ESIA REPORT - Zambian Side

May 2025

Environmental and Social Impact Assessment (ESIA) and Resettlement and Compensation Action Plan (RAP) for the Malawi - Zambia 400 kV Transmission Interconnector Project

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Executive Summary

The *Malawi–Zambia 400kV Interconnector Project* is a strategic regional infrastructure initiative aimed at improving electricity access, fostering regional integration, and enabling cross-border power trade between Zambia and Malawi. As part of the Southern African Power Pool (SAPP), the project contributes to the Southern African Development Community's (SADC) broader objective of enhancing socio-economic development through sustainable energy security.

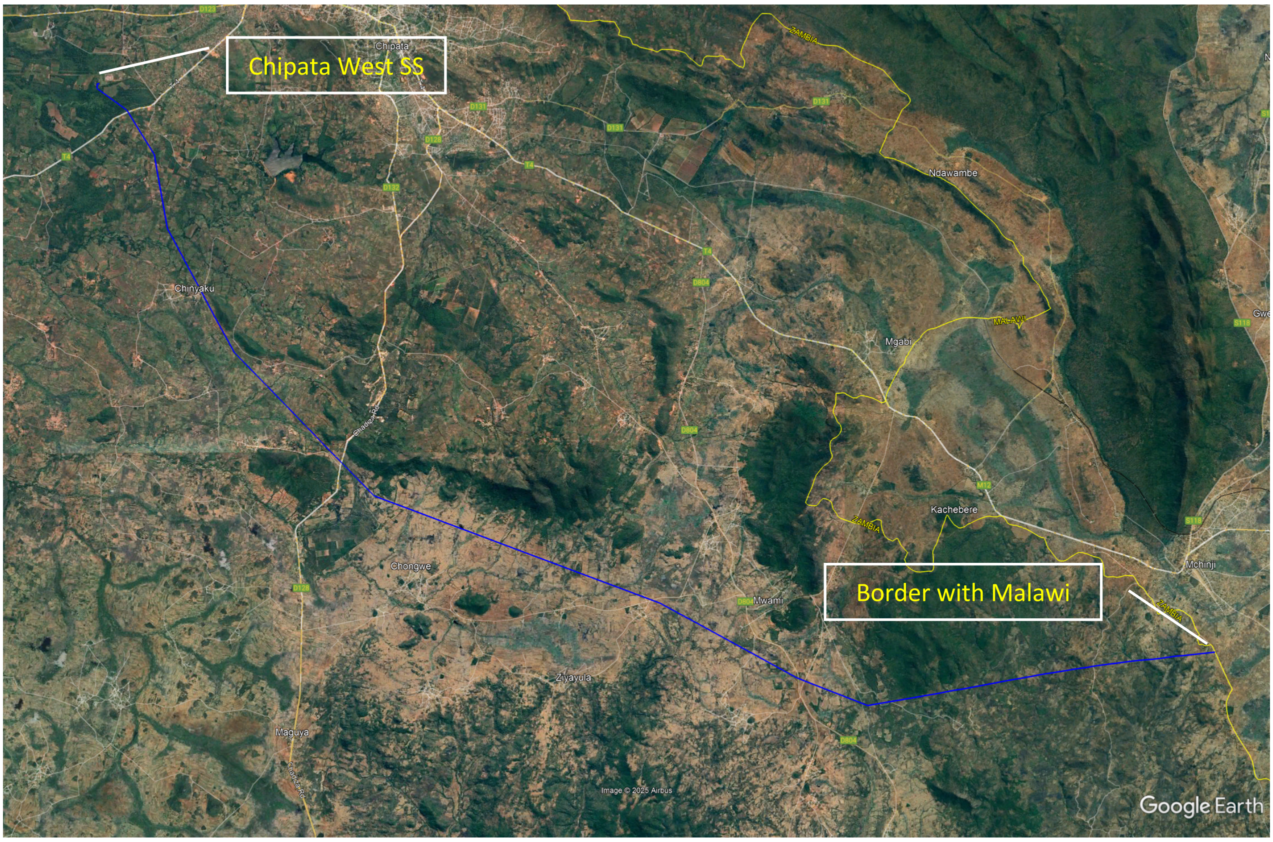
Project Background

The project is under the auspices of the two electricity utility companies ESCOM of Malawi and ZESCO of Zambia, based on an Inter-Utility Memorandum of Understanding (IUMoU) signed between them, which is in turn based on an Inter-Governmental Memorandum of Understanding (IGMoU) signed between the Governments of Malawi and Zambia. This ESIA study is funded by Swedfund.

This document is the **Environmental and Social Impact Assessment (ESIA) study report** for the **Zambian component of the project** and it has been prepared in according with the Zambian Environmental Regulations, the European Union EIA Directive and best industry international standards, such as the European Investment Bank (EIB) and World Bank (WB) Environmental and Social Standards.

