old ceramics factory in the municipality.



Figure 5-39: Front of the Vila parish church.

Figure 5-40: shows the location of the two sites, *Paróquia da Vila* (1) and Monumento Padre Ernesto Lecont.



Figure 5-40: Locations of Fr. *Paróquia da Vila* (1) *and* Ernesto Lecont Monument (2).

5.13 Social programmes to reduce poverty

Poverty in Angola refers to the substantial inequality in income distribution and the existence of a significant part of the population subject to minimum conditions of dignity and citizenship. The 2018-2022 Integrated Plan for Local Development and Combating Poverty (*Programa Integrado de Desenvolvimento Local e Combate à Pobreza*, PIDLCP) arises from the need to review the national objectives and priorities to be followed in the fight against extreme poverty in Angola, with the main objective being to reduce the incidence rate of poverty in the medium term (INE, 2019).

With a view to improving the well-being and quality of life of Angolan families, reducing inequalities and poverty, *Programme 1.1.1 Local Development and Combating Poverty*, of the NDP, established some priority actions to end poverty at the national level, such as:

- Municipalising social action services by promoting the creation of Integrated Social Centres (CASI);
- Building a vulnerability database and registering Social Action beneficiaries with information on beneficiaries, the nature and profile and dimensions of local vulnerability;
- To provide social benefits in cash or kind to families in extreme poverty;
- Implement the National Programme for the Delimitation and Subsequent Granting of Land and Titles to Rural Land;
- Ensure primary health care in all municipalities;
- Ensuring that the most vulnerable families are exempt from health/education fees; and
- Expanding the work of the Community and Health Development Agents (ADECOS).

In 2017, the Angolan government, through the Ministry of Social Action, Family and Women's Promotion (MASFAMU), launched the Municipalisation of Social Action Programme, with the inauguration of CASI, an example of which is shown in **Figure 5-41**. The Municipalisation of Social Action is operationalised through the implementation of the CASI and materialised through the intervention of Social Activists in communities to identify cases of people in situations of social vulnerability (domestic or sexual violence, abandonment of children or the elderly, people with disabilities, and others) and referring them to social services for Justice, Health or Education Departments, already provided by the State.



Figure 5-41: Jamba Integrated Social Action Centre.

Based on the graph below (**Figure 5-42**), in Huíla Province, the municipalities of Chicomba, Cacula and Gambos have an *incidence*[3] of 96% or more, which means that almost all the people in these three municipalities are multidimensionally poor. The municipality of Chibia has an intensity of 68%,

[3] The *incidence* of multidimensional poverty is the percentage of people who are poor, while the *intensity* is the average number of deprivations each poor person experiences.

the highest among all the municipalities in the Province, which means that the poor in this municipality suffer on average 68% deprivation of the selected indicators. The Incidence and Intensity rates for the project-affected municipalities are as follows, respectively:

- Chipindo: 87% and 59%
- Jamba: 93% and 66% (multidimensionally poor)
- Cuvango:94% and 66% (multidimensionally poor)

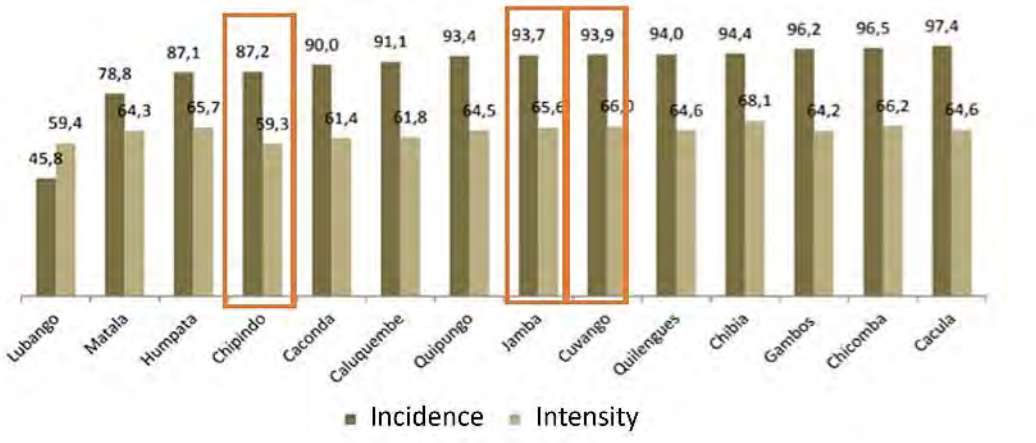


Figure 5-42: Incidence and Intensity of poverty by municipality (INE, 2019).

The results of the municipal estimates for the Multidimensional Poverty Index by Municipality (MPI-M) (rated on a scale between zero and one, where one is the highest in poverty dimensions), as well as the incidence of poverty and the intensity of poverty, show that 65 of the 164 municipalities have an incidence of poverty above 90%, i.e. at least nine out of every ten people in these municipalities are multidimensionally poor.

The ranges of the MPI-M in the municipalities of Angola are shown in **Figure 5-43** below.

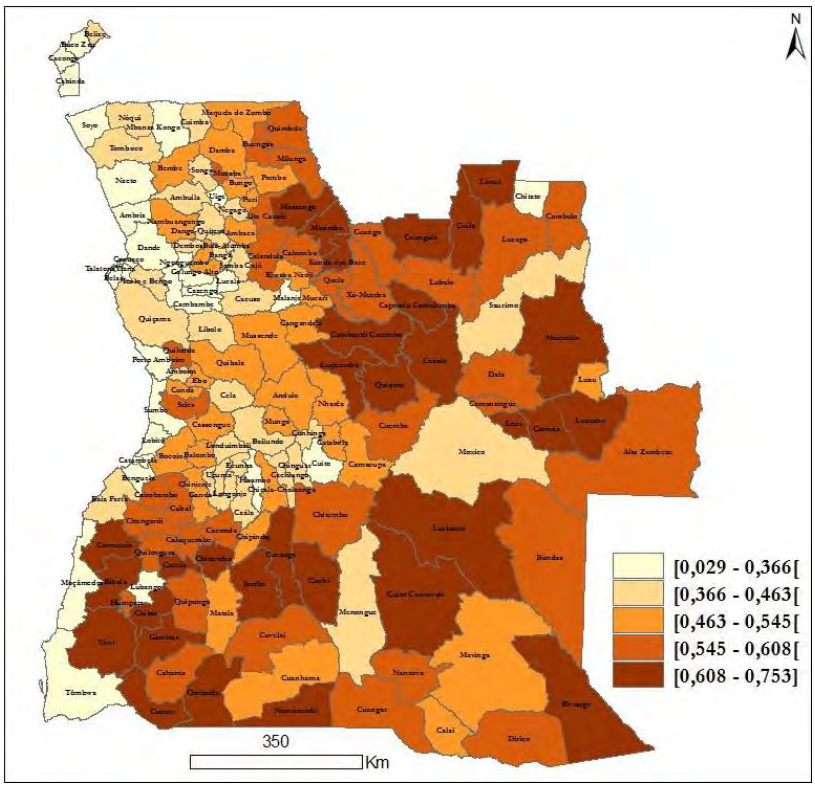


Figure 5-43: Multidimensional poverty by municipality (INE, 2019).

In Huíla province, the municipality with the highest MPI-M is Chibia, with 0.643. The municipality of Lubango has the lowest MPI-M (0.272) (see **Figure 5-44** below). The MPI-M for Jamba is 0.615, for Cuvango it is 0.62, and for Chipindo it is 0.517.



Figure 5-44: MPI-M, Huíla (INE, 2019).

Figure 5-45 below shows that in all the municipalities, the indicators on water, sanitation and grid electricity contribute more than 40% to poverty in these municipalities. The proportions of each of these indicators for the project-affected municipalities are as follows:

- 13%, 18% and 14%, respectively for water, sanitation and electricity in Chipindo
- 14%, 19% and 13% in Jamba
- 14%, 17% and 13% in Cuvango

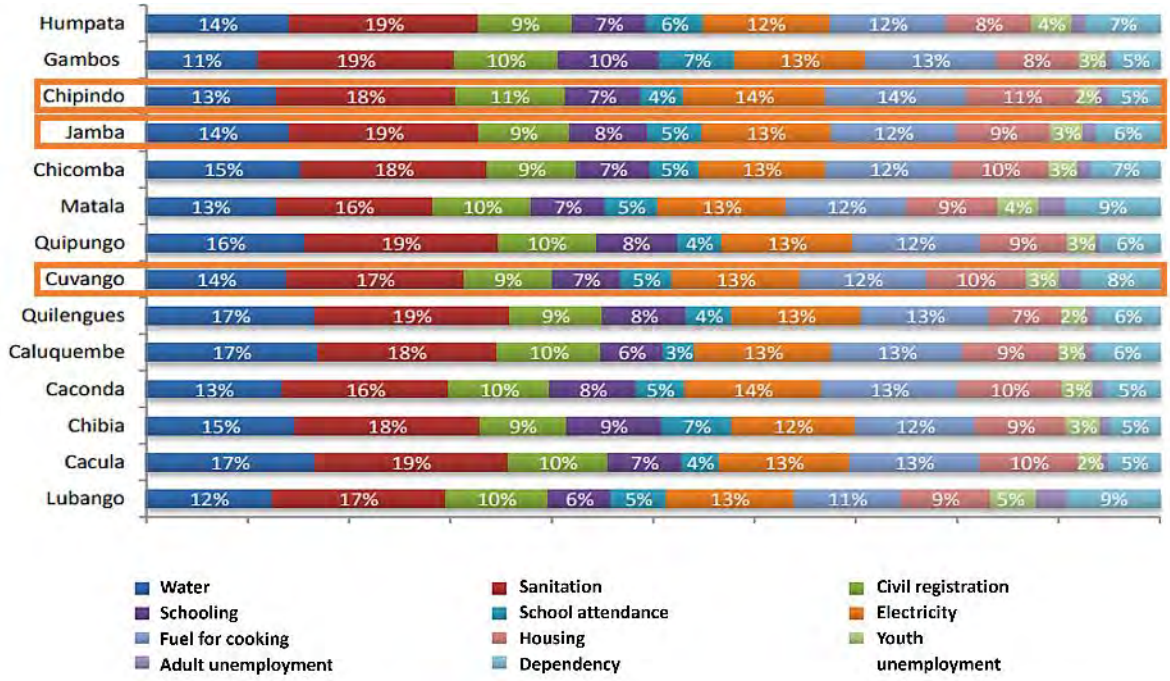


Figure 5-45: Percentage contribution of each indicator in the MPI-M (INE, 2019).

The Government of Angola (GoA) has received a loan of US$ 320 million from the World Bank (WB) to implement the National Social Protection System Strengthening Project (KWENDA), the aim of which is to strengthen the capacity of the Social Protection Sector to implement short and medium-

term poverty mitigation measures that: (i) increase the purchasing and financial capacity of families by providing a monthly income to poor families in selected areas and (ii) help to establish an effective National Social Protection System. None of the villages in the project area have yet been covered by the KWENDA project.

A survey carried out in 2020 by the Presidency of the GoA, the International Policy Centre for Inclusive Growth (IPC-IG) and the UNDP, mapped and analysed 36 social programmes managed by national and international institutions to combat poverty in Angola.

5.13.1 Municipality of Jamba

In the municipality of Jamba, five community development programmes were identified, namely: the PIDLCP, the Rural Development Extension Programme (*Programa de Extensão de Desenvolvimento*, PEDR) to support subsistence farming families and small farmers (assistance rates are shown in **Table 5-15**), the Programme to Promote and Strengthen Community Organisation, the Integrated Municipal Intervention Programme (*Programa Integrado de Intervenção Municipal*, PIIM) and the CarrinhoAgri Project.

Table 5-15: Review of the PEDR in the Jamba municipality

Communes	Approximate no. of inhabitants	Villages		No. of families		No. of small farmers assisted
		Existing	Assisted	Existing	Assisted	
Jamba	45 023	63	16	12 289	28	14 500
Dongo	57 970	41	08	6 226	99	11 200
Cassinga	27 096	76	14	2 500	54	6 800
Total	**130 029**	**127**	**38**	**18 515**	**241**	**32 500**

5.13.2 Municipality of Chipindo

In the municipality of Chipindo, three community development programmes have been identified, namely, PIDLCP, PIIM, and the CartAgri project.

5.14 Economy

According to the GoA's projections presented in the 2018-2022 NDP, the "GDP should grow between 2018 and 2022, in real terms, at an average rate of 3%, with the oil sector including natural gas declining by an average of 2% and the non-oil sector growing by an average of 5.1%". These decreases and increases were also forecast in the 2017-2022 NDP, as shown in **Table 5-16**.

Table 5-16: Evolution of Gross Domestic Product 2017-2022 (MINFIN, 2018)

Nominal GDP and growth rate	2017	2018	2019	2020	2021	2022
GDP (nominal) thousand million Kwanzas	16 455.90	23 274.50	29 220.60	33 673.90	37 784.00	42 191.40
Real GDP growth rate (%)	-2.1	2.3	3.5	2.4	2.6	4.1
Oil	-5.2	0.8	0.6	-3.6	-2.5	-4.5
Gas	461.4	18.5	14	1.8	-36	-10.8
Non-oil	-4.7	2.4	4.4	5	6.2	7.5

5.15 Agriculture and livestock

Family farming is the basis of Angolan agriculture and is fundamentally developed by subsistence farmers who still practice farming systems using family labour, selling some of their surplus production to the consumer market, namely cassava, maize, beans, potatoes and also some vegetables and even fruit. It is responsible for producing around 80% of cereals, 90% of roots and tubers and 90% of pulses and oilseeds. Entrepreneurial agriculture, on the other hand, comprises medium and large-scale investments geared towards the market and national self-sufficiency, which allow economies of scale to develop and ensure quality and competitive products, quantity and regularity of domestic distribution and export potential (GoA, 2018).

In 2016, 46% of households practiced some form of agricultural activity. The Province of Kwanza Sul had the highest proportion of households with agricultural activities, while the Provinces of Cabinda, Namibe and Luanda had the lowest proportions, as shown in **Figure 5-46**. In the Huila Province, this number ranged between 67.7% and 72.5%. Around 6% of households practised fishing activities.

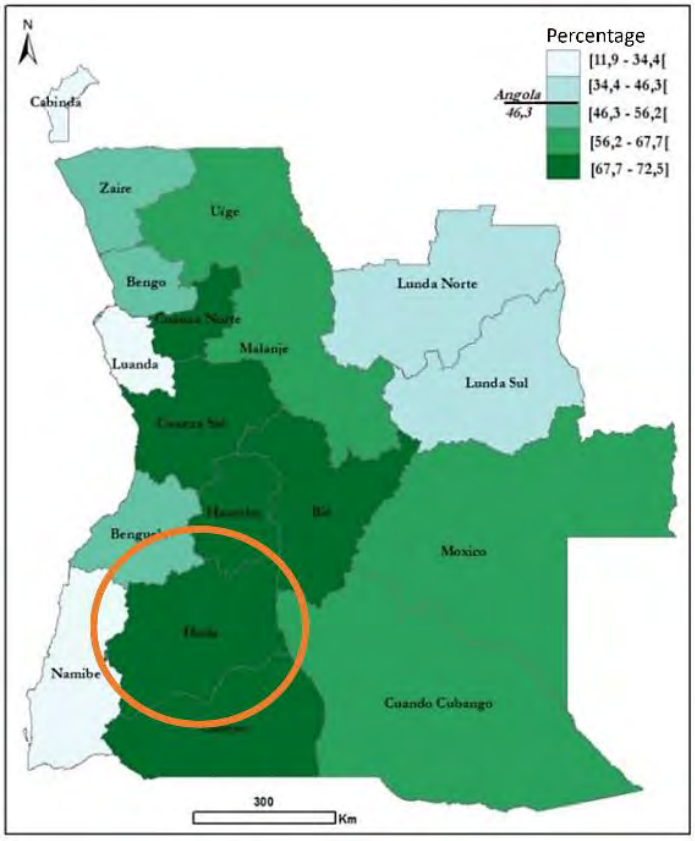


Figure 5-46: Households engaged in agricultural activities, by Province (INE, 2016).

During the 2018/2019 Agricultural Year, 5 699 533 080.00 Kwanzas were made available by the World Bank and the Government of Angola. The funds were used to purchase technological packages that enabled 81 579 families to be assisted. Along with initiatives from the Smallholder Agriculture Development and Commercialisation Project (MOSAP II) another 28 568 received assistance. Thus, a total of 110 147 families, which represents 4% of the total families controlled by the Agrarian Development Institute (IDA) (MINAGRIF, 2019), received assistance.

In the same year, almost 2 million tonnes of vegetables were produced, an increase of 2.6% on the same period last year. Central Angola contributed more than 72% of the total production volume. Nationally, the main crops produced were onions and tomatoes (MINAGRIF, 2019). This refers to national production in the period under review, not only as a result of the funding mentioned in the previous paragraph.

According to the 2019-2020 Agricultural and Fisheries Census (RAPP) there were 5 858 Agricultural and Aquaculture Businesses (AABs) in the country during the reference period. The provinces of Cabinda, Cuando Cubango and Moxico have the lowest number of AABs, corresponding to less than 2% of the total (INE, 2022). Of the 5 858 AABs registered in the country, 320 are in the Huíla Province, of which 88.8% are in its rural areas and 11.3% are in urban areas, as shown in **Table 5-17**.

Table 5-17: Provincial distribution of AABs according to area of residence (INE, 2022)

Country / Province	Farms by province and area of residence				
	Total agricultural and aquaculture business	Urban		Rural	
	n	n	%	n	%
Angola	**5858**	**642**	**10.96**	**5216**	**89**
Cabinda	49	20	40.8	29	59.2
Zaire	386	102	26.4	284	73.6
Uíge	415	69	16.6	346	83.4
Luanda	204	26	12.7	178	87.3
Cuanza Norte	352	8	2.3	344	97.7
Cuanza Sul	486	37	7.6	449	92.4
Malanje	274	7	2.6	267	97.4
Lunda Norte	473	50	10.6	423	89.4
Benguela	811	77	9.5	734	90.5
Huambo	550	37	6.7	513	93.3
Bíe	449	6	1.3	443	98.7
Moxico	84	9	10.7	75	89.3
Cuando Cubango	67	5	7.5	62	92.5
Namibe	186	10	5.4	176	94.6
Huíla	**320**	**36**	**11.3**	**284**	**88.8**
Cunene	146	12	8.2	134	91.8
Lunga Sul	213	53	24.9	160	75.1
Bengo	393	78	19.8	315	80.2

The total area occupied by agricultural and aquaculture businesses is 3 194 395 hectares (ha), with an average of 545 ha per business. The Province of Kwanza-Sul, with 520 773 ha and an average of 1 072 ha per farm, has the largest total area occupied, followed by the Provinces of Huíla with 386 347 ha and Cunene with 323 352 ha. The average surface area in Huíla is 1 207 ha per AAB, as shown in **Table 5-18**.

Table 5-18: Total AAB in ha by Province (INE, 2022)

Country / Province	Total surface area	Average surface area
Angola	**3 194 395**	**545**
Cabinda	17 302	353
Zaire	61 816	160
Uíge	217 258	524
Luanda	42 309	207
Cuanza Norte	172 234	489
Cuanza Sul	520 773	1 072
Malanje	295 712	1 079
Lunda Norte	265 827	562
Benguela	234 395	289
Huambo	112 829	205
Bié	107 654	240
Moxico	87 143	1 037
Cuando Cubango	35 633	532
Namibe	31 409	169
Huila	386 347	1 207
Cunene	323 352	2 215
Lunda Sul	159 315	748
Bengo	123 089	313

According to data from the Agricultural and Fisheries Census, maize is one of the main staples of the population's diet. Approximately 64% of AABs grow maize. In the roots and tubers sub-sector, 46% of farms cultivate cassava, followed by sweet potato at 23%. In the pulses and oilseeds, butter beans with 32%, followed by *ginguba* (peanuts) at around 16%. In the vegetables sub-sector, tomatoes are grown by 34% of farms, followed by onions, with 27% of farms growing onions. Cabbage and kale are grown by around 19% and 18% of farms respectively. The number of hectares on which various crops are cultivated is shown in **Figure 5-47**.

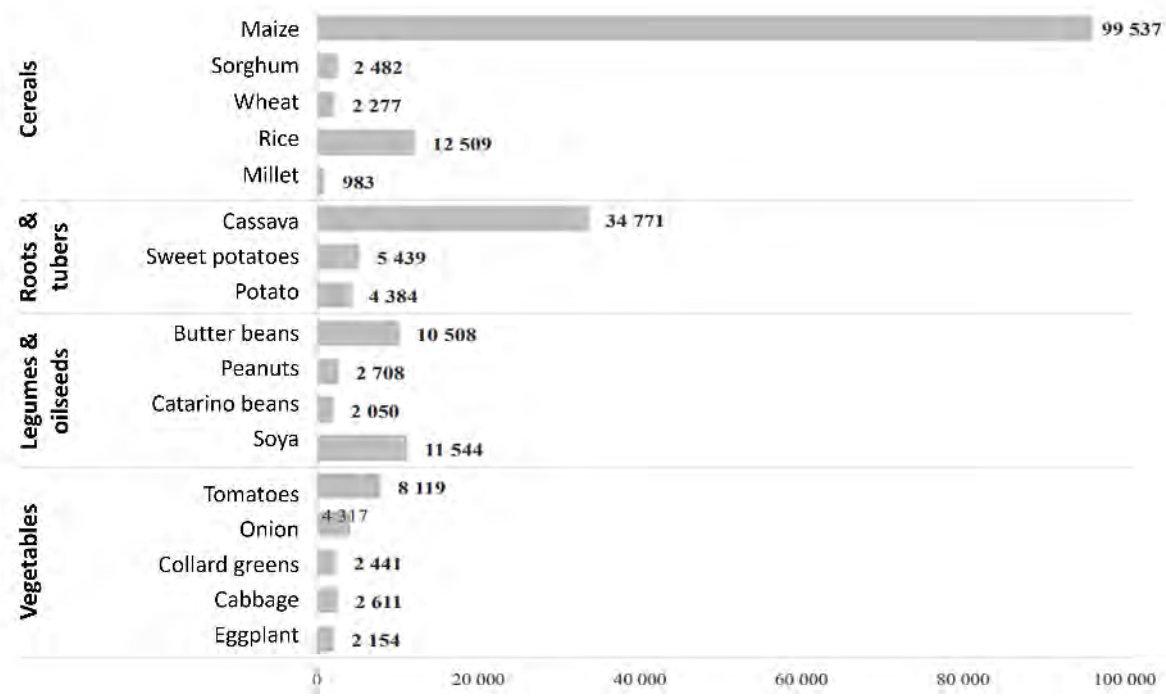


Figure 5-47: Areas cultivated with the main temporary crops (hectares) (INE, 2022).

Around 23% of the Entrepreneurial Agricultural and Aquaculture Farms use electricity for the production process. Of these EEs, 84% use generators and only 12% benefit from the public grid. Of

the Provinces with the highest percentages of farms using the public power grid, Bengo stands out with 46.2% and **Huíla** with 22.9%.

Table 5-19: Agricultural and aquaculture farms according to the source of electricity used by Province (INE, 2022)

Country / Province	Uses electricity		Public grid		Private grid		Generator		Solar	
	N	%	N	%	N	%	N	%	N	%
Angola	**1320**	**22,5**	**160**	**12,1**	**72**	**5,5**	**1106**	**83,8**	**88**	**6,7**
Cabinda	28	57,1	1	3,6	1	3,6	25	89,3	1	3,6
Zaire	49	12,7	5	10,2	1	2	37	75,5	5	10,2
Uige	87	21	6	6,9	1	1,1	81	93,1	4	4,6
Luanda	99	48,5	31	31,3	16	16,2	78	78,8	9	9,1
Cuanza Norte	92	26,1	5	5,4	4	4,3	85	92,4	0	0
Cuanza Sul	181	37,2	11	6,1	1	0,6	163	90,1	16	8,8
Malanje	123	44,9	12	9,8	23	18,7	88	71,5	5	4,1
Lunda Norte	72	15,2	1	1,4	2	2,8	69	95,8	3	4,2
Benguela	100	12,3	10	10	4	4	90	90	3	3
Huambo	59	10,7	1	1,7	0	0	55	93,2	7	11,9
Bie	42	9,4	1	2,4	0	0	40	95,2	1	2,4
Moxico	25	29,8	0	0	1	4	22	88	1	4
Cuando Cubango	16	23,9	1	6,3	0	0	15	93,8	3	18,8
Namibe	62	33,3	9	14,5	1	1,6	49	79	4	6,5
Huila	96	30	22	22,9	6	6,3	73	76	8	8,3
Cunene	29	19,9	1	3,4	3	10,3	24	82,8	9	31
Lunda Sul	67	31,5	0	0	0	0	65	97	5	7,5
Bengo	93	23,7	43	46,2	8	8,6	47	50,5	4	4,3

5.15.1 Municipality of Jamba

In the municipality of Jamba, the agricultural sector is strongly based on subsistence farming. There is agricultural potential in Jamba based on the production area (38 000 ha), but there is no evidence of existing cooperatives and associations. General indicators of the agricultural sector in Jamba are shown in **Table 5-20**.

Table 5-20: General indicators for the agricultural sector in Jamba (AMJ, 2024)

Indicators	Unit	Quantity
Number of hectares produced	ha	38 000
Cereal production	kg	24 000
Root and tuber production	kg	13 700
Pulses and oilseeds production	kg	12 000
Fruit production	kg	11 600
Vegetable production	kg	12 000
Sugarcane production	kg	16 000
Average cultivation area per family	ha	10
Degree of fertiliser availability	%	35
Degree of seed availability	%	25
Degree of availability of work tools/equipment	%	35
Farmer field schools (FFS)	no.	10
Demonstration pitches	no.	6
Agricultural Development Stations (EDAs)	no.	1
Cattle	no.	50 000
Caprine livestock (goats)	no.	69 667

Indicators	Unit	Quantity
Sheep	no.	7 000
Pig herds	no.	25 000
Poultry livestock	no.	22 500
Beef production	kg	7 200
Goat meat production	kg	1 200
Pork production	kg	2 500
Egg production	no.	1 050
Milk production	litres	3 000

5.15.2 Municipality of Chipindo

The municipality of Cuvango has a lot of potential for growth. It has nine cooperatives, 48 associations, three large farms, namely Mumba, AgriCuvango (**Figure 5-48**) and Kapunda, as well as small farmers. For the 2023-2024 agricultural year, 820 ha have been made available, 14 tonnes of Pannar® maize seeds have been distributed, and the harvest is expected to be around 39 023.21 tonnes.



Figure 5-48: AgriCuvango farm in the municipality of Cuvango.

A number of projects were also identified in the municipalities visited to support farming families, most notably CarrinhoAgri, run by Grupo Carrinho Comercio Lda, which supports 20 000 farming families in the Huíla Province (**Figure 5-49**). This initiative consists of providing families with equipment, working methods and various seeds and, in the end, buying the same harvest at market prices, without prejudice to the parties. Through its field schools, the project is mobilising families to adopt crops that are not widely grown and to make better use of the arable land available, on average between two and ten ha per family.



Figure 5-49: CarrinhoAgri's activities in the municipality of Cuvango.

There are 773 Business Farms (EEs) that practice livestock farming as their main activity and 2 341 that practice livestock farming as at least one of the company's activities. Huíla Province is one of the provinces with the largest cattle population, with 33 385 head (around 13%), after Benguela Province with 35 077 head (around 14% of the total) (INE, 2022).

5.16 Transport and traffic

5.16.1 Transport

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 5-50). Three-wheel motorbikes with passenger/cargo carriers are a commonly used form of transport (Figure 5-51).



Figure 5-50: A passenger and goods being carried on a motorbike in a rural area.



Figure 5-51: A three-wheel motorbike carrying passengers.

The more urbanised areas have a wider variety of transportation, such as private motor vehicles and minibus taxis (referred to locally as *candongueiros*, Figure 5-52). Roads are mostly unsurfaced, even in urban areas.



Figure 5-52: 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 line 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, and there is a station (**Figure 5-53**). The operation of

the Jamba Railway Branch began in 2018 and at the time it was expected to transport more than two million tonnes of pig iron[4] that would be concentrated in the municipality of Jamba (Huíla).



Figure 5-53: CFM station at Jamba.

5.16.2 Road infrastructure and traffic[5]

The largest part of the road network in the project area is made up of dirt roads, except the municipality of Jamba (Figure 5-54), which links the city of Lubango to Matala via asphalt road and the National Road (EN 280) linking Huíla to Cuando-Cubango and the Secondary Road linking Colui and Jamba. From Cuvango to Chipindo there are 105 km of dirt road and from Cuvango to Jamba there are 35 km of asphalted road (EN-280).



Figure 5-54: Road linking Jamba to Lubango.

The difficulty of travelling on dirt roads increases in rainy weather, and some sections become inaccessible, and bridges are damaged (Figure 5-55).

[4] Pig iron is a solid, hot metal that is a raw material for steel production.
[5] Detailed traffic data for the project AoI 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 5-55: Example of a bridge impacted by rainy weather.

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.

As far as road accidents are concerned, the most notable are those involving motorbikes. For example, in the municipality of Jamba, during the second quarter, according to data from the Municipal Command, nine road accidents were recorded (compared to the previous period), representing three accidents per month: two collisions, three hit-and-run accidents, four crashes, causing five deaths, eight serious injuries, three minor injuries as well as the death of three head of cattle and material damage. Crashes accounted for 44.44 per cent, hit-and-run accidents for 33.33 per cent, followed by collisions at 22.22 per cent each. Speeding, technical breakdowns and lack of warning signs were identified as the main causes of these incidents. With regard to road inspections, during the same period, the Municipal Command worked on the National Road 280 linking Huíla and Cuando-Cubango and the Secondary Road linking Colui and Jamba, where 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.

5.17 Labour force and employment structure

In 2014, the employment rate in Angola was 40%. The Provinces of Kwanza Sul and Malanje have the highest figures (INE, 2016). In Huíla Province, the municipalities of Gambos (formerly Chiang) and Chipindo have the highest employment rates at 63% and 61% respectively. At the opposite end of the spectrum is the municipality of Matala with 23%. Jamba (38.5%) and Cuvango (34.2%) are below the provincial average, as shown in **Figure 5-56**.

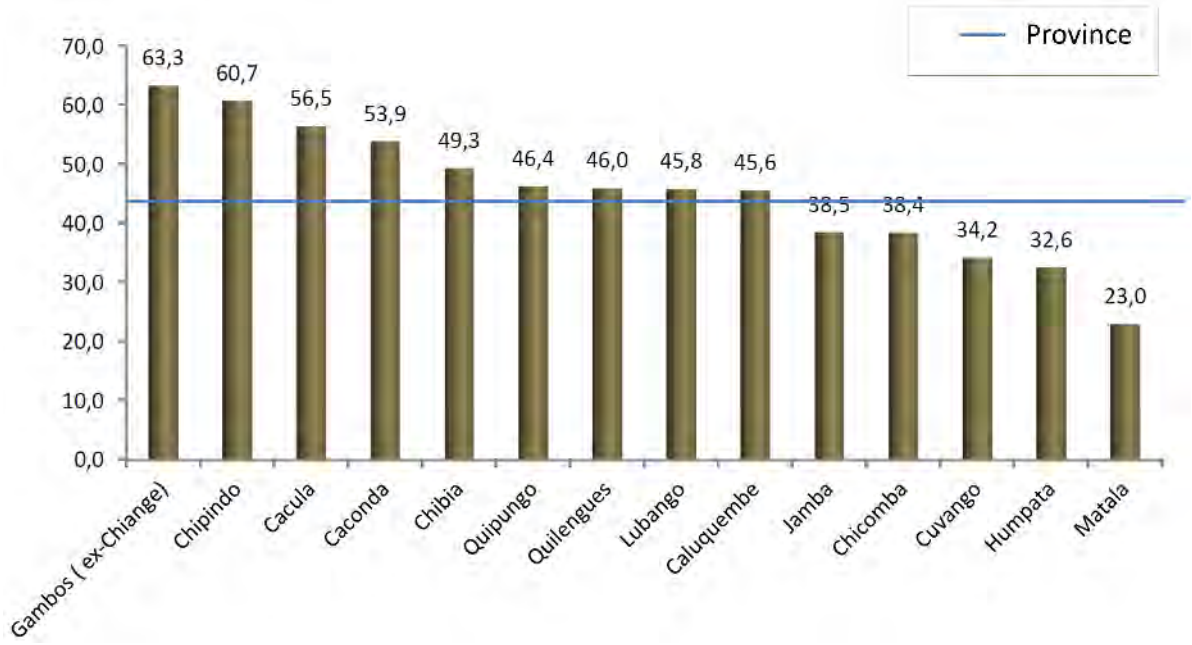


Figure 5-56: Employment rate by municipality (INE, 2016).

Agriculture and fishing are the most represented economic activities in Huíla Province, contributing to 60% of all employment, as shown in **Figure 5-57**. This sector represents the following proportions in the project-affected municipalities: 5.8% in Jamba; 4.8% in Chipindo; and 3.5% in Cuvango.

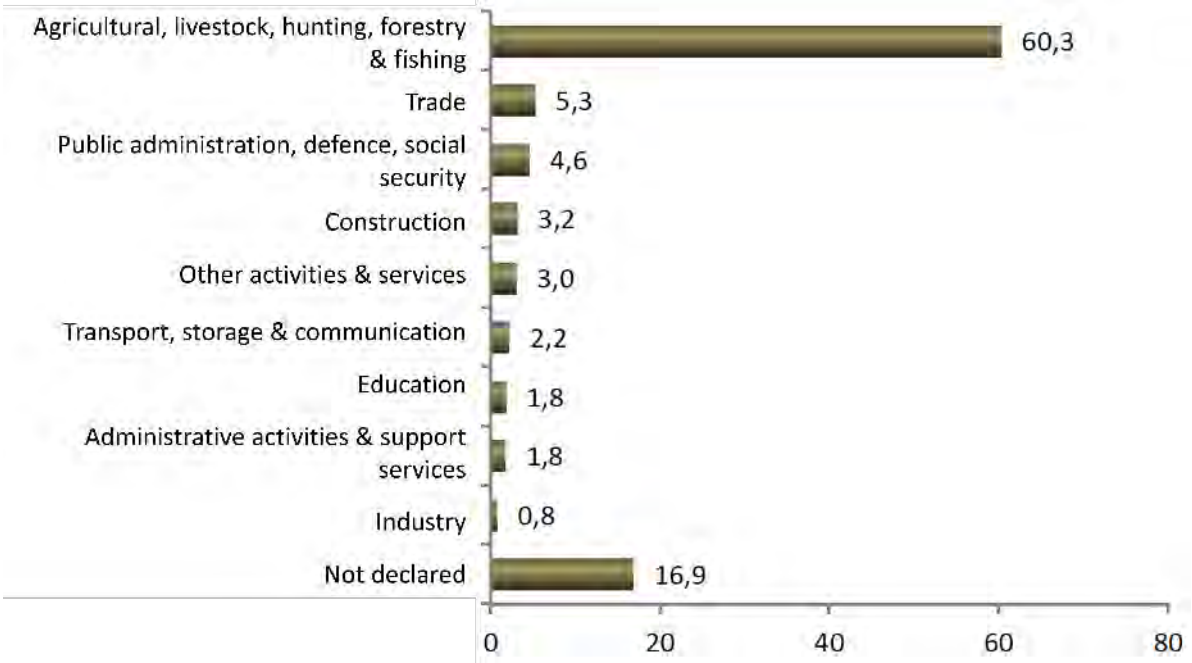


Figure 5-57: Employment proportions by sector in the Huíla Province (INE, 2016).

In 2014, the number of unemployed people in Huíla Province was 118 844, which corresponds to a provincial unemployment rate of 18%. The unemployment rate mainly affects young people aged 15-24. The highest unemployment rates were in the municipalities of Gambos (ex-Chinge) and Chipindo with 65% and 64% respectively. The municipalities of Humpata and Matala have the lowest unemployment rates at 38% and 35% respectively. The unemployment rates in Cuvango and Chipindo are 45% and 43%, respectively, as shown in **Figure 5-58** below.

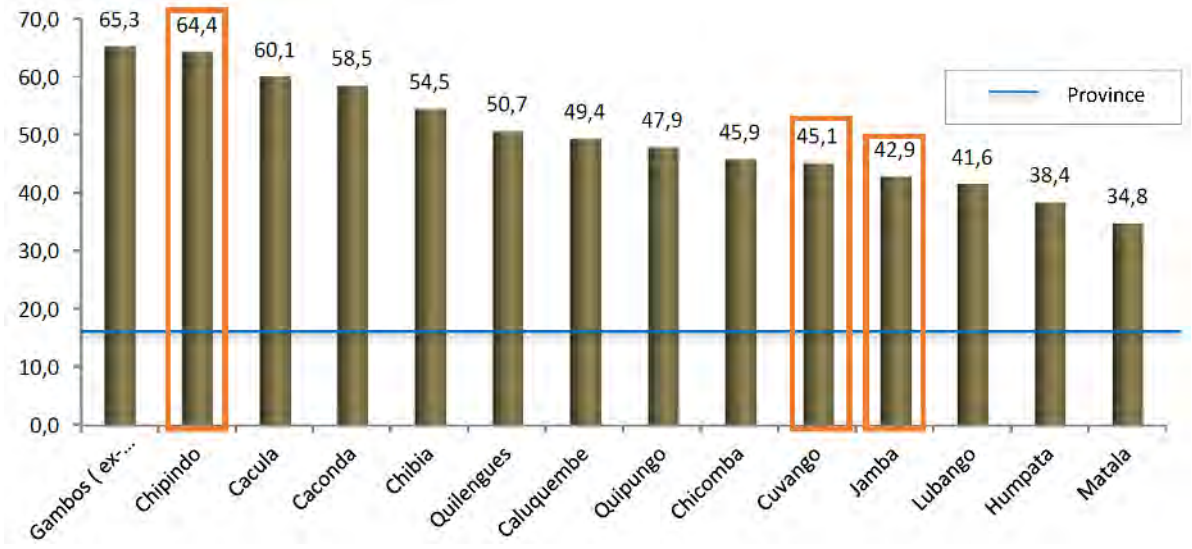


Figure 5-58: Unemployment rate by municipality (INE, 2016).

According to the data collected in the RAPP, the country's AABs employ around 87 897 workers, of which 2.5% are in the "manager" category, "workers with higher education" occupy 1.7%, "mid-level workers" make up 8.2%, "specialised workers" (in agriculture, livestock or related areas) make up 2.4%, "untrained workers" account for 78.9% and "other categories" account for 6.3%. The flow of temporary workers is very significant at the start of the agricultural season, particularly in September (27.8%), October (37.8%) and November (35.5%), due to the high demand for land preparation activities (**Figure 5-59**). However, agricultural companies have the least need for temporary workers in the month of April, as only 10% of their workers are temporary workers during that month.

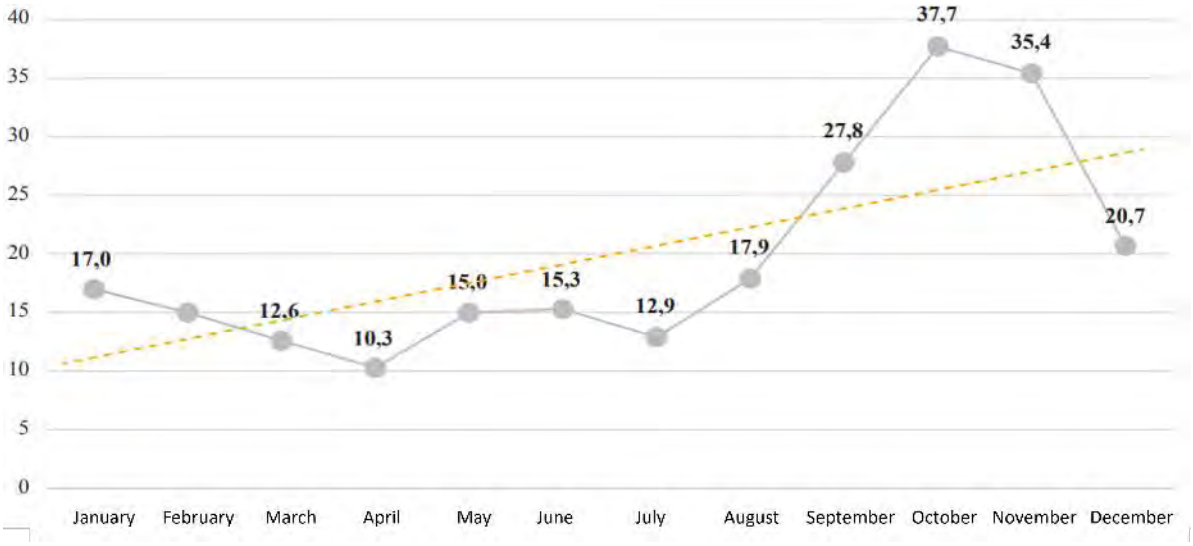


Figure 5-59: National percentage distribution of temporary workers per month on agricultural holdings (INE, 2022).

The highest average number of temporary workers in the country is in the Province of Bié, with around 67 workers in each agricultural business, followed by the Province of Huambo with 55. The Provinces of Uíge and Cabinda employ the fewest temporary workers, with an average of 17 and 16 workers in their companies, respectively. In Huíla, there is an average of 42 temporary workers in each agricultural business, as shown in **Figure 5-60**.