Project Location

The project area is geographically situated in the Chipata and Vubwi Districts of Zambia. The area is located between the coordinates of latitudes 13°39'7.626" South to 13°50'50.673" South and longitudes 32°33'27.619" East to 32°54'18.967" East. The overhead line (OHL) from Chipata West substation (SS) until the border with Malawi is 46.6 km long, with a wayleave width of 50m (25 m on both sides of the centreline).



Project Description and Components

The project comprises two main components:

- **Construction of a 400 kV transmission line** from Chipata West Substation to the Malawi border near Mwami.
- **Expansion of the Chipata West Substation** to accommodate new switchgear, transformers, and busbar infrastructure.

Construction materials include steel towers, concrete aggregates, electrical insulators, conductors, and a range of civil and electrical equipment. The project has a proposed lifespan of approximately **50 years**.

ZESCO Limited, the implementing agency on the Zambian side, is a government-owned utility company established in 1970. The capital investment for the Zambian segment is estimated at **USD 47.69 million**, of which USD 29.74 million is for the substation works and USD 17.95 million is for the transmission line. Construction works are expected to last 22 months.

Project Alternatives

Three alternative routes were considered for the Zambian segment based on environmental, social, and technical criteria. **Alternative 3** was selected as the preferred route due to its minimal impact on settlements, biodiversity, and sensitive habitats, despite being slightly longer and less accessible than the other options.

A **No-Project Scenario** was also assessed, revealing that without the interconnector, reliance on biomass energy would increase, exacerbating deforestation, habitat loss, and energy poverty.

Environmental and Socioeconomic Baseline

The OHL crosses a relatively uniform topography, with gently rolling flatlands, interspersed with occasional hills. These flatlands are primarily utilized for small-scale, family-run farms, which dominate the local landscape. The agricultural activities in this region are typically subsistence-based, focusing on crops such as maize, groundnuts and various vegetables, which are grown for both local consumption and sale in nearby markets.

The landscape is marked by the presence of small streams and seasonal rivers, such as Lutembwe River, Chibila River, Mwami and Lubwe Rivers, Nyongo and Choli streams. The streams are often seasonal, with water levels fluctuating significantly between the wet and dry seasons.

The natural vegetation in the project area consists largely of miombo woodlands, characterized by a mix of deciduous trees and shrubs, which provide fuelwood, non-timber forest products and habitat for local wildlife. However, much of the original vegetation has been cleared for agricultural purposes, leading to a landscape that is a mosaic of cultivated fields and patches of natural vegetation. The proposed project does not traverse any designated protected area (national park, game management area, or forest reserve).

The human settlement pattern in the Chipata and Vubwi districts is typically rural, with scattered homesteads and small villages dotting the landscape. These settlements are often closely associated with the agricultural plots they depend on, leading to a dispersed population density. The local communities are primarily engaged in farming, with some involvement in small-scale trading and other in-formal economic activities.

The area has basic road networks that connect the villages and farms to larger towns and markets. However, these roads are often unpaved and can become difficult to navigate during the rainy season. Access to services such as electricity, clean water, and healthcare is limited in many parts of the project area, reflecting the broader challenges of rural development in the region.

The project area is also culturally rich, with a population that includes various ethnic groups, each with its own traditions, languages, and social practices.

Potential Environmental and Social Impacts

The project may result in:

- Vegetation loss and habitat fragmentation during construction and operation.
- Soil erosion and potential pollution of surface waters during construction.
- Air and noise emissions during construction.
- Bird collision risks for migrating birds and raptors.
- Loss of 233 hectares of land under the wayleave and 12.69 hectares at the substation belonging to a total of **243 households** during construction. In addition, there will be a permanent uptake of land on tower locations.
- Potential loss of crops during construction.
- Relocation (resettlement) of **7 households** from the power line wayleave whose dwelling structures are affected by the proposed power line. A total 10 dwelling structures and 14 ancillary structures are affected by the project.
- Spread of communicable diseases, including HIV/AIDS, mainly during construction.
- Occupational health, safety and security.
- Employment opportunities mainly during construction.
- Boost to the local, regional, and national economy, mainly during construction.

Mitigation and Enhancement Measures

Mitigation strategies include:

- Implementing selective vegetation clearance and erosion control.
- Maintaining buffer zones where no construction activities will be allowed along rivers and streams.
- Monitoring air and noise emissions during construction.
- Installing bird diverters in high-risk avian flight zones (between 19 and 28 km from Chipata West Substation).
- Community sensitization and compensation for loss of houses and other structures, land, crops, or other assets or resources.
- Conduct mandatory induction and regular awareness sessions on HIV, GBV, and SEAH for all workers.
- Enforce a worker Code of Conduct addressing health risks and prohibiting exploitative behaviour.
- Provide adequate, gender-segregated sanitary and hygiene facilities at construction sites.
- Develop and implement a Grievance Redress Mechanism (GRM) to manage project related grievances, including resettlement, GBV and employment issues.
- Implement a “chance-find” procedure to deal with any cultural heritage artifacts that may be discovered during project construction.

The Malawi–Zambia 400 kV Interconnector is a transformative infrastructure investment designed to address regional energy deficits, promote clean energy integration, and bolster cross-border power trade. With comprehensive environmental and social safeguards in place, the project is positioned to deliver long-term sustainable benefits to both Zambia and Malawi.

Conclusion

The surveys and assessments carried out during ESIA preparation have demonstrated that the **biophysical impacts** of the project are largely **minor to moderate** in significance and can be effectively managed through robust mitigation and monitoring measures, as prescribed in the ESIA. **Socioeconomic impacts**—notably physical and economic resettlement, livelihood disruption, health risks and pressure on services by the influx of foreign staff —are also manageable through implementation of the **Resettlement Action Plan (RAP)**, **community health programs** and **labour and safety protocols**.

The Project is associated with positive outcomes such as improved energy security and reliability, support to economic growth, employment, climate change mitigation, and enhanced regional energy integration.

Adverse environmental and social impacts are also identified and assessed in this ESIA, together with corresponding mitigation and management measures.

With full implementation of the Environmental and Social Management Plan (ESMP), the Malawi–Zambia 400 kV Interconnector Project should proceed. It represents a **strategically significant, socially beneficial, and climate-aligned investment** with long-term benefits for Zambia, Malawi and the Southern African region.

Executive Summary in ChiChewa

CHIDULE CHA NTCHITO.
Ntchito ya Malawi–Zambia 400kV Interconnector Project ndi ntchito yayikulu ya zomangamanga m'chigawo yomwe cholinga chake ndi kukonza kupezeka kwa magetsi, kulimbikitsa mgwirizano wa m'chigawo, komanso kuthandiza malonda a magetsi pakati pa Zambia ndi Malawi. Monga gawo la Southern African Power Pool (SAPP), ntchitoyi ikuthandiza cholinga chachikulu cha Southern African Development Community (SADC) chokweza chitukuko cha zachuma ndi moyo wa anthu kudzera mu chitetezo chokhazikika cha mphamvu.

MBIRI YA NTCHITO
Ntchitoyi ikuyendetsedwa ndi makampani awiri amagetsi, ESCOM ya Malawi ndi ZESCO ya Zambia, motsatira Mgwilizano (IUMoU) yomwe idasainidwa pakati pawo, yomwe imachokera ku Inter-Governmental Memorandum of Understanding (IGMoU) yomwe idasainidwa ndi maboma a Malawi ndi Zambia. Kafukufuku wa ESIA uyu wathandizidwa ndi ndalama kuchokera ku Swedfund.

Chikalatachi ndi lipoti la Environmental and Social Impact Assessment (ESIA) la gawo la Zambia la ntchitoyi, ndipo lakonzedwa mogwirizana ndi malamulo a zachilengedwe a Zambia, European Union EIA Directive, komanso miyezo yabwino ya mayiko monga ya European Investment Bank (EIB) ndi World Bank (WB) pa zachilengedwe ndi chikhalidwe cha anthu.

MALO A NTCHITO
Malo a ntchitoyi ali pakati pa District ya Chipata ndi Vubwi ku Zambia. Malo amenewa ali pakati pa ma coordinate a latitude 13°39'7.626" South mpaka 13°50'50.673" South ndi longitude 32°33'27.619" East mpaka 32°54'18.967" East.

Mzere wa magetsi wa pamwamba (OHL) kuchokera ku Chipata West Substation mpaka kumalire a Malawi ndi 46.6 km kutalika, ndipo wayleave width yake ndi 50 metres (25 metres mbali iliyonse kuchokera pakati pa mzere).

KUFOTOKOZERA NTCHITO NDI ZIGAWO ZAKE.
Ntchitoyi ili ndi zigawo ziwiri zazikulu:

Kumanga mzere wa magetsi wa 400 kV kuchokera ku Chipata West Substation mpaka kumalire a Malawi pafupi ndi Mwami.

Kukulitsa Chipata West Substation kuti ikhale ndi ma switchgear, transformers, ndi busbaratsopano. Zida zomangira zikuphatikizapo:

- nsanja zachitsulo
- simenti ndi miyala.
- ma insulator amagetsi.
- ma conductor.
- zida zosiyanasiyana za Magetsi

Ntchitoyi ikuyembekezeka kukhala igwila nchito kwa zaka 50.
ZESCO Limited, yomwe ikuyendetsa ntchitoyi ku Zambia, ndi kampani ya boma yomwe inakhazikitsidwa mu 1970.
Ndalama zimene zikuyembekezeleka kugwilitsidwa nchito ku gawo la Zambia ndin USD 47.69 miliyoni, pomwe:

USD 29.74 miliyoni ndi za substation
USD 17.95 miliyoni ndi ya thambo za magetsi.
Ntchito yomanga ikuyembekezeka kutenga miyezi 22.

NJIRA ZINA ZAPADELA.