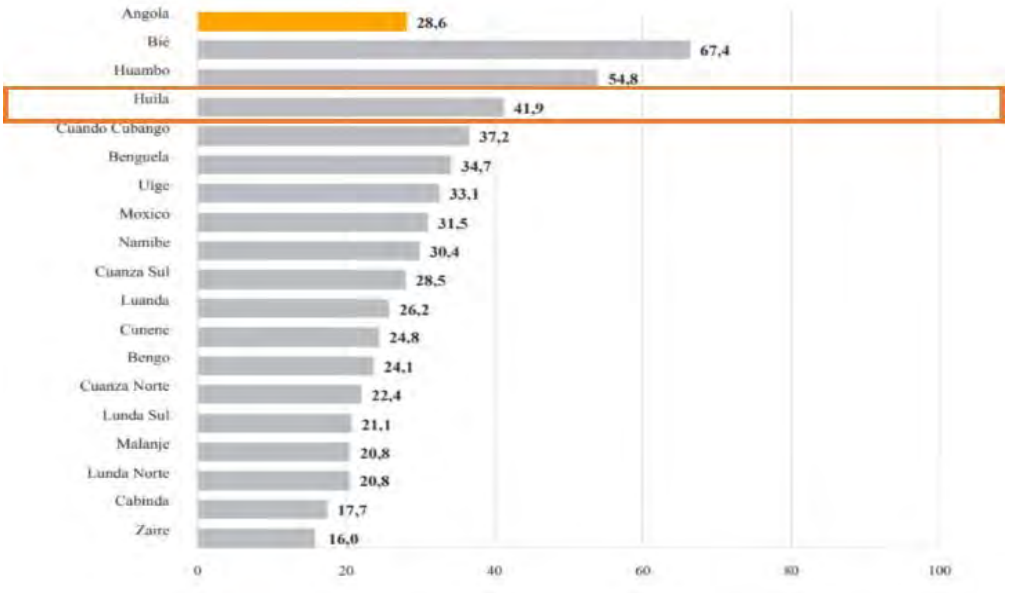


Figure 5-60: Distribution of business holdings in percentage according to the number of temporary workers, by Province (INE, 2022).

5.18 Hospitality and tourism

Angola's hotel and tourism sector is still characterised by a poorly diversified tourist offering, a quality-to-price ratio that is much lower than other tourist destinations in the region, constraints in terms of internal and external accessibility, poorly trained human resources and low levels of private investment. The *Hotel and Tourism Development* programme seeks to address these situations and create conditions for structured development of the sector, aimed at increasing and diversifying hotel and tourism services (supported by private investment), in order to attract domestic and foreign tourists, increase revenue and jobs and improve Angola's balance of services with the rest of the world (MINFIN, 2018).

Huíla Province has a high concentration of hotels and similar establishments, due to the various leisure options it offers with its natural resources. By the third quarter of 2013, the Province had 799 hotel units and complementary services, spread across 14 municipalities. The hotels / guesthouses and their capacities in Jamba are shown in **Table 5-21** below.

Table 5-21: Hotel establishments in the Municipality of Jamba

Enterprise	No. of rooms
Jukanda Guest House	12
Jovem Mania Hostel	06
Manungo Guest House	05
Popular Guesthouse	06

In Cuvango, there is only one hotel open to the public, the AGRS guest house (shown in **Figure 5-61**), with ten rooms, and in the Municipality of Chipindo there are no hotels.



Figure 5-61: Hostel in Cuvango.

The municipality of Jamba offers enough attractions to make it a tourist destination, with the Coluí and Kwandja rivers standing out as the main drawcards. In Chipindo, the geological formations and rubble of the Catholic Mission of Sangueve are one of the region's tourist destinations, as shown in **Figure 5-62**.



Figure 5-62: Tourist sites in the Catholic Mission of Sangueve, Chipindo.

5.19 Safety and security

5.19.1 Crime

The public security situation in the project area can be considered calm compared to the provincial capitals. According to data from the reports of the Operations and Information Section of the Municipal Police and the results of surveys of families and traditional leaders, the most common crimes are motorbike theft and cattle rustling (Cuvango Municipal Police, 2024). 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 site, posing a collision hazard for traffic.

There are also a few crimes of a different nature, such as 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 (Jamba Municipal Police, 2024). This 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 (Jamba Municipal Police, 2024). The crime rate in Cuvango 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.

In all the municipalities in the project area, there is a Municipal Command of the National Police and representations in the municipal centres.

5.19.2 ASM

It was pointed out during the reconnaissance site visit, that government officials, specifically the military, are potentially involved in or benefiting from Artisanal and Small-scale Mining (ASM) in Angola, as discussed in Section 5.23. ASM sites are often guided by armed militia and therefore pose a danger to ill-informed onlookers.

5.19.3 Unexploded Ordnances (UXOs)

Certain project areas are located in a former conflict zone which poses the risk of UXOs. UXOs are not limited to landmines and can include unexploded ammunition, remnants of war and other improvised explosive devices.

Three confirmed minefields within the project area were identified and must be avoided. The identification of these minefields and other UXOs is based on knowledge of conflict areas, reports of finding landmines by locals and incidents. Therefore, 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 locations and management measures are provided in the CHSS prepared for this project by SRK (2024).

5.19.4 Migration and influx

An assessment of the baseline migration status in Angola, as well as in-migration trends associated with Angolan development projects, are provided in the Addendum to the ESIA (Volume 6). An influx management framework has also been developed and included int eh Addendum.

5.19.5 Political context

An assessment of the political context in the project area is provided in the Addendum to the ESIA (Volume 6).

5.20 Overview of the results of the socio-economic survey

Household surveys and KIIs surveys were carried out in the villages and villages of the municipalities of Chipindo, Cuvango and Jamba located close to the route of the 220 kV OHL and future beneficiaries of household electricity connections in the municipal centres affected by the project. The majority of the population is concentrated in the urban areas of the municipal seats where social services are more available compared to the rural villages or villages far from the municipal headquarters. However, to obtain current data on the villages/communities in the rural areas along the line, it was important to concentrate household survey efforts in these rural areas that, if affected, might be impacted more than those in the urban areas.

Sixteen (16) villages/communities in the municipalities of Chipindo, Cuvango and Jamba were visited and surveyed. In addition to surveying a sample of households, social facilities were also visited, as well as sacred sites such as cemeteries, the ruins of the Sangueve Catholic Mission in Chipindo, and water lines located near the villages/communities surveyed. KIIs were also conducted with *sobas* to get an overview of information that households would not have, such as the number of households in each village/community.

According to data available from municipal administrations and on-site findings from fieldwork, the social baseline is very similar in all villages and villages in Huíla's rural municipalities in terms of

livelihoods, type of land occupation, and types of social facilities. Most villages use subsistence methods for farming and are involved in informal commerce and beekeeping. Instances of artisanal gold mining and some river fishing were also observed across the three municipalities, with some local variation.

The source of income for the majority of the population comes from the sale of field produce. Households with a maximum income of AKZ 180 000 per month and a minimum income of AKZ 38 000 per month were recorded. In the villages or villages located in the municipal centres, in addition to the income from selling field produce, there are other incomes such as civil servants in the local administrations, schools and health posts, as well as monthly government subsidies for former war combatants and traditional authorities.

Crop cultivation is similar in all the villages, where cultivation methods and tools are rudimentary. The staple crops are maize and beans, and others include sweet potatoes, reindeer potatoes, cassava, cabbage, onions, tomatoes, yams and peanuts (*ginguba*).

The rural land used by the community for their housing and agriculture is theirs by way of inheritance and “usufruct” (i.e. they have land ownership rights, but they are mostly informal) and in some cases, the rights to use the land for agriculture and housing are granted by the traditional authorities of the area (*sobas*).

Infrastructure and services are inadequate in most villages. There is no electricity supply, with the exception of the villages in the municipal centres, which are supplied by thermal generators that provide electricity six hours a day (from 6 pm to 12 pm). Most families use wood and charcoal for cooking and solar panel lanterns to light up at night. For most of the villages, except the municipal centres, the families’ water supply comes from hand-dug wells (*cacimbas*) and nearby streams. In the seat of the municipality of Jamba, households have home water connections as part of a government project, *Water for All*. All the villages and villages visited have at least one primary school, some of which use spaces in the local churches as classrooms.

There is no public transport. There are private motorbikes that transport people and goods, but for the most part, walking is the most common way to get to the fields and villages.

The diseases that most affect children of both sexes in households are malaria, bronchitis, diarrhoea and, seasonally (especially in rainy weather), cholera. In adults, the most frequent diseases are typhoid fever, rheumatism and chronic diseases such as hypertension and diabetes. Hypertension is more common in adult males.

Some activities are carried out exclusively by men, such as herding cattle, hunting and driving vehicles (motorcycles). Decisions on the most important household matters are always made by men, even in single-parent households, where the widow, for example, cannot make decisions without first consulting her uncles. Regarding school attendance, no gender differences were recorded: boys and girls of school age attend school when it is available in the community, but girls are generally the ones who drop out of school the most, when they become mothers. As far as farm work is concerned, both men and women take part in ploughing and harvesting.

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 San ethnic group. The San 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 San households occasionally live in the localities of Kassindi and Vilombelo (in the municipality

of Cuvango) and in the commune of Cassinga, in the villages of Tchamutete and Mutiapulo, 64 km from this commune (in the municipality of Jamba), as shown on the map in **Figure 5-68**.

It is likely that the villages in the Project area will continue to live as they do now, unless there is investment in infrastructure and services (roads) and employment opportunities arise.

Table 5-22, compiled using data obtained during the consultations carried out for the villages/communities consulted, shows an overview of some demographic information for the villages, such as population, the number of households, the number of people per family, the year in which the village was established, what kind of land ownership applies, the major ethnic groups, major sources of income or livelihoods, and the ranges of average monthly household incomes.

Table 5-22: Survey results on community demographics and income (Geolab, 2024)

Village / community	Soba/Secúlo	Population	No. of households	No. of people per family	Year established	Land ownership	Ethnic group	Sources of income / livelihoods	Monthly income (AKZ)
Jamba municipality									
Cacola	Mr Anibal Tsialo (Soba grande)	19 051	3 590	2 - 12	1974	Inheritance / transfer	Bantu / Nganguela	Subsistence farming / Civil service	25 - 130 000
Lucunga A	Mr Paulo Tyamba (Soba)	3 180	520	2 - 8	-	Inheritance	Bantu / Umbundo	Subsistence farming / informal trade	25 - 80 000
Kuandja	Mr José Cassanga Calulu (Soba)	2 344	450	2 - 9	-	Inheritance	Bantu / Nganguela	Subsistence farming / Artisanal mining	35 - 200 000
Eyela	Mr Constatino Rosário Tyamba (Soba)	2 190	410	2 - 6	1983	Inheritance	Bantu / Umbundo	Subsistence farming	35 - 95 000
Morro I	Mr Francisco Ndala Nyemo (Soba)	1 480	240	2 - 8	1981	Inheritance	Bantu / Umbundo	Subsistence farming / Artisanal mining	45 - 220 000
Cuvango municipality									
Km 50	Mr Pedro Tchindjamba (Soba)	10 000	2 980	2 - 10	1973	Inheritance / transfer	Bantu / Nganguela	Subsistence farming / Civil service	25 - 140 000
Tchicunho	Mr Sabino Calungo (Soba)	1 300	205	2 - 6	-	Inheritance / transfer	Bantu / Umbundo	Subsistence farming	35 - 80 000
Aunge	Mr Marcelino Manico (Soba)	2 162	305	2 - 8	-	Inheritance	Bantu / Umbundo	Subsistence farming	45 - 85 000
Ngokue	Mr Zacarias Bunanga (Soba)	264	52	2 - 8	1994	Inheritance	Bantu / Umbundo	Subsistence farming	35 - 70 000
Cavinga	Mr José Baptista Ntyamba (Soba)	500	95	2 - 9	1976	Inheritance	Bantu / Umbundo	Subsistence farming	25 - 70 000

Village / community	Soba/Secúlo	Population	No. of households	No. of people per family	Year established	Land ownership	Ethnic group	Sources of income / livelihoods	Monthly income (AKZ)
Chipindo municipality									
Bairro 1º de Maio	Mr Paulino Lutiki (Soba)	5 014	1 650	2 - 6	1973	Inheritance / transfer	Bantu / Umbundo	Subsistence farming / Civil service	60 - 200 000
Vingolo	Mr Manuel Capitango (Soba)	1 020	190	2 - 8	1976	Inheritance	Bantu / Umbundo	Subsistence farming / Artisanal mining	55 - 110 000
Buloteque	Mr Faustino Tchimbungo (Soba)	2 998	502	2 - 8	1969	Inheritance	Bantu / Umbundo	Subsistence farming	25 - 70 000
Capuca	Mr Celestino Chivela Numa (Soba)	1 300	205	2 - 8	-	Inheritance	Bantu / Umbundo	Subsistence farming	35 - 80 000
Oko	Mr José Tchiconguele (Soba)	1 445	190	2 - 9	-	Inheritance	Bantu / Umbundo	Subsistence farming	25 - 70 000
Operário A	António Matias João (Soba)	4 237	1 050	2 - 9	1974	Inheritance	Bantu / Umbundo	Subsistence farming / Civil service	60 - 190 000

Table 5-23 shows the basic services available in each community as well as the distance to secondary schools.

Table 5-23: Survey results on basic services by village / village (Geolab, 2024)

Village / community	Household water supply	Sanitation	No. of primary schools	No. of secondary schools *If there are none, the closest one is indicated*	Distance to secondary school	Nearest health centre
Jamba municipality						
Cacola	Home connections	Latrines	2	1	-	Cacola Health Centre
Lucunga A	Cacimba	Latrines	1	Jamba Headquarters	4 - 5 km	Jamba Headquarters
Kuandja	Fountain and cistern	Latrines	1	Cassinga	5 - 6 km	Cassinga
Eyela	Cacimba	Latrines	1	Jamba Headquarters	4 km	Jamba Headquarters
Morro I	Cacimba and fountain	Latrines	1	Jamba Headquarters	3 - 4 km	Jamba Headquarters
Cuvango municipality						
Km 50	Cacimba and fountain	Latrines	1	1	-	Km 50 Health Centre
Tchicunho	Cacimba and fountain	Latrines	2	1	-	Tchicunho Health Centre
Aunge	Cacimba and river	Latrine / Bush	1	Ya nduma	7 km	Ya nduma
Ngokue	Cacimba and river	Latrine / Bush	1	Ya nduma	7 - 8 km	Ya nduma
Cavinga	Cacimba	Latrine	1	Capoco	4 km	Capoco
Chipindo municipality						
Bairro 1º de Maio	Fountain and cacimba	Latrine	2	1	-	Chipindo Municipal Hospital
Vingolo	Fountain and cacimba	Latrine	1	Municipal centre	4 km	Chipindo Municipal Hospital
Buloteque	Fountain and cacimba	Latrine	1	Municipal centre	5 - 6 km	Buloteque Health Centre
Capuca	Fountain and cacimba	Latrine	1	Municipal centre	3 - 4 km	Buloteque health centre
Oko	cacimbaand cistern	Latrine	1	Blood Mission	7 - 8 km	Chipindo Municipal Hospital
Operário A	Fountain and cacimba	Latrine	2	1	-	Chipindo Municipal Hospital

As mentioned above, the localities of the three municipalities in the project area share the same socio-economic environment with little variation. The towns in the municipal centres have peri-urban

characteristics where, for example, the walls of the houses were built with adobe blocks but reinforced with cement, basic water and electricity supply are available, education and health infrastructures are more available than in the rural areas, households' monthly income does not depend solely on the sale of field produce but on other income such as salaries paid to civil servants. The villages/communities furthest away from the communal centres and the municipal headquarters have rural characteristics where, for example, the walls of the houses are made *only* of adobe blocks, the roof is made of sheets and grass, and there is no or very little basic infrastructure (including education, health, electricity, roads).

5.20.1 Key sites visited during consultations

Maps depicting the sites and infrastructure visited during the consultations are provided in **Figure 5-63** and photographs in **Figure 5-64**. The co-ordinates of key sites visited during consultations with stakeholders are provided in **Table 5-24**.

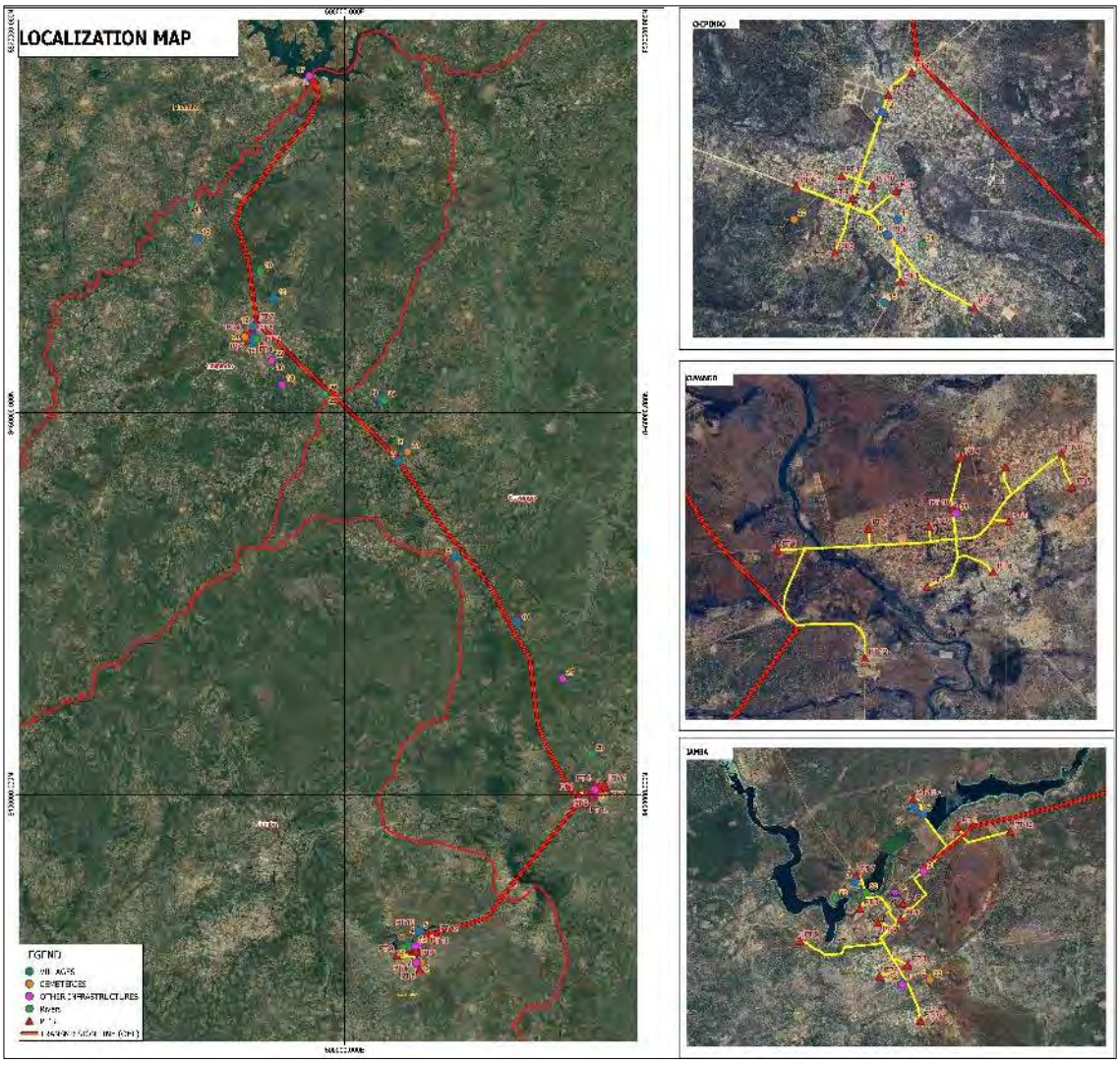


Figure 5-63: Map of the project area indicating the sites and infrastructures visited.

Table 5-24: Localities, cemeteries, rivers and other socio-economic infrastructure visited

Municipality	Localities, cemeteries, rivers and infrastructure	Coordinates	Location on the map
Jamba	Cacola village	S 14°42'33.56388" E 16°2'1.968"	1

Municipality	Localities, cemeteries, rivers and infrastructure	Coordinates	Location on the map
	Lucunga village A	S 14°42'30.456" E 16°2'28.53492"	2
	Kuandja Village	S 14°40'58.55412" E 16°1'15.22812"	3
	Eyela Village	S 14°39'48.79188" E 16°2'12.81012"	4
	Morro I Village	S 14°39'54.92988 E 16°2'21.05412	5
	River Colui	S 14°41'14.59788" E 16°0'56.592"	29
	Kuandja River	S 14 °41'8.68776" E 16°1'26.04972"	30
	Train station	S 14°40'48.55836" E 16°2'21.984"	31
	Former electricity substation	S 14°41'9.384" E 16°1'54.55812	32
	Municipal cemetery	S 14°42'30.44664" E 16°2'28.64436"	33
	Municipal administration	S 14°42'35.25444" E 16°2'1.75344"	34
Cuvango	Village Km 50	S 14°7'57.63432" E 16°5'14.47548"	6
	Tchicunho Village	S 13°59'46.29012" E 16° 0'20.88812"	7
	Aunge Village	S 13°58'42.348" E 16° 0'59.53608"	8
	Ngokue Village	S 13°54'32.63652" E 15°58'45.0984	9
	Cavinga Village	S 14°13'36.41988" E 16°10'45.11388"	10
	Cemetery, Tchicunho village	S 13°58'59.26296" E 16°1'5.9106"	23
	Calei Lagoon	S 13°54'38.92788" E 15°59'0.93696"	24
	Santa Rita Farm	S 13°54'7.24212" E 15°53'47.93388"	25
	Kusso River, Cuvango-Chipindo border	S 13°54'7.24212" E 15°53'47.93388"	26
	Agricuvango Farm	S 14°18'17.2422" E 16°14'44.55744"	27
	Cubango River, Cuvango	S 14°24'42.0066" E 16°17'19.60692"	28
	Cuvango Administration	S 14°27'44.0964" E 16°17'36.58776"	35
Chipindo	Bairro 1º de Maio	S 13°49'14.36412"	11

Municipality	Localities, cemeteries, rivers and infrastructure	Coordinates	Location on the map
		E 15°47'38.73588"	
	Vingolo Village	S 13º48'22.5432" E 15°47'30.92028"	12
	Buloteque Village	S 13°40'51.11868" E 15°42'40.89384"	13
	Capuca Village	S 13°45'56.367" E 15°49'22.40148"	14
	Oko Village	S 13°49'54.13188" E 15°47'32.64"	15
	Worker Village A	S 13°49'21.31788" E 15°47'33.71064"	16
	Cunene River, Chipindo border, Gove	S 13°37'50.16576" E 15°42'3.48552"	17
	Catholic Mission of Sangueve	S 13°53'18.19968" E 15°50'4.54812"	18
	Tchissoyo River	S 13°43'41.30472" E 15°48'9.38196"	19
	Municipal Cemetery	S 13°49'14.24496" E 15°46'47.90208"	20
	Locoma River	S 13°49'26.22036" E 15°47'51.1008"	21
	Kongue River	S 13°51'15.36336" E 15º 49'10.13412"	22
	Chipindo Administration	S 13°51'15.37092" E 15°49'10.20288"	36
Caála, Huambo	Gove Hydroelectric Plant	S 13°26'59.96868" E 15°52'19.91784"	37



Figure 5-64: Photographs of some of the villages, cemeteries, rivers and other infrastructure visited and their location on the project map (Geolab, 2024).

The socio-economic profile of some of the villages/communities visited and where surveys were carried out is provided in **Table 5-25** below.

Table 5-25: Household survey results, extracted from Geolab, 2024

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
Jamba Municipality							
Cacola	Traditional governance structure linked to formal administrative structure	• Polygamy occurs, contributing to larger family sizes • Five ethnolinguistic groups: Nganguela, Umbundo (predominant), Kuanhama, Nhaneca-Nkhumbi, and Tchokue • Main language is Umbundu	• Main livelihood is farming; additional income from trading agricultural products • Households solely reliant on agricultural sales earn between 30 000 and 80 000 Kz / month • Families often raise chickens, ducks, goats, oxen, and cows for subsistence • Families consume meat two to three times a week • Eggs and chicken meat purchased from local markets	• Most houses made of adobe; some have cement-reinforced walls and sheet metal roofs held down with stones • Electricity provided intermittently from 6pm to 11pm by municipality's thermal power station • Water supplied through taps under the "Water for All" project • No formal waste management system; waste often burned or buried in holes near houses	• Cacola health post is local health centre • Common illnesses are malaria, cough, diarrhoea, fever, and vomiting • Primary school (grades 1 to 6) and a junior secondary school (grades 7 to 9) • Nearest secondary school (grades 10-11) located 15 km away in seat of Jamba	-	• Mainly Catholic, Protestant, with some Adventists and Jehovah's Witnesses • Traditional ceremonies include *Alambamento* (*traditional* marriage), *Efiko* festival (transition of girls to adulthood), and *Evanda* (male circumcision and transition to adulthood) • Leisure activities are football, socialising among all ages, and children's recreational activities on special dates
Lucunga A	• Located on outskirts of Jamba municipality • Accessed via road under construction as part of PIIM	• Most residents natives • Mostly Bantu/Umbundu ethnic group • Main language is Umbundu • Official language is Portuguese – not widely	• Main livelihood is farming; additional income from informal trading of agricultural products • Household income from selling agricultural	• Most houses made from adobe with zinc sheeting roofs, typically consisting of 2-4 bedrooms, living room, and outside latrine • Lacks electricity supply, rely on wood for cooking and solar-powered	• No health centre; the nearest hospital (Hospital Municipal da Jamba) is 5 km away, a 35-minute walk • Medicinal plants are not		• Mainly Catholic, Protestant, and some Adventists • Traditional festivals are limited to a few ceremonies, including *Alambamento* and *Evamba*

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
		spoken among the elderly and women • Residents typically grow up in village • Residents only leave their parental homes when getting married	products ranges from 35 000 Kz to 85 000 Kz / month; temporary construction jobs, like bricklaying, pay 80 000 to 110 000 Kz / month • Fertile soils are along Coluí and Kwandja rivers, allow cultivation of mainly maize and beans, alongside sweet potatoes, cassava, and potatoes	lanterns or bonfires for light; some use generators for additional power needs • Water is sourced from self-dug *cacimbas* (wells), up to 20 m deep, consumed untreated; solar-powered fountain exists but is inoperative • No formal waste management system; organic waste buried in holes and other waste burned; villagers walk or use motorbikes for transportation	used for treating illnesses in the community • Lucunga A has a primary school (1st to 6th grade) built with local materials, consisting of five classrooms and five teachers • Nearest secondary school is in seat of Jamba, 30 to 45-minute walk from village		• Main leisure activities are football and socialising among young and old
Kuandja	• In commune of Dongo • Rural characteristics • Predates independence	• Estimated female population of 874 women, male population of 650, children/ adolescent population of 820 • Polygamy common; children with different mothers, families headed by fathers • Population includes native residents and migrants from neighbouring	• Main livelihoods are agriculture and artisanal fishing in the Kuandja and Coluí rivers • Agricultural products are primarily for family consumption and trade • Household incomes range between 35 000 and 200 000 Kz / month	• Most houses made of local materials such as adobe, wood, and grass; some use sheet metal for roofs, which are slightly sloping or flat and held by stones • Typical houses have three bedrooms, living room, and outside latrine • Water is sourced from *cacimbas* (wells) and solar-powered	• No health centre; nearest one is a 20-minute walk away in communal headquarters • Common illnesses include malaria, bronchitis, fever, headaches, diarrhoea, coughs, and rheumatism	• Community relies on land for subsistence and well-being, utilising the ecosystem's provisioning services • These services include soil and water (from wells/ *cacimbas*) for irrigation, bathing, washing clothes, and drinking • Firewood and timber are used	• Mainly Catholic, Protestant, some Jehovah's Witnesses • Traditional festivals are limited to a few ceremonies such as *Alambamento*, *Evamba*, *Eyele* (first harvest ceremony) • Main leisure activities are football and religious festivals

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
		province of Cunene • Migrants left due to armed conflict or to others join relatives to improve living conditions • Main language is Umbundu • Official language is Portuguese, but not widely spoken by many adults	• Households solely dependent on selling agricultural products earn between 35 000 and 95 000 Kz / month	borehole/*chafariz* with reservoir • No formal waste management system; waste is buried in holes near houses, and organic waste is used as fertiliser	• Some residents use medicinal plants like *Omoholi-holi* for menstrual pain and bay leaves for high blood pressure and headaches • Traditional healers use local plants for various remedies, including infertility • One primary school • Nearest secondary school in Cassinga	for fuel and building houses • Artisanal and Small Scale Gold Mining (ASGM) occurs on the banks of Kuandja River	
Cuvango Municipality							
Km 50 Village	• Located in commune of Galangue • Current soba is 14th since village establishment • Traditional governance structure linked to formal structure	• Most populous village in Cuvango • Predominantly women and children/ adolescents • Some polygamy, leading to larger family units • Most residents are not native to the village, having moved	• Agriculture is main livelihood; trading of agricultural products common • Household incomes from agricultural sales range between 35 000 and 95 000 Kz / month • Continuous use of plots led to	• Houses are mainly made from local materials like adobe, wood, and grass, with some using sheet metal or cement blocks for construction • Typical houses have 1 to 5 bedrooms, living room, sometimes an outside latrine	• Village has health centre (*Posto de Saúde*) and a private pharmacy • Km 50 has primary school (grades 1 to 6) and secondary school (1st and 2nd cycles), attended by village children	• Relies on the land for subsistence and well-being, utilising soil, water from *cacimbas*, wood for fuel and construction, and game for food • Changes in natural resources are affecting	• Mainly Catholic, some Protestants and Jehovah's Witnesses • Traditional festivals include *Alambamento*, *Evamba*, *Eyele*, and *Ekuivalenca* • Leisure activities are football and socialising among young and old

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
		due to civil war or to join relatives. • Primarily Bantu/ Umbundu ethnolinguistic group • Main language is Umbundu • Official language is Portuguese, but not widely spoken among elderly and women • Vulnerable groups people with disabilities, primarily elderly with stroke-related sequelae	decreased crop yields • Women heavily involved in harvesting • Common crops include maize, beans, sweet potatoes, cassava, and various vegetables • Maize flour a staple	• Cooking done in separate, open structures • Village lacks infrastructure, with meetings held under trees and social gatherings in open areas • There is no electricity supply, so firewood, charcoal, solar-panelled lanterns, and bonfires are used for cooking and lighting	• Medicinal plants like *Omoholi-holi* and bay leaf used for specific health issues such as menstrual pain and hypertension	community's traditional way of life • Provisioning services from ecosystem are vital for community's survival and daily activities • Sustainability of resources a growing concern due to environmental changes and overuse	• Football and social interactions are primary forms of entertainment and community bonding
Tchicunho Village	• Located in commune of Galangue • Predates independence • Traditional governance structure	• Households are mainly headed by fathers, but widows can also be heads of households • Most residents native • Mostly Bantu/ Umbundu ethnic ethnolinguistic group • Main language is Umbundu • Official language is Portuguese is; not widely spoken among	• Agriculture is main means of subsistence • Agricultural products primarily for family consumption; surplus sold along national road • Household incomes from agricultural sales range between 35 000 and 80 000 Kz / month • Continuous use of plots	• Houses made from local materials (adobe and grass), some with sheet metal roofs; typical houses have bedrooms, a living room, and sometimes an outside latrine. • Meetings held in Jango, a wooden and grass structure • Cooking done in separate rooms next to houses • Water obtained from borehole and hand-dug wells (*cacimbas*)	• Village has one health centre, Tchicunho Health Post • Traditional healers use local plants for remedies, including treatments for infertility • Tchicunho has two primary schools (1st to 6th grade) and one secondary school (7th to 9th grade); one primary school operates inside	• Community relies on the land for subsistence and well-being, with provisioning services including soil, water from the Cubango River, mini-hydro systems, and groundwater from *cacimbas* • Wood used for fuel and building houses; hunting common • Some residents produce	• Mainly Catholic and Adventist • Traditional festivals include *Alambamento* and *Evamba* • Main leisure activities are football and socializing among young and old • Village has two cemeteries • Cultural practices and leisure activities are integral to community life

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
		elderly and women	decreased crop yields • Common crops include maize, beans, sweet potatoes, cassava, and potatoes • Burning is used to clear land for agriculture • Tools include hoes, machetes, and axes, and some animal traction • Shortages of seeds and fertilisers common • Livestock includes cattle, goats, pigs, and poultry • Hunting involves using traps, dogs, and arrows • Meat consumed three to four times a week	• Families do not treat their water • There is no electricity; • Wood used for cooking, lanterns or bonfires for light at night • Borehole is powered by solar energy • No formal waste management system; organic waste buried near houses; other waste burned • No public transport available; villagers walk or use motorbikes for longer distances	Protestant church • Primary schools have five classrooms and five teachers • Secondary school serves the local children, providing basic education	charcoal for income • Ecosystem's resources are essential for daily activities and economic survival	and social cohesion
Ngokue Village	• Part of traditional *Ombala Ya Nduma* jurisdiction • Traditional governance structure linked to	• Polygamy common with children from multiple mothers leading to large households • Most residents native; others	• Main means of subsistence is family farming, some entrepreneurial farming of profitable crops like beans • Households earn between	• Houses made from local materials (adobe, wood, grass) • Some use sheet metal or cement blocks for construction	• No health centre; nearest is 7 km away • Has primary school with six classrooms (grades 1 to 6); nearest secondary	• Community relies on land for subsistence, using soil, water from rivers and wells, wood for fuel and building, and game for food	• Maonly Catholic, some Protestants and Adventists • Traditional festivals include *Alambamento*, *Evamba*, and *Eyele*

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
	formal administration	moved there due to civil war • Mostly Bantu/ Umbundu ethnic ethnolinguistic group • Main language is Umbundu • Official language is Portuguese is; not widely spoken among elderly and women	35 000 Kz and 70 000 Kz / month from selling agricultural products • Continuous use of land led to decreasing crop yields • Main crops include maize, sorghum, beans, cassava, and sweet potatoes • Common livestock include oxen, cows, goats, pigs, and poultry	• There is no electricity; wood and charcoal are used for cooking, and solar lanterns or bonfires provide light at night • Water obtained from hand-dug wells (*cacimbas*) and broken community borehole; some use rainwater retention reservoirs (*chimpacas*) for cattle • No formal waste management system; waste is buried or burned • Public transport is absent; villagers walk or use motorbikes for longer distances	school 7-8 km away • Health and educational facilities are limited; reliance on traditional practices for healthcare • Education is basic, with primary schooling available in village and secondary schooling at communal headquarters	• Soil fertility is reported to be declining, possibly due to reduced rainfall • Rivers used for bathing and washing clothes; changes in natural resources affect community livelihood • Ecosystem services crucial for community's daily activities and economic survival	• Main leisure activities are football and socialising among young and old • Community has two small cemeteries • Cultural practices and leisure activities are integral to community life and social cohesion
Chipindo Municipality							
Bairro 1º de Maio	• Accessed via main dirt road, currently under rehabilitation • Traditional governance structure linked to formal administration	• Polygamy common with children from multiple mothers • Mostly natives; some joining relatives to improve living conditions • Mostly Bantu/ Umbundu ethnic	• Agriculture is main livelihood; products used for family consumption and trade. • Household incomes from agricultural sale range between 60 000 and 200 000 Kz / month	• Houses are made from local materials (adobe, wood, grass), with some using cement blocks or bricks and cement • No electricity; wood and charcoal used for cooking; solar lanterns or bonfires provide light at night	• Community has one health centre, Chipindo Municipal Hospital • Traditional healers use local plants for remedies • Bairro 1º de Maio has two primary	• Relies on land for subsistence, using soil, water from rivers and wells, wood for fuel and construction, pasture for livestock, and some game • Soil infertility is a concern, likely	• Mainly Catholic, some Protestants and Jehovah's Witnesses • Traditional festivals include *Alambamento*, *Evamba*, *Eyele*, and *ekuivalenca* • Main leisure activities are football, socialising

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
		ethnolinguistic group • Main language is Umbundu • Official language is Portuguese is; not widely spoken among elderly and women • Households are mainly headed by fathers, but widows can also be heads of household	• Continuous use of plots decreased crop yields • Main crops include maize, beans, manioc, reindeer potatoes, sweet potatoes, tomatoes, onions, cabbage, and garlic • Burning to clear land; tools include axes, machetes, and hoes; animal traction used by some but requires payment • Animal husbandry common, with chickens, ducks, goats, oxen, and cows • Meat consumed two to three times a week, eggs used to raise chickens	• Water obtained from *cacimbas*, community fountain, Locoma River; some households treat water with remedies or physical methods • No formal waste management system; waste is buried or burned • Motorbikes main means of transport • Mobile network coverage available	schools and one secondary school; some children study in Lubango and Huambo for courses not available in Chipindo • Health services are basic, relying on both modern and traditional medicine • Educational facilities are limited but serve the community's basic needs	due to low rainfall • Ecosystem provides essential resources for daily activities and economic survival • Changes in natural resources affect the community's traditional way of life	among young and old, and religious activities • Leisure activities help maintain community bonds and cultural identity
Buloteque Village	• Access (via *picada*) is challenging during rainy seasons • Traditional governance structure linked to		• Agriculture is main livelihood; products primarily for family consumption and surplus sold • Households earn between 25 000	• Houses are made from local materials (adobe, wood, grass), some using sheet metal or cement blocks • Typical houses have two to five	• Village has a health centre; common illnesses include malaria, headaches, bronchitis, diarrhoea,	• The community relies on the land for subsistence, using soil, water from rivers and wells, wood for fuel and construction,	• Mainly Catholic and Protestant • Traditional festivals include *Alambamento*, *Evamba*, *Eyele*, and *Ekuivalenca*

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
	formal administration		Kz and 70 000 Kz / month from agricultural sale • Continuous use of plots decreased crop yields • Main crops include maize, millet, beans, potatoes, manioc, sweet potatoes, and pumpkin • Common tools are axes, machetes, and hoes; some use animal traction, but supplies are limited due to cost and low rainfall • Animal husbandry and hunting are prevalent • Common animals include chickens, ducks, goats, oxen, and cows • Villagers eat meat three to four times a week	bedrooms, living room, sometimes an outside latrine • Food cooked in separate, attached rooms • No electricity; wood and charcoal are used for cooking; solar lanterns or bonfires provide light at night • Water obtained from *cacimbas*, with system of ropes and buckets; water rarely treated, though some use physical methods • No formal waste management system; waste is buried or burned • Public transport is absent, with villagers walking or using motorbikes for longer distances	rheumatism, typhoid fever, and stomach aches • Some residents use medicinal plants for treatments, including *Ndembi* for chest pain, *Ufilanganga* for headaches, and *Tumbandjali* for typhoid fever • One primary school (grades 1 to 6) attended by village children, with most residing in municipal centre of Chipindo • Health services combine modern and traditional medicine to meet community needs • Education facilities basic, serving primary educational	and game for food • Soil infertility and decrease in wild animals reported, likely due to deforestation and charcoal production • Charcoal production prevalent, impacting ecosystem's sustainability • Ecosystem services are essential for daily activities and economic survival	• Main leisure activities are football and socialising among young and old • Cultural practices and leisure activities are important for social cohesion

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
					needs of village children		
Oko Village	• Kongue River crosses village • Accessed from unpaved road linking Chipindo and Cuvango • Traditional governance structure linked to formal administration		• Agriculture is main livelihood; products primarily for family consumption and surplus sold • Households earn between 25,000 Kz and 70,000 Kz / month from agricultural sale • Some receive government subsidies for being former war combatants • Continuous use of plots has decreased crop yields • Main crops include maize, beans, sweet potatoes, manioc, cabbage, onions, tomatoes, yams, and peanuts • Charcoal production is common, with families earning between 100 000 Kz and 150 000 Kz / month from sales	• Houses are made from local materials (adobe, wood, grass), with some using sheet metal for roofs • Typical houses have one to four bedrooms, a living room, and an outside latrine; food cooked in separate, attached rooms • There is no electricity; wood and charcoal are used for cooking, and solar lanterns or bonfires provide light at night • Water is obtained from *cacimbas*, using a system of ropes and buckets; water is rarely treated • No formal waste management system; waste is buried or burned • Public transport is absent, with villagers walking or using motorbikes for longer distances	• No public health centre; nearest one is 7-8 km away at Chipindo Municipal Hospital • Common illnesses include malaria, diarrhoea, vomiting, fever, back pain, and rheumatism; some residents use medicinal plants for treatment • Oko has a primary school (grades 1 to 6); the nearest secondary school (grades 7 to 9) is 15 km away at Catholic Mission of Sangueve • Health services limited, relying on both modern and traditional medicine • Education facilities are basic, serving	• Community relies on land for subsistence, using soil, water from wells, wood, medicinal plants, firewood, and game • Soil infertility and decrease in game animals reported, likely due to deforestation and charcoal production • Ecosystem services are crucial for daily activities and economic survival • Changes in natural resources affect community's traditional way of life	• Mainly Catholic • Traditional festivals include *Alambamento*, *Evamba*, *Eyele*, and *Ekuivalenca* • Main leisure activities are football and socialising among young and old • Cultural practices and leisure activities are important for social cohesion

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
					primary educational needs of village children		
Capuca Village	• Located on main road connecting Chipindo and Gove • Access via main road in poor condition • Traditional governance structure linked to formal administration		• Agriculture is main livelihood, with products primarily for family consumption and surplus sold • Households earn between 35 000 Kz and 80 000 Kz / month from agricultural sales • One former war veteran receives a government subsidy • Continuous use of plots decreased crop yields • Main crops include maize, sorghum, beans, sweet potatoes, manioc, cabbage, onions, tomatoes, yams, and peanuts • Animal husbandry is common, with chickens, ducks, goats, oxen, and cows	• Houses made from local materials (adobe, wood, grass), with some using sheet metal for roofs • Typical houses have one to four bedrooms, a living room, and an outside latrine; food is cooked in separate, attached rooms • No electricity; wood and charcoal are used for cooking, and solar lanterns or bonfires provide light at night • Water obtained from *cacimbas*, using system of ropes and buckets; water is rarely treated • No formal waste management system; waste buried or burned • Public transport is absent, with villagers walking or using motorbikes	• No public health centre; nearest is 3-4 km away in Buloteque • Common illnesses include malaria, diarrhoea, vomiting, fever, back pain, and rheumatism; some residents use medicinal plants for treatments • Has primary school (grades 1 to 6); the nearest secondary school is 7 km away in the commune centre • Health services are limited, relying on both modern and traditional medicine • Education facilities are basic, serving primary educational	• Community relies on land for subsistence, using soil, water from rivers and wells, wood, medicinal plants, and game • Soil infertility and a decrease in wild animals have been reported, likely due to deforestation and charcoal production • Ecosystem services are crucial for daily activities and economic survival • Changes in natural resources affect community's traditional way of life • Sustainable management of these resources is essential for the community's future	• Mainly Catholic, some Protestants from the Evangelical Congregational Church of Angola • Traditional festivals include *Alambamento*, *Evamba*, and *Efico* • Main leisure activities are football and socialising among young and old • Cultural practices and leisure activities are important for social cohesion • Cemetery approximately 35 km away

Village / Neighbourhood	Description	Household make-up and ethnic groups	Livelihoods and income	Housing, sanitation and infrastructure	Health and education	Ecosystem goods and services	Culture and leisure
			• Villagers regularly eat meat and milk • Seasonal pests affect livestock; local herbs are used as alternative treatments while awaiting veterinary support	for longer distances	needs of village children		

5.21 Indigenous people: the San

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, like many African countries, 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). Instead, 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 they are not formally identified based on ethnic lines. In specific references, these groups are collectively named or referred to as "*autóctone*", which is similar but not identical to the concept of Indigenous Peoples.