Njira zitatu zosiyanasiyana zinaganiziridwa pa gawo la Zambia molingana ndizachilengedwe, chikhalidwe cha anthu, ndi mbali ya luso.

Njira zitatu zidasankhidwa chifukwa imakhudza pang'ono malo okhala anthu, zamoyo zakuthengo, ndi malo osamala, ngakhale kuti ndi yaitali pang'ono komanso yovuta kufikako kuposa zina.

Njira ya No-Project Scenario nayo idawunikidwanso, ndipo zinapezeka kuti ngati ntchitoyi singachitike, kudalira nkhuni ndi biomass kudzawonjezeka, zomwe zingakulitse kudulidwa kwa mitengo, kuwonongeka kwa malo a nyama ndi zomera, komanso umphawi wa mphamvu.

ZACHILENGEDWE NDI ZACHUMA CHA ANTHU M'MALO A NTCHITO.

Mzere wa nthambo zamagetsi udutsa m'malo ofanana kwambiri, okhala ndi malo osalala komanso mapiri ang'onoang'ono.
Malo ambiri amagwiritsidwa ntchito ndi minda ya pamwamba ya mabanja ang'onoang'ono, yomwe amalima:
Chimanga, mtedza komanso ndiwo zamasamba osiyanasiyana.
Malo amenewa ali ndi mitsinje yaying'ono ndi mitsinje monga:
Lutembwe, Chibila, Mwami, Lubwe ,Nyongo ndi Choli. Mitsinje imeneyi nthawi zambiri imakhala ya nyengo, ndipo mlingo wa madzi umasinthasintha kwambiri pakati pa nyengo ya mvula ndi nyengo ya chilala.

Zomera zachilengedwe m'dera la polojekitiyi makamaka ndi nkhalango za miombo, zomwe zimadziwika ndi kusakanikirana kwa mitengo yotaya masamba ndi zitsamba. Izi zimapereka nkhuni zowotchera, zinthu zina zochokera m'nkhalango zosakhala matabwa, komanso malo okhalamo nyama zakutchire za m'deralo. Komabe, zomera zambiri zoyambirira zachotsedwa chifukwa cha ntchito zaulimi, zomwe zapangitsa dera kukhala losakanikirana ndi minda yolimidwa komanso zigawo zina zokhala ndi zomera zachilengedwe. Polojekiti yomwe ikukonzedwayi sidutsa m'malo aliwonse otetezedwa mwalamulo (monga paki ya dziko, malo oyang'aniridwa nyama zakutchire, kapena nkhalango yosungidwa).

Kapangidwe ka malo okhalamo anthu m'maboma a Chipata ndi Vubwi nthawi zambiri ndi akumidzi, pomwe pali nyumba zobalalika komanso midzi yaying'ono yofalikira m'deralo. Malo okhalamo amenewa nthawi zambiri amakhala pafupi kwambiri ndi minda yomwe amadalira, zomwe zimapangitsa kuchuluka kwa anthu kukhala kobalalika. Anthu am'madera amenewa makamaka amagwira ntchito yaulimi, komanso ena amachita malonda ang'onoang'ono ndi ntchito zina zachuma zosakhazikika.

Derali lili ndi misewu yoyambira yomwe imalumikiza midzi ndi minda ku matauni akuluakulu komanso misika. Komabe, misewu imeneyi nthawi zambiri si yopangidwa phula ndipo imakhala yovuta kuyendamo nthawi ya mvula. Kupeza mautumiki monga magetsi, madzi aukhondo, ndi chisamaliro chaumoyo n'kochepa m'madera ambiri a polojekitiyi, zomwe zikuwonetsa mavuto akuluakulu a chitukuko cha kumidzi m'derali.

Derali lilinso lolemera pa chikhalidwe, ndipo muli anthu a mafuko osiyanasiyana, aliyense ali ndi miyambo yake, zilankhulo zake, ndi machitidwe ake a pa chikhalidwe ndi pa moyo wa anthu.

ZOTSATIRA ZOMWE ZINGACHITIKE PA CHILENGEDWE NDI ANTHU

Polojekitiyi ikhoza kubweretsa izi:
• Kutayika kwa zomera ndi kugawikana kwa malo okhalamo nyama ndi zomera pa nthawi yomanga ndi pa nthawi yogwira ntchito.