5.21.1 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 consonants[6], 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)[7], Bushmen (regarded by some as pejorative), "*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.

[6] Different clicks are denoted by the symbols |, ||, !, ǂ, and ʘ.
[7] 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 are Griqua and Nama.

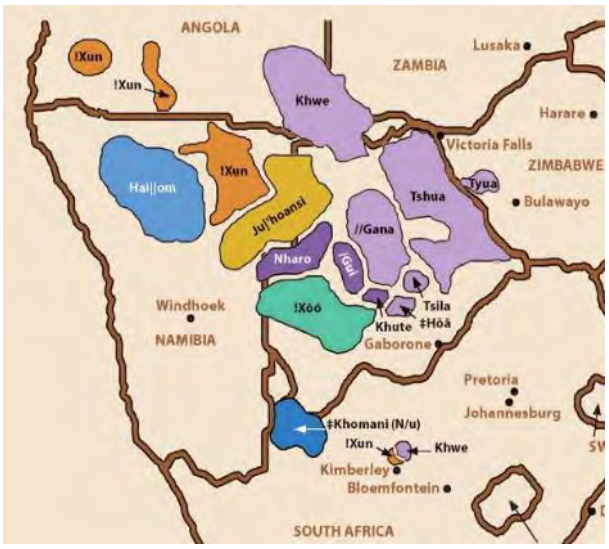


Figure 5-65: Geographical spread of the various "San" groups. The locations of the !Xun (!Kung) groups in the project area Angola are shown as an oblong orange polygon in the top left of the image (WIMSA, 2008, referenced in MASFAMU, 2019).

In previous decades, anthropologists estimated the population of San in Angola to number around 5 000. However, the population appears more likely to be 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 (around 60 000) and Namibia (around 40 000). 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 east[8]. Their movements are believed to have followed a north-south direction; a pattern observed in other parts of Africa as well.

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 5-66**.

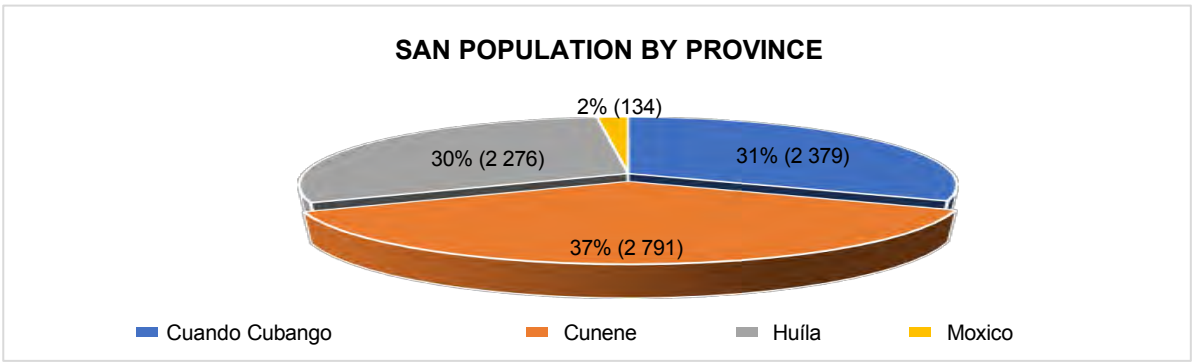


Figure 5-66: Distribution of total number of San people by Province, with those in Huíla making up 30% (IDL-FAS, 2022)

[8] Available at https://upload.wikimedia.org/wikipedia/commons/thumb/7/70/Angola_Ethnic_map_1970-en.svg/800px- ngola_Ethnic_map_1970-en.svg.png.

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.

5.21.2 Languages of the San

Angola's !Xun speak one of between 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 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.

5.21.3 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 that the San in Angola seem to share similar socio-economic challenges, such as marginalisation and deprivation, common to some countries in the region, as well as the experience of more than 25 years of civil war and cross-border changes since 1966[9]. However, reports of marginalisation are mostly from the Cuando Cubango area.

Reports from the government, NGOs, and testimonies from members of San communities indicate varying degrees of marginalisation, particularly detailing discriminatory labour and social relations with neighbouring groups, poverty, and poor access to education and health services. For instance, 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, both 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.

[9] 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.

5.21.4 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 the San community to settle more permanently in certain regions from 2013 to 2021, where they typically seek means of 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, they 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, and therefore delayed. 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.

They are a significant source of informal manual labour (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 with using money. They also depend on food aid.

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.

Water resources are experienced and utilised in very similar ways as the villages described in the sections above. This includes locally dug wells, springs, and less frequently boreholes and river water.

5.21.5 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 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.

5.21.6 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.

5.21.7 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)[10].

Figure 5-67 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 location at the closest points.

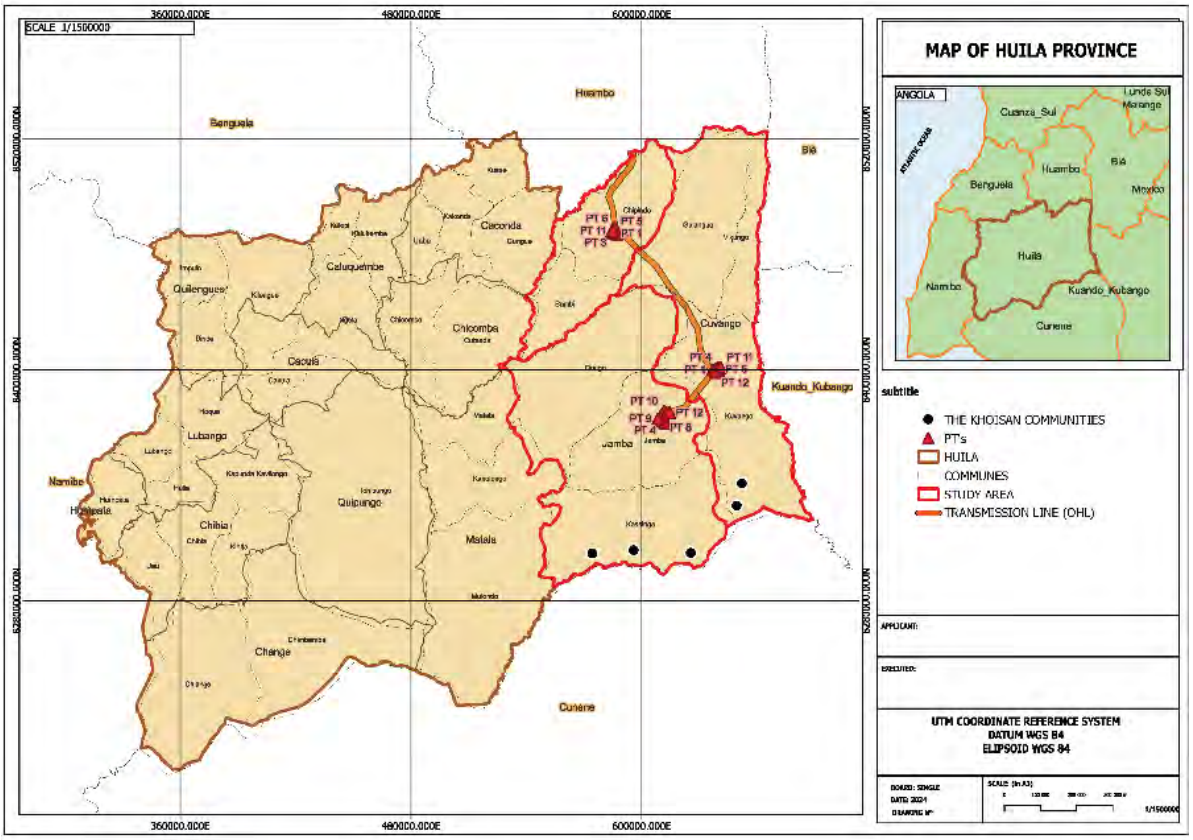


Figure 5-67: Map showing the location of the Khoisan community in the municipalities of Jamba and Cuvango (Cambinda, 2024).

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 5-68**. 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.

[10] Remote pre-screenings are usually recommended if populations meeting ESS7 criteria have been known or reported in a given area through confirmation with municipal staff and/or NGOs.



Figure 5-68: Khoisan household in Cuvango municipality (AMC, 2023).

5.21.8 Support for San communities

Support is provided in the form of food and other goods through 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.
- ACADIR (*Associãcao de Conservacão 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 from 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 program.

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 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. However, 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 expected soon.

The government also offers different levels of technical support to San farmers, such as establishing monitoring groups to distribute agricultural inputs, provide seeds, offer vaccinations, and conduct treatment campaigns during livestock disease outbreaks. However, there are no training facilities or agricultural schools available to San communities in these regions.

5.21.9 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.

However, special mitigation measures for this vulnerable group have been compiled (in Section 7.2.5) for inclusion in the ESMP.

5.21.10 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.

5.22 Key issues identified during the stakeholder consultation process

The following key issues were raised by stakeholders consulted during the consultations undertaken to date (Geolab, 2024).

5.22.1 Local municipal administrations

The project received significant support from the municipal administrations. Municipal representatives pointed out that the lack of electricity is hampering the start-up of various investments in the mining, industry and agriculture sectors. Therefore, it is regarded as an important government investment project, as supplying electricity to communities is essential for the well-being of families and the community as a whole. In addition to the benefit of providing household electricity, the benefits of job creation, particularly during the construction phase, were also emphasised.

5.22.2 Traditional leadership (*sobas*)

Traditional leadership structures were less enthused by the project, mainly because of a legacy of similar projects that have not yet benefited the communities they represent. They pointed out that the government often constructs high-voltage transmission lines which merely pass through the communities without being transformed into localised electricity distribution.

5.22.3 Community members

Many community members used the consultations as a platform to express their difficulties related to the lack of basic services, schools, health units, drinking water and adequate support for former war veterans and the elderly, such as the fact that community members built some of the existing schools, if somewhat precariously. Other schools operate in churches. These schools have few resources and, in some cases, pupils must bring their own water and chairs to school.

Farmers raised concerns about the loss of fields in those places where government and private projects install infrastructure as these are often the only fertile fields in the area.

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.

5.23 Artisanal and Small-scale Mining (ASM)

ASM is primarily driven by poverty. In some areas, people engage in this laborious and risky work with the hope of striking it rich. However, many communities turn to artisanal mining, whether permanently or seasonally, because it is often the best available cash-generating activity locally. The lack of alternative income sources forces people to endure the physical hazards, unhealthy conditions, social disruption, and unreliable or poor financial returns associated with ASM.

In Angola, while large and medium-scale companies dominate mining, Artisanal and Small Scale Mining (ASM) is also significant, especially for diamonds[11], gold, and dimension stones (black granite / marble) (ECA, 2024). Base metals such as copper, cobalt, nickel, manganese and tin are also mined, along with development minerals such as aggregates, sand, silica sand, clay, limestone, gypsum and salt.

ASM is allowed only in areas where industrial-scale mining is no longer economically viable. The government has approved nearly 500 km^2 for artisanal diamond mining in the northern inland regions. By the end of 2013, the government had issued mining permits to 594 artisanal miners, who produced about 935 000 carats that year.

On the other hand, the government is still working to better understand the ASM of **gold** in Angola – the kind of ASM observed in the project area (Musukwa & Mukwilima, 2023). This understanding will help build knowledge and a shared perspective with all stakeholders, including large-scale mining (LSM) companies. Artisanal and Small Scale Gold Mining (ASGM) is not yet well-structured. However, the government has established the Gold Authority Agency to regulate gold production and commercialisation. This agency has the potential to organise the entire gold production value chain, from mining to market and value-addition initiatives.

Market access and the establishment of specialised shops for buyers have been provided for by the government. The government has established the Gold Authority to regulate and guide the gold production and its commercialisation (including awarding licenses). This entity has the potential to

[11] Angola is the third largest diamond producer in Africa, by value, though second to the DRC in carat production.

organise the entire value chain of gold production from mining to market and value-addition initiatives in the country. FERANGOL is a government body that licences gold shops.

Artisanalmining.org estimates the ASM population of Angola as between 200 000 and 300 000. The ASGM population is estimated at 50 000. The proportion of ASGM made up of women is estimated to be higher than in the diamonds ASM sector.

5.23.1 Legislation on ASM

The government currently provides facilitation and funding for ASM during its initial stages. Efforts are underway to establish a Mining Development Fund, aimed at contributing to the overall development of the mining sector, with a particular focus on the ASM sub-sector.

Article 12 of the Mining Code states that, in the interest of local processing and treatment, beneficiation, or value addition of mineral products, the State has the right to requisition the production, or part of it, for use in local industry. The Angolan government also promotes downstream investments in facilities such as refineries.

Article 8g of the 2011 Mining Code, describes one of the strategic objectives of the mining sector “to guarantee the integration of gender and combat the discrimination of woman in the mining industry”.

In Angola, it is forbidden to trade minerals sourced from unlicensed producers. This means that informal or unlicensed ASM production cannot be traded in official channels. This has implications in the smuggling of ASM products from Angola into neighbouring countries.

Key licencing criteria include (Musukwa & Mukwilima, 2023):

- Authorisation by the Minister
- Must be Angolan
- For strategic minerals, the applicant must have been be resident of the mining area for at least ten consecutive years.

Other prescriptions include that:

- It is not allowed to detain more than 1 Artisanal Mining Area (Article 178).
- The Artisanal License holder is to comply with Environmental legislation (Article 184).
- The license holder has all rights on minerals occurring in his area (Article 186)

It is therefore important to note that, although ASGM is locally regarded as illegal, the Angolan government is trying to, and has already formulated instruments to regulate the ASM industry.

5.23.2 Engaging ASM

As mentioned in Section 5.19 above, it was pointed out during the reconnaissance site visit, that government officials, specifically the military, are potentially involved in or benefiting from ASM in Angola.

Careful consideration needs to be given to the engagement of ASM in the project area, by trying to determine whether it works under cooperatives, gathering intelligence on all aspects of the local ASM landscape, and having sound conflict resolution mechanisms in place. It is also important that the project does not inadvertently contribute to human rights violations by contracting security forces or involving the police that could use force or arms gratuitously. This aspect is discussed in detail in the HRIA.

6 Impact assessment and management actions

This section describes the social **change processes** relevant to the project, the resultant positive and negative socio-economic and cumulative **impacts**, and measures to mitigate negative impacts and enhance positive impacts. Potential socio-economic impacts are assessed for the construction, and operation phases of the Project. The significance of each impact is presented before and after the implementation of mitigation or enhancement measures.

The 24 socio-economic impacts identified are grouped under themes and change drivers and summarised in Table 6-1. For example, the first theme is “Land Acquisition”, under which there are several change drivers such as “loss of farm or grazing land or access to such land”. Some impacts will be felt during the construction and operation phase and are therefore repeated.

Table 6-1: Summary of socio-economic themes, change drivers and impacts

Theme	Change driver	Impact
1. Land acquisition	Loss of farming or grazing land or access to such land	1.1. Reduced income-earning opportunities
		1.2. Increased food insecurity
	Loss of available artisanal mining areas	1.3. Reduced income-earning opportunities for artisanal miners
	Presence of powerlines and substations	1.4. Disruption of access in and between communities
		1.5. Altered sense of place of community members
	Compensation and plot provision	1.6. Undercompensating economically displaced PAHs/PAPs
		1.7. Undercompensating physically displaced PAH/PAPs
		1.8. Increased gender marginalisation
	Site establishment, vegetation clearing and vehicle movement	1.9. Reduced ecosystem services
2. Culture and religion	Cultural heritage disturbance	2.1. Cultural heritage disturbance due to disruption of access to graves and culturally significant sites
		2.2. Discrimination or inadvertent exclusion of indigenous peoples (Khoi San)
3. Employment	Job opportunities and local procurement	3.1. Improved household incomes and livelihoods
		3.2. Increased gender marginalisation
	Influx of job-seekers/construction workers	3.3. Increase in social pathologies
		3.4. Increase in the local economy
4. Health and safety	Unfenced project infrastructure, unsafe access routes or speeding heavy vehicles	4.1. Increased safety hazards and accidents to people and livestock during the construction phase
	Permanent project infrastructure	4.2. Increased safety hazards and accidents to people and livestock during the operational phase

Theme	Change driver	Impact
	Air, water and/or noise pollution	4.3. Nuisance impacts
	Harassment or tension between construction and security workers, and community members	4.4. Increased vulnerability of villagers
		4.5. Increased vulnerability of artisanal miners due to abuse by security
	Removal of UXOs prior to construction	4.6. Improved safety resulting from removal of UXOs
		4.7. Safety risks to personnel and community members during UXO removal processes
5. Socio-economic development	Provision of social infrastructure	5.1. Improved access to electricity
		5.2. Downstream economic development

6.1 Identification of potential Impacts

The impacts identified are described and rated pre- and post-mitigation in the sub-sections below. They are grouped per theme as per **Table 6-1**.

Where a **vulnerable** group is potentially impacted, the mitigation measure is preceded by an exclamation mark as shown to the left, to highlight the special precautions needed over and above the listed mitigations.

6.1.1 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) and in **Section 3.3.1**. It relates to ecosystem services, competing land use demands, food security, gender divisions, basic human rights, and household strengths and vulnerabilities.

Impact 1.1: 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 transmission line 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 6-2.

Table 6-2: Impact 1.1: 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

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:								
• Ensure the project design is adapted to avoid any impacts on farming or grazing land. • 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. • 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. • Compile and implement an IFC PS1-compliant Stakeholder Engagement Plan (SEP), including a grievance mechanism. • Informed by the Land Acquisition and Resettlement Framework (LARF) prepared for this project, compile e a comprehensive IFC PS5-compliant Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP) and implement for any physical or economic displacement requirements. • 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.								
After Management	*Moderate*	*Long-term*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 1.2: 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 less food availability and affected food utilisation;
- Reduced farming activities resulting in 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 6-3**.

Table 6-3: Impact 1.2: Increased food insecurity due to loss of farming or grazing land or access to such land

Activity: Land acquisition								
Project phase: Construction and operation								
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:								

• 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. • Construction activities should be limited to demarcated areas and avoid farming or grazing land used by local communities. • 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. • 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. • 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*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 1.3: Reduced income-earning opportunities for artisanal miners due to loss of available artisanal mining areas

Although Artisanal and Small-scale Mining (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 6-4**.

Table 6-4: Impact 1.3: Reduced income-earning opportunities for artisanal miners due to loss of available artisanal mining areas

Activity: Land acquisition								
Project phase: Construction and operation								
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	*Moderate*	*Long-term*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*High*
Management Measures:								
• 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. • 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 (*Empresa Nacional de Electricidade de Angola*) land for the distribution network).								
After Management	*Moderate*	*Medium-term*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 1.4: Disruption of access in and between communities and sites used by Khoi San people

The construction and placement of the transmission and distribution powerlines, 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 (**Figure 6-1**), 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 project infrastructure. 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.



Figure 6-1: Informal access roads and footpaths through the substation locations of Chipindo (top), Cuvango (bottom left) and Jamba (bottom right).

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 6-11**.

Table 6-5: Impact 1.4: Disruption of access in and between communities and sites used by Khoi San people

Activity: Land acquisition								
Project phase: Construction and operation								
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	*Minor*	*Long-term*	*Regional*	***Medium***	*Definite*	***Medium***	-	*High*
Management Measures:								
• 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). • 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. • 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.								

• 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	*Minor*	*Short-term*	*Regional*	***Low***	*Possible*	***Low***	-	*Medium*

Impact 1.5: 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 to the proposed substation location, as shown in **Figure 6-2**.

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.



Figure 6-2: An agricultural field being prepared (left) next to the proposed substation location in Cuvango (right).

The impact rating before and after mitigation measures are applied is described in **Table 6-6**.

Table 6-6: Impact 1.5: 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								
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	*Moderate*	*Long-term*	*Regional*	***High***	*Definite*	***High***	-	*Medium*
Management Measures:								
• 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. – 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. • 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 (for instance, an agricultural field was identified adjacent to the potential Chipindo substation location as shown in **Figure 6-2**).								
After Management	*Minor*	*Long-term*	*Regional*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 1.6: 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 the 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 Good International Industry Practices (GIIP) on displacement, as national standards might be more "relaxed" than, for instance, the 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 (discussed in ***Impact 1.8: Increased gender marginalisation and vulnerability resulting from compensations to mostly male household heads***), 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 6-7**.

Table 6-7: Impact 1.6: Undercompensating economically displaced PAHs/PAPs

Activity: Land acquisition								
Project phase: Construction and operation								
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:								
• Compile 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 which is informed by the LARF. • 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). • 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. • 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. • Any cash compensation should be provided along with relevant education on financial literacy and responsible spending. – 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*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 1.7: 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 Good International Industry Practices (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 (discussed in ***Impact 1.8: Increased gender marginalisation and vulnerability resulting from compensations to mostly male household heads***), 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 6-8**.

Table 6-8: Impact 1.7: Undercompensating physically displaced PAH/PAPs

Activity: Land acquisition								
Project phase: Construction and operation								
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:

- 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.
- Compile 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 which is informed by the LARF.
- 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).
- Externally monitor the physical relocation process to ensure that GIIP, IFC PS5, and RAP requirements are adequately implemented, monitored, and periodically reviewed.
- Any cash compensation should be provided along with relevant education on financial literacy and responsible spending.
- Any changes to residential locations should be accompanied by security of tenure.
- 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.
- Counselling and training on house maintenance and the management of household budgets should be provided.

• Livelihood restoration mitigation measures described in ***Impact 1.6: Undercompensating economically displaced PAHs/PAPs*** should also be taken into account if there will be changes to farming locations.								
After Management	*Moderate*	*Long-term*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 1.8: 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 6-9**.

Table 6-9: Impact 1.8: Increased gender marginalisation resulting from compensation payments to mostly male household heads

Activity: Land acquisition								
Project phase: Construction and operation								
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: • 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. • Compile 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 which is informed by the LARF. • 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. • 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.								

	• Care should be taken not to overlook households that were not born in the affected villages, but who have **migrated** there after the war. • 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. • 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**. • 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. • Any cash compensation should be provided along with relevant education on financial literacy and responsible spending. • 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). • 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. • Inform and consult with Sobas and traditional leaders, including female representatives, prior to the construction phase. • 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. • Ensure community leaders are aware of issues such as sexual exploitation and abuse prevention, and how these can be reported through the Project Grievance Mechanism.							
After Management	*Moderate*	*Long-term*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 1.9: 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 as described in **Section 5**. 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 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 6-10**.

Table 6-10: Impact 1.9: Reduced community and Khoi San ecosystem services as a result of construction activities

Activity: Construction activities								
Project phase: Construction and operation								
Impact Summary: Reduced community and Khoi San ecosystem services as a result of construction activities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Long-term*	*Regional*	***High***	*Definite*	***High***	-	*Medium*
Management Measures:								
• Establish and monitor conservation corridors. • Establish safe access routes to natural resource-use areas. • 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. • No recreational hunting or fishing should take place by construction workers on- or off-duty. • Vegetation clearing should be limited to the absolute minimum. • Hydrocarbon spills should be prevented as prescribed in the ESMP. • Any construction activities should be restricted to the established and demarcated construction sites. • Vehicle movement should be restricted to existing roads. • Locations of medicinal plants should be identified prior to site establishment to ensure that they can be avoided or replanted.								
After Management	*Moderate*	*Long-term*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

The impacts of reduced resource and ecosystem accessibility by IPs are assessed as SE1.10 in the Addendum to the ESIA (Volume 6).

6.1.2 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. It aligns with the *"Culture and religion"* theme described in **Section 3.3.1**. The change processes are related to graves, heritage and indigenous peoples.

Impact 2.1: 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 6-11**.

Table 6-11: Impact 2.1: Cultural heritage disturbance due to disruption of access to graves and culturally significant sites

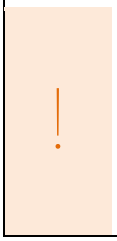
Activity: Land acquisition								
Project phase: Construction and operation								
Impact Summary: Cultural heritage disturbance due to disruption of access to gravesites								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Long-term*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Low*
Management Measures:								
• Care should be taken to identify any features that can potentially indicate unmarked graves prior to site establishment and vegetation clearing. • Develop and implement a Chance Find Procedure. • If any graves are identified, these should be avoided, work stopped if needed, and the relevant authorities contacted. Exhumation should only be considered as a last resort and it must be in line with local customs. • If access to graves is altered in any way (as discussed in **Impact 1.4: Disruption of access in and between communities**, 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*	*Site / local*	***Low***	*Possible*	***Low***	-	*Low*

Impact 2.2: Discrimination or inadvertent exclusion of indigenous peoples (Khoi San)

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 6-12**.

Table 6-12: Impact 2.2: Discrimination or inadvertent exclusion of indigenous peoples (Khoi San)

Activity: Land acquisition								
Project phase: Construction and operation								
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*	*Site/ local*	***High***	*Unlikely*	***Medium***	-	*Medium*
Management Measures:								
 • Liaise with the local municipal administration of Cuvango that has intelligence on the 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 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 San applicants. Consider informing San people of potential temporary employment opportunities in a separate forum as above and in the !Kung language spoken by them. • Where 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 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. • Ensure that honey collection sites are not destroyed, disturbed, or access thereto denied during construction activities.							
After Management	*Moderate*	*Medium-term*	*Regional*	***Medium***	*Unlikely*	***Low***	-	*Medium*

6.1.3 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 described in **Section 3.3.1**. 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. This aligns *"Community/Social Supports and Political Context"* sphere of Vanclay and Smyth's social change processes chart.

Impact 3.1: 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 6-13.

Table 6-13: Impact 3.1: Improved household incomes and livelihoods as a result of temporary employment opportunities

Activity: Employment
Project phase: Construction

Impact Summary: Improved household incomes and livelihoods as a result of temporary employment opportunities								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Short-term*	*Regional*	***Medium***	*Possible*	***Medium***	+	*Medium*
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.								
After Management	*Moderate*	*Short-term*	*Regional*	***Medium***	*Definite*	***Medium***	+	*Medium*

Impact 3.2: 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. 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".

The impact rating before and after mitigation measures are applied is described in Table 6-14.

Table 6-14: Impact 3.2: Increased gender marginalisation and vulnerability as a result of temporary employment opportunities

Activity: Employment

Project phase: Construction								
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. • 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*	*Medi8um-term*	*Regional*	***Medium***	*Possible*	***Medium***	-	*Low*

Impact 3.3: 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 (SITs), 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 6-15.

Table 6-15: Impact 3.3: Increase in social pathologies as a result of migrant worker influx and increased spending power

Activity: Employment								
Project phase: Construction								
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	*Moderate*	*Long-term*	*Regional*	***High***	*Possible*	***High***	-	*Medium*
Management Measures:								
• 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. • 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 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. • Ensure that adequate insurance policies are in place. – 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. – Khoi San women might also be affected by unplanned pregnancies. These issues are to be addressed in focused engagements with these groups. • 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 job seekers are provided with an opportunity to apply without needing to travel to the construction sites when it is already too late.								

• 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. • Publicise the required qualifications, years of experience, and professional certifications/registrations required for any positions that might be available. • Compile influx management plan to manage construction impacts and economic downturn once construction stops to: – Promote economic growth; – Plan access routes and control, material transportation, worker transportation, and worker housing (if applicable); – Collaborate with multi-stakeholder forums to build capacity and manage resource allocation; – Assist PAPs to access banking services, micro-finance or enterprise development initiatives; and – Strengthen capacity of local security, governance, spatial planning, housing, water and sanitation proportionate to project impacts. • Collect specific data on the following aspects prior to finalisation of detailed management plans: – Traffic incidents and accidents within the Project's direct Area of Influence. To be collected as part of the development of the Construction Traffic Management Plan; and – Crime incidents within the Project's direct Area of Influence. To 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*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 3.4: 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 6-16.

Table 6-16: Impact 3.4: Increase in the local economy as a result of increased income and spending by temporary workers/contractors

Activity: Employment								
Project phase: Construction								
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*	*Site / local*	***Low***	*Possible*	***Low***	+	*Medium*
Management Measures:								
• 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. • 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*	*Site / local*	***Medium***	*Possible*	***Medium***	+	*Medium*

6.1.4 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 described in **Section 3.3.1**. The change processes are related to safety, security and health hazards, as well as fears, anxieties and conflicts.

Impact 4.1: Increased safety hazards, traffic 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 equipment 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 as shown in **Figure 6-3**. 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.



Figure 6-3: A variety of livestock observed along the proposed route. From top left clockwise, pictures were taken from south to north.

The impact rating before and after mitigation measures are applied is described in Table 6-17.

Table 6-17: Impact 4.1: Increased safety hazards, traffic and accidents to community members, Khoi San, and livestock

Activity: Construction activities
Project phase: Construction
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: • Ensure that the Community Health, Safety and Security (CHSS) plan is included in contract documents of the main contractor and that it is implemented, including the Traffic and Transport Management Plan. • 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. • Require contractor personnel to drive at appropriate speed limits and enforce this where possible. • Include community safety in inductions and toolbox talks, along with the usual occupational health and safety (OHS) measures. • Consult the relevant municipal or provincial traffic administrations for the relevant support e.g. place speed limit signage and limit road access. • 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. – 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 the ESIA for this project, complaints might be cleared up before they turn into grievances if managed proactively.							
After Management	*Moderate*	*Medium-term*	*Regional*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 4.2: Safety hazards, traffic and accidents to people and livestock during operations

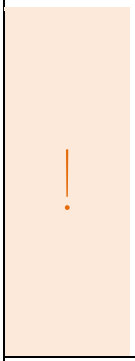
Although the project will aim to ensure that the transmission line and substations are structurally sound and access controlled where needed, there is a possibility that community members may be exposed to hazards. Climate events such as strong winds or sabotage could undermine the structural integrity 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 6-18**.

Table 6-18: Impact 4.2: Safety hazards, traffic and accidents to people and livestock

Activity: Powerline operation								
Project phase: Operation								
Impact Summary: Safety hazards, traffic and accidents to people and livestock								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Major*	*Long-term*	*Regional*	***High***	*Possible*	***High***	-	*Medium*
Management Measures:								

- Ensure that the Community Health, Safety and Security (CHSS) plan is implemented by the transmission and distribution line operators, including a Traffic and Transport Management Plan.
- 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.
- Consult the relevant local municipal administrations when maintenance activities are being conducted.
- Consider including participatory monitoring by the community members if anything out of place is observed along the powerlines.
- 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.
- 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.



  - 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 Community Liaison Officer (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 the ESIA, complaints might be cleared up before they turn into grievances if managed proactively.
  - 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	*Moderate*	*Long-term*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 4.3: Nuisance impacts due to air, water and noise pollution

The movement of construction vehicles and equipment 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 proper waste management practices are not enforced on construction sites.

The impact rating before and after mitigation measures are applied is described in Table 6-19.

Table 6-19: Impact 4.3: Nuisance impacts due to air, water and noise pollution

Activity: Construction activities								
Project phase: Construction								
Impact Summary: Nuisance impacts due to air, water and noise pollution								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium-term*	*Site / local*	***Medium***	*Definite*	***Medium***	-	*Medium*
Management Measures:								

• 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. • 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. • 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. – 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 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	*Minor*	*Medium-term*	*Site / local*	***Low***	*Definite*	***Medium***	-	*Medium*

Impact 4.4: 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 6-20.

Table 6-20: Impact 4.4: Increased crime and 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								
Impact Summary: Increased crime and 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	*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;								

– The code of conduct must be consistent with the United Nation's (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. • 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*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 4.5: 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 6-21.

Table 6-21: Impact 4.5: 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								
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; – The code of conduct must be consistent with the United Nation's (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. • 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 and semi-skilled labour from the PACs as far as possible.								

• 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). • 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*	*Site / local*	***Medium***	*Possible*	***Medium***	-	*Medium*

Impact 4.6: Improved safety resulting from removal of UXOs

UXOs will be removed from the areas that need to be entered for construction (project footprint) prior to that phase of the project. 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 6-22**.

Table 6-22: Impact 4.6: Improved safety resulting from removal of UXOs

Activity: Removal of UXOs								
Project phase: Pre-construction								
Impact Summary: Improved community safety after removal of UXOs from project construction footprint								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Long-term*	*Site*	***Medium***	*Possible*	***Medium***	+	*Medium*
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	*Moderate*	*Long-term*	*Site*	***Medium***	*Possible*	***Medium***	+	*Medium*

Impact 4.7: Safety risks to personnel and community members during UXO removal processes

UXOs will be removed from the areas that need to be entered for construction (project footprint) prior to that phase of the project. This poses a potential safety risk to community members and personnel if a UXO is inadvertently triggered during this process.

The impact rating before and after mitigation measures are applied is described in **Table 6-23**.

Table 6-23: Impact 4.7: Safety risks to personnel and community members during UXO removal processes

Activity: Removal of UXOs								
Project phase: Pre-construction								
Impact Summary: Safety risk to community and personnel during removal of UXOs in project footprint								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**

Before Management	*Major*	*Short-term*	*Site*	***Medium***	*Possible*	***Medium***	-	*Medium*
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	*Moderate*	*Short-term*	*Site*	***Low***	*Possible*	***Low***	-	*Medium*

The following impacts are assessed in the Addendum to the ESIA (Volume 6):

- **SE4.8: Unfair distribution of electricity;**
- **SE4.9: Perceived preferential project benefits;**
- **SE4.10: Safety risks associated with restrictions on ASM activities; and**
- **SE4.11: Restriction of traditional agricultural practices.**

6.1.5 Theme five: Socio-economic development

This theme refers to the benefit that the transmission line provides in enabling electricity delivery to three towns and, in the long term, other connections. It aligns with the theme of *"Infrastructure and Services"* theme described in **Section 3.3.1**. It relates to utilities and public services.

Impact 5.1: Improved access to electricity due to presence of transmission and distribution lines

The transmission line 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 1000 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 6-24**.

Table 6-24: Impact 5.1: 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								
Impact Summary: Improved access to electricity due to presence of transmission and distribution lines								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Major*	*Long-term*	*Regional*	***High***	*Definite*	***High***	+	*Medium*
Management Measures:								
• The long-term functioning and maintenance of the powerlines and substations must be sustained to ensure that it benefits the PACs permanently. • Expansions from the newly constructed transmission line (after this project) would further increase the geographical reach of the benefits associated with electricity availability.								

• 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.								
After Management	*Major*	*Long-term*	*Regional*	***High***	*Definite*	***High***	+	*Medium*

Impact 5.2: 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 6-25**.

Table 6-25: Impact 5.2: Downstream economic development

Activity: Provision of electricity								
Project phase: Operation								
Impact Summary: Improved access to electricity due to presence of transmission and distribution lines								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Long-term*	*Regional*	***High***	*Possible*	***High***	+	*Medium*
Management Measures:								
• The long-term functioning and maintenance of the powerlines and substations must be sustained to ensure that it benefits the PACs permanently. • Expansions from the newly constructed transmission line (after this project) would further increase the geographical reach of the benefits associated with electricity availability. • 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. • 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.								
After Management	*Moderate*	*Long-term*	*Regional*	***High***	*Possible*	***High***	+	*Medium*

The following additional impacts are assessed in the Addendum to the ESIA (Volume 6):

- **SE5.3 on the potential dissatisfaction caused by potential unfulfilled expectations; and**
- **SE5.4 on the opportunity for economic participation by IPs.**

6.1.6 Cumulative impacts

The following three key cumulative impacts have been identified:

- **Loss of land-based livelihoods:** widespread deforestation due to slash-and-burn activities for charcoal and land preparation for agricultural purposes, along with the current decrease in soil fertility and quality as well as rainfall are ongoing. This impacts subsistence farming communities' ability to produce high-quality and diverse crops. If farming land is acquired for the project purpose as discussed in ***Impact 1.1: Reduced income-earning opportunities due to a loss of, or access to, farming and livestock grazing land*** and ***Impact 1.2: Increased food insecurity due to loss of farming or grazing land or access to such land***, a cumulative impact might result

not only for agriculture, but also for ecosystem services used as described in ***Impact 1.9: Reduced community and Khoi San ecosystem services as a result of construction*** activities.

- **Exclusion of indigenous peoples from development opportunities and benefits:** If interactions with **indigenous peoples**, specifically the Khoi San in the area, are not done as per the relevant recommendations in this report (***Impact 2.2: Discrimination or inadvertent exclusion of indigenous peoples (Khoi San)***), the HRIA, the SEP, the ESMP and the IFC PS 8 and the relevant guidelines and standards, the current systematic discrimination felt by these groups will be exacerbated.
- **Gender marginalisation:** If employment opportunities, negotiations for physical or economic displacement, project consultation and any other engagements with female members of the PACs are not done in an inclusive way, in the language of Umbundu and/or Nganguela, at times when they are at home, the differences between genders will be even more apparent as women are excluded from decision-making and do not have access to information or knowledge which they are entitled to.

6.2 Impact assessment summary

The impacts that have been identified and rated pre- and post-mitigation for the different phases of the project are summarised in **Table 6-26** below.

Table 6-26: Summary of socio-economic impacts

№	Impact	Construction phase	Operational phase	Significance ratings	
				Pre-mitigation	Post-mitigation
1.	Reduced income-earning opportunities due to a loss of, or access to, farming and livestock grazing land	✓	✓	High	Medium
2.	Increased food insecurity due to loss of farming or grazing land or access to such land	✓	✓	High	Medium
3.	Reduced income-earning opportunities for artisanal miners due to loss of available artisanal mining areas	✓	✓	Medium	Medium
4.	Disruption of access in and between communities and sites used by Khoi San	✓	✓	Medium	Low
5.	Altered sense of place of community members and Khoi San people due to the presence of the powerlines and substations	✓	✓	High	Medium
6.	Undercompensating economically displaced PAHs/PAPs	✓	✓	High	Medium
7.	Undercompensating physically displaced PAH/PAPs	✓	✓	High	Medium
8.	Increased gender marginalisation and vulnerability resulting from compensations to mostly male household heads	✓	✓	High	Medium
9.	Reduced community and Khoi San ecosystem services as a result of construction activities	✓	✓	High	Medium
10.	Cultural heritage disturbance due to disruption of access to graves and culturally significant sites	✓	✓	Medium	Low
11.	Discrimination or inadvertent exclusion of indigenous peoples (San)	✓	✓	Medium	Low

№	Impact	Construction phase	Operational phase	Significance ratings	
				Pre-mitigation	Post-mitigation
12.	Improved household incomes and livelihoods as a result of temporary employment opportunities	✓		Medium +	Medium +
13.	Increased gender marginalisation and vulnerability as a result of temporary employment opportunities	✓		Medium	Low
14.	Increase in social pathologies as a result of migrant worker influx and increased spending power	✓		High	Medium
15.	Increase in the local economy as a result of increased income and spending by temporary workers/contractors	✓		Low +	Medium +
16.	Increased safety hazards and accidents to community members, Khoi San and livestock during construction	✓		Medium	Medium
17.	Safety hazards and accidents to people and livestock during operations		✓	High	Medium
18.	Nuisance impacts due to air, water and noise pollution	✓		Medium	Medium
19.	Increased vulnerability of villagers due to harassment or tension between construction and security workers, and community members	✓		High	Medium
20.	Increased vulnerability of artisanal miners due to abuse by security, law enforcement and/or local police	✓	✓	High	Medium
21.	Improved safety resulting from removal of Unexploded Ordnances (UXOs)	*Pre-construction*	*Pre-construction*	Medium +	Medium +
22.	Safety risks to personnel and community members during UXO removal process	*Pre-construction*	*Pre-construction*	Medium	Low
23.	Improved access to electricity		✓	High +	High +
24.	Downstream economic development		✓	High +	High +

7 Summary of mitigation and management measures

7.1 Socio-economic impact mitigation and enhancement measures

The measures that have been recommended to mitigate the negative and enhance the positive impacts are summarised in **Table 7-1** below. Broad implementation timeframes and responsibilities are also listed – pre-construction and construction mitigations typically fall to Pak, whereas RNT and/or ENDE generally look after operational phase impact mitigation.