• Kukokoloka kwa nthaka ndi kuipitsidwa kwa madzi a pamwamba pa nthawi yomanga.
• Kutulutsa mpweya woipa ndi phokoso pa nthawi yomanga.
• Ngozi ya mbalame zogundana ndi zingwe zamagetsi, makamaka mbalame zosamuka ndi mbalame zazikulu zodya nyama.
• Kutayika kwa mahekitala 233 a nthaka yomwe ili pansi pa njira ya zingwe zamagetsi (wayleave) ndi mahekitala 10 pa substation, zomwe ndi za mabanja okwana 243 pa nthawi yomanga. Kuphatikizapo apo, padzakhalanso kutengedwa kwa nthaka kosatha pamalo omangira nsanja za zingwe zamagetsi.
• Kutayika kwa mbewu pa nthawi yomanga.
• Kusamutsidwa kwa mabanja 7 kuchokera m'njira ya zingwe zamagetsi, chifukwa nyumba zawo zakhudzidwa ndi polojekiti ya zingwe zamagetsi yomwe ikukonzedwayi. Nyumba zokhalamo 10 ndi nyumba zina zothandizira 14 zakhudzidwa ndi polojekitiyi.
• Kufalikira kwa matenda opatsirana, kuphatikizapo HIV/AIDS, makamaka pa nthawi yomanga.
• Zaumoyo, chitetezo, ndi zachitetezo pantchito.
• Mwayi wa ntchito, makamaka pa nthawi yomanga.
• Kulimbikitsa chuma cha m'deralo, m'chigawo, komanso mdziko lonse, makamaka pa nthawi yomanga.

NJIRA ZOCHEPETSERA MAVUTO NDI KUPITITSA PATSOGOLO UBWINO
Njira zochepetsera mavuto zikuphatikiza izi:
• Kuchotsa zomera mosankha komanso kuletsa kukokoloka kwa nthaka.
• Kusunga malo otetezedwa m'mbali mwa mitsinje ndi timitsinje pomwe sipadzaloledwa ntchito iliyonse yomanga.
• Kuyang'anira mpweya ndi phokoso pa nthawi yomanga.
• Kuyika zida zoletsa mbalame kugundana ndi zingwe zamagetsi m'malo omwe mbalame zimadutsa kwambiri (pakati pa 19 ndi 28 km kuchokera ku Chipata West Substation).
• Kuphunzitsa anthu am'madera komanso kuwalipira chifukwa cha kutayika kwa nyumba ndi zomangamanga zina, nthaka, mbewu, kapena katundu ndi zinthu zina.
• Kupereka maphunziro oyambira ovomerezeka komanso maphunziro opitilira pa HIV, GBV, ndi SEAH kwa ogwira ntchito onse.
• Kukhazikitsa malamulo a khalidwe la ogwira ntchito okhudza zoopsa za umoyo komanso kuletsa khalidwe lozunza kapena lopezerera ena.
• Kupereka zimbudzi ndi malo aukhondo okwanira, osiyanitsidwa pakati pa amuna ndi akazi, pamalo omangira.
• Kupanga ndi kugwiritsa ntchito njira yothetsera madandaulo (GRM) kuti isamalire madandaulo okhudzana ndi polojekiti, kuphatikizapo kusamutsidwa kwa anthu, nkhanza za GBV, ndi nkhani za ntchito.
• Kukhazikitsa njira ya "chance-find" yothana ndi zinthu za chikhalidwe kapena mbiri zomwe zingapezeke pa nthawi yomanga.

Polojekiti ya **Malawi–Zambia 400 kV Interconnector** ndi ndalama zazikulu za zomangamanga zomwe zapangidwa kuti zithandize kuthetsa kusowa kwa magetsi m'dera lino, kulimbikitsa kugwiritsa ntchito mphamvu zoyera, komanso kulimbitsa malonda a magetsi pakati pa mayiko. Ndi njira zonse zotetezera chilengedwe ndi anthu zomwe zakhazikitsidwa, polojekitiyi ili pamalo abwino opereka phindu lokhazikika kwa nthawi yayitali ku Zambia ndi Malawi.

MAPETO

Kafukufuku ndi ma assessment omwe anachitika pokonzekera ESIA awonetsa kuti zotsatira za polojekitiyi pa chilengedwe ndi zachilengedwe zambiri ndi zochepa mpaka zapakati ndipo zingathe kuyendetsedwa bwino kudzera mu njira zolimba zochepetsera mavuto ndi kuyang'anira monga zafotokozedwera mu ESIA.

Zotsatira za pa moyo wa anthu ndi zachuma — makamaka kusamutsidwa kwa anthu ndi katundu, kusokonekera kwa moyo ndi ntchito, zoopsa za umoyo, komanso kupanikizika kwa mautumiki chifukwa cha kubwera kwa antchito akunja — nazo zingathe kuyendetsedwa bwino kudzera mu kukhazikitsa **Resettlement Action Plan (RAP)**, mapulogalamu a zaumoyo wa anthu, komanso malamulo a ntchito ndi chitetezo.

Polojekitiyi ilinso ndi zotsatira zabwino monga kulimbitsa chitetezo ndi kudalirika kwa magetsi, kuthandiza kukula kwa chuma, kupereka mwayi wa ntchito, kuchepetsa kusintha kwa nyengo, komanso kulimbikitsa kulumikizana kwa magetsi m'dera.

Zotsatira zoipa pa chilengedwe ndi anthu nazonso zadziwika ndi kuunikidwa mu ESIA, limodzi ndi njira zofananira zochepetsera ndi kuziyendetsa.