Table 7-1: Summary of socio-economic mitigation measures

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
1.	Reduced income-earning opportunities due to a loss of, or access to, farming and livestock grazing land	• Ensure the project design is adapted to avoid any impacts on farming or grazing land. • 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. • 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. • Compile and implement an IFC PS1-compliant SEP, including a grievance mechanism. • Informed by the LARF prepared for this project, compile a comprehensive IFC PS5-compliant Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP) and implement for any physical or economic displacement requirements. • 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.	Pre- and post-construction	Pak RNT
2.	Increased food insecurity due to loss of farming or grazing land or access to such land	• Determine if any of the existing agricultural projects, institutes or facilities, such as the PEDR, CarrinhoAgri (run by Grupo Carrinho Comercio Lda), Agri 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. • 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. • Construction activities should be limited to demarcated areas and avoid farming or grazing land used by local communities. • 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. • 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. • Consultation with *sobas* and local municipal administrations will be important to ensure that farmland is identified and avoided prior to site establishment.	Pre- and post-construction	Pak RNT

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
3.	Reduced income-earning opportunities for artisanal miners due to loss of available artisanal mining areas	• 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. • 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).	Pre-construction and construction	Pak RNT
4.	Disruption of access in and between communities and sites used by Khoi San people	• 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). • 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. • 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. • 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.	Pre-construction and construction	Pak
5.	Altered sense of place of community members and Khoi San people due to the presence of the powerlines and substations	• 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. • 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. • 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.	Pre-construction	Pak
6.	Undercompensating economically displaced PAHs/PAPs	• Compile 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 which is informed by the LARF. • 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	Pre-construction	Pak RNT

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		valuations are used (taking inflation into account if the latest published guidelines are pre-2024 or whichever year the compensation will take place). • 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. • 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. • Any cash compensation should be provided along with relevant education on financial literacy and responsible spending. • 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.	Undercompensating physically displaced PAH/PAPs	• 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. • Compile 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 which is informed by the LARF. • 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). • Externally monitor the physical relocation process to ensure that GIIP, IFC PS5, and RAP requirements are adequately implemented, monitored, and periodically reviewed. • Any cash compensation should be provided along with relevant education on financial literacy and responsible spending.	Pre-construction	Pak RNT

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		• Any changes to residential locations should be accompanied by security of tenure. • Most households in the PACs do not have security of tenure as their houses have been inherited or provided by sobas without records. 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 community. • 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 souring of replacement housing. • Counselling and training on house maintenance and the management of household budgets should be provided. • Livelihood restoration mitigation measures described in Impact 1.6: Undercompensating economically displaced PAHs/PAPs should also be taken into account if there will be changes to farming locations.		
8.	Increased gender marginalisation and vulnerability resulting from compensations to mostly male household heads	• 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. • Compile 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 which is informed by the LARF. • 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. • 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. • Care should be taken not to overlook households that were not born in the affected villages, but who have **migrated** there after the war. • 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. • 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**.	Pre-construction	Pak RNT

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		• 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. • Any cash compensation should be provided along with relevant education on financial literacy and responsible spending. • 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). • 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. • Inform and consult with *Sobas* and traditional leaders, including female representatives, prior to the construction phase. • 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. • Ensure community leaders are aware of issues such as sexual exploitation and abuse prevention, and how these can be reported through the Project Grievance Mechanism.		
9.	Reduced community and Khoi San ecosystem services as a result of construction activities	• Establish and monitor conservation corridors. • Establish safe access routes to natural resource-use areas. • 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. • No recreational hunting or fishing should take place by construction workers on- or off-duty. • Vegetation clearing should be limited to the absolute minimum. • Hydrocarbon spills should be prevented as prescribed in the ESMP. • Any construction activities should be restricted to the established and demarcated construction sites. • Vehicle movement should be restricted to existing roads.	Pre-construction and construction	Pak

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		• Locations of medicinal plants should be identified prior to site establishment to ensure that they can be avoided or replanted.		
10.	Cultural heritage disturbance due to disruption of access to graves and culturally significant sites	• Care should be taken to identify any features that can potentially indicate unmarked graves prior to site establishment and vegetation clearing. • Develop and implement a Chance Find Procedure. • If any graves are identified, these should be avoided, work stopped if needed, and the relevant authorities contacted. Exhumation should only be considered as a last resort and it must be in line with local customs. • If access to graves is altered in any way (as discussed in **Impact 1.4: Disruption of access in and between communities**, 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.	Pre-construction and construction	Pak
11.	Discrimination or inadvertent exclusion of indigenous peoples (Khoi San)	• 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.	Pre-construction, construction, and operation	Pak RNT

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		• 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. • Ensure that honey collection sites are not destroyed, disturbed, or access thereto denied during construction activities.		
12.	Improved household incomes and livelihoods as a result of temporary employment opportunities	• 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.	Pre-construction and construction	Pak
13.	Increased gender marginalisation and vulnerability as a result of temporary employment opportunities	• 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	Pre-construction and construction	Pak

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		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. • 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.		
14.	Increase in social pathologies as a result of migrant worker influx and increased spending power	• 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. • 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 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. • Ensure that adequate insurance policies are in place. • 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. • Khoi San women might also be affected by unplanned pregnancies. These issues are to be addressed in focused engagements with these groups.	Pre-construction and construction	Pak

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		• 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 job seekers are provided with an opportunity to apply without needing to travel to the construction sites when it is already too late. • 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. • Publicise the required qualifications, years of experience, and professional certifications/registrations required for any positions that might be available. • Compile influx management plan to manage construction impacts and economic downturn once construction stops to: – Promote economic growth; – Plan access routes and control, material transportation, worker transportation, and worker housing (if applicable); – Collaborate with multi-stakeholder forums to build capacity and manage resource allocation; – Assist PAPs to access banking services, micro-finance or enterprise development initiatives; and – Strengthen capacity of local security, governance, spatial planning, housing, water and sanitation proportionate to project impacts. • Collect specific data on the following aspects prior to finalisation of detailed management plans: – Traffic incidents and accidents within the Project's direct Area of Influence. To be collected as part of the development of the Construction Traffic Management Plan; and – Crime incidents within the Project's direct Area of Influence. To be collected as part of the development of the Security Management Plan, or the Gender-Based Violence and Harassment (GBVH) Prevention and Response Plan. •		
15.	Increase in the local economy as a result of increased income and spending by temporary workers/contractors	• Where local 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.	Pre-construction and construction	Pak

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		• 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.		
16.	Increased safety hazards and accidents to community members, Khoi San and livestock during construction	• Ensure that the CHSS plan included in contract documents of the main contractor and that it is implemented. • 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. • Require contractor personnel to drive at appropriate speed limits and enforce this where possible. • Include community safety in inductions and toolbox talks, along with the usual occupational health and safety (OHS) measures. • Consult the relevant municipal or provincial traffic administrations for the relevant support e.g. place speed limit signage and limit road access. • 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. • 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 the ESIA for this project, complaints might be cleared up before they turn into grievances if managed proactively.	Construction	Pak RNT
17.	Safety hazards and accidents to people and livestock during operations	• Ensure that the Community Health, Safety and Security (CHSS) plan is implemented by the transmission and distribution line operators. • 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. • Consult the relevant local municipal administrations when maintenance activities are being conducted. • Consider including participatory monitoring by the community members if anything out of place is observed along the powerlines.	Operations	RNT ENDE

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		• 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. • 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. • 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 the ESIA for this project, complaints might be cleared up before they turn into grievances if managed proactively. • 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.		
18.	Nuisance impacts due to air, water and noise pollution	• 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. • 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. • 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. • 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	Construction	Pak

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		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 the ESIA for this project, complaints might be cleared up before they turn into grievances if managed proactively.		
19.	Increased vulnerability of villagers due to harassment or tension between construction and security workers, and community members	• Use the existing community forums to communicate the IFC-compliant grievance mechanism. • 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. • All workers are to be informed about the roles and responsibilities of the security personnel.	Construction	Pak
20.	Increased vulnerability of artisanal miners due to abuse by security, law enforcement and/or local police	• Use the existing community forums to communicate a revised IFC-compliant grievance mechanism. • 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;	Operations	RNT ENDE

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		– 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. • 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 and semi-skilled labour from the PACs as far as possible. • 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).		
21.	Improved safety resulting from removal of Unexploded Ordnances (UXOs)	• 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.	Pre-construction, construction, and operations	Pak RNT
22.	Safety risks to personnel and community members during UXO removal process	• 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.	Pre-construction	Pak RNT
23.	Improved access to electricity	• The long-term functioning and maintenance of the powerlines and substations must be sustained to ensure that it benefits the PACs permanently. • Expansions from the newly constructed transmission line (after this project) would further increase the geographical reach of the benefits associated with electricity availability. • 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.	Operations	RNT ENDE
24.	Downstream economic development	• The long-term functioning and maintenance of the powerlines and substations must be sustained to ensure that it benefits the PACs permanently. • Expansions from the newly constructed transmission line (after this project) would further increase the geographical reach of the benefits associated with electricity availability. • Shortly before the connections through the distribution network are implemented in the different beneficiary areas, create awareness on using electricity efficiently to	Operations	RNT ENDE

№	Impact	Mitigation / enhancement measure	Implementation timeframes	Responsibility
		ensure that the project remains cost-effective and that the demand does not exceed the available supply. • 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.		

7.2 Special mitigations for vulnerable groups

7.2.1 Women and elderly

Visuals and simple text in Umbundu, Nganguela, and Portuguese should be used whenever **consultations** are done. It is important to use Umbundu and/or Nganguela to ensure that women and the elderly whose understanding of Portuguese is limited, are equally informed about important project activities, such as compensation negotiations, job opportunities, and the grievance mechanism.

Visuals and simple text in Umbundu, Nganguela, and Portuguese should also be used in awareness and education sessions on **sustainable farming** and **financial literacy** as part of transitional support and livelihood restoration. This will ensure that they are empowered to undertake sustainable farming. They also need to understand what the compensation entails and what *their* rights are as PAPs.

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.

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 assets.

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**.

Ensure that, when any engagements related to displacement compensation, 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 surveys or negotiations are done.

Where possible, designate employment opportunities for women from within all six affected municipalities, not just the three beneficiary municipalities.

Ensure compliance with IFC PS 2 and the relevant ILO conventions where women 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 female 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.

Any wage payments should be provided along with relevant education on financial literacy and responsible spending.

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*.

Create awareness around sexual health and family planning 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.

The grievance mechanism must be accessible by women and therefore in a language that they understand. Community 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.

Inform and consult with *Sobas* and traditional leaders, including female representatives, prior to the construction phase.

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.

Ensure community leaders are aware of issues such as sexual exploitation and abuse prevention, and how these can be reported through the Project Grievance Mechanism.

7.2.2 Community members without security of tenure and displaced PAPs

It is strongly recommended that the valuation and compensation process 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, is externally monitored by a suitably qualified third party., This is especially important if the process is undertaken by government agents.

The physical relocation process should also be externally monitored to ensure that GIIP, IFC PS5, and RAP requirements are adequately implemented and periodically reviewed.

Any cash compensation should be provided along with relevant education on financial literacy and responsible spending and changes to residential locations should be accompanied by security of tenure.

7.2.3 Migrant / internally displaced / marginalised community members

Care should be taken not to overlook households that were not born in the affected villages, but who have **migrated** there after the war.

Ensure compliance with IFC PS 2 and the relevant ILO conventions where 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.

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.

7.2.4 Disabled and elderly

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.

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.

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.

Where possible, designate employment opportunities for women and disabled persons employees from within all six affected municipalities, not just the three beneficiary municipalities.

Ensure that, when any engagements related to displacement compensation, employment opportunities and financial management, take place, **all** adult members of the household are present.

Ensure compliance with IFC PS 2 and the relevant ILO conventions disabled 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.

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.

The grievance mechanism must be accessible by the disabled. They 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.

7.2.5 Indigenous people

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 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.

Ensure that honey collection sites are not destroyed, disturbed, or access thereto denied during construction activities.

Khoi San women might be affected by unplanned pregnancies if there is an influx of migrant workers during the construction phase. These issues are to be addressed in focused engagements with these groups.

The grievance mechanism must be accessible by the Khoi San. Community 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.

7.2.6 Artisanal miners

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.

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.

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).

8 Ongoing community engagement strategy and grievance mechanisms

As part of the Cassinga ESIA, an SEP has been produced. This SEP contains a grievance mechanism.

It is important to note that, although some stakeholder engagements have taken place as part of the ESIA consultations, stakeholder engagements should continue for the life of the project. For this reason, the SEP contains stakeholder engagement strategies for both the construction and operational phases of the project.

8.1 Responsibilities

Pak will own it for most of the construction (and pre-construction) phase activities, RNT (and ENDE, for electricity *distribution* components of the project) will have the responsibility to implement the SEP and grievance mechanism once the transmission line and substations become operational. However, certain stakeholder engagements will call for a combined effort between Pak and RNT. These engagements mostly have to do with any form of displacement, whether physical or economic. The reason for this is that the RNT is mostly responsible for the various processes in planning and executing resettlement and livelihood restoration (Pak, 2024). RNT, being a state-owned entity with the specific mandate of electricity transmission provision, might involve other government entities, such as the local municipal administrators in the displacement management process. To ensure that the process is done according to IFC standards, it is strongly recommended that Pak play an oversight role or involves a third-party to plan, implement and monitor the process, as state entities might not have the requisite capacity or experience.

8.2 Grievance mechanism

As discussed in Section 7.2 above the grievance mechanism for external parties, such as members of the PACs, PAHs, PAPs, vulnerable people such as women, the elderly, the disabled, the illiterate, and the indigenous/ethnolinguistic minority group of the Khoi San people must be offered an equal opportunity to know of, understand, use, and receive recourse through the grievance mechanism.

To ensure that it reaches these groups and is understood by them, it must be publicised in both Umbundu, Nganguela, and Portuguese. It must take the form of meetings or allow for verbal reporting of complaints of grievances, to allow those who are illiterate or have sensory disabilities an additional avenue through which to make use of the mechanism.

Separate engagements must be done with indigenous peoples for the purpose of making them aware of the project, and the availability of a grievance mechanism must be communicated to them during these engagements as well (preferably in !Kung).

Since most of the villages in the project AoI are fairly remote with severely limited access to public transport, it strongly recommended that a CLO or similar role player conducts routine engagements with these villages to record any grievances they might have.

9 Conclusions and recommendations

An SEIA was conducted for the proposed Cassinga Power Supply Project in Huíla Province, Angola, covering Chipindo, Cuvango, and Jamba municipalities. The assessment included a desktop review of socio-economic baselines, consultation of Angolan census data, and a site visit with initial meetings with local administrations. Household surveys were conducted in rural areas along the OHL route, covering 16 villages. Surveys collected data on social facilities, sacred sites, water lines, and household numbers, with local leaders providing additional insights.

Findings revealed that most villagers engage in subsistence farming, informal commerce, beekeeping, artisanal gold mining, and river fishing, with field produce sales as the primary income source. Monthly household incomes range from AKZ 38,000 to AKZ 180,000. Additional income in municipal centres comes from civil service jobs and government subsidies. Crop cultivation is rudimentary, with staple crops including maize, beans, sweet potatoes, cassava, and yams. Land is typically inherited or granted by traditional authorities, with limited formal ownership. Infrastructure is poor, with no electricity except from thermal generators in municipal centres. Families rely on wood and charcoal for cooking and solar panels for lighting. Water is sourced from wells and streams, with some municipal centres having government water connections. Education facilities are basic, often using church spaces. Public transport is absent, with private motorbikes and walking as primary modes of transportation.

Health issues are prevalent, including malaria, bronchitis, diarrhoea, and cholera in children, and typhoid fever, rheumatism, hypertension, and diabetes in adults. Men dominate herding and driving, and important household decisions are typically made by men. School attendance is generally equal among boys and girls, though girls are more likely to drop out due to motherhood. Farming responsibilities are shared between men and women. Vulnerable groups include people with disabilities and the non-Bantu San ethnic group, traditional hunter-gatherers at risk of socio-cultural extinction. Without investments in infrastructure, services, and employment opportunities, the living conditions of these villages are expected to remain unchanged.

24 socio-economic impacts were identified, some of which occur in the construction phase, others in the operation phase, and the rest in both phases. All impacts of high severity can be mitigated to have medium to low severity. Management and mitigation measures have been suggested for each of the impacts identified. Special mitigation measures required for vulnerable groups are highlighted.

This report should be read in conjunction with the HRIA, LARF and the CHSS prepared for this project. The implementation of the plans such as the LARF, CHSS and ESMP will ensure that the negative environmental and social impacts of the project are reduced and that the benefit of the project is felt in the areas that will now, for the first time, receive reliable electricity.

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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Appendices

Appendix A: Additional information on OHL infrastructure

Stage 1: Gove – Chipindo – Cuvango

The Gove – Chipindo – Cuvango section of the OHL will comprise the following components:

- High Voltage Transmission Line, 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 mm^2 (2 by phase).
- 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 will comprise the following components:

- High Voltage Transmission Line, 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 mm^2 (2 by phase).
- Two Guard Wires will be installed, one conventional “Guinea” and another type “OPGW” with 24 Optical Fibres.

Appendix L: Visual

Cassinga Electric Power Supply Project –

Visual Impact Assessment

Report Prepared for

Pak Yatirim

Report Number 595657



Report Prepared by

srk consulting

September 2024

Cassinga Electric Power Supply Project – Visual Impact Assessment

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Disclaimer

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1 Introduction

1.1 Overview of the project

The Republic of Angola, through its Ministry of Energy and Water (MINEA), is embarking on a significant enhancement of its electrical infrastructure with the Cassinga Project, aiming to boost electric power supply across various communities within the Province of Huíla. The Project is structured around the establishment of a new 220 kV Overhead Line (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. Furthermore, the Project includes the laying down of medium voltage overhead lines for distribution, along with the necessary low voltage 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 OHL 220 kV interconnection to Cuchi/Menongue.

An estimated power demand of 80 MW has been calculated for the Cassinga 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 Cassinga Electric Power Supply Initiative represents a significant leap forward in Angola's energy infrastructure development. The Project 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 Hydro Plant to the Cassinga Project and the future OHL 220 kV interconnection to Cuchi/Menongue.

1.2 Purpose of study

As the proposed infrastructure will be visible in the landscape, a Visual Impact Assessment (VIA) is required to inform the Environmental and Social Impact Assessment (ESIA) underway.

This report provides the outcomes of the VIA that was undertaken for the project. The purpose of the study was to identify and assess the visually sensitive areas and receptors within the project area and to calculate the magnitude of visual impact associated with the project. The assessment also aims to recommend possible measures that can be followed to reduce the visual impact of the project.

1.3 Assumptions, exclusions and limitations

The following assumptions and limitation apply to the VIA:

- The viewshed illustrates the areas from which the infrastructure relating to the Cassinga Power Supply Project is likely to be visible. It does not take local undulations, existing vegetation and man-made structures into account.
- At the time of performing this assessment a site visit was not viable, therefore models are purely 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.
- It is assumed that the layout information for the infrastructure and powerline corridor provided at the time of the assessment is correct and will not be changed.

- Locations and footprint of the construction camps 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.
- Location of the temporary laydown areas was unknown at the time of modelling. These areas were excluded from the viewshed models, and the visual impact could not be analysed. Visual impacts are assumed to be localised and of short duration for these areas.
- At the time of compiling the visual assessment report, the locations of the transmission towers, layout plans and infrastructure dimensions were not available. As such SRK assumed approximate values, i.e., tower heights of 50m high and with conductor spans of 400m between towers.
- Substation footprint areas were not provided hence an evaluation of the approximate locations provided was done. Modelling parameters used were based on digital research on similar existing substations and SRKs experience with similar infrastructure.
- Viewpoints (representing potentially visually sensitive areas) were selected based on a digital inspection of the site and surrounds.
- The visual impact analysis does not include the impact of lighting, as this information was not available at the time of compiling the visual impact assessment.
- 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 are not available. 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.

1.4 Information sources

The following sources of information relating to the site and surrounding area were used in this visual impact assessment:

- KMZ of the proposed powerline alignment and the approximate locations of the substations and power transformation stations.
- Reconnaissance Survey findings.
- Digital surface models and digital terrain models, covering a 350m wide area along the path of the powerline, from Gove Hydro Dam to about 11km southeast of Chipindo.
- Project description provided by the Environmental Assessment Practitioner.
- Open Buildings.
- NASA SRTM.
- Google Earth and ESRI hybrid imagery.

2 Standards applied to study

Due to the absence of guidelines for assessing visual impacts in Angola, the methodology and assessment criteria is based on the South African developed “Guideline for involving visual & aesthetic specialists in EIA processes”, issued by the Provincial Government of the Western Cape (WC Guidelines), the Landscape Institute and Institute of Environmental Management and Assessment

(UK) “Guidelines for Landscape and Visual Impact Assessment” and SRK’s experience in conducting VIAs.

3 Approach and methodology

3.1 Scope of work

The following scope of work underpin the VIA:

- Determine areas that will be visually exposed to the infrastructure related to the Cassinga Power Project.
- Identify and map potentially sensitive visual receptors.
- Digitally assess the study area to determine the extent assess the extent of the visual impact of the Cassinga Power Supply Project on the potentially sensitive visual receptors and to understand the receiving environment.
- Describe the landscape and sense of place of the project and surrounding area.
- Evaluate the visual impact of the Cassinga Power Supply Project on the surrounding environment, specifically focussed on the potentially sensitive visual receptors.
- Describe and recommend potential alternatives, mitigation measures and monitoring programmes if necessary.

3.2 Objectives

The VIA aimed to achieve the following outcomes:

- Gain an understanding of visual related issues and consider of any concerns raised in the ESIA, sensitive areas identified, concerns raised by other specialists and feedback received from Interested and Affected Parties (IAPs).
- Identify receptors that could be visually sensitive to the construction of the powerlines and related infrastructure.
- Understand the receiving environment, establish the Sense of Place, Visual Characteristics of the area and Visual Absorption Capacity (VAC) of the surrounding environment.
- Determine and assess the visual impact the Cassinga Power Supply Project will have on the potentially visually sensitive receptors.
- Identify potential alternatives, mitigation measures and monitoring programs if necessary.

3.3 Methodology

Given the absence of set criteria for assessing visual impacts and the subjective nature of visual related issues, attention has been given to use environmentally accepted methodology and rating criteria. Emphasis has been placed on ensuring that the methodology and visual rating criteria used are clearly stated and transparent.

The following methodology was applied to assess the visual impact of the Cassinga Power Supply Project in the most objective way:

- Identification of data requirements and collation of data. This included acquiring spatial data of the project area and proposed infrastructure, topography of the site and surrounding area and

assessing the existing visual character and quality of the area designated for the Cassinga Power Supply Project as well as the surrounding area. This was done by:

- Desktop study of the site and surrounding area to gain an understanding of the characteristics of the landscape and identify potentially sensitive visual receptors.
  - Using aerial imagery, elevation surfaces and Google Open Buildings to identify potential sensitive areas.
  - Preliminary viewshed modelling to determine areas that may be visually sensitive to the proposed project.
  - Based on digital observation[1] and the preliminary viewshed modelling results, identify potentially sensitive visual receptors represented as viewpoints to be assessed against site information.
- Use data collected onsite and information from other specialists to verify the results of the desktop study and visibility from the viewpoints, and become familiar with the site and surrounding area.

- A geo-spatial raster analysis[2] of all the processed data was conducted to determine the magnitude of the visual impacts of the following attributes:
  - Visual exposure (viewshed) and viewing distance.
  - Visibility.

4 Project activities posing potential impacts

4.1 Overview of Design and Structural Aspects Influencing Visual Impact

To understand the impact a structure may have on a receptor (viewer) it is important to understand the visual representation of the structure. The following key parameters are usually considered when assessing the probable visual impact on a receptor:

- **Height:** The higher the structure or facility is, the more extensive the visual envelope (viewshed) will be. The height of a structure may be mitigated / shielded by the topography of the surrounding area, man-made features or by natural features. The opposite is also true as the lack of the above mentioned “mitigation” or “shielding” may increase the visibility of a structure. Visually the perception of the height of a building or structure is partially a function of the spatial interaction between topography, height of existing man-made features and the height of natural features, such as trees and shrubs in the vicinity of the infrastructure.
- **Surface area:** The combination of the total surface area and the degree of visibility of the infrastructure has an impact on receptors. A smaller surface / face-area / cross-sectional area may reduce visibility from areas further away from the infrastructure and, hence could reduce the potential visual impact the infrastructure may have. A larger surface / face / cross-sectional area will obstruct views which would previously have been visible and may lead to a more significant impact.
- **Arrangement of construction:** A staggered configuration, such as a powerline (as an example), ensures that the infrastructure might “blend” into the surrounding environment. Solid structures (retaining walls and buildings) are more obstructive and visible over a larger area.
- **Arrangement of colours:** The colour of infrastructure has an important function as it could either add emphasis on the structure, or it could assist in hiding / camouflaging it. It is therefore important

1 Using digital data: satellite imagery, Open Buildings (building footprints), Open Street Map data (roads, rivers, railway lines) and European Space Agency landcover data, to get an understanding of the project area and identify potentially sensitive locations (such as communities, where road and railway users will potentially have views of the project infrastructure).

2 Using raster (data with cell based information) in conjunction with spatial information an analysis of the potential visual impacts can be undertaken.

that structures or buildings are painted with neutral colours which should be consistent with the colours of similar structures in the wider area.

- **Boundary with the environment:** The boundary of a facility may significantly change the appearance of the natural area in which it is located. It is therefore important to retain as many natural features as possible, such as the landscape and vegetation surrounding the site, where it does not pose a health or safety risk from an operational perspective.

4.2 Description of project activities and the potential visual impact

This section provides a brief description of the project components that could potentially have a visual impact on the surrounding environment. The locations of these project components are shown on Figure 5-2: Project Infrastructure.

4.2.1 Transmission lines and towers

The towers associated with transmission lines generally form a staggered configuration and tend to blend into the surrounding environment more than solid infrastructure. The conductors associated with transmission lines have a very small cross-sectional/face area means that they are only visible at very close proximities (visual impact of less than 200m). The transmission towers, although not a solid structure, have a greater surface area and are clearly visible within 600m and blur into background at approximately 1200m.

4.2.2 Substations

Three new substations in Chipindo, Cuvango and Jamba will be constructed. Footprint areas and design is not currently available however each substation will be based on the single busbar configuration.

4.2.3 Overhead line infrastructure

Overhead line (OHL) infrastructure will be constructed and refers to the network of towers, poles, conductors and equipment used to transmit and distribute electrical power through aerial cables.

4.2.4 Medium Voltage OHL Network for electrification of community homes and public lighting

A 30 kV network is proposed to be constructed from the substations to be constructed at the 30 kV outlets, to the city of Jamba and Cuvango. This infrastructure will be constructed along existing access roads and assembled on concrete poles and be used to interconnect power transformation stations.

4.2.5 Construction Sites

One main construction site is planned to be located next to the AH Gove and three secondary construction sites will be located along the powerline route. The construction sites will be located within 40 km of the working project sites.

4.2.6 Access roads and pathways

The project will mainly make use of existing roads and pathways to access the site. Improvements to these roads and pathways will be made if necessary. In certain areas where no existing road/pathway exist new routes have been planned. The new pathways requiring clearance run within close proximity to and parallel to the planned powerline.

5 Baseline conditions

5.1 Site description/project location

The Project is located South of the centre of Angola, namely, in the provinces of Huila and Huambo. The Project powerline extends for about 170 km, crossing six municipalities (Municípios) which include Jamba, Kuvango, Dongo, Galangue, Chipindo and Kalima (Figure 5-1).

The main works will be carried out largely in Huila Province near the Gove Hydro Dam (Huambo) 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 associated with the electrification of villages at Chipindo, Cuvango and Jamba will be constructed (Figure 5-2).

This VIA investigates the visual impact of the project within a 20km radius of the project infrastructure.

5.2 Local and regional context

The visual effects of the project are not expected to impact areas further than 5km from the project site.

5.3 Ambient conditions

Visual Impact Assessment is a subjective process and a number of criteria have been used to describe the visual aspects of the environment. The criteria evaluate the current visual landscape and the potential changes to the landscape that the current infrastructure may have.

The following criteria can be used to describe the visual landscape of an area:

- **Visual Character:** Visual character is descriptive and non-evaluative, which implies that it is based on defined attributes that are neutral. A change in visual character cannot be described as having positive or negative attributes until it is compared with the viewer response to that change. The probable change caused by the implementation of the Cassinga Power Supply Project is assessed against the existing degree of change caused through its development.
- **Sense of Place:** Our sense of a place depends not only on spatial form and quality but also on culture, temperament, status, experience and the current purpose of the observer (Lynch, 1992). Central to the idea of ‘sense of place’ or *Genus Loci* is identity. An area will have a stronger sense of place if it can easily be identified, that is to say if it is unique and distinct from other places within the area.
- **Visual Quality:** Visual quality is evaluated by identifying the vividness, intactness and unity present in the viewshed. This approach to evaluating visual quality can also assist in identifying specific methods for mitigating specific adverse impacts that may occur as a result of a project.

These criteria are combined with an assessment of the magnitude of the impact to determine its severity, it must however be noted that the sense of place is used to inform the potential sensitivity of a viewer and does not have its own rating. Criteria used in the determination of the magnitude, which are discussed in more detail in Section 7, include:

- **Visual exposure:** An objects “zone of visual influence” or how visible an object may be in the landscape and how exposed the viewers are to the object.
- **Viewshed:** The viewshed indicates areas where the development components will potentially be visible from. This is established through spatial modelling.

- **Viewing Distance and Visibility:** The distance of a viewer from the proposed development 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. This is a measurement of how visual impacts are modified by distance. The effect of scale, topography, vegetation, weather, and distance, in turn alters the degree of a visual effect.
- **Visual Absorption Capacity (VAC):** The Visual Absorption Capacity (VAC) is the potential for the area to conceal an object.
- **Landscape Compatibility:** Landscape or townscape compatibility refers to the compatibility of the proposed structure with the existing landscape and townscape.
- **Viewer Sensitivity:** The sensitivity of viewers is determined by the number of viewers and by how likely they are to be impacted upon, this is informed by the sense of place of an area. Sensitivity is also dependent on the viewer's perception of the area and their ability to adapt to changes in the environment. This can also include how frequently they are exposed to the view, i.e. static views from houses would have a higher sensitivity than transient views experienced by motorists.

5.3.1 Visual Character

The project and surrounding area can be described as a rural landscape interspersed with natural areas. Several main roads run across the project site (EN 358, EN 270, EN 120, EN 280 and HLA 125). Notable towns and villages falling within the study area includes Gove, Bunjei, Chipindo, Catala, Cului, Cuvango and Jamba. There are also numerous communities located mainly alongside roads. Gove Dam and hydroelectric power plant is situated at the North of the project site. Mining activities in the study area mostly consist of artisanal and small-scale mining (ASM) except for close to Gove where they are reportedly prospecting for gold and the Cassinga Mine adjacent to Jamba.

The main land uses within the study area can be described as:

- Subsistence agricultural land (crop land);
- Mining (mostly Artisanal and small-scale);
- Natural Forest;
- Plantations;
- Grassland; and
- Residential/built-up area (communities).

The visual character of the study area is evaluated numerically using the Hassel matrix (see Table 5-1 below).

Table 5-1: 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.

Description	Value	Typical Character / Use
Highly modified landscape, urban/industrial.	1	Substantially developed landscape. High levels of visual impact associated with buildings, factories, roads and other related infrastructure.

The visual character of the study area can predominantly be described as agricultural land (subsistence farming), forest (natural and plantations) and built-up (community) areas. In terms of the rating system presented in Table 5-1, the visual character of the study area is classified as a **natural transition landscape (4)**. The sites for the three new substations (Chipindo, Cuvango and Jamba) fall on the edge of the towns in landscape classified as **natural transition landscape (4)**.

The visual character for the medium voltage distribution networks in the towns of Chipindo, Cuvango and Jamba is classified as **Transition landscape (2)**. The towns are not highly developed areas. Agriculture and open space is interspersed with small-scale buildings/dwellings.

5.3.2 Sense of place

Most of the study area is interspersed with residential buildings, subsistence agricultural land, mining activities and natural and forest (commercial and natural). The area is very diverse with little distinct pattern. The sense of place for most of the study area can therefore 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 memorable landscape feature and hence the sense of place in Gove will be high in comparison to the rest of the study area.

5.3.3 Visual Quality

Visual quality is evaluated by identifying the vividness, intactness, and unity present in the viewshed. Aesthetic value is an emotional response derived from our experience and perceptions. As such, it is subjective and difficult to quantify in absolute terms. Studies in perceptual psychology have shown that humans prefer landscapes with higher complexity (Crawford, 1994). Landscape quality can be said to increase when:

- Topographic ruggedness and relative relief increases;
- Water forms are present;
- Diverse patterns of grassland and trees occur;
- Natural landscape increases and man-made landscape decreases; and
- Where land use compatibility (coherence) increases.

Thus, visual quality decreases when elements deter from the natural environment and, hence, influence the wider area of influence in a negative way. Elements that decrease the visual quality of an area includes “visual clutter” and man-made features, such as roads, mines, factories.

Figure 5-3 shows the land cover as classified by the European Space Agency. Figure 5-4 shows the land cover reclassified based on the visual quality rating related to the land use.

Visual Quality is largely subjective, therefore adapted from the United States Department of Transport: Visual Impact Assessment for Highway Projects (1981) and the Landscape Institute with the Institute of Environmental Management and Assessment (2002), visual quality can be calculated as per Equation 5-1 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.*

Equation 5-1:

$$Visual\ Quality = \frac{Vividness + Intactness + Unity}{3}$$

Visual Quality was calculated according to Equation 5-1, based on the following rating criteria specified in Table 5-2.

Table 5-2: 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.

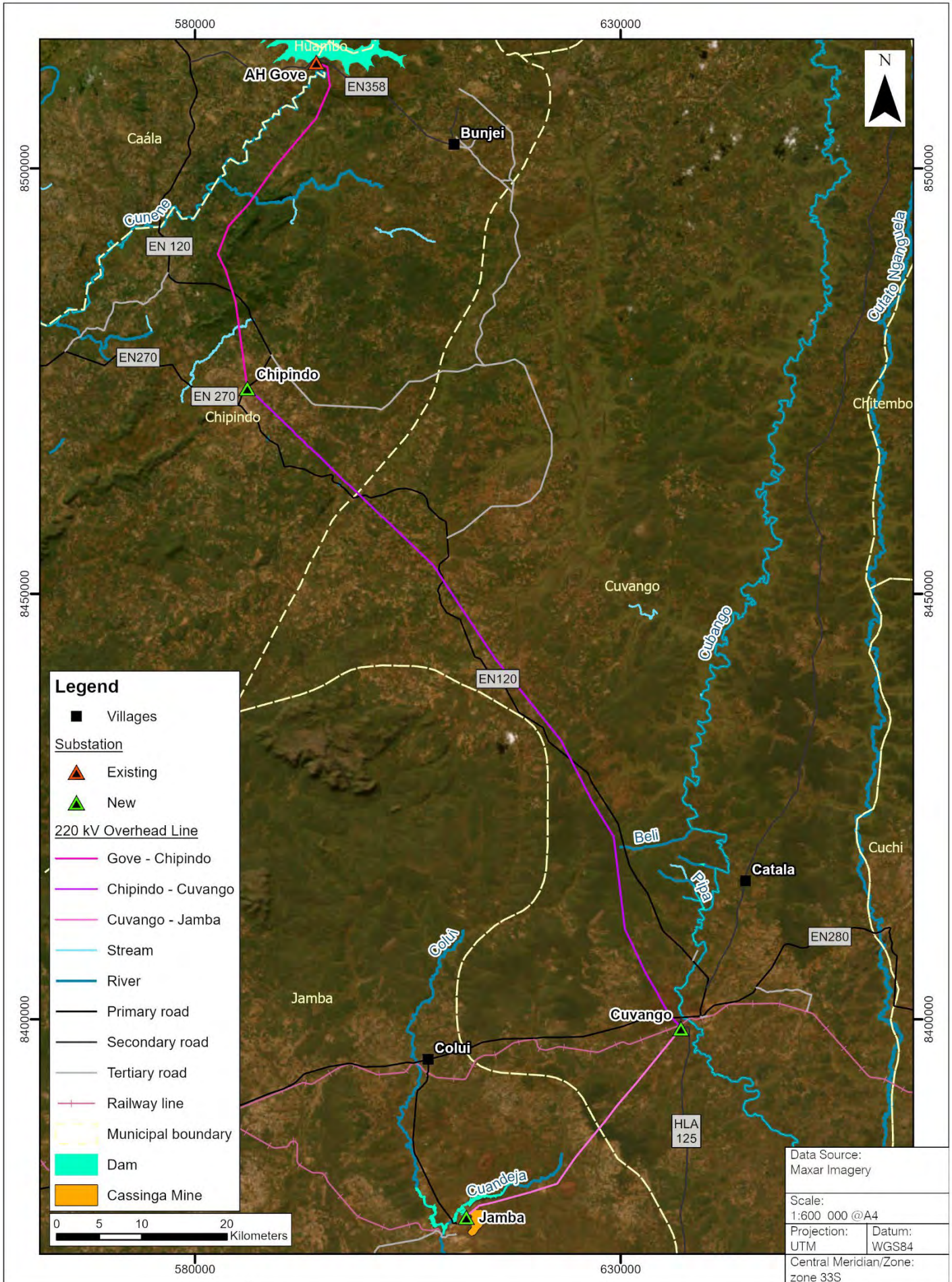
The visual quality of the study area is calculated and summarised in Table 5-3, based on Equation 5-1 and the rating criteria presented in Table 5-2.