Ngati **Environmental and Social Management Plan (ESMP)** ikakhazikitsidwa mokwanira, polojekiti ya Malawi–Zambia 400 kV Interconnector iyenera kupitirirabe. Ndi ndalama zofunika kwambiri pa njira, zothandiza anthu, komanso zogwirizana ndi kusintha kwa nyengo, zomwe zili ndi phindu la nthawi yayitali ku Zambia, Malawi, ndi dera lonse la Southern Africa.

0 Non-Technical Summary

0.1 Overview

The **Malawi–Zambia 400 kV Interconnector Project** is a strategic regional electricity transmission development aimed at linking the national grids of Zambia and Malawi. By constructing a high-voltage interconnector, the project will strengthen energy security, promote regional power trade within the **Southern African Power Pool (SAPP)**, and reduce reliance on costly and carbon-intensive thermal generation.

The project is being implemented by **ZESCO Limited** in Zambia and **ESCOM** in Malawi, with financial and technical support from international partners, **Swedfund** and **EU** with Swedfund managing the funds, for the feasibility studies, i.e. technical studies and the Environmental and Social Impact Assessment (ESIA) and the Resettlement Action Plan (RAP).

On the Zambian side, the project involves:

- Construction of a **46.6 km 400 kV overhead transmission line (OHL)**, extending from Chipata West Substation to the Zambia–Malawi border near Mwami.
- Expansion of **Chipata West Substation** to accommodate the new line.
- Establishment of a **50 m-wide wayleave** (25 m either side of the centreline) along the alignment.

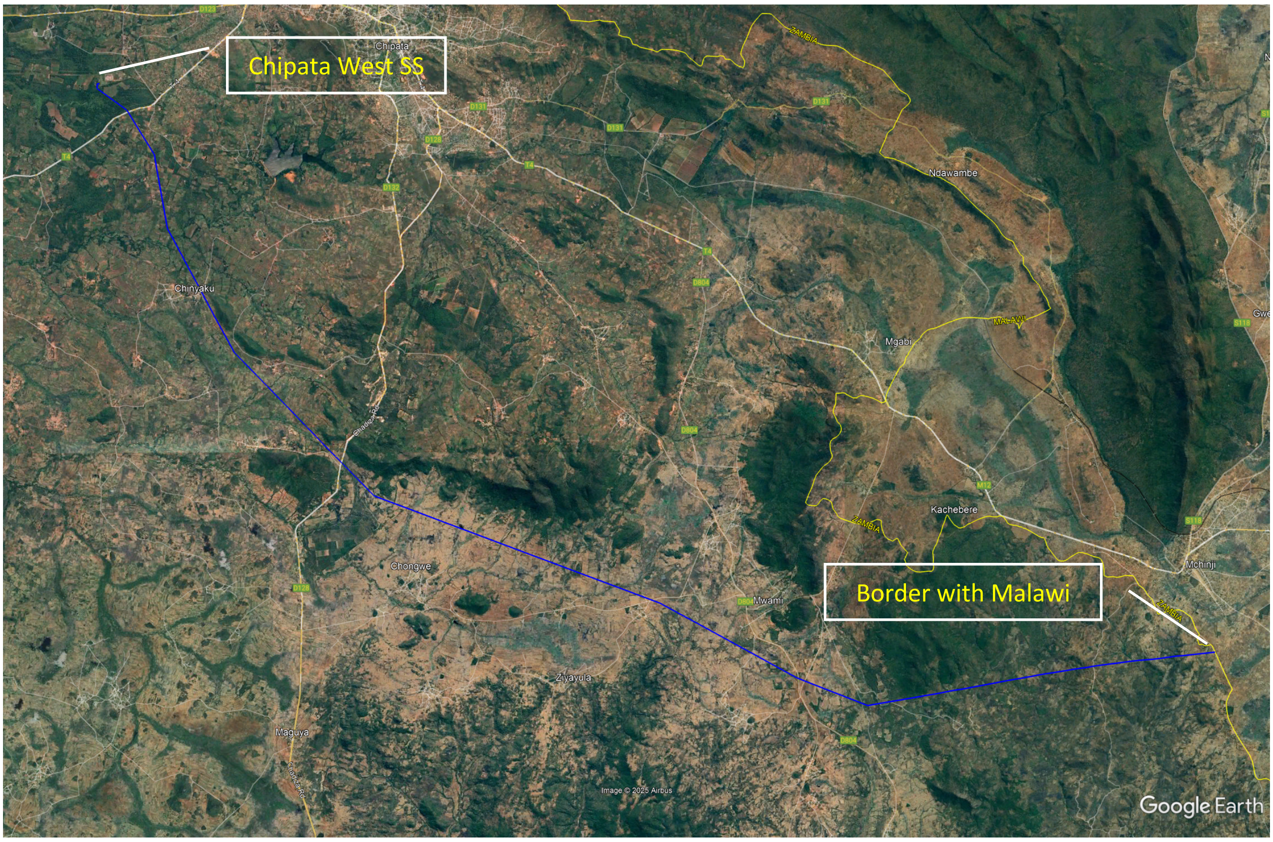


Figure 1. Location of the project in Zambia

The estimated investment for the Zambian section is **USD 47.69 million**, with construction expected to be completed within **22 months**. The infrastructure is designed for a lifespan of **50 years**.