Table 5-3: Visual Quality rating for the Cassinga Power Supply 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**.
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	$Visual\ Quality = \frac{2\ +\ 3\ +\ 3}{3} = 2.67\ (MEDIUM)$		$Visual\ Quality = \frac{3\ +\ 4\ +\ 4}{3} = 3.66\ (MEDIUM - HIGH)$	

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	$Visual\ Quality = \frac{2 + 2 + 3}{3} = 2.33$ $(LOW - MEDIUM)$		$Visual\ Quality = \frac{3 + 3 + 3}{3} = 3.00\ (MEDIUM)$		$Visual\ Quality = \frac{4 + 3 + 3}{3} = 3.33\ (MEDIUM)$	

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	$Visual\ Quality = \frac{4 + 2 + 2}{3} = 2.66$ $(LOW - MEDIUM)$	



Data Source: Maxar Imagery

Scale: 1:600 000 @A4

Projection: UTM | Datum: WGS84

Central Meridian/Zone: zone 33S

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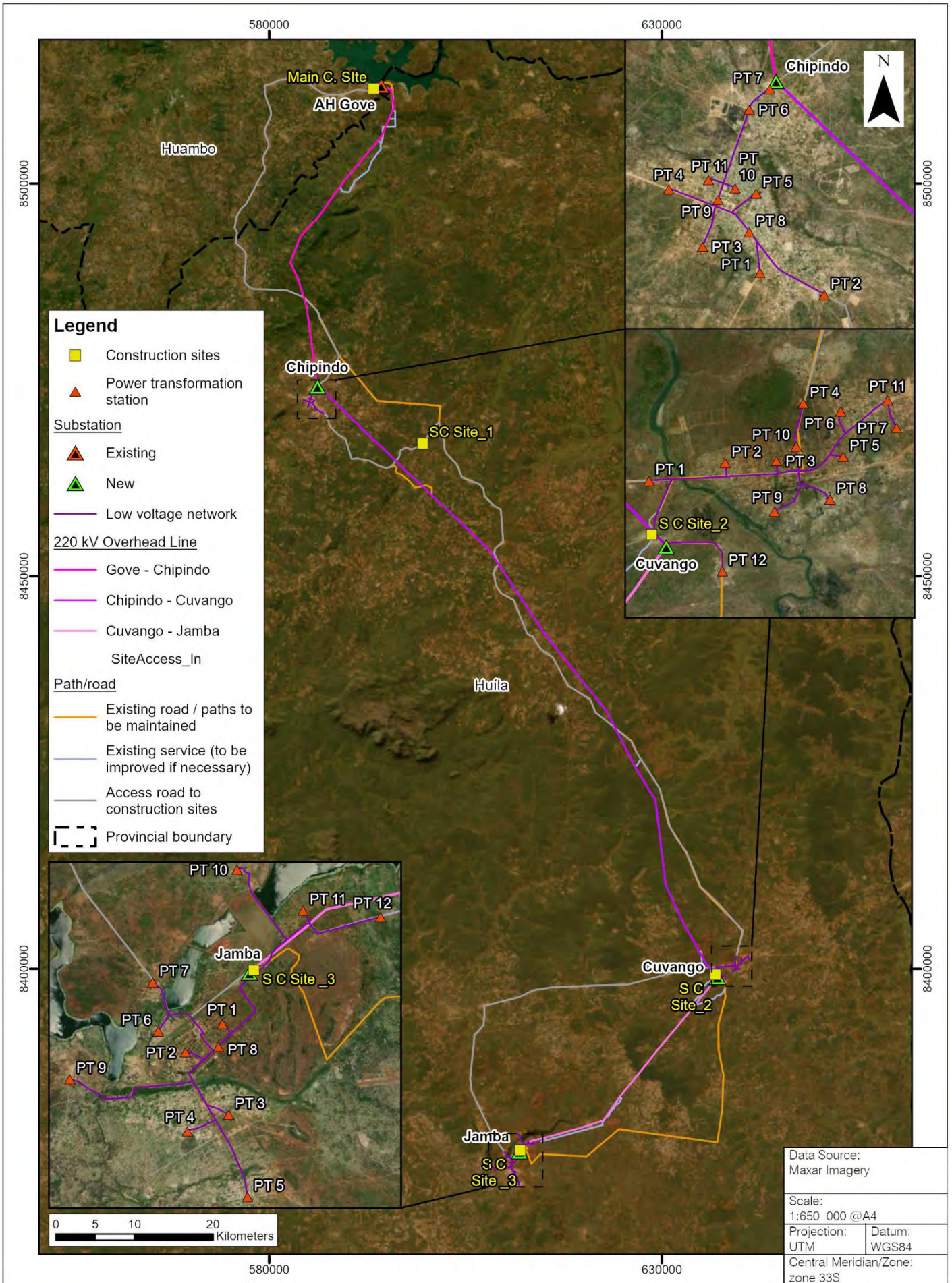
CASSINGA POWER SUPPLY PROJECT VIA
PROJECT LOCATION

Date: 26/04/2024 | Compiled by: BRCH

Project No. 595657 | Fig No. 5-1

Revision: A Date: 28 08 2024

Path: C:\Users\brch\SRK Consulting\ZA 595657 ESIA Cassinga Power Supply Project - Internal\8GIS\GISPROJ\PRO\595657_Cassinga_VIA\595657_Cassinga_VIA_maps.aprx\F5-1_Locality_A4L_20240426



Data Source: Maxar Imagery

Scale: 1:650 000 @A4

Projection: UTM | Datum: WGS84

Central Meridian/Zone: zone 33S

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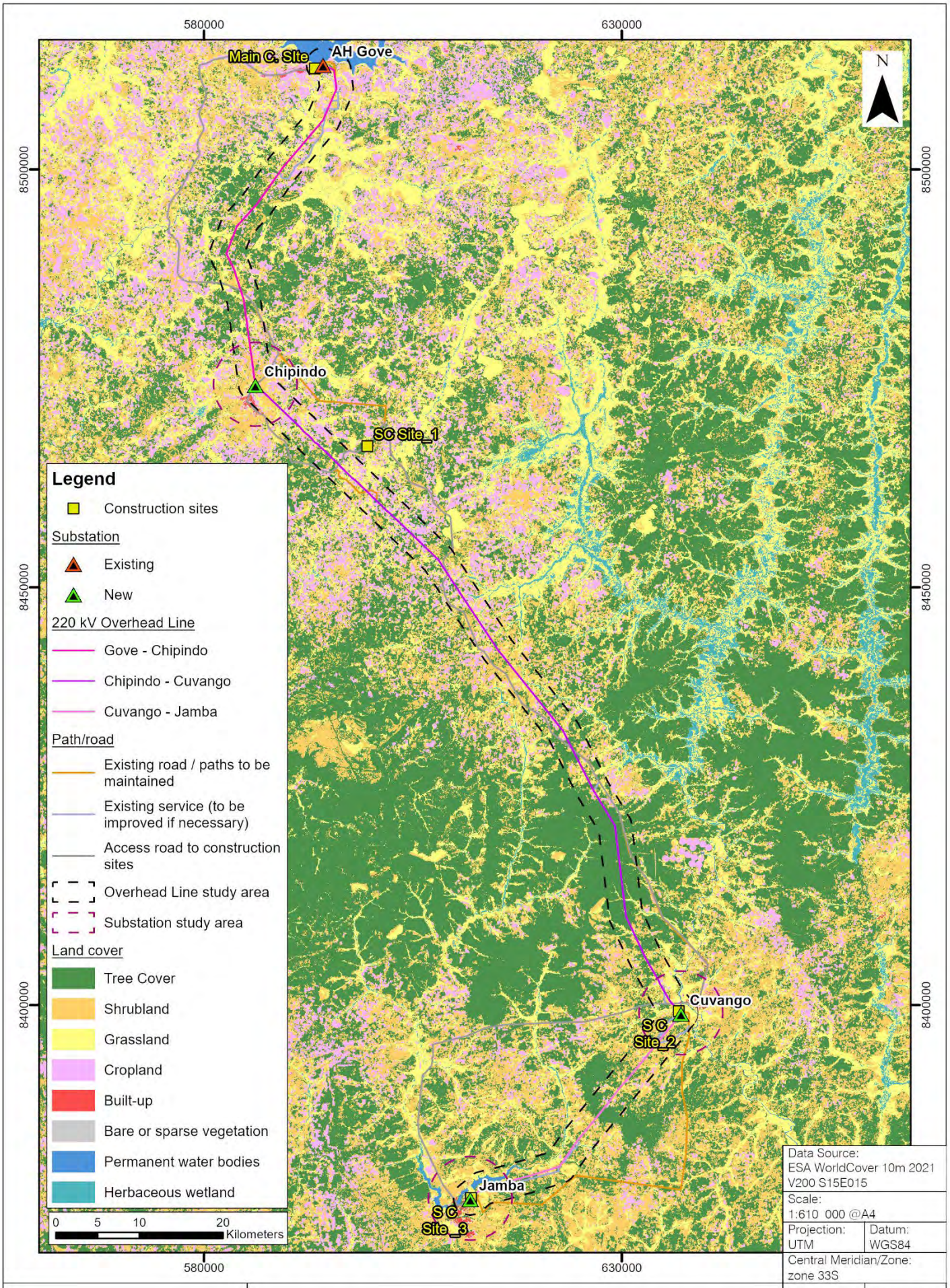
CASSINGA POWER SUPPLY PROJECT VIA
PROJECT INFRASTRUCTURE

Date: 26/04/2024 | Compiled by: BRCH

Project No. 595657 | Fig No. 5-2

Revision: A Date: 02 09 2024

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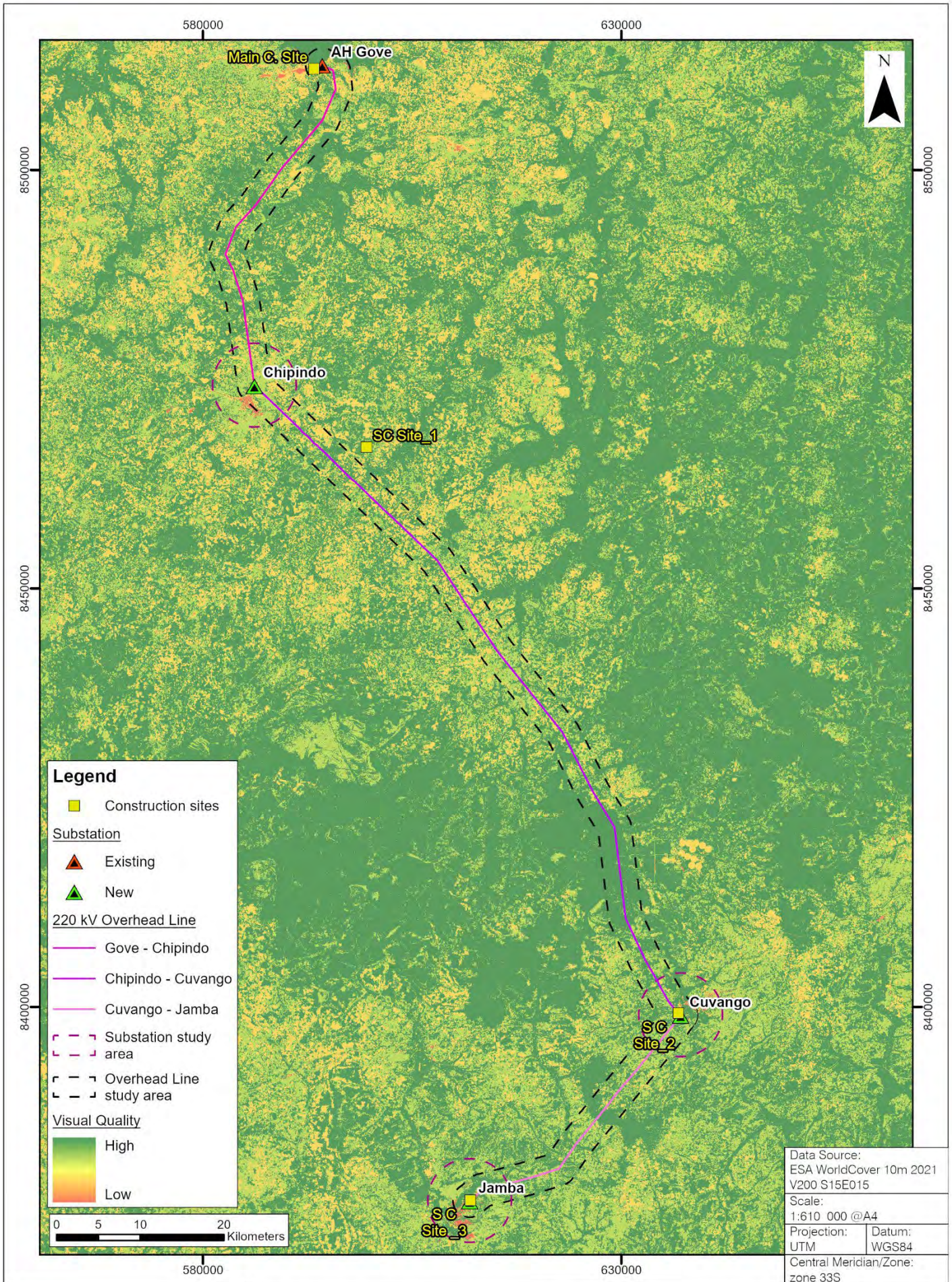
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CASSINGA POWER SUPPLY PROJECT VIA
LAND COVER

Date: 26/04/2024	Compiled by: BRCH
Project No. 595657	Fig No. 5-3

Revision: A Date: 02 09 2024

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CASSINGA POWER SUPPLY PROJECT VIA
VISUAL QUALITY

Date:	Compiled by:
26/04/2024	BRCH
Project No.	Fig No.
595657	5-4

Revision: A Date: 02 09 2024

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6 Identification of issues

The main visual impact of the project can be attributed to direct views of the project infrastructure and related activities. However, during the construction phase added secondary visual impacts could arise such as visible air pollution due to dust and light pollution due to additional lighting at night for construction camps or work, potentially requiring management measures to be introduced.

Other visual impacts of the project that could not be measured is the increased traffic of heavy vehicles passing through the region (especially considering most of the traffic currently is on-foot or by motorbikes).

Vegetation comprises mainly Miombo Woodland which is semi-deciduous, which could provide less VAC during winter time when plants loses their leaves.

Visual receptors will be more sensitive to the project infrastructure if they feel it changes the feeling of area or obstruct any views related to natural beauty, cultural, religious or heritage value. Viewpoints representing potential visual receptors to the overhead line running from Gove to Jamba are shown on Figures 7-2 and 7-3. Each building (identified in the Open Buidings dataset) within a 5km radius of the substations was considered as a potential visual receptor (shown on F7-3).

7 Assessment of impacts and identification of management actions for the construction, operation and decommissioning phases

7.1 Analysis of the Magnitude of the Visual Impact

The following section outlines the assessment that was undertaken to determine the magnitude of the visual impact associated with the Cassinga Power Supply Project. Cumulative visual impacts, associated with the changing the implementation of the project, were assessed.

Various factors were considered in the assessment, as indicated in Section 5.3, including:

- Visual exposure of the proposed infrastructure in terms of the viewshed;
- Visibility and viewing distance;
- Visual absorption capacity (VAC);
- Integrity with existing landscape / townscape; and
- The viewer's sensitivity to change.

These criteria are explained further in the following sections and are used to calculate the magnitude of visual impact, presented in Table 7-5.

7.1.1 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 an object can be broken down into two elements:

- Firstly, how exposed is the object to the surrounding area? This can be determined by the topography in which the object is located; and
- Secondly, how exposed are viewers to the object? This can be determined through topography and land use in which the viewer is situated.

The topography of an area limits or exposes the visibility of an object. To assess how topography influences the visual exposure of a feature, a predictive model known as a "viewshed" is used.

A viewshed model uses topography datasets to predict the visibility of a feature in the surrounding landscape. This model assumes that the surface is smooth (not taking into account vegetation and man-made objects). The viewshed model also does not take into account distance from the project, this will be assessed in Section 7.1.2. Due to these aspects, a site verification of the viewshed is usually undertaken in the form of a site visit to moderate the outcome of the viewshed model. As a site visit was not feasible, the visual exposure rating has been determined by solely analysing the viewshed results. Table 7-1 shows the rating criteria used to determine predicted visual exposure, i.e., predicted visibility of infrastructure in the landscape.

Table 7-1: Visibility criteria (Exposure)

Visibility Ranking			
Not Visible	Marginally Visible	Visible	Highly Visible
Final Visibility Criteria (Exposure Rating)			
1	2	4	5

For the overhead powerlines the visual exposure was determined by calculating the portion of the powerline visible from each building (identified in the Open Buildings dataset) within a 2km radius of the proposed powerline route, and by averaging the result. 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.

Footprint areas were not available for the proposed substations. The footprint areas were assumed and an exposure rating predicted by calculating the percentage of the study area that the substation could potentially be visible from. 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)**.

Information regarding the positioning and height of the pylon infrastructure and the design of the lighting for the medium voltage network was not available at the time of the VIA. It is expected that the visual exposure to visual receptors in the area will be limited to residents within close proximity of the infrastructure.

7.1.2 Viewing 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.

Hull and Bishop, 1988 identify the inverse relationship between viewing distance and visual impact, this relationship can be described as an exponential decrease in impact as the distance from the site or infrastructure increased. Figure 7-1 shows this relationship.

Traditional viewsheds do not consider the distance between the viewer and the infrastructure when determining the visibility of infrastructure. A method, known as the Fuzzy Viewshed, attempts to take into account the distance a viewer is from the proposed development (refer to Figures 7-2 - 7-4).

Equation 7-1 (Ogburn, 2006) defines the equation used to determine the possible impact of a feature in the landscape, where:

μ = fuzzy membership

dvp->ij= distance of object from the viewpoint

b1 = maximum distance from viewpoint of clear visibility

b2 = distance from viewpoint at which visibility drops to 50%

For this instance, and based upon the Hassell Matrix, the definition of where a feature may become 50% less visible was 1km.

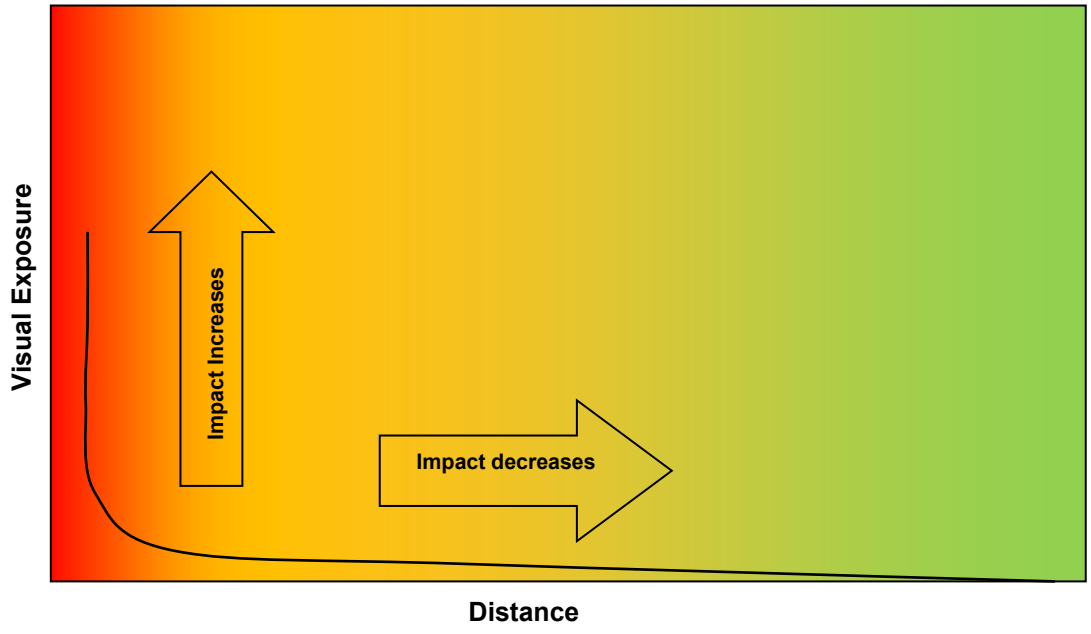
$$1 \; for \; d_{vp \rightarrow ij} \leq b_1$$

$$and$$

$$\mu(x_{ij}) = \frac{1}{\left(1+2\left(\frac{d_{vp \rightarrow ij} - b_1}{b_2}\right)^2\right)} \; for \; d_{vp \rightarrow ij} > b_1$$

.... Equation 7-1

Figure 7-2 to 7-4 indicates the Fuzzy Viewshed for the overhead lines and the substations.



srk consulting	**CASSINGA POWER SUPPLY PROJECT VIA** Depiction of how impact decreases with an increase in distance from a site (after Hull and Bishop, 1988)	Project No. 607183

Figure 7-1: Relationship between impact and distance from a site (after Hull and Bishop, 1988)

The following rating system (Table 7-2 and Table 7-3) has been incorporated spatially with the viewshed to moderate distance between a viewer and an object. This rating system does not however, take into account all existing features (such as vegetation and man-made structures). Using the selected viewpoints and site points, it is possible to create a representative ranking for viewing distance and visibility for the infrastructure.

Table 7-2: Distance Rating System for high voltage overhead lines and towers

Location of project infrastructure (From Viewpoint)	Category	Value	Description
0 to 200 m	Adjacent	5	Adjacent – Proposed infrastructure can be clearly seen. Usually on the property boundary or property grounds.
200 m to 600 m	Foreground	4	This is the zone in which details such as colour, texture and form can be appreciated. Objects in this zone are highly visible unless obscured by other landscape features, existing structures or vegetation.
600 m to 1.2 km	Middle ground	3	The zone which occupies the area “between” detail and indistinct colour and line discernment. Objects in this zone can be classified as visible to moderately visible unless obscured by other elements within the landscape.
1.2 km to 2 km	Distant middle ground	2	This zone is discerned by means of line and colour. Texture and form are generally not seen. Objects in this zone can be classified as marginally visible to not visible. Areas beyond 5 km are usually not investigated as the impact would be negligible on these areas.
2 km and greater	Background	1	Background – Not Visible (The facility can hardly / not be seen).

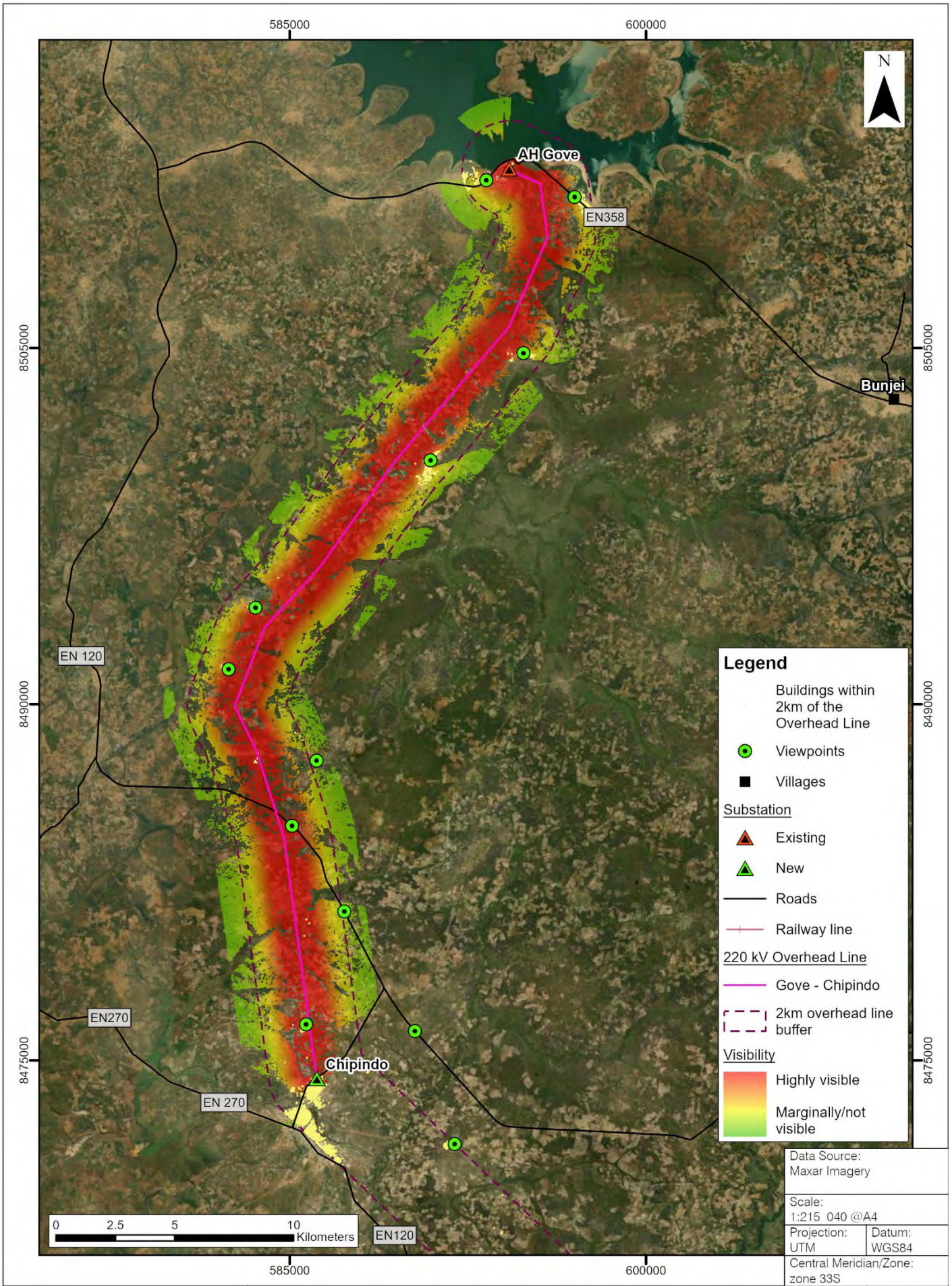
Table 7-3: Distance Rating System for substations

Location of project infrastructure (From Viewpoint)	Category	Value	Description
0 to 600 m	Adjacent	5	Adjacent – Proposed infrastructure can be clearly seen. Usually on the property boundary or property grounds.
600 m to 1 km	Foreground	4	This is the zone in which details such as colour, texture and form can be appreciated. Objects in this zone are highly visible unless obscured by other landscape features, existing structures or vegetation.
1 km to 3 km	Middle ground	3	The zone which occupies the area “between” detail and indistinct colour and line discernment. Objects in this zone can be classified as visible to moderately visible unless obscured by other elements within the landscape.
3 km to 5 km	Distant middle ground	2	This zone is discerned by means of line and colour. Texture and form are generally not seen. Objects in this zone can be classified as marginally visible to not visible. Areas beyond 5 km are usually not investigated as the impact would be negligible on these areas.
5 km and greater	Background	1	Background – Not Visible (The facility can hardly / not be seen).

The high voltage overhead transmission lines were evaluated using digitally placed viewpoints on roads and within communities and using a count of buildings identified in the Open Buildings layer. For the overhead lines most of the buildings fell in the distant middle ground category, however for the Gove-Chipindo-Cuvango overhead line most of the viewpoints fell into the middle ground category and for the Cuvango-Jamba overhead line most of the viewpoints fell into the foreground category.

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. Location of the viewpoints and indication of the buildings is recorded in Appendix B.



Data Source: Maxar Imagery

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Projection: UTM | Datum: WGS84

Central Meridian/Zone: zone 33S

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CASSINGA POWER SUPPLY PROJECT VIA

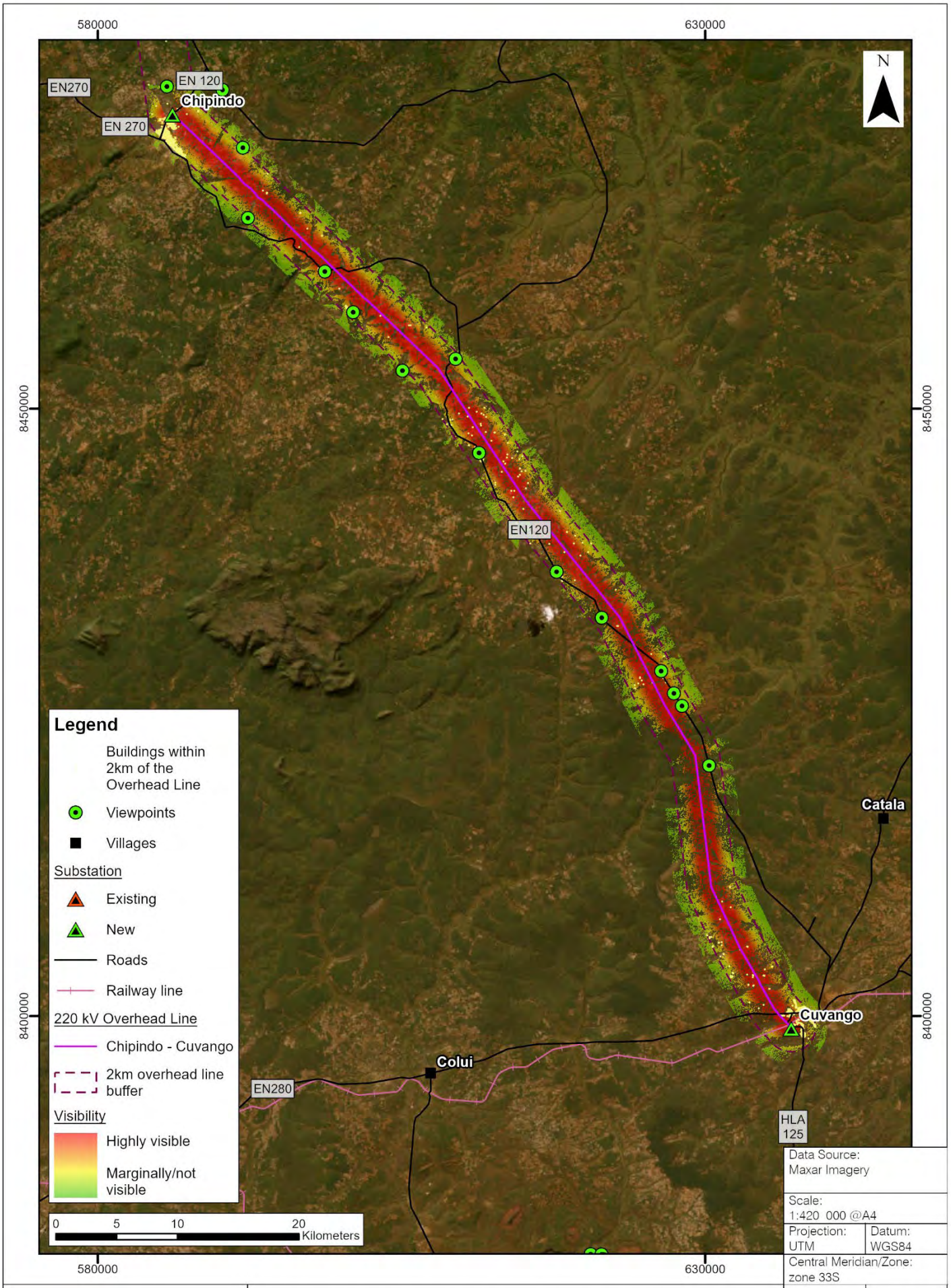
FUZZY VIEWSHEDS: OHL GOVE-CHIPINDO

Date: 26/04/2024 | Compiled by: BRCH

Project No. 595657 | Fig No. 7-2

Revision: A Date: 02 09 2024

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Project No. 595657	Fig No. 7-3

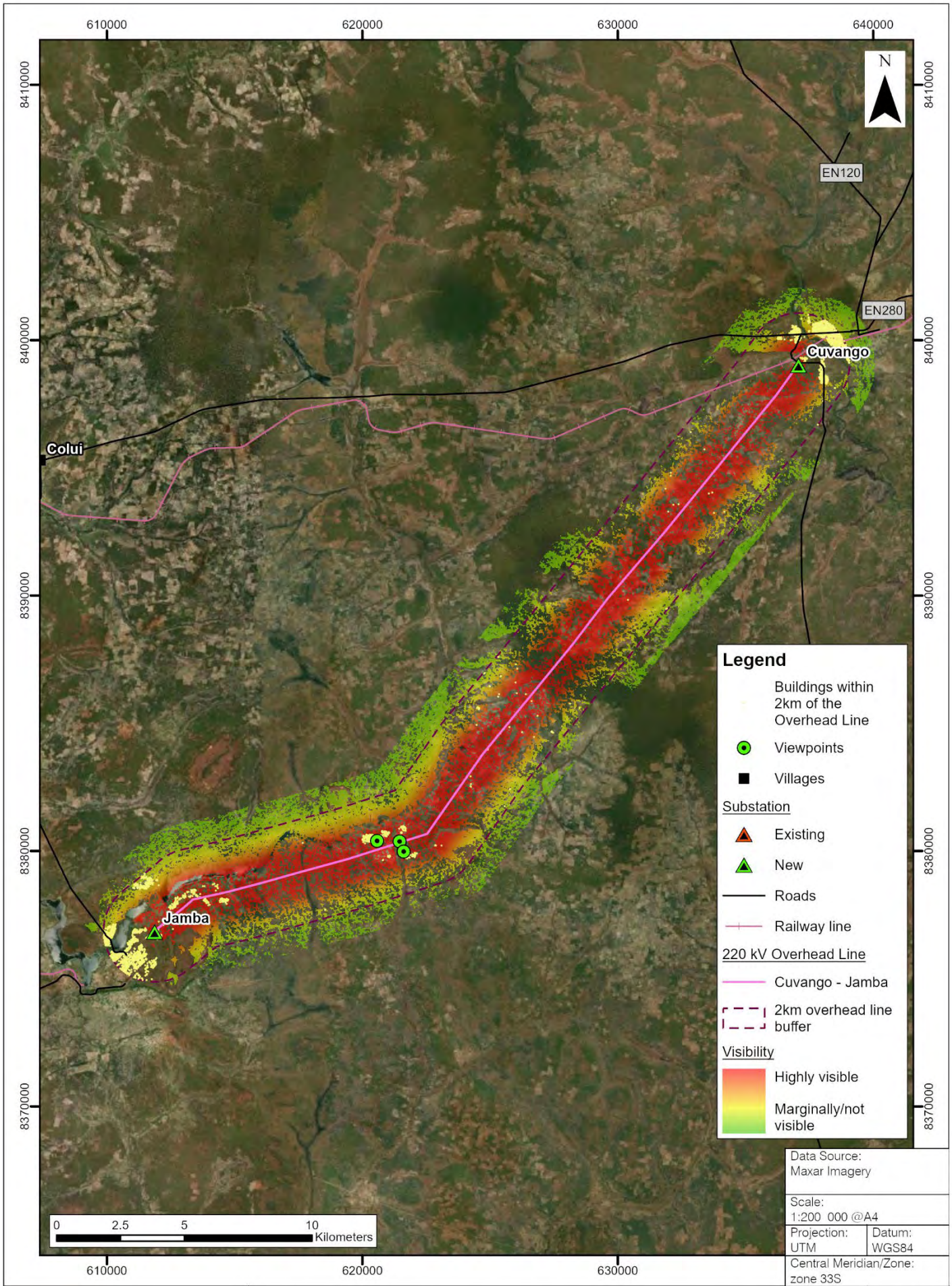
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CASSINGA POWER SUPPLY PROJECT VIA

FUZZY VIEWSHEDS: OHL CHIPINDO-CUVANGO

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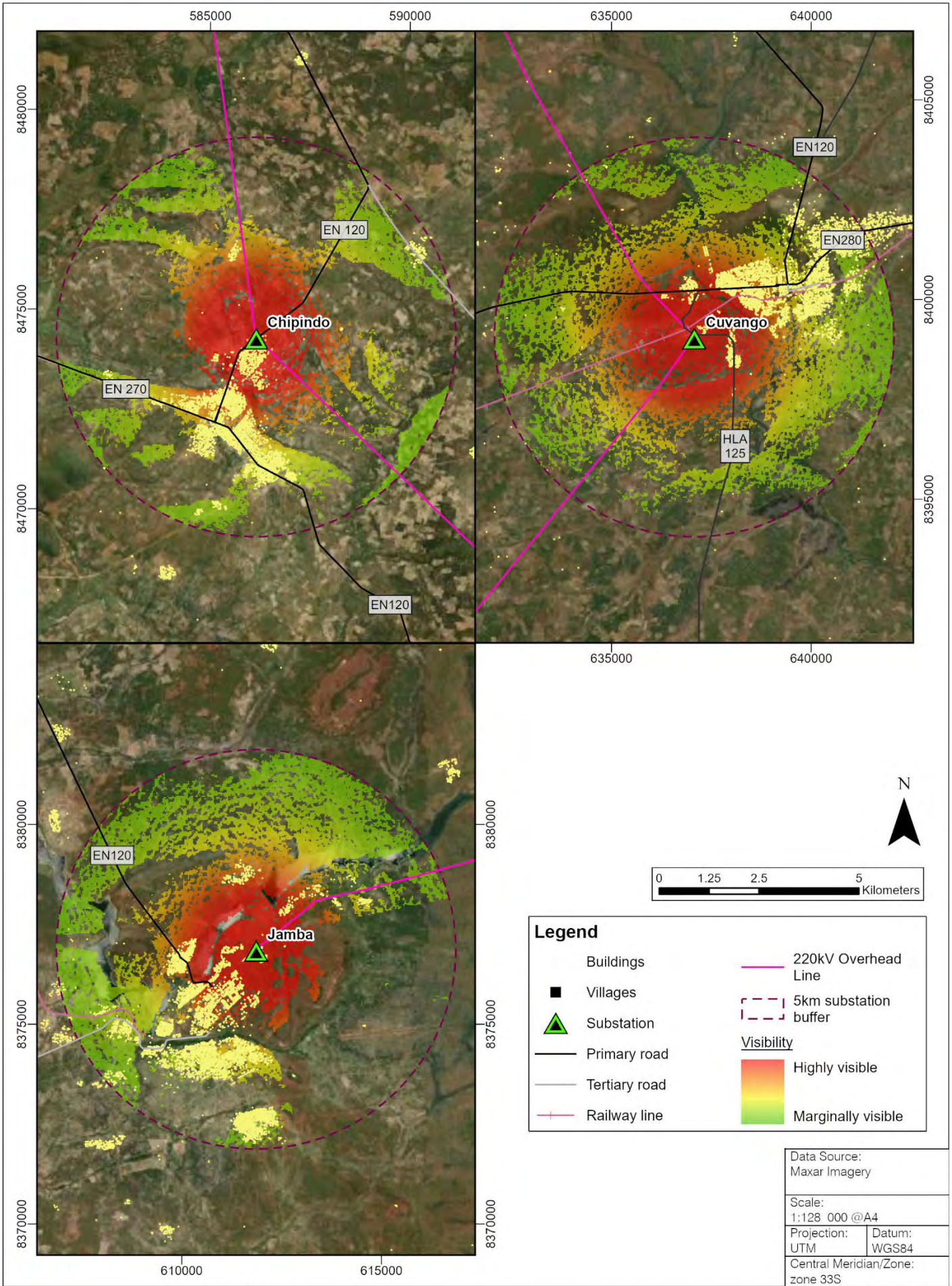


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CASSINGA POWER SUPPLY PROJECT VIA

FUZZY VIEWSHEDS: OHL CUVANGO-JAMBA

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Central Meridian/Zone: zone 33S	
Date: 03/05/2024	Compiled by: BRCH
Project No. 595657	Fig No. 7-5

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CASSINGA POWER SUPPLY PROJECT VIA

FUZZY VIEWSHEDS: SUBSTATIONS

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7.1.3 Visual Absorption Capacity

The Visual Absorption Capacity (VAC) is the potential for the area to conceal / mitigate the impact of the Cassinga Power Supply Project through natural or man-made features in the landscape. Factors contributing to the VAC include:

- 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.

Visual absorption within the wider area of influence will further be provided by:

- Residential suburbs or villages which may reduce the visibility of the site to people residing in the centre or towards the back of the residential area.
- The existing road infrastructure between viewpoints further than 2 km away.
- Powerlines, railway lines etc.

The VAC is rated from high (1) to low (5) based on the capacity of the environment to absorb the visual impact. The VAC will be high when the environment can impede the infrastructure and as such, the colour of a structure can also determine its VAC. The VAC will be low in areas where the topography is flat and natural features such as trees, outcrops and mountains are absent.

The topography of the area can be described as hilly. Besides for the four towns (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 50m 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.

7.1.4 Landscape/Townscape Compatibility

Landscape or townscape compatibility refers to the compatibility of the proposed infrastructure with the existing landscape or townscape.

The landscape / townscape compatibility of the Cassinga Power Supply Project was rated based on the following criteria specified in Table 7-4.

Table 7-4: Landscape / townscape compatibility rating criteria

High (1)	Moderate (3)	Low (5)
The project: • Is consistent with the existing land use of the area; • Is highly sensitive to the natural environment;	The project: • Is moderately consistent with the existing land use of the area; • Is moderately sensitive to the natural environment;	The project: • Is not consistent with the existing land use of the area; • Is not sensitive to the natural environment;

• Is consistent with the urban texture and layout; • The buildings and structures are congruent / sensitive to the existing architecture / buildings; and • The scale and size of the development is similar to what exists.	• Is moderately consistent with the urban texture and layout; • The buildings and structures are moderately congruent / sensitive to the existing architecture / buildings; and • The scale and size of the development is moderately similar to what exists.	• Is very different to the urban texture and layout; • The buildings and structures are not congruent / sensitive to the existing architecture / buildings; and • The scale and size of the development is different to what exists.

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 overhead powerlines and transmission 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 Chipndo and Cuvango substations the landscape/townscape compatibility rating is predicted to be **low-to-moderate (4)**. However, 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 distribution network currently exist, however all infrastructure is within town areas and along existing roads.

7.1.5 Sensitivity of viewers

The sensitivity of viewers is determined by the number of viewers and by how likely they are to be impacted upon. Sensitivity is also dependent on the viewer's perception of the area and their ability to adapt to changes in the environment. This can also include how frequently they are exposed to the view i.e. static views from houses would have a higher sensitivity than transient views experienced by motorists.

Residents living near the infrastructure of the Cassinga Power Supply Project 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 ranked from high (5) to low (1) based on the probable perceptions of the viewers and their willingness to change.

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 lines leaving the existing the plant. In Chipindo, Cuvango and Jamba, many residents don't 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 project but are not benefitting directly from it. 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. Motor bikers 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.

7.1.6 Calculation of the Magnitude of the 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 7-5, are described in Sections 5.3 and 7.1.1 - 7.1.5.

Table 7-5: Summary of the magnitude of the Visual Impact of the Cassinga Power Supply Project

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), and is included in Section 7.2.2 as the Severity rating to inform the overall assessment of the visual impact, by means of using the prescribed impact ranking system.

7.2 Visual Impact

The following section incorporates the findings of Section 7.1 and compiles them into a visual impact rating system. This impact assessment focuses on the impact for the construction, operation and decommissioning phases of the Cassinga Power Supply Project.

The significance of the impacts was assessed according to the following criteria:

- Magnitude – severity or intensity.
- Duration (temporal influence) – Temporal influence.
- Scale (spatial influence) – Spatial influence.
- Probability - likelihood of an event occurring.

7.2.1 Impact Assessment Methodology

The following section will outline some of the key factors used in the final assessment of the visual impacts of the Cassinga Power Supply Project. The prescribed assessment criteria are an adaptation of the environmental impact assessment criteria provided in Appendix 3(1) of the National Environmental Management Act (Act 107 of 1998) as amended (NEMA), which states the following:

An environmental impact assessment report must contain the information that is necessary for the competent authority to consider and come to a decision on the application, and must include—

- an assessment of each identified potentially significant impact and risk, including—
  - cumulative impacts;
  - the nature, significance and consequences of the impact;
  - the extent and duration of the impact;
  - the probability of the impact occurring;
  - the degree to which the impact can be reversed;
  - the degree to which the impact may cause irreplaceable loss of resources; and
  - the degree to which the impact and risk can be mitigated.

Based on the above, the EIA Methodology will require that each potential impact identified is clearly described (providing the nature of the impact) and be assessed in terms of the following factors:

- Duration (temporal scale) – how long will the impact last?
- Extent (spatial scale) - will the impact affect the regional or local environment, or only that of the site?
- Magnitude (severity) – will the impact be of major, moderate or minor severity?
- Probability (likelihood of occurring) – how likely is it that the impact may occur?

The rating criteria for the determination of the environmental significance (importance) is described in Table 7-6.

Table 7-6: Method for rating 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	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

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**
POPULATION	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	Medium	High
		Short term	Low	Medium	Medium
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

7.2.2 Visual Impact Assessment

Table 7-7: Impact significance rating and mitigation measures for the impact

Activity: 220kV Overhead Lines								
Project phase: Construction								
Impact Summary: Negative visual impact is imminent however only for a medium term duration. Overall significance: medium.								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Definite*	***Medium***	-	*Medium*
Management Measures: • Minimise vegetation clearing where possible, especially at construction camps, along access roads, around laydown areas and the project site. • Use manmade barriers around laydown areas and construction camps where sensitive viewers exist. • Adhere to the management measures regarding dust provided by the air quality specialist. • Use existing paths and roads to access the project site. • Ensure the construction sites and camps are kept neat and tidy (minimise litter). • If construction is happening at night, lighting should face inwards to ensure excess light does not escape to the surrounding areas.								
After Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Definite*	***Medium***	-	*Medium*
Activity: 220kV Overhead Lines								
Project phase: Operation								
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: • If maintenance is done at night, lights should be faced inwards towards the site to avoid disturbing the surrounding area. • 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***	*Definitely*	***High***	-	*Medium*
Activity: 220kV Overhead Lines								
Project phase: Decommissioning								
Impact Summary: During decommissioning the visual impact significance is expected to be medium. Adherei								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**
Before Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Possible*	***Medium***	-	*Low*
Management Measures: • Ensure all infrastructure is removed from site. • Use existing access roads. • Where possible use the already degraded areas for work camps and minimise the size and number of camps. • Adhere to dust management measure provided by the air quality specialist • Plant natural vegetation in cleared corridor to increase VAC of the project site.								
After Management	*Minor*	*Medium term*	*Local*	***Low***	*Possible*	***Low***	-	*Low*

Activity: Substations								
Project phase: Construction								
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: • Minimise vegetation clearing where possible, especially at construction camps, along access roads, around laydown areas and the project site. • Use manmade barriers around laydown areas and construction camps where sensitive viewers exist. • Adhere to the management measures regarding dust provided by the air quality specialist • Use existing paths and roads to access the project site. • Ensure the construction sites and camps are kept neat and tidy (minimise litter). • If construction is happening at night, lighting should face inwards to ensure excess light does not escape to the surrounding areas.								
After Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Definite*	***Medium***	-	*Medium*
Activity: Substations								
Project phase: Operation								
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. • Physical barriers and covers can be used to prevent excess light leaving the project site. • External signage should be kept to a minimum and placed on existing buildings where possible. • 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***	*Definitely*	***High***	-	*Medium*
Activity: Substations								
Project phase: Decommissioning								
Impact Summary: Decommissioning the substations is expected to significantly reduce the visual impact								
	Magnitude	**Duration**	**Scale**	**Consequence**	**Probability**	**SIGNIFICANCE**	**+ /-**	**Confidence**

Before Management	*Moderate*	*Medium term*	*Local*	***Medium***	*Possible*	**Medium**	-	*Low*
Management Measures: • Ensure all infrastructure is removed from site. • Use existing access roads. • Use already degraded areas for work camps. • Adhere to dust management measure provided by the air quality specialist. • Plant natural vegetation in around substations to reduce the visibility of the substations and associated infrastructure, where technically feasible and safe to do so.								
After Management	*Minor*	*Medium term*	*Local*	***Low***	*Possible*	***Low***	-	*Low*

8 Recommendations for the ESMP

Minimizing vegetation loss, keeping the project site neat and tidy and shielding light from the surrounding area from spreading into the surrounding area are key measures to minimise the visual impact in the operational and construction phase. In the construction phase implementing dust management measures will help reduce viewers visual exposure to the project.

It is recommended that topsoil removed during the construction phase is stockpiled separately and covered or vegetated (to minimise loss) for rehabilitation of impacted areas.

At the time of this report the social and heritage specialists had not identified any sensitive viewers or heritage areas or areas with cultural significance. If sensitive viewers or visually sensitive areas are identified, it would be recommended to perform a VIA focusing on these viewers and/or areas.

The visual impacts, mitigation actions and the monitoring plan is detailed in Tables 8-1 and 8-2.

Table 8-1: Summary of visual impacts and mitigation actions

Project phase	Potential impact	Detailed actions	Responsible person/ entity
Construction phase	Construction camps, laydown areas, project infrastructure and access paths replacing landscape features which have a higher visual quality. Increased traffic (specifically large vehicles) which degrades the visual quality of the area. Loss of vegetation which enhances the visual quality of the area. Construction materials and project infrastructure replacing views of features of higher visual quality. Light pollution. Dust pollution	• Minimise loss of vegetation where possible. • Where possible use existing access paths and already degraded areas for construction camps and laydown areas • Use physical barriers for shielding laydown areas and construction camps. • Stockpile removed topsoil for rehabilitation. • Keep the construction site, laydown areas and construction camps neat and tidy. • Work during daylight hours or direct lighting into the project site and/or use barriers to shield artificial lighting from escaping to the surrounding area. • Adhere to management measures for dust pollution supplied by the air quality specialist.	The Project engineer
Operational phase	Light pollution. Views obstructed by project infrastructure. Clearing and maintenance activity.	• Use directed lights or barriers to minimise light pollution. • Ensure the project site is kept neat and tidy (site inspections) • Plant/rehabilitate vegetation as a visual barrier where possible or use physical barriers to shield viewers of the project site. • Use existing access roads and paths.	Environmental section of the Contractor.
Decommissioning phase	Increased traffic of heavy vehicles. Laydown areas and construction camps. Equipment and demolished infrastructure on site.	• Demolition activities and maintenance activities to be done during daytime periods only.	Environmental section of the Contractor.

	Clear/bare areas and evidence of disturbance left after infrastructure has been removed. Dust pollution from decommissioning process.		

Table 8-2: Management Plan

Management Plan						
	Objective	**Detailed Mitigation measures**	**Procedures**	**Responsibility**	**Start**	**End**
Land use change - change of traditional land use to special.	Minimise visual impacts on potentially sensitive visual receptors	• Restrict disturbance to areas dedicated as the project area, construction camps and laydown areas. Keep the site neat and tidy and minimize loss of vegetation. Ensure lighting is directed towards the project site. • For access roads use existing paths where possible. Minimise vegetation clearing when constructing new access routes. • Rehabilitate disturbed areas where possible and when removed retain top soil to use for rehabilitation at a later stage. • Adhere to dust mitigation measures provided by the air quality specialist.	Minimize the negative visual impact of the project on the surrounding area.	Project Engineer	Construction	Decommissioning phases

9 Conclusions and impact statement

The Cassinga Power Supply Project will have a visual impact on the surrounding area. The significance of the visual impact of the Cassinga Power Supply Project was rated as **Medium** during construction, **High** during the operational phase and **Low** for the decommissioning phase. Management measures can be used to reduce the extent and severity of the visual impact on the surrounding environment.

The specified rating system used to calculate the significance of the visual impact are very broad and heavily weighted by the duration and probability of exposure to the impact. It is therefore unlikely that the implementation of management measures will reduce the overall significance rating of the impact. Implementing management measures will lower the magnitude/intensity of the visual impact to sensitive viewers and reduce the area in which the visual impacts of the project are felt.

It must be noted that the results are based on digital analysis as site verification of the models was not feasible at the time. At the time of performing the visual analysis, there were many project unknowns. The entire distribution network has been commented on but not given a visual impact rating. Construction camps and laydown areas to be used in the construction phase of the project still need to be visually assessed when more information regarding layout or footprint has been received. Little is also known about the study area. No visually sensitive heritage sites or areas of cultural significance were found in the digital analysis or by the heritage specialist. Feedback from the social specialist with regards to visual sensitivity of members of the communities towards the project was not available at the time of compiling this report.

Prepared by



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GIS Scientist

Reviewed by



Wouter Jordaan

Partner and Principal Environmental Scientist

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

10 References

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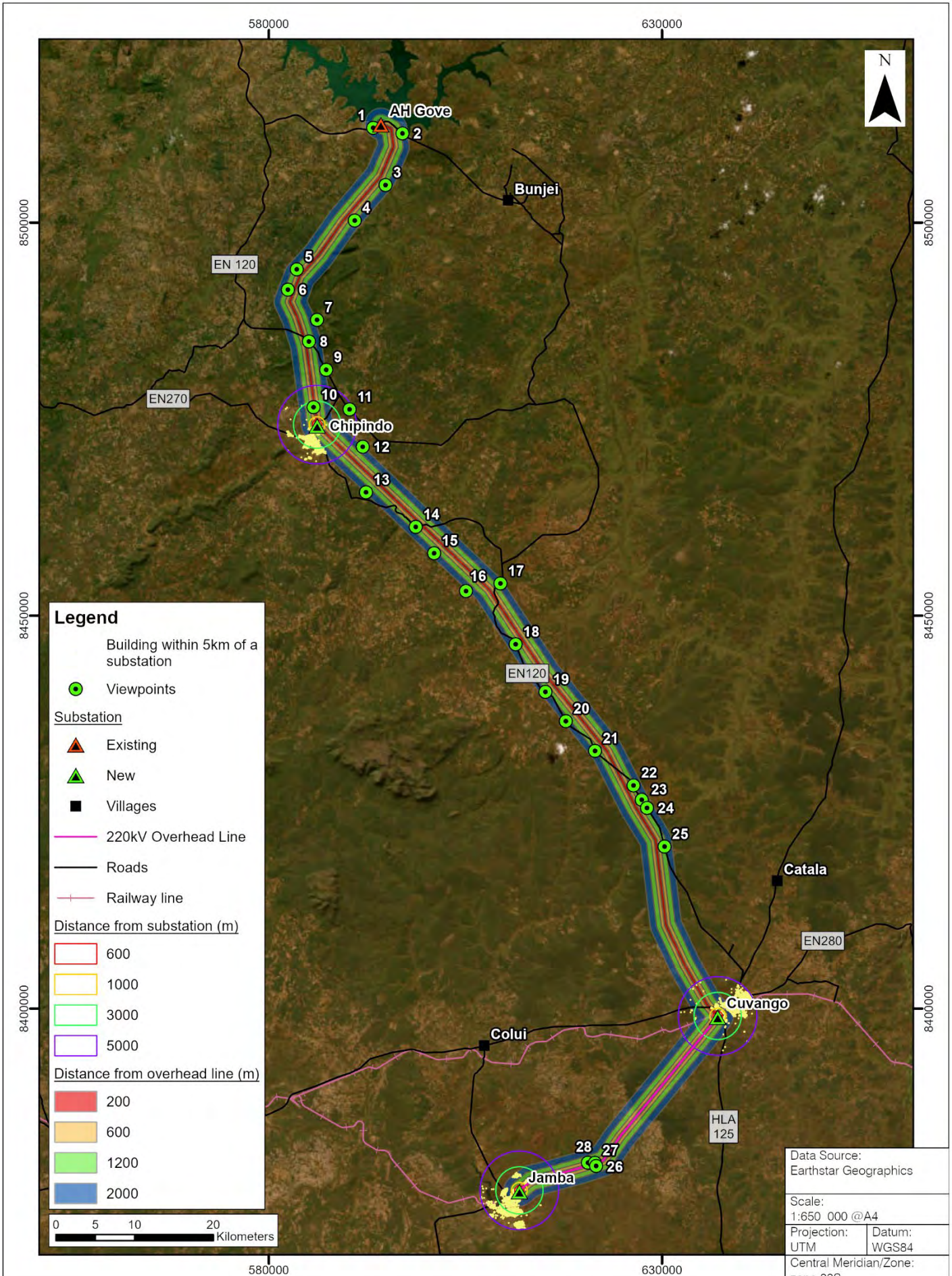
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Appendices

Appendix A:
Viewpoint



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CASSINGA POWER SUPPLY PROJECT VIA
VIEWPOINTS REPRESENTING POTENTIAL VISUAL RECEPTORS

Date:	Compiled by:
24/05/2024	BRCH
Project No.	Fig No.
595657	B1

Revision: A Date: 24 05 2024

Path: C:\Users\brch\SRK Consulting\ZA 595657 ESIA Cassinga Power Supply Project - Internal\8GIS\GISPROJ\PRO\595657_Cassinga_VIA\595657_Cassinga_VIA_maps2.aprx\FB1_Viewpoints_A4P_20240524

WGS84 UTM 33 South coordinates of the viewpoints		
VP_ID	**X**	**Y**
1	593276.556900	8512059.520600
2	596996.669400	8511350.813500
3	594839.889000	8504780.266700
4	590927.865100	8500266.751200
5	583559.485900	8494059.867000
6	582428.152500	8491470.723000
7	586129.132300	8487624.010700
8	585099.991800	8484880.159400
9	587299.309800	8481273.254200
10	585689.906900	8476517.690900
11	590269.674800	8476236.574700
12	591944.273500	8471480.141200
13	592358.317700	8465689.902900
14	598685.580000	8461286.653300
15	601020.763500	8457937.352900
16	605076.678800	8453123.448600
17	609455.476700	8454093.676400
18	611386.880200	8446355.286100
19	615170.639900	8440299.846700
20	617765.424700	8436570.159800
21	621480.243600	8432788.120800
22	626371.552100	8428395.363700
23	627419.253100	8426565.075200
24	628089.005400	8425530.506700
25	630319.481700	8420620.081600
26	621615.693600	8379978.932600
27	621456.843100	8380374.663000
28	620575.134700	8380396.493400

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Appendix M: HRIA

Human Rights Impact Assessment for the Cassinga Power Supply Project ESIA

Report Prepared for

Pak Yatirim

Report Number 595657/HRIA



Report Prepared by

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December 2024

Human Rights Impact Assessment for the Cassinga Power Supply Project ESIA

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December 2024

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Executive summary

Purpose and scope

A Human rights Impact Assessment (HRIA) was conducted to evaluate the potential adverse human rights impacts of the proposed Cassinga Power Supply Project. HRIA is a key tool in human rights due diligence (HRDD), involving continuous assessment throughout the life of the project.

Methodology

The key items included to understand and assess the human rights context and impacts associated with the project in this HRIA are:

- **Rights-holders** include local communities, project workers, and Indigenous peoples (if present). Other key concepts such as “duty-bearers” and their responsibilities are outlined.
- Impacts are assessed against **international human rights standards and principles**, including the International Covenant on Civil and Political Rights (ICCPR), the International Covenant on Economic, Social and Cultural Rights (ICESCR), International Labour Organization (ILO) conventions, and the United Nations Guiding Principles on Business and Human Rights (UNGPs).
- The **context analysis** includes an evaluation of the country’s human rights performance, laws, policies, and observations by UN bodies and interest groups.
- The identification, rating and listing of an impact does not mean that Pak, RNT or the project has caused it. It means that the issue was observed in the project area, or the project *may* cause it, contribute to it, or be directly linked to it through its business relationship with contractors and suppliers.

Potential impacts

Eighteen (18) potential impacts were identified and rated, and the following issues are worth noting:

- **Land acquisition and compensation** were identified as the most salient impact area, affecting multiple human rights, especially the right to an adequate standard of living.
- **Community Health Safety and Security (CHSS) impacts** relate to the safety of PACs during construction activities and potential interactions with migrant workers and security forces. Because of the Angolan context (albeit more common in urban areas), security forces could also inhibit people’s need to express concerns related to the project. Once the construction phase is complete, the impacts are expected to be low, but there is a possibility in any largescale infrastructure project, for maintenance and onsite engagements with rights-holders to be neglected during the operational phase. CHSS impacts are therefore assessed for both the construction and operational phases.
- **Worker rights** were assessed against the backdrop that there are no current employees, and that potential risks like forced and child labour are more likely in the deeper supply chain.
- Since there is no expected presence of the San people, human rights impacts on **Indigenous peoples** were **not** assessed.
- The **Artisanal and Small-Scale Mining (ASM)** assessment notes that the project is not considered a cause of ASM issues but should avoid exacerbating existing problems.
- **Women’s rights** include cross-cutting impacts, with risks related to discrimination, safety, and access to information.

The human rights heat maps showing all impacts pre-mitigation (**Figure 5-1**), and post-mitigation (**Figure 5-2**) are presented below. All impacts were rated, and mitigations were provided. Impact ratings do not correspond to that of the other specialist reports that were prepared as part of this ESIA, so as to prioritise a focus on human rights consequences of the impact.

Severity of potential adverse human rights impact on rights-holders	1	2	3	4	5
5			Unsafe and unhealthy working conditions		
4		Forced labour and modern slavery	CHSS impacts during operational phase Violations of rights to freedom of opinion, expression, association and assembly Interactions with security forces in ASM	CHSS impacts during construction phase Reduced safety and access to resources Discrimination of Pak, 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					

Likelihood that human rights impact occurs

Figure ES-1: Pre-mitigation human rights heat map

Severity of potential adverse human rights impact on rights-holders	1	2	3	4	5
5					
4			CHSS impacts during construction phase		
3		Violations of rights to freedom of opinion, expression, association and assembly Forced labour and modern slavery	CHSS impacts during operational phase Child labour in ASM Inadequate OHS standards in ASM Interactions with security forces in ASM Discrimination of Pak, 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					

Likelihood that human rights impact occurs

Figure ES-2: Post-mitigation human rights heat map

Mitigation and monitoring

All potential impacts were rated, and mitigation measures were proposed. An action framework for ongoing tracking and communication is provided, to be updated as the project progresses through its various milestones such as the start of construction and the beginning of electrical connections being made. Key mitigation measures include:

Land acquisition and compensation:

- Identify and avoid farmland or land that is occupied prior to site establishment through consultations with local authorities. If impacts on farming or grazing land are unavoidable, provide alternative land with equivalent or better carrying capacity and similar travel distance. Limit construction activities to demarcated areas, avoiding farming or grazing land. Determine the potential of leveraging existing agricultural projects, institutes, or facilities.
- Compile an International Finance Corporation (IFC)-compliant Land Acquisition and Resettlement Framework (LARF) and, if necessary, a Resettlement Action Plan (RAP) and Livelihood Restoration Plan (LRP). Avoid physical displacement wherever possible. If unavoidable, mitigate proportionally and ensure security of tenure for new locations. Offer additional support to vulnerable groups, such as the elderly and disabled, during relocations.
- Externally monitor valuation, compensation, and physical relocation processes to ensure compliance with standards. Provide livelihood restoration and transitional support. Offer education on responsible and sustainable farming practices, financial literacy, and household budget management, using visuals and simple text in local languages.
- Rehabilitate impacted farmland to pre-construction condition or better. If not possible, provide replacement land. Address construction impacts such as soil compaction, hydrocarbon spills, and water contamination immediately. Conduct stakeholder engagement to ensure awareness of proposed land usage. Establish and monitor conservation corridors and safe access routes to natural resource-use areas. Allow villagers to harvest natural resources before site establishment and vegetation clearing. Prevent recreational hunting or fishing by construction workers. Limit vegetation clearing to the minimum necessary. Prevent hydrocarbon spills as per the Environmental and Social Management Plan (ESMP). Restrict vehicle movement to existing roads.

Labour impacts in the community:

- Provide employment opportunities for semi-skilled and unskilled labour from Project-Affected Communities (PACs). Aim to employ local workers wherever possible, using skills databases from local municipal administrations. Ensure the main construction contractor has a preferential recruitment policy requiring local employees from all six affected municipalities, not just the three beneficiary ones, or develop and implement a local employment strategy with contractors and suppliers. Establish a mobile labour desk before construction to ensure potential workers from villages, not just urban centres, have a fair chance to apply through a single channel. Conduct labour audits of contractors and suppliers.
- Designate employment opportunities for women and disabled persons from all six affected municipalities. Comply with IFC Performance Standard (PS) 2 (Labour and Working Conditions) and relevant ILO conventions, particularly regarding the employment of women, disabled, and migrant workers. Create awareness among contractors' employees about the importance of inclusivity and non-discrimination through visual media, toolbox talks, and posters in dining and ablution areas. Conduct capacity building with municipal administrators and *sobas* on the importance of inclusivity and non-discrimination to ensure true support. Communicate job opportunities clearly and manage expectations with local leadership to minimise conflicts.
- Develop and implement an IFC PS1-compliant Stakeholder Engagement Plan (SEP) with a grievance mechanism. Conduct stakeholder engagement before site establishment. Raise awareness of job application opportunities beforehand with the support of local municipal administrators and *sobas*, ensuring applicants can prepare the relevant documents. Use visuals and simple text in Umbundu, Nganguela, and Portuguese in workplaces and education sessions on inclusion and financial literacy, especially to ensure women understand their rights.
- Include financial literacy awareness and education in toolbox talks, inductions, and posters in dining and ablution areas. Provide wage payments with relevant education on financial literacy and responsible spending. Ensure all adult household members are present during engagements

related to employment opportunities and financial management, considering women's typical daytime activities.

CHSS impacts and interactions with security forces

- Communicate an IFC-compliant grievance mechanism in the PACs. Ensure the grievance mechanism is accessible to all PAC members, including vulnerable groups, through various platforms, and is systematically recorded and managed by a Community Liaison Officer (CLO) or similar role. Engage with government and other companies to discuss and mitigate the adverse impacts of influx.
- Agreements with the appointed security company should include screening of security personnel for past abuses, proper training in the use of force and conduct towards villagers, and severe penalties for security personnel involved in theft or abuse. A code of conduct consistent with UN guidelines and the Voluntary Principles on Security and Human Rights (VPSHR) must be developed and undersigned by all security personnel. Security personnel should be trained on VPSHR as well as Gender Based Violence and Harassment (GBVH). Ensure all workers are informed about the roles and responsibilities of security personnel.
- Conduct stakeholder engagement prior to site establishment to ensure widespread awareness of land use, project components, and potential impacts. Use visuals and simple text in Umbundu, Nganguela and Portuguese to ensure all community members, especially vulnerable groups, are informed. Highlight potential nuisance impacts and the temporary nature of these impacts during engagements. Clearly mark and maintain construction and no-entry areas to prevent unauthorised entry and safety risks.
- Include community safety in inductions and toolbox talks, along with usual Occupational Health and Safety (OHS) measures. Require appropriate speed limits for contractor personnel and enforce them where possible. Consult with municipal or provincial traffic administrations for support in placing speed limit signage and limiting road access. Construct new roads with safety features for villagers, such as fenced walking side paths, and outside biodiversity buffer areas.
- Conduct ongoing risk assessments and comply with Health & Safety (H&S) measures to control and isolate hazards. Ensure the siting of substations is far from established villages and community activities. Ensure compliance with mitigation and monitoring measures in air quality, noise, and hydrology impact assessments, along with the ESMP. Ensure the CHSS plan is included in contract documents and implemented by the main contractor and transmission and distribution line operators. Consult local municipal administrations when conducting maintenance activities. Consider participatory monitoring by community members to observe and report any issues along the powerlines.

Information access impacts

- Compile and implement an IFC PS 1-compliant SEP, including a grievance mechanism to be used by the contractor, Pak, and RNT. Publicise, implement, and evaluate the grievance mechanism to allow PAPs to report incidents, ensuring grievances are investigated and resolved promptly and systematically. Ensure the grievance mechanism is accessible to all PAC members, including vulnerable groups such as the elderly, illiterate, disabled, and women. Grievances can be raised through various platforms, recorded by a CLO or similar role, and proactively managed to prevent escalation.
- Conduct stakeholder engagement prior to site establishment to ensure widespread awareness of land usage for the transmission line and the physical project components. Highlight potential nuisance impacts during engagements to create awareness of their temporary nature. Use visuals and simple text in Umbundu, Nganguela and Portuguese to ensure meaningful consultation and information dissemination, especially to women and the elderly. Carefully manage communication about job and procurement opportunities with local leadership to minimize conflict and manage expectations.
- Undertake ongoing engagement with women to manage potential impacts, increase their participation in the project, and strengthen trust in the grievance mechanism.

Women’s rights

- Create awareness about non-discrimination and provide more opportunities for women to be recruited and advance in the workforce. Provide ongoing training on freedom from harassment and Gender-Based Violence (GBV) for employees and contractor workers, especially security personnel.

- Implement internal and external grievance mechanisms to address serious risks or impacts related to harassment or GBV, including hotlines for reporting issues. Ensure those managing grievance mechanisms are prepared to handle complaints related to inappropriate behaviour, harassment, or other gender-based issues.
- Implement policies addressing equality, opportunity, diversity, and inclusion, ensuring these are followed by employers, contractors, and suppliers. Develop a comprehensive long-term strategy for the education, training, recruitment, and advancement of women in the workforce, encouraging similar strategies among contractors and suppliers.
- Prioritise non-discrimination and gender equality in engagement, monitoring, and auditing processes with contractors and suppliers.
- Invest in educational opportunities for girls to increase the number of qualified female graduates entering the job market. Provide specialised training opportunities for women in the workforce to help them progress into supervisory and management positions.
- Undertake ongoing engagement with women in the community to manage potential impacts, increase their participation in the project, and strengthen trust in the community grievance mechanism.

ASM

- Liaise with local law enforcement and security entities to manage ASM activities. Engage with authorities to regularly rotate public security forces, reducing collusion opportunities and ensuring ongoing engagement and training on UNGP, security standards, and human rights expectations. Implement access restrictions to prevent ASM activities within the project area, mitigating H&S risks.
- The project is not required to provide direct remediation for child labour or unsafe working conditions but should use its leverage to prevent and mitigate these impacts. Raise awareness about child labour and H&S in ASM. Provide specific training and measures related to children's rights for security forces. Support Civil Society Organisations (CSOs) that offer shelter and education for orphans involved in ASM activities, run initiatives to prevent and remediate child labour in ASM, and organise holiday programs for school children to keep them out of ASM activities during school holidays.
- Support CSOs that raise awareness and promote safe and healthy working conditions. Back alternative livelihood projects for artisanal miners offering safer and healthier working conditions. Collaborate with ASM associations to improve safe and healthy working conditions encourage the use of Personal Protective Equipment (PPE), and enhance access to medical services. Involve ASM cooperatives, organisations, and community leaders in human rights training.
- Implement reporting protocols for incidents involving the use of force. Conduct due diligence on any prior human rights allegations. Include relevant UNGP clauses in contracts/agreements with security forces. Provide first aid and medical attention to injured individuals.

Worker's rights (including contractors and suppliers)

- Evaluate contractors and suppliers on their commitment to workers' rights, including freedom of association and collective bargaining; fair remuneration, working hours, and conditions; H&S standards; prohibitions on forced labour, modern slavery, and child labour; and non-discrimination based on race, nationality, religion, gender, age, sexual orientation, disability, ancestry, social origin, trade union membership, political belief, or any other potential bias.
- Include specific clauses in contracts with contractors and suppliers to prohibit discrimination, forced labour, modern slavery, and child labour; mandate sound H&S practices, the use of PPE, and zero tolerance for fatalities; and encourage freedom of association and fair working conditions.
- Provide capacity-building programs for local contractors on non-discrimination, freedom of association, and workers' rights; Management capacity, human resource management, and written employee contracts; compliance with fair remuneration, decent working conditions, and H&S standards; and prevention of forced labour, modern slavery, and child labour.
- Prioritise hiring local contractors and suppliers. Advertise employment opportunities and prepare local applicants with the support of local municipal administrators and community leaders.
- Ensure local employment initiatives specifically target women and San communities. Raise awareness and provide training on inclusivity and non-discrimination. Provide separate forums and locations for benefits and employment opportunities for San communities. Monitor workplace discrimination, harassment, and bullying of potential San employees. Inform San people of job opportunities in their language and support their participation in the workforce.

- Ensure grievance mechanisms are accessible and trusted, with strong assurances against retaliation. Include training for those managing grievance mechanisms to handle complaints related to inappropriate behaviour, harassment, or other gender-based issues.
- Provide onsite oversight to ensure proper working conditions, adequate water, lunch breaks, and correct use of PPE. Ensure timely payments to contractors to support small local businesses. Engage with unions to support freedom of association. Maintain ongoing engagement with local municipal administrators and community leaders to promote inclusivity and non-discrimination. Conduct labour audits of contractors and suppliers.

Indigenous peoples

As shown in the SEIA, there are no known occurrences of Indigenous peoples (San) in the project area. Per the records received, they are located more than 70 km south of the project site. The San in Angola are currently far less nomadic than they traditionally were, due to increased pressures associated not only with urbanisation but also with systematic discrimination. This impact is therefore not assessed as we consider it to be misleading to do a risk and impact assessment on an issue that is not salient to the project. However, the Project may indirectly result in pathways that could impact the San people's human rights as it pertains to general project awareness as assessed under "Land and ecosystem service use", "Reduced access to information, consultation and participation" and employment opportunities as assessed in "Unjust labour practices and marginalisation in the community". For this reason, the mitigation measures suggested under these impacts must be implemented to avoid adverse impacts on the San people's human rights.

Conclusion

The HRIA is not the end of the HRDD process for the project. HRDD is an ongoing process that must be undertaken for all impacts and ongoing activities that could have adverse human rights impacts, as per the UNGP. The project should aim for positive long-term social impacts while avoiding inadvertent human rights violations. While the Cassinga Power Supply Project is expected to bring long-term benefits, careful management and mitigation of human rights impacts are essential.

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Disclaimer

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List of Abbreviations

ACADIR	*Associãcao de Conservacão do Ambiente e Desenvolvimento Integrado Rural* / Association for Environmental Conservation and Integrated Rural Development
ACHPR	African Commission on Human and People's Rights
AoI	Area of Influence
ASM	Artisanal and Small-scale Mining
AU	African Union
CASI	*Centros de Acção Social Integrada* / Integrated Social Action Centres
CFM	*Caminho de Ferro de Moçâmedes* / Moçâmedes Railway
CHSS	Community Health, Safety and Security
CLO	Community Liaison Officer
CRC	Convention on the Rights of the Child
CRPD	Convention on the Rights of Persons with Disabilities
CSO	Civil Society Organisation
DIHR	Danish Institute of Human Rights
ECA	*Escolas de Campo de Agricultores* / Farmer Field Schools
EDA	*Estações de Desenvolvimento Agrícola* / Agricultural Development Stations
EKN	*Exportkreditnämnden* / Swedish Export Credit Agency
ENDE	*Empresa Nacional de Electricidade de Angola*
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GBV	Gender Based Violence
GBVH	Gender Based Violence and Harassment
GIIP	Good International Industry Practice
GRI	Global Reporting Initiative
H&S	Health and Safety
Ha	hectare

HRDD	Human Rights Due Diligence
HRIA	Human Rights Impact Assessment
ICCPR	International Covenant on Civil and Political Rights
ICERD	International Convention on the Elimination of All Forms of Racial Discrimination
ICESCR	International Covenant on Economic, Social and Cultural Rights
ID	Identification Document
IDA	*Instituto de Desenvolvimento Agrário* / Agrarian Development Institute
IFC	International Finance Corporation
ILO	International Labour Organization
INE	*Instituto Nacional de Estatísticas* / National Institute of Statistics
kV	kiloVolt
LARF	Land Acquisition and Resettlement Framework
LRP	Livelihood Restoration Plan
LV	Low Voltage
MASFAMU	*Ministério da Acção Social, Família e Promoção da Mulher* / Ministry of Social Protection, Family and Promotion of Women
MBAKITA	*Missão de Beneficência Agro-pecuária do Kubango, Inclusão, Tecnologia e Ambiente* / Mission of Agricultural and Livestock Beneficence of Kubango, Inclusion, Technology, and Environment
MINEA	*Ministério da Energia e Águas* / Ministry of Energy and Water
MINAMB	*Ministério do Ambiente* / Ministry of Environment
MINFIN	*Ministério das Finanças de Angola* / Ministry of Finance of Angola
MPI-M	Multidimensional Poverty Index by Municipality
MV	Medium Voltage
NDP	National Development Plan
NGO	Non-governmental Organisation
NPSA	*Política Nacional da Acção Social* / National Policy on Social Action

OCADEC	*Organizacao Crista de Apoio ao Desenvolvimento Comunitario* / Christian Organisation for Community Development Support
OECD	Organisation for Economic Co-operation and Development
OHCHR	Office of the United Nations High Commissioner for Human Rights
OHL	Overhead Line
OHS	Occupational Health and Safety
PAC	Project Affected Community
PAP	Project Affected Party
PEDR	*Programa de Extensão de Desenvolvimento* / Rural Development Extension Programme
PIDLCP	*Programa Integrado de Desenvolvimento Local e Combate à Pobreza* / Local Development and Combating Poverty Programme
PIIM	*Programa Integrado de Intervenção Municipal* / Integrated Municipal Intervention Programme
PPE	Personal Protective Equipment
PS	Performance Standard
RHs	Rights-holders
RNT	Rede Nacional de Transporte de Electricidade
SEIA	Socio-economic Impact Assessment
SEP	Stakeholder Engagement Plan
UDHR	Universal Declaration of Human Rights
UN	United Nations
UNGP	UN Guiding Principles on Business and Human Rights
UNHCR	United Nations High Commission for Refugees
USD	United States Dollar
VPSHR	Voluntary Principles on Security and Human Rights

1 Introduction

SRK Consulting (South Africa) (Pty) Ltd (SRK) has been appointed by Pak Yatirim (Pak) to conduct an Environmental and Social Impact Assessment (ESIA) for the proposed Cassinga Power Supply Project (the Project). Geolab Engenharia & Serviços (Geolab) is SRK's in-country partner in Angola. The ESIA is to meet local legislative requirements as well as lender requirements. Therefore, the ESIA includes various specialist studies and plans to support the ESIA and to ensure that the Project meets relevant Good International Industry Practices (GIIP).

This report, the Human Rights Impact Assessment (HRIA) has been prepared as part of the ESIA for the project. It should be read in conjunction with the Socio-Economic Impact Assessment (SEIA), the Stakeholder Engagement Plan (SEP), the Land Acquisition and Resettlement Framework (LARF), and the Community Health, Safety and Security (CHSS) Plan prepared for the project.

The purpose of this report is to identify, assess and manage potential adverse human rights impacts that the project might cause, contribute to, or be directly linked to.

1.1 Background

The Republic of Angola, through its Ministry of Energy and Water (*Ministério da Energia e Águas* – MINEA), is embarking on a significant enhancement of its electrical infrastructure through the Project which aims to boost electric power supply across various communities within the Province of Huíla. The Project is structured around establishing a new 220 kV Overhead Line (OHL) network, extending from Gove Hydro Plant to Cuvango which branches out to Chipindo and Jamba. This project includes the construction of new substations in the municipalities of Chipindo, Cuvango, and Jamba, each equipped with a capacity of 220/30 kV – 20 MVA to efficiently distribute the power generated to these municipalities which are all located in the Huíla Province in south-west Angola. The Project further includes the construction of 30 kV medium voltage (MV) overhead lines for distribution, along with the necessary low voltage (LV) network to supply 1 000 connections in each of the three villages, including public lighting, within the communities of Chipindo, Cuvango, and Jamba.

The overarching goal is to create a robust and reliable electric power supply system that caters to the current demands and is scalable to accommodate future expansions, including the prospective OHL 220 kV interconnection to Cuchi/Menongue. An estimated power demand of 80 MW has been calculated for the Cassinga Project, with an additional 10 MW anticipated for local community demands. This project is critical in addressing the electricity needs of the region to foster economic growth, improve the quality of life of its residents, and to meet the growing energy demands of the region.

A detailed project description is provided in the ESIA and the SEIA.

1.1.1 Location

The Project is located south of the centre of Angola, namely, in the provinces of Huíla and Huambo (**Figure 1-1**). The OHL extends for about 170 km, crossing six municipalities (*Municípios*) which include Jamba, Cuvango, Dongo, Galangue, Chipindo and Kalima.

The OHL will start near the Gove Hydro Dam in the Huambo Province, but the main works will be carried out largely in the Huíla Province. From Gove, the 220 kV OHL will extend to Chipindo, then Cuvango, and finally Jamba where new 220/30 kV substations will be built in each of these

municipalities' seats[1]. In addition, the infrastructure associated with the electrification of villages at Chipindo, Cuvango and Jamba will be constructed, such as the aforementioned MV and LV distribution powerlines. The project will comprise two stages, namely Stage 1, a 135 km section between Gove, Chipindo and Cuvango, and Stage 2, a 35 km section between Cuvango and Jamba.

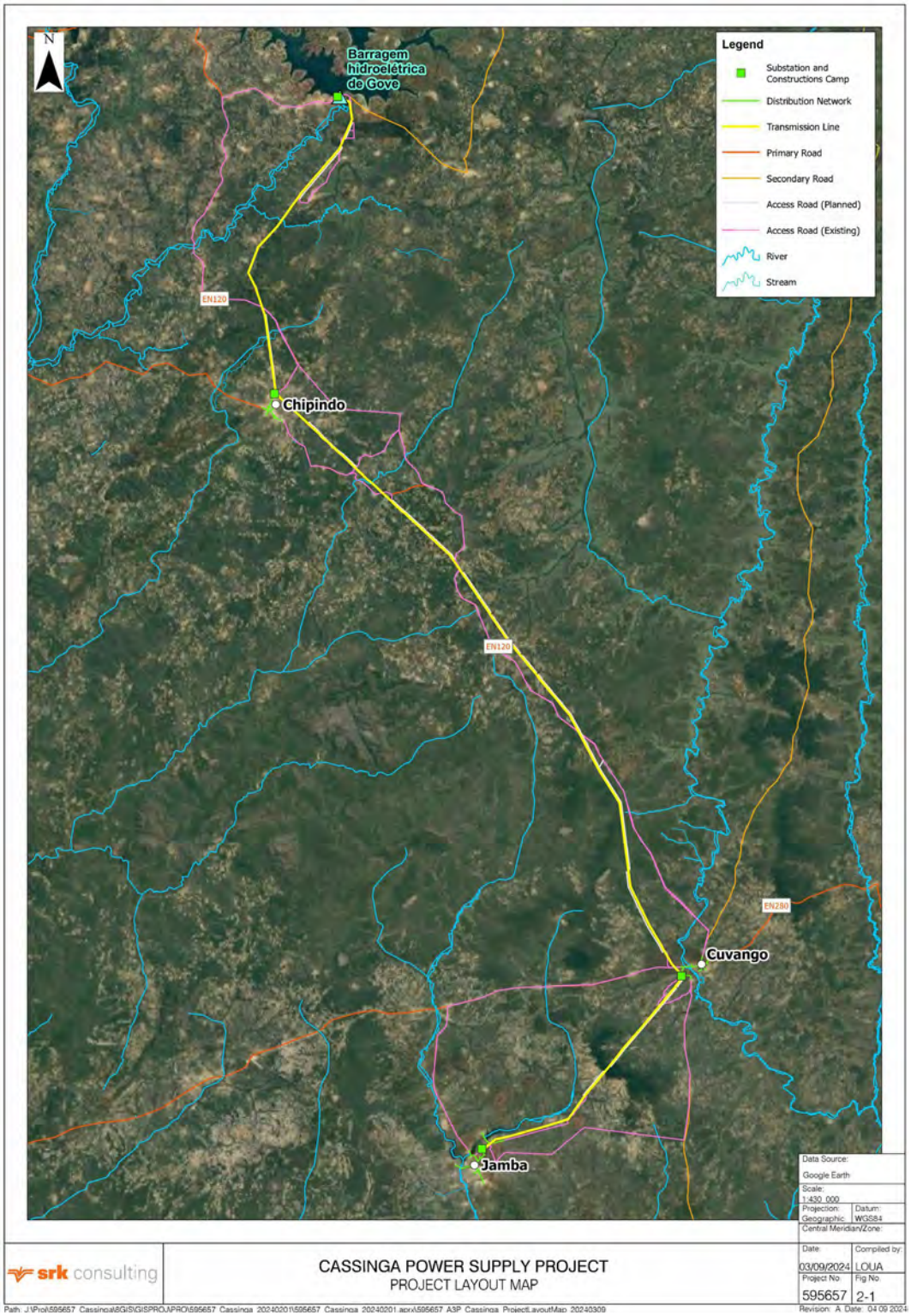


Figure 1-1: Location of the proposed 220 kV OHL and the towns it will supply with electricity.

[1] The name of the main town, commune or seat of the municipality, is the same as the name of the administrative division of the municipality which is geographically larger and contains numerous villages or smaller communes. For instance, the *communes* of Jamba, Dongo, and Tchamutete (formerly, Cassinga) are located in the *municipality* of Jamba.

1.2 Scope of HRIA

This HRIA is an *ex-ante* impact assessment, which means that it takes place before the project occurs. It considers the nature of the project and the context:

- This is a new, linear, electricity supply project that is planned in the context of a post-conflict country setting.
- The construction phase will be overseen by Pak Yatirim, an international company with little experience in Angola ("new country context", as defined in the Danish Institute of Human Rights (DIHR) *HRIA Guidance and Toolbox* (DIHR, 2016)).
- The operational phase will be overseen by RNT (*Rede Nacional de Transporte de Electricidade*), a state agent of MINEA which is tasked with electricity transmission in Angola.
- There are vulnerable groups in the project area, such as women, the elderly, and the "war maimed".
- The project will affect common property resources such as grazing and farmland, and there may be some resettlement.

Note that HRIAs only look at the potential **adverse** human rights impacts, and not any positive human rights contributions or enhancements of the project, as is the case in SEIA (DIHR, 2016).

1.3 Objectives of an HRIA

An *ex-ante* HRIA aims to measure the potential future adverse human rights impacts of the project. Its objectives are to (DIHR, 2016):

- Identify adverse human rights impacts, particularly from the perspectives of affected rights-holders such as workers and community members.
- Determine measures to address any identified adverse human rights impacts through prevention, mitigation, and remediation.
- Facilitate dialogue between the business, rights-holders, and other relevant parties.
- Promote capacity building and learning for company stakeholders, rights-holders, and others involved in the impact assessment, including raising awareness of their respective rights and responsibilities.
- Enhance the accountability of businesses by documenting the identified impacts and the actions taken to address them.
- Build partnerships between businesses and other stakeholders to tackle human rights impacts, including through developing joint actions to address cumulative impacts or legacy issues.
- Gather insights that can inform human rights due diligence (HRDD) practices for other projects or activities.

1.4 Key concepts

Since HRIA is a relatively new field of assessment, and since there are overlaps between other impact assessment tools such as SEIA, the reader's attention is drawn to the following key concepts which are used in this report. The definitions below are extracted from the DIHR *HRIA Guidance and Toolbox* (DIHR, 2016).

- **HRIA:** a process for identifying, understanding, assessing and addressing the adverse effects of a business project or business activities on the human rights enjoyment of impacted rightsholders such as workers and community members.
- **Rights-holders:** All individuals are human rights-holders. In the context of HRIA, the emphasis is on those rights-holders who might be negatively affected by the project. Rights-holders have the inherent entitlement to enjoy and exercise their rights and to seek effective remedy when their rights are violated. While organisations or entities, such as trade unions or religious institutions, are not human rights-holders themselves, they can act in a representative capacity for individuals.
- **Duty-bearers:** Duty-bearers are entities that have obligations to uphold the human rights of others. States are the primary duty-bearers with a legal obligation to respect, protect and fulfil human rights. Companies also bear responsibility, which involves respecting human rights, avoiding infringements on the rights of others, and addressing any impacts they contribute to or

are involved in. In this project, the duty bearers are the state (the Government of Angola), businesses (Pak Yatirim) and state actors (RNT and municipal; administrations).

- **Stakeholder:** A stakeholder is an individual, group, or organisation with an interest in or influence on the business project or activities, as well as those potentially affected by it. Relevant stakeholders for assessing human rights impacts include affected rights-holders, duty-bearers, and other pertinent parties.
- **Duty of the state:** to **respect** by refraining from interfering with the enjoyment of the right; to **protect** by preventing others, including third parties such as businesses, from interfering with the enjoyment of the right through appropriate legislation, policies, regulation and adjudication; and to **fulfil** by taking steps to facilitate the enjoyment of human rights.
- **Duty of businesses:** to **respect** human rights, meaning that businesses are expected to avoid infringing on the human rights of others and to address adverse human rights impacts with which they are involved.
- **Impact relationships:** The project can either:
  - **Cause** human rights impacts;
  - **Contribute to** human rights impacts; or
  - **Have a direct link to** impacts through its activities or outcomes via business relationships, including both contractual and non-contractual relationships.

2 Approach and methodology

This HRIA was conducted in alignment with the DIHR Guidance and Toolbox document and practitioner supplements. The United Nations Guiding Principles on Business and Human Rights (UNGP) also provide a criteria matrix on the ratings of human rights impacts, which is outlined in **Section 2.2**.

Where necessary, current literature on HRIA was also consulted, such as *Human Rights Impact Assessments: Review of the Literature, Differences with other forms of Assessments and Relevance for Development*, which was commissioned by the Nordic Trust Fund, a World Bank initiative.