0.2 Legal and regulatory framework

The present ESIA complies with the requirements of the Environmental Management Act (EMA), No. 12 of 2011, as amended by the Environmental Management (Amendment) Act, No.8 of 2023, as well as the The Environmental Management (Environmental Impact Assessment), Regulations, Statutory Instrument No. 3 of 2026 – according to which all transmission power lines above 220kV and more than 1 km long, require an EIA study before undertaking the project.

Other applicable legislation which was taken into account during ESIA preparation includes the following:

- The Environment Management (Licensing) Regulations (SI 112 of 2013)
- Environmental Management (E-Waste Management) Regulations, 2024
- The Electricity Act No. 11 of 2019
- The Energy Regulation Act No. 12 of 2019
- The Lands Act, No. 27 of 1995
- The Lands Acquisition Act (Chapter 189) of the Laws of Zambia
- Occupational Health and Safety Act of 2010
- The Forests Act, No. 4 of 2015
- The Employment Code Act, No. 15 of 2019
- The Workers Compensation Act, No. 10 of 1999
- The Public Health Act, No. 22 of 1995
- The National Heritage Conservation Act No. 23 of 1989 and National Heritage Conservation Commission Amendment Act No. 13 of 1994
- The Zambia Wildlife Act No. 14 of 2015

The Zambia Environmental Management Agency (ZEMA) is the key authority empowered under the Environmental Management Act (EMA), No. 12 of 2011 to ensure that major developmental activities in Zambia adhere to the provisions of the Environmental Impact Assessment (EIA) Regulations. Upon the successful conclusion of the EIA, ZEMA issues a Decision Letter to either approve or disapprove such a project. During project implementation, ZEMA is mandated to inspect the project site to check for compliance to the provisions of the Environmental Management Plan of the project and EIA Regulations.

In addition to national legislation, the project is committed to meeting international best practices in environmental and social performance by adhering to standards set by key international stakeholders, including Swedfund, the European Investment Bank (EIB), the EU and the World Bank. A gap analysis has shown that Zambian environmental legislation is largely in line with international standards – where gaps have been identified, the strictest provisions will prevail.

0.3 Analysis of alternatives

The analysis of alternatives carried out as part of the ESIA covered the alternative alignments for the installation of the OHL; technological options for the towers and the conductor as well as the no-project option.

In terms of OHL alignment, three alternative line routes were considered for the project as shown in the map overleaf.

A detailed site investigation exercise was undertaken to identify and evaluate the environmental/ecological and socio-economic (including archaeological and cultural) constraints associated with each alternative and to recommend the optimal route that minimizes environmental and social economic impacts. The overall evaluation of the OHL alternatives (including technical, environmental and socioeconomic parameters) was based on the Multi Criteria Decision Analysis (MCDA) methodology.

It was demonstrated that, in terms of environmental and socioeconomic footprint, Alt 3 (the southern alternative) performs better than Alt 1 (the northern alternative) and Alt 2 (the middle alternative). Although Alt 3 is slightly longer (approx. 1.5%) than the other two Alternatives, it affects much less built structures, and it has less impact to biodiversity as it avoids crossing hilly areas with primary vegetation. In contrast, it is less accessible (in terms of existing access roads) than the other two Alternatives. Consequently, Alt 3 has been selected as the preferred alternative OHL route.