To ensure that human rights are addressed comprehensively, the content, process and outcomes of the assessment must apply and be compatible with international human rights standards and principles. Drawing on the UNGP, as well as current guidance and literature on HRIA, the following aspects are essential for HRIA of business projects:

- **International human rights standards and principles must be used as the benchmark:** The international human rights standards and principles that are used as benchmark for this assessment are discussed in **Section 2.1** below. Although regional and national human rights standards are also considered, the International Bill of Rights is used as the minimum standard and a country or region's lenience towards its implementation does not mean that a project can be exempted as part of the assessment. Angola's accession statuses to various human rights instruments are discussed in **Sections 3.2.1** and **0**.
- **Undertaking the HRIA must respect human rights:** During the HRIA, particular attention was paid to key human rights principles such as non-discrimination, participation, empowerment and transparency.
- **Accountability must be emphasised in the assessment process:** the entitlements of rightsholders to have their rights respected is recognised in the HRIA, and the corresponding duties and responsibilities of duty-bearers to uphold and respect these rights are subsequently discussed.

The HRIA was largely a desktop assessment supplemented by primary data collected via the socio-economic surveys conducted in the project area (details provided on this process in the SEIA (SRK, 2024)).

The list of stakeholders consulted is detailed in the SEIA and SEP.

Human rights impacts were assessed against the relevant international human rights standards and principles and then rated according to the SRK impact rating methodology. To ensure that the

methodology is in line with the most suitable method of assessing human rights impacts, the methodology was tweaked as discussed in **Section 2.2**.

2.1 International human rights standards and principles

Human rights are rights that people have simply because they exist as human beings (UNHR, 2024). These rights are not granted by any state or government. Human rights range from the most fundamental rights, such as – the right to life – to those that make life worth living, such as the rights to food, education, work, health, and liberty. Human rights are:

- **Universal and inalienable**, meaning that they apply to all human beings;
- **Interdependent and indivisible,** meaning that there is no hierarchy between human rights and the improvement of one right facilitates the advancement of the others; likewise, the deprivation of one right adversely affects the others; and
- **Equal and non-discriminatory**, meaning they are enjoyed by everyone equally, irrespective of nationality, place of residence, sex, national or ethnic origin, colour, religion, language or any other status.

International human rights are articulated in international conventions, treaties, and declarations, as well as customary international law. International human rights treaties become binding on states through ratification (UNHR, 2024). By ratifying an international human rights convention, a state commits itself to implementing the international convention into domestic laws and policies. This is discussed in more detail below.

2.1.1 International Bill of Rights

The first legal document to set out fundamental human rights that needed to be protected universally was the Universal Declaration of Human Rights (UDHR), adopted by the UN General Assembly in 1948. The UDHR, which has 30 articles, is the foundation of all international human rights law. It provides the principles and building blocks of current and future human rights conventions, treaties and other legal instruments.

The UDHR, together with two covenants, the International Covenant for Civil and Political Rights (ICCPR), and the International Covenant for Economic, Social and Cultural Rights (ICESCR) make up the International Bill of Rights.

Civil and political rights refer to absolute rights, such as the right to freedom from torture, to partake in public affairs and to property, whereas **economic, social and cultural rights** are more gradual in attainment, such as the rights to an adequate standard of living, education and the highest attainable standard of physical and mental health. Economic, social and cultural rights are ‘progressively realised’ (DIHR, 2016).

Progressive realisation means that **states** are expected to take appropriate measures towards the full realisation of economic, social and cultural rights to the maximum of their available resources. As such, it is recognised that not all economic, social and cultural rights can be fully realised immediately when a state ratifies the treaties protecting these rights in international law, but also that a lack of resources cannot justify inaction or indefinite postponement of measures to implement these rights.

Irrespective of their available resources, states must take immediate action towards the full realisation of economic, social and cultural rights in five areas (DIHR, 2016):

- The elimination of discrimination;
- Immediate implementation of economic, social and cultural rights that are not subject to progressive realisation (e.g., the right to freedom of association, equal remuneration for work of equal value, and the obligation to protect children and young persons from economic and social exploitation);

- Actionable steps towards the realisation of economic, social and cultural rights that are subject to progressive realisation (e.g., implementing strategies and plans, adopting the necessary laws and policies and regularly monitoring and assessing the progress made towards the full implementation of the rights);
- Non-retrogression on measures, meaning that the protection of the rights should not deteriorate; and
- Attention to minimum core obligations; i.e., states are required to meet the minimum essential levels of each of the rights (e.g., the right to minimum essential food, basic shelter, sanitation and adequate drinking water).

2.1.2 UNGP

The *Guiding Principles on Business and Human Rights: Implementing the United Nations "Protect, Respect and Remedy" Framework* (UNGP) are the global standard for preventing and addressing the risk of adverse impacts on human rights involving business activity, and they provide the internationally accepted framework for enhancing standards and practices concerning business and human rights (OHCHR, 2012). The expectation that businesses need to exercise HRDD arises from the UNGP. This includes the expectation that businesses **assess** and **address** their impacts, both those arising from operations and business relationships and that they must also **respect** human rights (DIHR, 2016).

2.2 Impact assessment methodology

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.

2.2.1 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 levels of severity that can be assigned based on these considerations are summarised in **Table 2-1**. While determining severity is not an exact science, here are some considerations:

- 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
- 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 2-1: 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
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

2.2.2 Likelihood

Likelihood is the second factor in assessing human rights impacts and positioning them on a human rights heat map (**Section 2.2.4**). The levels of likelihood that can be assigned are summarised in **Table 2-2**. 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
- Certain types of projects have a higher likelihood of impacts (e.g., ASM, agriculture, informal businesses)

Table 2-2: 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

2.2.3 Other factors

Vulnerability and mitigation measures can also influence severity and likelihood ratings.

- 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.
- Mitigation measures can reduce the *likelihood* of an impact occurring, as well as the potential *severity* of the impact.

2.2.4 Heat map

The human rights heat map combines the outcomes of the severity x likelihood ratings. The outcome of the project's human rights heatmap is shown in **Section 5**. 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.

2.3 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. That is, if a project *causes* an impact, it should prevent or mitigate the impact. If it *contributes* to an impact, it should prevent or mitigate its contribution to the impact, use or increase its leverage with other responsible parties to prevent or mitigate the impact, and contribute to remediating the harm of the impact to the extent of its contribution. Finally, if the project is *linked* to an impact, then it should use or increase its leverage with other responsible parties to prevent or mitigate the impact and consider how to *enable* remedy, but has no responsibility to remediate it. 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.

3 Context and baseline description

This section provides an overview of the:

- Country and region in terms of demographics, governance and socio-economic characteristics (for a complete overview of the current socio-economic baseline please refer to the SEIA prepared for this project (SRK, 2024)). Several salient baseline conditions are discussed in this section, as they have a bearing on the human rights baseline condition.
- Country in terms of human rights performance.

3.1 Country and regional context

3.1.1 Socio-economic profile

Located south of the equator along Africa's Atlantic coast, Angola shares borders with the Republic of Congo to the north, the Democratic Republic of Congo (DRC) to the north and east, Zambia to the east, and Namibia to the south. Angola's climate varies from tropical in the north to arid central plateaus and desert in the south. The country's Cabinda Province, situated in the northwest, is geographically separated from the rest of Angola by a narrow strip of the DRC along the Congo River.

Cabinda is primarily inhabited by the Bakongo minority and holds the majority of Angola's oil wealth. Northern and central Angola is known for high-quality diamonds, including easily accessible alluvial diamonds found in riverbeds and kimberlite pipes, which require industrial equipment for extraction. Despite challenges such as desertification and deforestation leading to soil erosion, Angola boasts vast arable land, much of which remains unused due to the lengthy civil war, even though approximately 70% of Angolans are engaged in farming.

According to the 2014 Census, while the majority (71%) of Angolans speak Portuguese (the only official language), other languages are spoken at home. These languages include Umbundu (23%), Kikongo (8%), Kimbundu (8%), Chokwe (7%), Nhaneca (3%), Nganguela (3%), Fiote (2%), Kwanhama (2%), Muhumbi (2%), Luvale (1%), and others (4%) (Minority Rights Group, 2023).

Angola's ethnic groups include Ovimbundu (37%), Mbundu (25%), Bakongo (13%), *mestiço* (2%), Lunda-Chokwe (8%), Nyaneka-Nkumbi (3%), Ambo (2%), Herero (up to 0.5%), San and Kwisi (up to 0.5%). The Bantu groups, Ovimbundu, Mbundu and Bakongo, therefore make up the majority.

Poverty in Angola is complex, manifesting economically, socially, and politically. The Multidimensional Poverty Index (MPI) assesses poverty across health, education, standard of living, and economic activity, using indicators such as nutrition, child mortality, years of schooling, school attendance, cooking fuel, sanitation, drinking water, electricity, housing, and assets. Defining poverty by a single measure like income or expenditure oversimplifies the issue.

3.1.2 Geopolitical context

Following a prolonged post-independence conflict, Angola has now experienced thirteen years of peace, stability, and economic growth (OHCHR, 2016). This progress has led to an influx of migrants from neighbouring countries. However, Angola's extensive and permeable border presents challenges in monitoring undocumented migration.

The legacy of colonial rule in Angola is evident in the existence of Europeanised *assimilados* (Africans classified as Westernised), including *mestiços* (people of mixed African and European ancestry). These classifications influenced Angola's civil conflict: the Movimento Popular de Libertação de Angola (MPLA) was led by *mestiços* and *assimilados*; the Frente Nacional de Libertação de Angola (FNLA) by traditional leaders and *assimilados*; and the União para a Independencia Total de Angola (UNITA) emerged as an anti-*mestiço* movement with some younger *assimilado* leadership.

Decades of conflict, starting with the anti-colonial insurgency in the 1960s and continuing with the civil war from independence in 1975 until 2002, have left Angola with poverty, inequality, and political factionalism (Minority Rights Group, 2023). Ethnic and regional divisions played a significant role, with the three main factions drawing support from different regions and communities. Angola's diverse population, including Ovimbundu, Mbundu, Bakongo, a mixed Portuguese-Angolan *mestiço* population, and indigenous San, still sees identity and geography influencing its politics. Despite the MPLA's dominance and increasing repression against human rights activists, journalists, and political opposition, the country has avoided a return to civil conflict.

Angola also faces persistent corruption in its oil sector, which has exacerbated governance challenges and entrenched deep poverty among its population, despite significant oil revenues. This has particularly affected the Cabinda region, which, despite containing the majority of Angola's oil, has seen little development and continues to experience insecurity. Separatist violence has occurred sporadically, with significant incidents in 2010 and 2016/17, involving attacks on soldiers and the abduction of workers by separatists.

Angola and the Democratic Republic of Congo (DRC) have historically conducted violent expulsions of each other's nationals. Concerns over Angola's treatment of undocumented migrants have persisted, with the UN Special Rapporteur on the human rights of migrants calling for a national

strategy to protect their rights. In October 2018, following an expulsion order, at least 360 000 Congolese nationals crossed back into the DRC, many facing violence, extortion, and other abuses.

3.1.3 Indigenous peoples

The government does not officially recognise the indigenous peoples living within its borders, resulting in unaddressed discrimination in accessing health care, education, and basic needs (Minority Rights Group, 2023). Indigenous populations, including the San, Himba, Kwepe, Kuvale, and Zwemba, estimated at around 25 000 (0.1% of the total population), face environmental stresses like drought and the dispossession of ancestral lands for tourism, logging, and other developments, which devastate their way of life. Many were displaced to neighbouring countries during the civil conflict and have not returned.

More detail on the San people is provided in the SEIA prepared as part of this project.

3.1.4 Artisanal and small-scale mining (ASM)

ASM in Angola is a significant part of the country's mining sector, particularly in diamond-rich regions. In Angola, this sector is primarily driven by the quest for diamonds, but also includes other minerals like gold and copper.

Many artisanal miners operate informally without official permits or regulation, making it difficult to regulate. This lack of formalisation can lead to a range of issues, from legal challenges to environmental degradation. However, ASM provides livelihoods for thousands of Angolans. It is an essential source of income, particularly in rural areas where economic opportunities are limited.

ASM is labour-intensive, often involving entire families in the mining process. Child labour is reportedly not uncommon, despite being illegal.

Artisanal miners typically use simple tools and techniques. These include manual digging, panning, and sluicing, which are often inefficient and environmentally harmful. In this way, ASM contributes to deforestation, soil erosion, and water pollution due to the use of hazardous materials like mercury. Miners face numerous health and safety (H&S) risks, including exposure to these toxic substances, dangerous working conditions, and inadequate safety equipment.

Artisanal mining in Angola has been linked to conflict, particularly in diamond-rich areas. Illegal mining activities can fund armed groups and contribute to instability. Efforts to establish conflict-free certification schemes aim to ensure that diamonds and other minerals are not funding conflict and are mined under fair conditions.

Despite the wealth generated by ASM, miners often receive a small fraction of the profits. Middlemen and buyers typically gain the most financial benefit, leading to economic disparities.

The Angolan government has made efforts to formalise the ASM sector through the issuance of licenses and the establishment of cooperatives. However, the implementation and enforcement of these policies remain challenging.

ASM was identified in three villages in the vicinity of the project.

More information on the ASM sector is provided in the SEIA.

3.2 Legislative framework

The level of respect and enforcement of human rights within a country can significantly influence a company's access to funding and its ability to engage in international business. At the country level, support for human rights is demonstrated by ratifying international treaties and conventions, integrating

human rights issues into domestic legislation, and the actual implementation of these principles in practice.

3.2.1 Legislation

A high-level overview of constitutional rights, key legislation and policies related to human rights in Angola are provided in **Table 3-1**.

3.2.2 International human rights instruments

The key international human rights conventions and treaties applicable to Angola are outlined in **Table 3-2**.

Table 3-1: Overview of constitutional rights, key legislation and policies related to human rights in Angola

Legislation / strategy	Description and project application
Constitution of Angola (Republic of Angola, 2010) / *Constituicao da Republica de Angola*	The Constitution of Angola 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 organisation of the government and the rule of law in Angola. Chapter II of the Constitution provides for individual and collective fundamental rights, freedoms and guarantees. The principles of the Articles summarised below are considered in this HRIA: • Article 30 Right to life: Human life is inviolable. • Article 30 Right to life: Human life is inviolable. • Article 31 Right to personal integrity: The moral, intellectual and physical integrity of individuals is inviolable, and respect and the human person and human dignity are protected. • Article 32 Right to identity and privacy: Everyone's right to personal identity, civil capacity, nationality, a good name and reputation, likeness, free speech, and privacy in personal and family life are recognised. • Article 33 Inviolability of the home: The home is inviolable. • Article 35 Family, marriage and filiation: The family is based on marriage or a de facto union between a man and a woman, is the basic nucleus of social organisation and enjoys special protection by the state. Men and women are equal within the family, in society and before the state, enjoy the same rights and are responsible for the same duties. All children, despite filiation, are equal before the law and are not discriminated against. Families, the state and society prioritise the protection of children's rights through balanced upbringing, health care, education and living conditions. The state, family and society, promote balanced development of young people, and create conditions to fulfil their political, economic, social and cultural rights. It fosters youth organisations established for economic, cultural, artistic, recreational, environmental, scientific, and educational, purposes. • Article 36 Right to physical freedom and personal security: Everyone has the right to physical freedom, individual security, physical and mental integrity, and protection and control over their own body without violence, torture, cruel, inhumane or degrading treatment and punishment. • Article 37 Right to property, requisitions and expropriations: The right to private property and its transmission is guaranteed for everyone under the terms of the Constitution and law. The state respects and protects the property rights in rem of private individuals, corporate bodies and local communities. Temporary civil requisition and expropriation for public use shall only be permitted upon prompt payment of just compensation under the terms of the Constitution and law. • Article 38 Right to free economic initiative: Private enterprise, free business and cooperative initiatives can be undertaken under the terms of the Constitution and law. The law promotes, regulates and protects the economic activities and investments of private, national or foreign individuals and corporate bodies to enable their contribution to the country's development. It defends the economic and technological emancipation and interests of the Angolan people and of workers. • Article 39 Environmental rights: Everyone can live in a healthy, unpolluted environment and must defend and preserve it. The location of economic activities and the development and use of all natural resources happen sustainably to respect the rights of future generations. • Article 41 Freedom of conscience, religion and worship: Freedom of conscience, religion and worship is inviolable. • Article 42 Intellectual property: Intellectual, artistic, political, scientific and communication activities can be expressed without censorship or licence. • Article 43 Freedom of cultural and scientific creation: The freedom to invent, produce and publicise scientific, literary and artistic works are not restricted and are protected by copyright law.

Legislation / strategy	Description and project application
	• Article 46 Freedom of residence, movement and emigration: Any Angolan citizen may freely establish their residence, move and settle anywhere in the country. • Article 48 Freedom of association: All citizens can freely associate with one another without requiring administrative authorisation, as long as it is democratic and under the terms of the law. No-one can be obliged or coerced to belong to or remain a member of an association. Associations or groupings whose purposes or activities incite and practice violence, and promote tribalism, racism, dictatorship, fascism, xenophobia, or militarisation are prohibited. • Article 49 Freedom of professional and business association: All professionals and self-employed workers can belong to a professional association that defends their rights and interests and regulates the profession's ethics. • Article 50 Trade union freedoms: Workers may create trade union organisations to defend their collective and individual interests and conduct social dialogue. • Article 51 Right to strike and prohibition of lock-outs: Workers have the right to strike, lock-outs are prohibited, and employers may not forbid workers to access their workplaces to influence the outcome of labour conflicts. • Article 52 Participation in public life: Every citizen can participate in political life and the direction of public affairs. The potential of the project to violate, influence, or impede the enjoyment of these rights is considered when identifying its adverse human rights impacts.
Basic Law on Social Protection (Law 7/04 of October 15, 2004) */ Lei n. 7/04 – Estabelece a Lei de Bases da Protecção Social*	The Basic Law on Social Protection establishes a legal framework for social protection. Its purpose is to ensure that the well-being of Angolan citizens is protected through social security, health care, pensions, and other social benefits. It focuses on vulnerable groups such as the elderly, disabled individuals, children, and those living in poverty. The law seeks to protect individuals and families from the economic risks associated with old age, sickness, disability, unemployment, and other situations of need. It also aims to promote social inclusion and overall quality of life, to reduce poverty and inequality, and by providing a basic level of social protection to all citizens. This social protection is financed through tax in an act of national solidarity. The well-being of people, families and the community, is achieved through social promotion and regional development. This Law gives effect to some of the Constitutional rights summarised above. This is a structure put in place by the state as a duty-bearer to improve the current enjoyment of human rights. The project should not jeopardise what the act tries to achieve – especially for vulnerable groups.
Presidential Decree No. 37/21 approving the National Policy on Social Action (NPSA) */ Decreto Presidencial n. 37/21 – Política Nacional da Acção Social*	The Decree approves and establishes the theoretical and methodological bases for the NPSA. It establishes the State's responsibility for the guidance, management, financing and control of the NPSA. The purpose of the NPSA is to guide the government's efforts to address social challenges and promote social development. It aims to improve the quality of life of Angolans, particularly the most vulnerable groups such as children, women, the elderly, people with disabilities, and those living in poverty. The NPSA focuses on enhancing social protection, access to basic services, and social inclusion. It also emphasises the importance of community participation and collaboration among various stakeholders to achieve its objectives. The potential adverse human rights impacts caused by the project will be identified and assessed against the backdrop of the aims of this Decree and the NPSA so that the project does not compromise what the NPSA is attempting to accomplish.
Land Use Planning and Urban Development Act (Law of Territorial Planning and Urbanisation), No. 3/04 of 25 June 2004 / *Lei do*	The Act adopts a concept of integrated planning. It includes socio-economic aspects and attempts to create synergy between urban and rural areas. It calls for the establishment of a decentralised system to coordinate land use planning. The Act was established in response to outdated and ineffective land use planning and urban management legislation. Existing laws on territory, town planning, and urban issues are fragmented and do not align with current scientific and technological standards. Rapid urbanisation, particularly in coastal areas due to war and migration, has worsened urban management issues, resulting in

Legislation / strategy	Description and project application
Orderamento do Territorio e do Urbanismo	overcrowded and deteriorating cities. The lack of integrated and coordinated plans has further compounded problems, leading to inefficient urban development and growth. Any issues regarding land acquisition associated with this project should take into consideration that the implementation of legislation can take time. That is, there is still a substantial difference between the achievement of human rights enjoyment in urban and rural areas. Laws and policies might be established but the reality might be that some land uses and tenure rights might not yet be in line with them.
Land Law, No. 9/04 of 9 November 2004 / *Lei da Terras*	The Land Law regards land as the property of the state and describes it as a: • Shelter and home for the inhabitants of Angola, implying the existence of an appropriate urban planning system; • Source of natural resources; and • Support for economic, agricultural and industrial activities. It presents two land classifications, namely urban land (areas for the construction of buildings) and rural land (areas for agriculture, raising livestock, forestry and mining). The government decides on the establishment of land areas to be used for roads, inland borders, airports and ports, and military bases. Since the State holds all ownership of land, any engagements regarding land acquisition or lease should take note thereof. The State may decide not to meaningfully consult land users based on the premise that it owns the land. This will be important in avoiding and mitigating the impacts of involuntary physical or economic displacement, where the sourcing of replacement land and the fair compensation of Project Affected Parties (PAPs) might be required.
Local Municipalities Act, No. 17/99 of 1999 / *Lei das Autoridades Locais*	The Act establishes that local governments are responsible for the promotion of development, basic sanitation, environmental protection and land management. Any aspects related to land acquisition or leasing for use by PAPs (i.e., those who might be affected by involuntary physical or economic displacement as a result of the project) must be managed in close collaboration with the affected local municipalities.
New General Labour Law (NGLL), Law No. 12/23 of 27 December 2023 / *Nova Lei Geral do Trabalho*	The NGLL replaces the General Labour Law, Law No. 7/15 of 15 June 2015. It recently came into force, on 26 March 2024. It introduced several significant changes and new features to the labour landscape in Angola. The changes and additions aim to modernise and regulate labour relations in Angola, addressing various aspects of employment contracts, disciplinary procedures, work conditions, and employee rights and protections. Labour laws will apply to all phases of the project in some way, notably in the construction phase. The confluence of the need for labour by the proponent as well as the need for employment by potential labourers and their families are duly considered in this HRIA as it could have or contribute to negative adverse human rights impacts.
Occupational Health and Safety (OHS) legislation	The following OHS decrees apply in Angola: • Decree No. 31/94 of 5 August 1994 • Decree No. 31/95 of 5 November 1995 • Executive Decree No. 128/04 of 23 November 2004 • Decree No. 53/05 of 5 August 2005 These decrees establish principles and regulations to promote health, safety and workplace conditions, OHS systems, and the legal regime relating to occupational accidents and diseases. The presence of the project will likely require labour from local communities. Potential OHS impacts on workers in the area might therefore also be regarded as impacts on the communities in the Area of Influence (AoI).

Legislation / strategy	Description and project application
Energy supply legislation	The following energy supply decrees apply in Angola: • Decree No. 39/04, 2 July 2004 • Decree No. 40/04, 2 July 2004 • Decree No. 41/04, 2 July 2004 These decrees govern the licensing of installations to use electric energy networks in buildings, the production, transport, and distribution of electric energy, and the statute of the technicians responsible for electrical installations. These regulations collectively define the legal framework for the proper handling and operation of electrical energy installations. Compliance with these regulations is crucial for the successful implementation and operation of the Project, since it directly involves the transmission and distribution of electrical energy. Rights-holders in the AoI will need to understand what the legal requirements, timelines, and larger project objectives are.
Angola 2025: Long-Term Strategy / *Estratégia de Longo Prazo and Strategy to Combat Poverty* (2003)	These strategies provide details on current obstacles to development in Angola, such as low human development, a weak economy, inadequate health and education services, and regional inequality. They were developed as part of an ongoing process of reconstruction and national development. The strategies contain plans to eliminate or improve the conditions that Angolan citizens live in. It considers the possible growth of various sectors and the main activities to realise this growth. They allowed for stakeholder engagement to allow the vulnerable to participate actively in the socio-economic development process. These strategies are further instruments that the state has put in place to increase the enjoyment of human rights by rights-holders in Angola.

Table 3-2: Key international human rights conventions and treaties applicable to Angola

Body / treaty / convention	Description and project application
United Nations	As a Member State of the United Nations (UN) since 1 December 1976, Angola is considered to agree with UN declarations and non-binding documents issued by the UN General Assembly or UN conferences. Ratifying the two Covenants, the International Covenant on Economic, Social and Cultural Rights (ICESCR), and the International Covenant on Civil and Political Rights (ICCPR), makes them binding to Angola and that the government has explicitly agreed to abide by them. Angola is accountable to several UN human rights bodies, including the Human Rights Council with its Universal Periodic Review and specialised thematic procedures (IJRC, 2017). As a signatory to specific universal human rights treaties, Angola's policies and actions are monitored by UN treaty bodies. Angola has agreed to the complaints process of three treaty bodies. The major international human rights instruments that Angola has signed or ratified are: • ICESCR (the first International Covenant) – Angola has signed, but not ratified, the Optional Protocol to the ICESCR • ICCPR (the second International Covenant) – Angola has ratified the Optional Protocol to ICCPR and the Second Optional Protocol to the ICCPR, aiming at the abolition of the death penalty • Convention on the Rights of the Child (CRC): ratified/acceded to in 1990 – Optional Protocol to the CRC on the involvement of children in armed conflict: ratified/acceded to in 2007 – Optional Protocol to the CRC on the sale of children, child prostitution and child pornography: ratified/acceded to 2005

Body / treaty / convention	Description and project application
	• Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW): ratified/acceded to in 1986 – Optional Protocol to the CEDAW: ratified/acceded to in 2007 • Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment: ratified/acceded to in 2019 – Optional Protocol to the Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment: signed in 2013, but not ratified • Convention on the Rights of Persons with Disabilities (CRPD): ratified/acceded to in 2014 – Optional Protocol to the CRPD: ratified/acceded to in 2014 • International Convention on the Elimination of All Forms of Racial Discrimination: ratified/acceded to in 2019 • International Convention for the Protection of all Persons from Enforced Disappearance (signed, not ratified): signed in 2014, but not ratified Angola has **not** signed, ratified or acceded to the following conventions: • Optional Protocol to the CRC on a communications procedure • International Convention on the Protection of the Rights of All Migrant Workers and Members of their Families Angola must submit State reports to each UN treaty body associated with the relevant treaty it has ratified. These reports must be submitted periodically and should describe the steps taken to implement the treaty provisions. Angola has ratified optional protocols or issued relevant declarations that enable individuals to lodge complaints against the State for violations of the ICCPR, CEDAW, and CRPD. Furthermore, specific UN treaties feature inquiry mechanisms that enable the UN treaty body to investigate claims of serious or systemic human rights abuses. Angola has agreed to the inquiry mechanisms of the CEDAW and CRPD.
International Labour Organization (ILO) Conventions	The following Conventions have been ratified by and are in force in Angola (ILO, 2024): • Forced Labour Convention, 1930 (No. 29) on 4 June 1976 • Abolition of Forced Labour Convention, 1957 (No. 105) on 4 June 1976 • Minimum Age Convention, 1973 (No. 138) (minimum age of 14 was specified) on 13 Jun 2001 • Worst Forms of Child Labour Convention, 1999 (No. 182) on 13 June 2001 • Tripartite Consultation (International Labour Standards) Convention, 1976 (No. 144) on 24 April 2020 • Labour Inspection Convention, 1947 (No. 81) on 4 June 1976 • Discrimination (Employment and Occupation) Convention, 1960 (No. 111) on 4 June 1976 • Equal Remuneration Convention, 1951 (No. 100) on 4 June 1976 • Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87) on 13 June 2001 • Right to Organise and Collective Bargaining Convention, 1949 (No. 98) on 4 June 1976 • Hours of Work (Industry) Convention, 1919 (No. 1) on 4 June 1976 • Night Work of Young Persons (Industry) Convention, 1919 (No. 6) on 4 June 1976 • Weekly Rest (Industry) Convention, 1921 (No. 14) on 4 June 1976 • Workmen's Compensation (Accidents) Convention, 1925 (No. 17) on 4 June 1976

Body / treaty / convention	Description and project application
	• Workmen's Compensation (Occupational Diseases) Convention, 1925 (No. 18) on 4 June 1976 • Equality of Treatment (Accident Compensation) Convention, 1925 (No. 19) on 4 June 1976 • Night Work (Women) Convention (Revised), 1948 (No. 89) on 4 June 1976 • Weekly Rest (Commerce and Offices) Convention, 1957 (No. 106) on 4 June 1976 • Indigenous and Tribal Populations Convention, 1957 (No. 107) on 4 June 1976 The remaining conventions that Angola has signed or ratified are listed in **Appendix A**.
African Union	Angola has acceded to the African Charter on Human and Peoples' Rights, subjecting its human rights policies and practices to scrutiny by the African Commission on Human and Peoples' Rights (ACHPR) (IJRC, 2017). The ACHPR evaluates the state's reports on its human rights status and adjudicates complaints of purported violations. However, Angola has not granted jurisdiction to the African Court on Human and Peoples' Rights. Angola has ratified the following African Union (AU) regional treaties related to human rights (AU, 2024): • African Charter on Human and Peoples' Rights on 2 March 1990 • Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (2007) on 30 August 2007 • African Charter on the Rights and Welfare of the Child on 11 April 1992 • Protocol To The African Charter On Human And Peoples' Rights On The Rights Of Persons With Disabilities In Africa on 12 April 2022 • Agreement for the Establishment of the African Rehabilitation Institute (ARI) on 26 March 2007 • Protocol of the Court of Justice of the AU on 21 February 2020 • Protocol on the Statute of the African Court of Justice and Human Rights on 21 February 2020 • OAU Convention Governing Specific Aspects of Refugee Problems in Africa on 30 April 1981 • AU Convention for the Protection and Assistance of Internally Displaced Persons in Africa (Kampala Convention) 14 May 2013 • African Nuclear-Weapon-Free Zone Treaty (Pelindaba Treaty) on 8 May 2014 • OAU Convention on the Prevention and Combating of Terrorism on 20 August 1999 • Protocol Relating to the Establishment of the Peace and Security Council of the AU on 30 August 2004 • Protocol to the African Charter on Human and Peoples' Rights on the Rights of Older Persons on 12 April 2022 (not in force) Angola has signed, but not ratified the following AU human rights treaties (AU, 2024): • Protocol to the African Charter on Human and Peoples' Rights on the Establishment of an African Court on Human and Peoples' Rights on 22 January 2007 • Convention for the Elimination of Mercenarism in Africa, 19 July 1979 • AU Non-Aggression and Common Defence Pact on 27 January 2012 • Protocol to the Treaty Establishing the African Economic Community Relating to Free Movement of Persons, Right of Residence and Right of Establishment on 21 March 2018 (not in force) The remaining treaties that Angola has signed or ratified are listed in **Appendix A**.
Armed conflict and refugees	Angola has ratified the following conventions and protocols relating to armed conflict and refugees (Médecins Sans Frontières, 2024): • 1st Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field (1984)

Body / treaty / convention	Description and project application
	• 2nd Geneva Convention for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea (1984) • 3rd Geneva Convention relative to the Treatment of Prisoners of War (1984) • 4th Geneva Convention relative to the Protection of Civilian Persons in Time of War (1984) • Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts (Protocol I) of 8 June 1977 (1984) • Convention Governing the Specific Aspects of Refugee Problems in Africa (United Nations High Commissioner for Refugees [UNHCR]) (1981) • Convention and Protocol Relating to the Status of Refugees (UNHCR) (1981)

3.3 Current status of human rights in Angola

Although the Constitution is comprehensive in its coverage of fundamental human rights, there are still some shortcomings in its universal achievement in the country (OHCHR, 2008; da Silveira, 2014). Angola is a Member State of the AU and UN and has human rights obligations at both regional and international levels.

The Human Rights Committee considered a 2013 report on how Angola implements the provisions of the ICCPR (UN, 2013). The Committee expressed concerns about various human rights issues in Angola, including restrictions on freedom of expression, association, and peaceful assembly, as well as reports of excessive use of force by security forces.

In 2022, there were still ongoing challenges with the enforcement of human rights instruments in Angola according to Amnesty International and Human Rights Watch (Amnesty International, 2023; Human Rights Watch, 2021). These include violations of the right to adequate housing, freedom of expression and assembly, freedom from arbitrary arrest and detention, fair trial, lack of accountability for past human rights abuses, concerns about the independence of the judiciary, and challenges faced by civil society organisations and human rights defenders in the country.

3.3.1 UN Special Procedures

Angola has not issued a standing invitation to UN special procedures, necessitating that special rapporteurs and working groups request specific invitations from Angola to conduct visits within the country. For instance, the Special Rapporteur on freedom of religion or belief visited Angola in November 2007 and published a report on the visit in July 2008. The UN Special Rapporteur on the Human Rights of Migrants also visited Angola In 2016, as discussed in Sections 3.3.3 and 3.3.4 (OHCHR, 2016)

3.3.2 Disability rights

During the 28th Session of the UN CRPD, which took place from 6 to 24 March 2023, several key outcomes and concerns were highlighted (OHCHR, 2023):

- **Positive developments:** Angola's efforts to implement the CRPD were acknowledged, particularly in areas such as education, health, accessibility, and social protection.
- **Challenges in implementation:** Concerns were raised regarding the actual implementation of the CRPD in Angola, noting gaps in legislation, policies, and programs to fully protect the rights of persons with disabilities.
- **Legal capacity:** There were concerns about Angola's legal framework concerning legal capacity, particularly the lack of recognition of supported decision-making mechanisms. The Committee urged Angola to ensure equal legal recognition for people with disabilities and to establish supported decision-making mechanisms in all aspects of life.
- **Education:** Angola was encouraged to improve inclusive education practices to ensure equal access to quality education for persons with disabilities.
- **Healthcare:** Access to healthcare services for persons with disabilities was highlighted as an area needing improvement, including access to rehabilitation services and mental health support.
- **Accessibility:** Angola was urged to enhance accessibility in the built environment, transportation, and information and communication technologies.
- **Independent living:** The need to promote independent living for persons with disabilities through adequate support services and community-based programs was emphasised.
- **Employment:** Concerns were raised about the low employment rates among persons with disabilities in Angola and the lack of effective policies to promote their inclusion in the workforce. Angola has not met its targets of reserving 4% of public sector jobs and 2% of private sector jobs for people with disabilities. The Committee recommended enforcing these quotas through penalties to ensure compliance in both sectors.

- **Decision-making:** substituted decision-making is still allowed, enabling others to make decisions on behalf of people with disabilities, which can infringe upon their rights.

While Angola has shown some progress in implementing the CRPD, there are still significant challenges to overcome to ensure the full enjoyment of rights by persons with disabilities in the country.

3.3.3 Migrants

In 2016, the UN Special Rapporteur on the Human Rights of Migrants visited Angola (OHCHR, 2016). The Special Rapporteur noted that immigration regulations in Angola are not widely understood, and even when they are, their enforcement is hindered by inadequate institutional frameworks and corruption. The strict immigration laws often leave many migrants with no choice but to live undocumented. Nonetheless, migrants continue to go to Angola for employment, particularly in construction and mining, and to start businesses, which greatly benefits the economy. However, their legal status is rarely regularised, leaving them vulnerable to exploitative working conditions.

Concerns were raised about intimidation and harassment faced by undocumented migrants, asylum seekers, and refugees by law enforcement officials in Angola. Police conduct operations in various locations to apprehend undocumented migrants, often resorting to violence, threats, and destruction of valid Identification Documents (ID). Migrants, including pregnant women and children, are regularly arrested and detained, with reports of bribery by police. Advocates for migrant rights are also reportedly intimidated.

Several concerns were raised regarding the detention of migrants in Angola. Migrants are often arrested under suspicion of irregular entry or stay, even when they present documents. They may be detained while their documents are verified or arrangements for their expulsion are finalised. Mandatory detention of undocumented migrants and asylum seekers is criticised as neither legitimate nor effective, often driving migrants further underground. Conditions in detention centres are described as overcrowded and unsanitary, with limited access to basic hygiene products and little privacy. Detainees may only have access to phones for obtaining bribery money. Detainees have limited access to legal information, struggle to access lawyers, and lack access to legal aid. Detention can be indefinite and only ends upon expulsion, verification of documentation (a lengthy process), or release after payment of a bribe. Detention centres are not subject to independent monitoring, and detention occurs without prior authorisation from a judicial body. Children are detained from time to time for reasons related to their migratory status or that of their parents. Migrants often lack access to competent lawyers and legal aid systems. Migrants and those assisting them often lack information about migration and protection proceedings.

Collective expulsions of undocumented migrants, particularly at the border with the DRC in Dondo, where deportations often occur on the day of arrest, denying migrants the opportunity to seek judicial remedy, were also reported. Despite legal protections in Angola's Law on Refugee Status, which prohibits the expulsion of refugees and asylum-seekers except under specific circumstances, there are concerns that this principle is being eroded due to the increasing number of immigration arrests and the difficulties migrants and refugees face in accessing legal services, civil society organisations, or international organisations once detained.

Concerns were highlighted regarding birth registration for children born to foreigners in Angola, including refugees. A Ministry of Justice and Human Rights instruction from 2011 has suspended the birth registration of foreigners born in Angola, leading to many being unable to register their children and obtain birth certificates. When birth certificates are provided, they often indicate the parents are foreigners, leading to discrimination by employers or civil servants against migrants. Birth registration is crucial for protecting migrant children and preventing statelessness, as it enables access to education and healthcare.

Migrants have difficulty accessing complaint mechanisms, partly because of a lack of information, a shortage of legal representation and partly because they fear being immediately detained and deported. Undocumented migrants and their children face discrimination and often have inadequate access to basic education, housing, and healthcare. There is negative rhetoric that equates all undocumented migrants to criminals and religious extremists.

3.3.4 Asylum seekers

Since the promulgation of the new Asylum Law in June 2015, the previous system for refugee status determination has been discontinued, but regulations for establishing a new system have yet to be created. This legal gap is detrimental to asylum seekers, who are provided with no alternative status (OHCHR, 2016).

The 2015 Asylum Law provides for new ID for refugees and asylum seekers, but the regulation introducing these new IDs has not been finalised. As a result, documentation issuance for asylum seekers has been suspended since the law's entry into force.

The right to work is not recognised for asylum seekers in Angola, forcing them to engage in the informal labour market for basic subsistence. Additionally, refugees can no longer obtain mandatory business licences, restricting their economic self-sufficiency and ability to find durable solutions.

The complicated and lengthy asylum procedure, along with restrictions on freedom of movement and lack of documentation, discourage potential refugees from registering as asylum seekers. The 2015 Asylum Law introduces a policy of mandatory detention for asylum seekers, violating international law principles.

The Special Rapporteur urged Angolan authorities to promptly register all asylum seekers, finalise and implement regulations for issuing identification documentation, and commit to issuing documents for asylum seekers and refugees timeously. It also recommends reconsidering the reservation to Article 26 of the 1951 Convention to recognise freedom of movement for all foreigners, including asylum seekers and refugees.

3.3.5 Security forces

In 2022, Angola's efforts in implementing priority recommendations were "largely satisfactory" for its efforts to reduce the excessive use of force by law enforcement officials (OHCHR, 2022). These efforts included training security forces and police officers on international standards for the use of force and human rights, particularly during states of emergency or disasters. Additionally, human rights education was integrated into the curriculum of the National Institute of Judicial Studies to sensitise and train judges and prosecutors.

3.3.6 African Commission on Human and Peoples' Rights (ACHPR)

Angola has lagged in submitting its regular reports to the ACHPR regarding the state of human rights within the country (IJRC, 2017). The ACHPR conducted a promotional mission to Angola in 2010 and a mission focused on women's rights in 2002. Individuals and groups have filed complaints of human rights violations against Angola with the African human rights system. One notable case involved the mass deportation of non-nationals from Angola. In the case of *Union Interafricaine des droits de l'Homme et al. v. Angola*, the ACHPR determined that Angola violated the African Charter by arbitrarily and illegally expelling West African nationals without allowing them to challenge their expulsion in court.

3.3.7 Children's rights

In 2022, the AU issued a report on the progress that Angola has made in the implementation of the African Charter on the Rights and Welfare of the Child (AU, 2022). The main outcomes of the report regarding Angola's respect for child rights include:

- **Progress in legislative measures:** Angola has made progress in aligning its national legislation with international standards, particularly through the adoption of the Law on the Protection and Development of the Child.
- **Establishment of institutions:** Angola has established institutions such as the National Council for Children's Affairs and the National Institute for Children to promote and protect children's rights.
- **Education and health:** Efforts have been made to improve access to education and health services for children, although challenges remain in ensuring quality and accessibility, especially in rural areas.
- **Child labour and trafficking:** Angola has taken steps to address child labour and trafficking, including the adoption of the National Plan to Combat Child Labour and Trafficking.
- **Juvenile justice:** Angola has made progress in reforming its juvenile justice system to ensure the rights of children in conflict with the law are protected.
- **Challenges remain:** Despite these efforts, challenges remain in fully implementing and enforcing laws and policies to protect children's rights, particularly in areas such as child labour, education, health, and juvenile justice.

Overall, while Angola has made progress in promoting and protecting children's rights, there is still work to be done to ensure that all children in the country can enjoy their rights fully.

3.3.8 Rights of San people

The Committee on Economic, Social and Cultural Rights (CESCR) in 2016 highlighted several concerns in its concluding observations, including the lack of recognition of Indigenous peoples, instances of discrimination, limited service provision, absence of consent procedures for economic activities on territories, and insufficient data on Indigenous peoples in Angola. The 2014 Human Rights Council report also noted issues such as discrimination against San children and reported evictions of indigenous peoples.

3.4 Project-related labour

3.4.1 Accommodation

According to Pak, camp areas will be planned for migrant workers on site. The priorities for accommodation arrangements will focus on the welfare and comfort of the staff, the establishment of proper communication systems, and the provision of entertainment options during off-hours. Specific planning for the effective accommodation of workers will be clarified during the construction of the camp.

3.4.2 Workforce

Personnel will come from Angola, Portugal, Brazil, and Turkey. According to the signed Engineering, Procurement and Construction (EPC) contract, the ratio of local to foreign workers will be set at 70:30, with a preference for Angolan nationals. Laydown areas will be removed after the construction process is completed, and these areas will be fully cleared once the project is finished.

4 Stakeholder engagement

Stakeholders are all individuals and groups who are or could be impacted by or influencing a given project. They include individuals, interest groups, and organisations. Stakeholder analysis is a deliberate process of identifying all project stakeholders and understanding their concerns or relationship with the project. This analysis helps project owners understand the local cultural and

political context. It is recognised that different stakeholder groups have varying interests, and there are individual differences within stakeholder groups.

This section of the report aims to describe stakeholder groups in the context of human rights assessment. It should be noted that a stakeholder analysis was conducted as part of the SEP prepared for the ESIA, but, in the context of HRIA, stakeholders are categorised differently. The key stakeholder groups are “Duty-bearers”, “Rights-holders”, and “other relevant parties”. The individual stakeholders that fall within each of these three groups are detailed in **Table 4-1**.

Table 4-1: Human rights stakeholders

Group	Stakeholder
Duty-bearers	• Business/corporates: – Pak Yatirim – Business suppliers, contractors and sub-contractors of Pak and RNT • State agents: – RNT – ENDE (*Empresa Nacional de Electricidade de Angola*) – PRODEL (*Empresa Pública de Produção de Electricidade* / PRODEL-EP) – National Police • Government ministries: – MINEA (*Ministério da Energia e Águas* / Ministry of Energy and Water) – MINFIN (*Ministério das Finanças de Angola* / Ministry of Finance of Angola) – MINAMB (*Ministério do Ambiente* / Ministry of Environment) – MINAGRIF (*Ministério da Agricultura e Florestas* / Ministry of Agriculture and Forestry) – MASFAMU (*Ministério da Acção Social, Família e Promoção da Mulher* / Ministry of Social Protection, Family and Promotion of Women) • Provincial governments of: – Huíla – Huamba • Municipal administrations of – Jamba – Cuvango – Chipindo
Rights-holders	• Impacted communities in the municipality of Jamba: – Cacola – Lucunga A – Kuandja – Eyela – Morro I • Impacted communities in the municipality of Cuvango: – Km 50 – Tchicunho – Aunge – Ngokue – Cavinga • Impacted communities in the municipality of Chipindo: – 1º de Maio – Vingolo – Buloteke

Group	Stakeholder
	– Capuca – Oko – Operário A • Impacted community members, both within the geographic vicinity of the project, but also other downstream or neighbouring communities – Women – Men – Youth – Elderly – Children and adolescents – Migrants/internally displaced people who moved to the project area during or after the war – War veterans, mostly elderly – War maimed (disabled) persons, mostly elderly – Indigenous peoples / ethnic minorities, namely the San people – Artisanal and Small-scale Gold Miners (ASGM) in the project area – Physically or economically displaced PAPs • Migrant workers • Local workers and their families
Other relevant parties	• Rural or social development agencies / programmes (Government of Angola) – CASI (*Centros de Acção Social Integrada* / Integrated Social Action Centres) – ECA (*Escolas de Campo de Agricultores* / Farmer Field Schools) – EDA (*Estações de Desenvolvimento Agrícola* / Agricultural Development Stations) – IDA (*Instituto de Desenvolvimento Agrário* / Agrarian Development Institute) – PEDR (*Programa de Extensão de Desenvolvimento* / Rural Development Extension Programme) – PIDLCP (*Programa Integrado de Desenvolvimento Local e Combate à Pobreza* / Local Development and Combating Poverty Programme) – PIIM (*Programa Integrado de Intervenção Municipal* / Integrated Municipal Intervention Programme) – Angola Agricultural Transformation Project (MOSAP) – IDL-FAS (*Instituto de Desenvolvimento Local – Fundo de Apoio Social* / Institute for Local Development – Social Support Fund) • NGOs working with San people: – OCADEC (*Organizacao Crista de Apoio ao Desenvolvimento Comunitario* / Christian Organisation for Community Development Support) – MBAKITA (*Missão de Beneficência Agro-pecuária do Kubango, Inclusão, Tecnologia e Ambiente* / Mission of Agricultural and Livestock Beneficence of Kubango, Inclusion, Technology, and Environment) – ACADIR (*Associãcao de Conservacão do Ambiente e Desenvolvimento Integrado Rural* / Association for Environmental Conservation and Integrated Rural Development)

4.1 Vulnerable rights-holders

The following vulnerable rights-holders have been identified:

- Impacted community members, both within the geographic vicinity of the project, but also other downstream or neighbouring communities
- Women
- Youth
- Elderly

- Children and adolescents
- Migrants/internally displaced people who moved to the project area during or after the war
- War veterans, mostly elderly
- War maimed (disabled) persons, mostly elderly
- Indigenous peoples / ethnic minorities, namely the San people, although they do not occur in the project-area (SRK, 2024)
- Artisanal and Small-scale Gold Miners (ASGM) in the project area
- Community members without security of tenure, physically or economically displaced PAPs
- Unemployed persons in municipal centres
- Individuals/groups that are economically or socially marginalised due to their historical pasts, or political or social beliefs

Stakeholder mapping for HRIA requires a different approach to that which is typically taken in stakeholder mapping (and as was done in the SEP prepared for this project). While typical stakeholder mapping focuses on the risk to business, HRIA mapping focuses on the risk to rights-holders (DIHR, 2016). The human rights stakeholder map for this project is shown in **Figure 4-1**.

Influence of stakeholder on project

Relevant stakeholders Low impact / High influence • National police, security forces • Provincial administrations	**Highly relevant stakeholders** High impact / High influence • MINEA, MINFIN, MINAMB • Pak, RNT, ENDE • Municipal administrations
Least relevant stakeholders Low impact / Low influence • Rural or social development agencies / programmes (Government of Angola) • NGOs • PRODEL, MINAGRIF, MASFAMU	**Key stakeholders** High impact / Low influence • Project-affected communities • Vulnerable rights-holders • Migrant workers • Local workers and their families

Impact of project on stakeholder

Figure 4-1: HRIA stakeholder map.

5 Human Rights Impact Analysis

An overview of the potential human rights impacts considered in the HRIA process is shown in **Table 5-1**. 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 5-1: 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 phase – CHSS during operational phase	• Discrimination • Freedom of association • Just and favourable working conditions • Safe and healthy working conditions • Forced labour • Child labour

– 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	
Cross-cutting human rights impacts applicable to community members and workers	
• Discrimination against women in the workplace • Reduced safety and access to resources	

The assessment of potential human rights impacts was done in two steps whereby an initial list of impacts was prepared based on the literature and context review (**Section 3**) and then further refined with due consideration of fieldwork results.

Eighteen (18) salient community-related human rights issues were identified. These include human rights impacts that can be potentially experienced by Project-affected Communities (PACs), workers employed by Pak, 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).

5.1 Summary and heatmaps

These 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 for not exacerbating 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.**

The human rights heat map **pre-mitigation** is shown in **Figure 5-1** below.

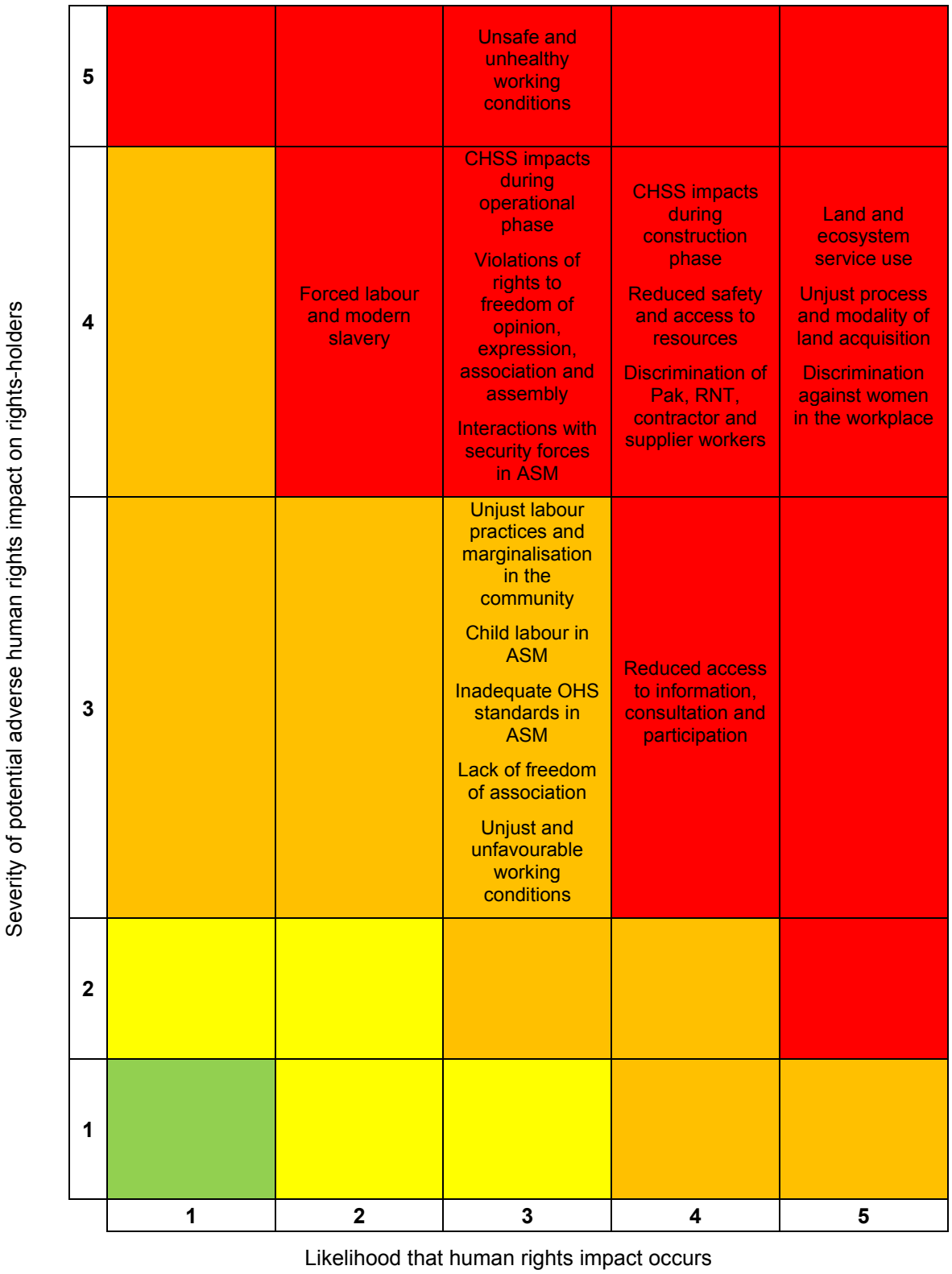


Figure 5-1: Pre-mitigation human rights heat map

The human rights heat map **post-mitigation** is shown in **Figure 5-2** below.

Severity of potential adverse human rights impact on rights-holders					
5					
4			CHSS impacts during construction phase		
3		Violations of rights to freedom of opinion, expression, association and assembly Forced labour and modern slavery	CHSS impacts during operational phase Child labour in ASM Inadequate OHS standards in ASM Interactions with security forces in ASM Discrimination of Pak, 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				

Figure 5-2: Post-mitigation human rights heat map

The following section of the report provides the assessment of the potential adverse human rights impacts associated with the project, as identified and rated based on the methodology explained in **Sections 2.2** and **2.3**.

5.2 Impact theme 1: Community members' human rights

The following sub-section assesses the potential adverse human rights impacts of the project on community members in the AoI.

5.2.1 Human rights impact 1.1: 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 ecosystem services used by IPs could also be impacted indirectly by the project.

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 lines 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 ratings, before and after mitigation measures are applied, are described in **Table 5-2**.

Table 5-2: Human rights impact 1.1: Land and ecosystem service use

Activity: Project planning and siting						
Project phase: Pre-construction and construction						
Impact Summary: Land and ecosystem service use						
	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:						
• Ensure the project design is adapted to avoid any impacts on farming or grazing land. • 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. • Compile and implement an International Finance Corporation Performance Standard (IFC PS) 1-compliant SEP, including a grievance mechanism. • Compile 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 which is informed by the LARF.						

• 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. • 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. • 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. • Construction activities should be limited to demarcated areas and avoid farming or grazing land used by local communities. • 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. • 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. • 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. • 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 semi-skilled and unskilled labour from the PACs as far as possible. • 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). • Establish and monitor conservation corridors. • Establish safe access routes to natural resource-use areas. • 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. • No recreational hunting or fishing should take place by construction workers on- or off-duty. • Vegetation clearing should be limited to the absolute minimum. • Hydrocarbon spills should be prevented as prescribed in the project Environmental and Social Management Plan (ESMP). • Any construction activities should be restricted to the established and demarcated construction sites. • Vehicle movement should be restricted to existing roads. • 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 RHs affected*	*Difficult*	***3***	***4***	

5.2.2 Human rights impact 1.2: 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 ratings, before and after mitigation measures are applied, are described in **Table 5-3**.

Table 5-3: Human rights impact 1.2: Unjust process and modality of land acquisition

Activity: Land acquisition process						
Project phase: Pre-construction and construction						
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:						
• Compile 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 which is informed by the LARF. • 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 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. • 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. • Any cash compensation should be provided along with relevant education on financial literacy and responsible spending. • 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. • 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. • 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). • Externally monitor the physical relocation process to ensure that GIIP, IFC PS5, and RAP requirements are adequately implemented and periodically reviewed. • Any changes to residential locations should be accompanied by security of tenure. • 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 souring of replacement housing. • 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***	

5.2.3 Human rights impact 1.3: 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 ratings, before and after mitigation measures are applied, are described in **Table 5-4**.

Table 5-4: Human rights impact 1.3: Unjust labour practices and marginalisation in the community

Activity: Employment of local and foreign labour, services, and supplies						
Project phase: Construction						
Impact Summary: Unjust labour practices and marginalisation in the community						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
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 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. • 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***	

5.2.4 Human rights impact 1.4: CHSS impacts during construction phase

H&S 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 ratings, before and after mitigation measures are applied, are described in **Table 5-5**.

Table 5-5: Human rights impact 1.4: CHSS impacts during construction phase

Activity: Construction activities						
Project phase: Construction						
Impact Summary: CHSS impacts						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
Before Management	*Significant*	*Multiple RHs affected*	*Can be remediated*	***4***	***4***	
Management Measures:						
• Consult with government and other companies about the best platforms and initiatives to discuss and contribute to mitigation of the adverse impacts of influx. • Develop a local employment strategy and work with contractors and suppliers to ensure its effective implementation. • 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. • 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). • 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.						

• 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. • 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. • 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. • 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. • Ensure that the CHSS plan included in contract documents of the main contractor and that it is implemented. • 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. • Require contractor personnel to drive at appropriate speed limits and enforce this where possible. • Include community safety in inductions and toolbox talks, along with the usual OHS measures. • Consult the relevant municipal or provincial traffic administrations for the relevant support e.g. place speed limit signage and limit road access. • 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. • 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 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. • 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. • 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	*Moderate*	*Small number of RHs affected*	*Can be remediated*	***4***	***3***	

5.2.5 Human rights impact 1.5: CHSS impacts during operational phase

During the operational 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 ratings, before and after mitigation measures are applied, are described in **Table 5-6**.

Table 5-6: Human rights impact 1.5: CHSS impacts during operational phase

Activity: Powerline and substation maintenance						
Project phase: Operation						
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:						

- Ensure that the CHSS plan is implemented by the transmission and distribution line operators.
- 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.
- Consult the relevant local municipal administrations when maintenance activities are being conducted.
- Consider including participatory monitoring by the community members if anything out of place is observed along the powerlines.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- Require personnel to drive at appropriate speed limits and enforce this where possible.
- Include community safety in employee training, along with the usual OHS measures.
- Consult the relevant municipal or provincial traffic administrations for the relevant support e.g. place speed limit signage and limit road access.
- 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***	

5.2.6 Human rights impact 1.6: 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 operational 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 ratings, before and after mitigation measures are applied, are described in **Table 5-7**.

Table 5-7: Human rights impact 1.6: Violations of rights to freedom of opinion, expression, association and assembly

Activity: Interactions with external stakeholders						
Project phase: All phases						
Impact Summary: Violations of rights to freedom of opinion, expression, association and assembly						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
Before Management	*Moderate*	*Multiple RHs affected*	*Can be remediated*	***4***	***3***	
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; – The code of conduct must be consistent with the United Nation's (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); – A requirement to train security personnel on VPSHR and Gender Based Violence and Harassment (GBVH). • All workers are to be informed about the roles and responsibilities of the security personnel.						
After Management	*Moderate*	*Small number of RHs affected*	*Can be remediated*	***3***	***2***	

5.2.7 Human rights impact 1.7: 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 ratings, before and after mitigation measures are applied, are described in **Table 5-8**.

Table 5-8: Human rights impact 1.7: Reduced access to information, consultation and participation

Activity: Interactions with external stakeholders						
Project phase: All phases						
Impact Summary: Reduced access to information, consultation and participation						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
Before Management	*Moderate*	*Multiple RHs affected*	*Can be remediated*	***3***	***4***	
Management Measures:						
• Compile and implement an IFC PS1-compliant SEP, including a grievance mechanism that will be used by the contractor, Pak and RNT. • 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. • 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 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. • Visuals and simple text in Umbundu, Nganguela and Portuguese should be used in in all engagements at PAC-level. 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 meaningfully consulted and that they receive information on project activities that could affected them. • 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. • 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). • 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.						

• 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. • 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. • 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.						
After Management	*Minor*	*Small number of RHs affected*	*Can be remediated*	***2***	***3***	

5.2.8 Note: Indigenous peoples

As shown in the SEIA, there are no known occurrences of indigenous peoples (San) in the project area. Per the records received, they are located more than 70 km south of the project site (Geolab, 2024). The San in Angola are currently far less nomadic than they traditionally were, due to increased pressures associated not only with urbanisation but also with systematic discrimination (IDL-FAS, 2022). This impact is therefore not assessed as we consider it to be misleading to do a risk and impact assessment on an issue that is not salient to the project.

However, the Project may indirectly result in pathways that could impact the San people's human rights as it pertains to the use of ecosystem services in Section 5.2.1: *Human rights impact 1.1: Land and ecosystem service use,* general project awareness as assessed in Section 5.2.7: *Human rights impact 1.7: Reduced access to information, consultation and participation,* and employment opportunities as assessed in Section 5.2.3: *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 Impact SE1.4 of the SEIA (SRK, 2024), 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 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 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.

Additional impact assessments of the indirect project impacts on ecosystem services used by IPs are included in the Volume 6 Addendum. These impacts are described as Socio-economic Impacts SE 1.10 and SE 5.4, with mitigation measures added to the ESMP (Volume 2).

5.3 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.

5.3.1 Human rights impact 2.1: 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 or RNT's employment policies was available, 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 contractors' and suppliers' workers.

The impact ratings, before and after mitigation measures are applied, are described in **Table 5-9**.

Table 5-9: Human rights impact 2.1: Discrimination against women in the workplace

Activity: Employment of local and foreign labour, services, and supplies						
Project phase: All phases						
Impact Summary: Discrimination against women in the workplace						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
Before Management	*Significant*	*Multiple RHs*	*Difficult*	***4***	***5***	
Management Measures:						
• Create awareness about non-discrimination and more opportunities for women to be recruited and advance. • 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. • Policies to address equality, opportunity, diversity and inclusion should be in place and implemented by both employers on this project, Pak and RNT. • 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. • More specialised training opportunities could be provided for women already in the workforce to help them progress into supervisory and management positions. • 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.						

• Prioritise non-discrimination and gender equality in ongoing engagement, monitoring, and auditing processes with contractors and suppliers. • 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***	

5.3.2 Human rights impact 2.2: 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 GBV. 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 ratings, before and after mitigation measures are applied, are described in **Table 5-10**.

Table 5-10: Human rights impact 2.2: Reduced safety and access to resources

Activity: Construction activities						
Project phase: Construction						
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:						
• Create awareness about non-discrimination and more opportunities for women to be recruited and advance. • 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. • Provide ongoing training on freedom from harassment and GBV for both employees and contractor workers, especially security personnel. • 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. • 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***	

5.4 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 countries[2].

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.

5.4.1 Human rights impact 3.1: 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 5-11**, 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 5-11: Human rights impact 3.1: Child labour in ASM

Activity: ASM in the project area
Project phase: All phases
Impact Summary: Child labour

[2] The world map on Artisanalminnig.org shows that all but one African country has ASM activity (Artisanalmining.org, 2022).

	Scale *Gravity*	Scope *No. of affected rights-holders*	Irremediability	Severity	Likelihood	Heat map rating
Before Management	*Moderate*	*Small no. of RHs*	*Difficult*	***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 Civil Society Organisations (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 – supporting holiday programmes for school-children to keep them out of ASM activities during school holidays						
After Management	*Moderate*	*Small no. of RHs*	*Difficult*	***3***	***3***	

5.4.2 Human rights impact 3.2: 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 ratings, before and after mitigation measures are applied, are described in **Table 5-12**, 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 5-12: Human rights impact 3.2: Inadequate OHS standards in ASM

Activity: ASM in the project area						
Project phase: All phases						
Impact Summary: Inadequate OHS standards						
	Scale *Gravity*	Scope *No. of affected rights-holders*	Irremediability	Severity	Likelihood	Heat map rating

Before Management	*Moderate*	*Small no. of RHs*	*Difficult*	***3***	***3***	
Management Measures:						
• Under the UNGPs, the project is not required to provide for remediation of impacts related to unsafe and unhealthy ASM 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 – support alternative livelihood projects for artisanal miners that would provide safer and healthier working conditions – work with ASM associations to improve the safe and healthy working conditions of their members, the use of Personal Protective Equipment (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. • 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 (outside of the scope of this Project). 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***	

5.4.3 Human rights impact 3.3: 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 ratings, before and after mitigation measures are applied, are described in **Table 5-13**. 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 5-13: Human rights impact 3.3: Interactions with security forces in ASM

Activity: ASM in the project area

Project phase: All phases						
Impact Summary: Interactions with security forces						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
Before Management	*Significant*	*Small no. of RHs*	*Can be remediated*	***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 – Include relevant UNGP clauses in their contracts/agreements – Provide training on VPSHR and GBVH • Provide first aid and medical attention to injured people • Involve ASM cooperatives or organisations and community leaders in human rights training to ensure a comprehensive understanding of the importance and **universality** of human rights, thus promoting a level playing field. • 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. • Establish, join or support a working group on CHSS.						
After Management	*Moderate*	*Small no. of RHs*	*Can be remediated*	***3***	***3***	

5.5 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 and RNT could have relatively good control over how its 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 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 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"[3]. 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".

5.5.1 Human rights impact 4.1: Discrimination of Pak, 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, as discussed in **Section 5.3**.

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*.

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 ratings, before and after mitigation measures are applied, are described in **Table 5-14**.

Table 5-14: Human rights impact 4.1: Discrimination of Pak, RNT, contractor and supplier workers

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
Impact Summary: Discrimination of Pak, RNT, contractor and supplier workers						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
Before Management	*Significant*	*Small no. of RHs*	*Can be remediated*	***4***	***4***	
Management Measures:						
• Conduct due diligence on contractors and suppliers, including their subscription or acknowledgement of workers' rights aspects in their policies. • 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. • Enterprise development programs could be done with local contractors where capacity can be built on non-discrimination. • Where possible, hire local contractors and suppliers.						

[3] A theoretical income level that allows individuals or families to afford adequate shelter, food, and other necessities.

• 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. • 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 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. • Where Khoi San applicants are successful in obtaining even temporary employment, the occurrence of workplace discrimination, harassment and bullying should be monitored closely. • 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. • 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. • Conduct labour audits of contractors and suppliers.						
After Management	*Moderate*	*Small no. of RHs*	*Can be remediated*	***3***	***3***	

5.5.2 Human rights impact 4.2: Lack of freedom of association

There is a possibility that workers employed by Pak, 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 ratings, before and after mitigation measures are applied, are described in **Table 5-15**.

Table 5-15: Human rights impact 4.2: Lack of freedom of association

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
Impact Summary: Lack of freedom of association						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
Before Management	*Moderate*	*Small no. of RHs*	*Can be remediated*	***3***	***3***	
Management Measures:						
• 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. • Conduct due diligence on contractors and suppliers, including their views on freedom of association and collective bargaining in their policies. • 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. • 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. • Conduct labour audits of contractors and suppliers.					
After Management	*Minor*	*Individual RHs*	*Can be remediated*	***2***	***3***	

5.5.3 Human rights impact 4.3: Unjust and unfavourable working conditions

There is a risk that workers employed by Pak, 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 ratings, before and after mitigation measures are applied, are described in **Table 5-16**.

Table 5-16: Human rights impact 4.3: Unjust and unfavourable working conditions

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
Impact Summary: Unjust and unfavourable working conditions						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
Before Management	*Moderate*	*Small no. of RHs*	*Can be remediated*	***3***	***3***	
Management Measures:						
• Provide onsite oversight and supervision into working conditions to ensure that adequate water and lunchtimes are provided, that PPE is used correctly, amongst others. • Conduct due diligence on contractors and suppliers, including their views on commitments to offer fair remuneration, working hours and working conditions to their employees. • 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. • 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.						

• 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. • Conduct labour audits of contractors and suppliers.						
After Management	*Minor*	*Individual RHs*	*Can be remediated*	***2***	***3***	

5.5.4 Human rights impact 4.4: 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 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 ratings, before and after mitigation measures are applied, are described in **Table 5-17**.

Table 5-17: Human rights impact 4.4: Unsafe and unhealthy working conditions

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
Impact Summary: Unsafe and unhealthy working conditions						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
Before Management	*Major*	*Multiple RHs*	*Can be remediated*	***5***	***3***	
Management Measures:						
• Conduct due diligence on contractors and suppliers, including their commitments to H&S in their policies. • Enforce, at Pak 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. • 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. • Ensure that working conditions that Pak and RNT have direct control over, are decent so as not to contribute to H&S issues experienced by contractor and supplier employees. • Conduct labour audits of contractors and suppliers.						
After Management	*Moderate*	*Individual RHs*	*Can be remediated*	***3***	***3***	

5.5.5 Human rights impact 4.5: Forced labour and modern slavery

The likelihood of forced labour within Pak, RNT and PRODEL (which generates electricity at Gove Dam) 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 ratings, before and after mitigation measures are applied, are described in **Table 5-18**.

Table 5-18: Human rights impact 4.5: Forced labour and modern slavery

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
Impact Summary: Forced labour and modern slavery						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**
Before Management	*Significant*	*Small no. of RHs*	*Difficult*	***4***	***2***	
Management Measures:						
• Conduct due diligence on contractors and suppliers, including their views on forced labour and modern slavery for instance, in their policies. • Include prohibitions on all forms of forced labour and modern slavery in contracts and agreements with contractors and suppliers. • 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. • Conduct labour audits of contractors and suppliers. • Request goods and services providers to disclose supply chain practices. • Collaborate with local communities, non-governmental organisations, and governments to ensure responsible practices through local sourcing where possible. • Partner with organisations that certify ethical sourcing where possible (e.g., Rainforest Alliance, Fair Labour Association).						
After Management	*Minor*	*Individual RHs*	*Difficult*	***3***	***2***	

5.5.6 Human rights impact 4.6: Child labour

The likelihood of child labour within Pak, RNT and PRODEL (which generates electricity at Gove Dam) 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 ratings, before and after mitigation measures are applied, are described in **Table 5-19**.

Table 5-19: Human rights impact 4.6: Child labour

Activity: Employment, including workers employed by contractors and suppliers						
Project phase: Construction and operation						
Impact Summary: Child labour						
	Scale *Gravity*	**Scope** *No. of affected rights-holders*	**Irremediability**	**Severity**	**Likelihood**	**Heat map rating**

Before Management	*Significant*	*Small no. of RHs*	*Difficult*	***4***	***2***	
Management Measures:						
• Conduct due diligence on contractors and suppliers, including their acknowledgement of child labour in their policies. • Include prohibitions on all forms of child labour in contracts and agreements with contractors and suppliers. • Enterprise development programs could be done with local contractors where capacity can be built on child labour. • Conduct labour audits of contractors and suppliers. • Request goods and services providers to disclose supply chain practices. • Collaborate with local communities, non-governmental organisations, and governments to ensure responsible practices through local sourcing where possible. • Partner with organisations that certify ethical sourcing where possible (e.g., Rainforest Alliance, Fair Labour Association).						
After Management	*Minor*	*Individual RHs*	*Difficult*	***3***	***2***	

The potential human rights impact upon migrant labour in the working environment and accommodation is assessed in an additional human rights impact (HR4.7) in the Addendum to the ESIA, Volume 6.

6 Impact mitigation and management

For the project, as with many other large-scale projects, the appropriate response to salient issues to which it contributes or is directly linked is to use or increase its leverage with other responsible parties to prevent or mitigate the impacts. According to the UNGPs, the key strategies for exercising and increasing leverage include capacity-building and collaborating with others through multistakeholder initiatives. Therefore, for several priority issues that are more systemic, complex and over which the project duty-holders (Pak and RNT) have less control (e.g., interaction with public security forces, the presence of ASM close to the project infrastructure, contractor and suppliers' workers' labour rights), the suggested mitigation strategy involves raising awareness, engagement, and collaboration with other actors.

It is also important to note that other actors, such as the Government of Angola, municipal administrations, contractors and suppliers, with whom the project should collaborate on systemic issues, also have their own duties and responsibilities to promote, protect, and respect human rights, as outlined in the UNGPs. As global awareness of business and human rights grows it should become easier to find national and international allies to collaboratively address complex human rights issues that are beyond the full control of any single actor.

Based on the impact assessment above, a Human Rights Action Framework has been drawn up and is provided in **Table 6-1** below. It is organised by the different components of HRDD according to the UNGPs (i.e. noting which assessments have been done and which ones are recommended, integration, actions, tracking and communication required) and integrates the recommendations from the assessment of salient issues in the HRDD Report.

Table 6-1: Human rights action framework

Human rights impacts	Assessment	Integration and action	Tracking	Communicating
Land and ecosystem service use	• HRIA (this report), LARF and SEIA conducted in 2024 (as part of this project's ESIA) • Conduct HRDD during construction and every three to five years during operational phase • Relevant subsequent studies, such as RAP and LRP, should be conducted once the positions of project pylons are decided – this must occur after all attempts at avoiding and preventing any form of displacement have been exhausted	Refer to measures listed in Table 5-2	• Implement all relevant resettlement-related engagement plans • Ongoing review of salient human rights risks and impacts by external human rights HRDD experts and through monitoring of stakeholder engagement and grievance mechanisms	• Prepare annual public summary reports on progress, challenges and lessons learned about ongoing HRDD for the project and translate these into Portuguese and Umbunbdu to support ongoing engagement with local stakeholders • Promote the grievance mechanism while emphasising safeguards for nonretaliation and that the primary objectives is to provide remedy where necessary
Unjust process and modality of land acquisition		Refer to measures listed in Table 5-3		
Unjust labour practices and marginalisation in the community	• HRIA (this report) and SEIA conducted in 2024 (as part of this project's ESIA) • Conduct HRDD during construction and every three to five years during operational phase	Refer to measures listed in Table 5-4	• Ongoing review of salient human rights risks and impacts by external HRDD experts and through monitoring of stakeholder engagement and grievance mechanisms • Implement monitoring and mitigation measures recommended in the SEP prepared as part of this ESIA • Consider how to enhance community participation in monitoring efforts to strengthen their credibility • Solicit feedback from community members and vulnerable groups about the implementation of the SEP on a periodic basis. • Review the movement and positions of indigenous peoples from time to time and ensure that, if necessary,	• Promote the grievance mechanisms with relevant stakeholder groups while emphasising safeguards for nonretaliation and that the primary objectives of grievance management are continuous improvement and providing remedy where necessary • Communicate the types of grievances and outcomes of grievances received to relevant stakeholder groups on a periodic (and anonymised) basis to build trust in the mechanism and manage expectations about the type of outcomes that are possible
CHSS during construction phase		Refer to measures listed in Table 5-5		
CHSS during operational phase		Refer to measures listed in Table 5-6		
Violations of rights to freedom of opinion, expression,	HRIA (this report) conducted in 2024 (as part of this project's ESIA)	Refer to measures		

Human rights impacts	Assessment	Integration and action	Tracking	Communicating
association and assembly		listed in Table 5-7	appropriate engagement measures are implemented • Consult with government and other companies about how to track influx and identify "hot spots". • Analyse trends in grievances on a regular basis to contribute to ongoing HRDD • Ensure strong engagement with contractors and suppliers about implementing effective grievance mechanisms to proactively track and resolve potential workers' rights issues • Review the grievance procedures for community members, workers, contractors and suppliers' workers and ensure there are appropriate safeguards and supports for women to raise sensitive issues, including harassment or gender-based violence	
Reduced access to information, consultation and participation		Refer to measures listed in Table 5-8		
Discrimination against women in the workplace	• HRIA (this report) and SEIA conducted in 2024 (as part of this project's ESIA) • Conduct HRDD during construction and every three to five years during operational phase	Refer to measures listed in Table 5-9	• Periodically review the grievance procedures for community members, workers, contractors and suppliers' workers and ensure there are appropriate safeguards and supports for women to raise sensitive issues, including harassment or gender-based violence • Ensure that non-discrimination and gender equality are a priority in ongoing engagement, monitoring and auditing	Promote grievance mechanisms with women on a regular basis, including as part of induction and refresher training for the workforce, including contractors and suppliers.
Reduced safety of women and access to resources		Refer to measures listed in Table 5-10	• Engage with women to evaluate and assess the effectiveness and efforts to improve CHSS	Promote grievance mechanisms with women on a regular basis

Human rights impacts	Assessment	Integration and action	Tracking	Communicating
			• Track community grievances and information from stakeholder engagement that are related to CHSS	
Child labour in ASM		Refer to measures listed in Table 5-11	Review the movement and positions of ASM from time to time and ensure that, if necessary, appropriate engagement measures are implemented	• Ensure that any findings of ongoing engagements or studies on ASM are communicated to participants and shared with interested stakeholders
Inadequate OHS standards in ASM		Refer to measures listed in Table 5-12		
Interaction with security forces in ASM		Refer to measures listed in Table 5-13		
Discrimination of Pak, RNT, contractor supplier workers		Refer to measures listed in Table 5-14	• Periodically review the grievance procedures for workers, contractors and suppliers' workers and ensure there are appropriate safeguards and supports for workers to raise sensitive issues • Ensure that freedom of association, favourable, safe and healthy working conditions, and child and forced labour are a priority in ongoing engagement, monitoring and auditing	• Consider establishing an internal forum for the managers of contractors and suppliers to periodically discuss good practice lessons learnt about human rights issues. This could create a virtuous cycle of voluntary compliance that diminishes the need for monitoring over time • Promote the grievance mechanisms with relevant stakeholder groups while emphasising safeguards for nonretaliation and that the primary objectives of grievance management are continuous improvement and providing remedy where necessary • Communicate the types of grievances and outcomes of grievances received
Lack of freedom of association	HRIA (this report) conducted in 2024 (as part of this project's ESIA)	Refer to measures listed in Table 5-15		
Unjust and unfavourable working conditions		Refer to measures listed in Table 5-16		

Human rights impacts	Assessment	Integration and action	Tracking	Communicating
Unsafe and unhealthy working conditions		Refer to measures listed in Table 5-17		to relevant stakeholder groups on a periodic (and anonymised) basis to build trust in the mechanism and manage expectations about the type of outcomes that are possible
Forced labour and modern slavery		Refer to measures listed in Table 5-18		
Child labour		Refer to measures listed in Table 5-19		

7 Conclusions

An HRIA was conducted for the proposed Cassinga Power Supply Project. HRIA is used as a tool in HRDD, which is an ongoing process throughout a project's lifetime.

The potential adverse human rights impacts that the project could cause, contribute to or be linked to through its relationships with contractors and suppliers, were assessed in this HRIA. Rights-holders, or people whose rights could be affected by the project, include those who reside in communities close to the project, as well as the workers to be employed by the project. The potential adverse human rights impacts are assessed against international human rights standards and principles, such as the ICCPR the ICESR and the ILO conventions, as well as taking into consideration the UNGP's requirement for all business to provide access to remedy (a grievance mechanism). Certain key terms and concepts are also explained since the HRIA practice is relatively new and different from EIA and SEIA methodologies.

An assessment of the country's human rights context, or its performance in terms of human rights, is included. It ranges from legislation and policy instruments, the ratification of international treaties, to in-practice observations by UN Special Rapporteurs and interest groups.

The most salient impacts were around human rights impacts associated with any potential land acquisition and compensation processes. This is because several human rights are impacted by this activity, included the universal Right to an Adequate Standard of Living. Land and ecosystem service usage could be impacted, and there is a risk of unjust processes being followed during the land acquisition and compensation processes, including long-term and inadvertent consequences.

The CHSS impacts relate to the safety of PACs during construction activities and potential interactions with migrant workers and security forces. Because of the Angolan context (albeit more common in urban areas), security forces could also inhibit people's need to express concerns related to the project. Once the construction phase is complete, the impacts are expected to be low, but there is a possibility in largescale infrastructure projects for maintenance and onsite engagements with rights-holders to be neglected during the operational phase. CHSS are therefore assessed for both the construction and operational phases.

Although not regarded as one of the most severe potential human rights impacts potential exists for people to experience a lack of access to information on a project or associated activities that affect them. This can be remedied through the implementation of focused engagements with key stakeholders, and differentiated modes of engagements with the different types of rights-holders. It is crucial that ongoing engagements do not assume that representative or authoritative groups have the resources to engage rights-holders. For instance, the municipal administration might have all the information they need on the project because it is easier to communicate with them, but the villages located in their jurisdiction are inaccessible due to geographical distance, technological access, or language barriers. It is these simple realities of on-the-ground logistics and practicalities that could lead to unintentional human rights impacts.

As for worker-rights, there are currently no employees associated with the project (apart from those currently involved in the ESIA process from Pak and RNT), but potential impacts based on the country and industry context were identified. The risk of severe human rights issues such as forced and child labour, are more likely to occur deep within the project's supply chain than among Pak or RNT's own workers.

The human rights impacts of indigenous peoples were not assessed, as it is not anticipated that the project will impact the San people whose whereabouts have been document more than 70 km south of the project.

Human rights impacts of ASM were assessed, as there is ASM activity within the project area. However, the project is not considered to cause or contribute to the issues identified related to ASM, but caution is provided to not further increase any human rights abuses experienced by ASM, through problematic confrontation with police, and national or private security.

Impacts on women's human rights are cross-cutting, which means that it could occur for both workers and communities. The country context, the local context and roles of females, as well as their vulnerability (in terms of e.g. literacy rates) make this a complex human right but there is an opportunity for the project to not cause or even contribute to human rights impacts felt by women, in particular those associated with discrimination, safety, and their right to accessing information.

All impacts were rated, and mitigations were provided. Impact ratings do not correspond to that of the other specialist reports that were prepared as part of this ESIA, so as to prioritise a focus on human rights consequences of the impact. Ongoing tracking and communication measures are also summarised in an action framework at the end of the report. This framework needs to be updated as the project progresses through its various milestones such as the start of construction and the beginning of electrical connections being made. Most importantly, the HRIA is not the end of the HRDD process for the project. HRDD is an ongoing process that must be undertaken for all impacts and ongoing activities that could have adverse human rights impacts, as per the UNGP.

The project is expected to provide a positive social impact in the long-term, but requisite consideration for inadvertent and unintentional contributions to human rights impacts must be done.

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Appendices

Appendix A: International treaties

Angola has ratified the following ILO conventions, in addition to those listed in the main report:

- Workmen's Compensation (Agriculture) Convention, 1921 (No. 12) on 4 June 1976
- Minimum Wage-Fixing Machinery Convention, 1928 (No. 26) on 4 June 1976
- Marking of Weight (Packages Transported by Vessels) Convention, 1929 (No. 27) on 4 June 1976
- Underground Work (Women) Convention, 1935 (No. 45) on 4 June 1976
- Food and Catering (Ships' Crews) Convention, 1946 (No. 68) on 4 June 1976
- Certification of Ships' Cooks Convention, 1946 (No. 69) on 4 June 1976
- Employment Service Convention, 1948 (No. 88) on 4 June 1976
- Accommodation of Crews Convention (Revised), 1949 (No. 92) on 4 June 1976
- Seafarers' Identity Documents Convention, 1958 (No. 108) on 4 June 1976
- Work in Fishing Convention, 2007 (No. 188) on 11 October

Angola has ratified the following AU regional treaties (AU, 2024):

- Constitutive Act of the AU on 19 September 2001
- African Convention on the Conservation of Nature and Natural Resources on 17 February 2014
- Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa on 17 August 2016
- Treaty Establishing the African Economic Community on 11 April 1992
- Protocol to the Treaty Establishing the African Economic Community Relating to the Pan-African Parliament on 29 October 2003
- Revised African Convention on the Conservation of Nature and Natural Resources on 31 August 2020
- AU Convention on Preventing and Combating Corruption 20 December 2017
- African Youth Charter on 10 July 2009
- African Charter on Democracy, Elections and Governance on 8 July 2021
- Charter for African Cultural Renaissance 11 March 2016
- African Charter on Statistics on 8 July 2022
- Revised African Maritime Transport Charter on 1 August 2020

Angola has signed, but not ratified the following AU regional treaties (AU, 2024):

- General Convention on the Privileges and Immunities of the Organization of African Unity on 2 February 2010
- Inter-African Convention Establishing an African Technical Co-operation Programme on 27 January 2012
- African Maritime Transport Charter on 27 January 2012
- Protocol on the African Investment Bank on 27 January 2012
- African Charter on Values and Principles of Public Service and Administration on 27 January 2012
- Revised Constitution of the African Civil Aviation Commission 27 January 2012