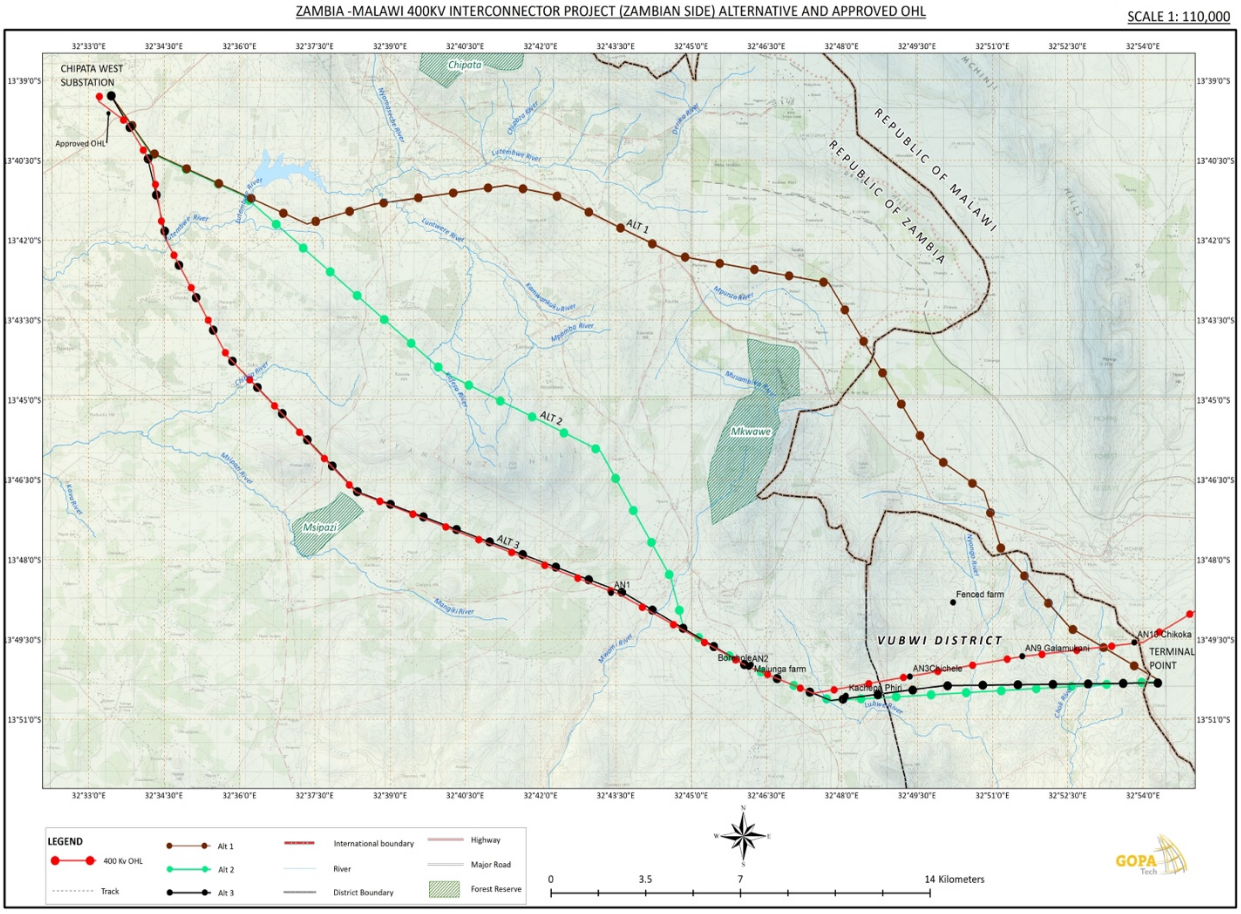


Figure 2. OHL alignment alternatives

In terms of technology alternatives, a number of options were examined in the framework of the feasibility study for the project. The selected support structure for the transmission line is the **lattice steel tower**, chosen for its optimal balance of technical performance, cost-effectiveness, and regional compatibility, while for the conductor selection, the chosen configuration—**triple ACSR Tern**—represents the most technically and economically balanced solution for the long-term operation of the transmission line. In terms of E&S considerations, there are no significant differences between the different technology options.

The “no project” alternative was also evaluated. This scenario explores the potential consequences of not constructing the Malawi - Zambia 400 kV Transmission Interconnector, which are proved to be negative in several respects:

- If the project is not undertaken, ZESCO and ESCOM will not be able to import electricity during the periods of scarcity, due to variation in rainfall for generation mixes heavily dominated by hydropower, climate change and equipment failure. This would result in continued load shedding and low voltage supply, which would further compromise reliability of electricity supply to customers. In times of excess power, the two utilities will be unable to export electricity to each and other countries, with obvious impacts to economic development in both countries.
- The absence of reliable electricity will have a detrimental impact to key social sectors like education, healthcare, several economic activities and overall quality of life.
- The absence of the project will have adverse environmental impacts as well. Existing electricity supply challenges will persist, exacerbating environmental pressures related to continued reliance on charcoal, deforestation and habitat loss.

- Eventually, the lack of transmission infrastructure will limit the development of renewable energy sources.

For all these reasons, the no-project scenario is not a sustainable option in both environmental and socioeconomic terms.

0.4 Project description

0.4.1 Project components

The project area is geographically situated within the Chipata and Vubwi Districts in Eastern Province of Zambia. The proposed OHL covers a distance of 46.6 km, from Chipata West Substation until the border with Malawi, with a wayleave width of 50m (25 m on both sides of the centre line).

The project will have the following components:

- Construction of the 400kV overhead transmission line between Chipata West Substation and Zambia – Malawi border at Mwami, for a length of 46.6 km.
- Expansion of Chipata West Substation to accommodate a new busbar arrangement and associated infrastructure.
- Construction of access roads, where necessary, to allow access of personnel and machinery to the construction corridor.

In addition to the above, the contractor will establish **construction camps** for the workers and **storage yards** for storage of equipment and materials. The location and size of the workers' camps and the yards will be determined by the contractor and ZESCO.

0.4.2 Towers

The type of towers proposed for the project is a double circuit lattice tower arranged on a traditional vertical configuration (staked) for both suspension and tension towers. The RoW for the line is 50m, 25m each side from the centre of the tower.

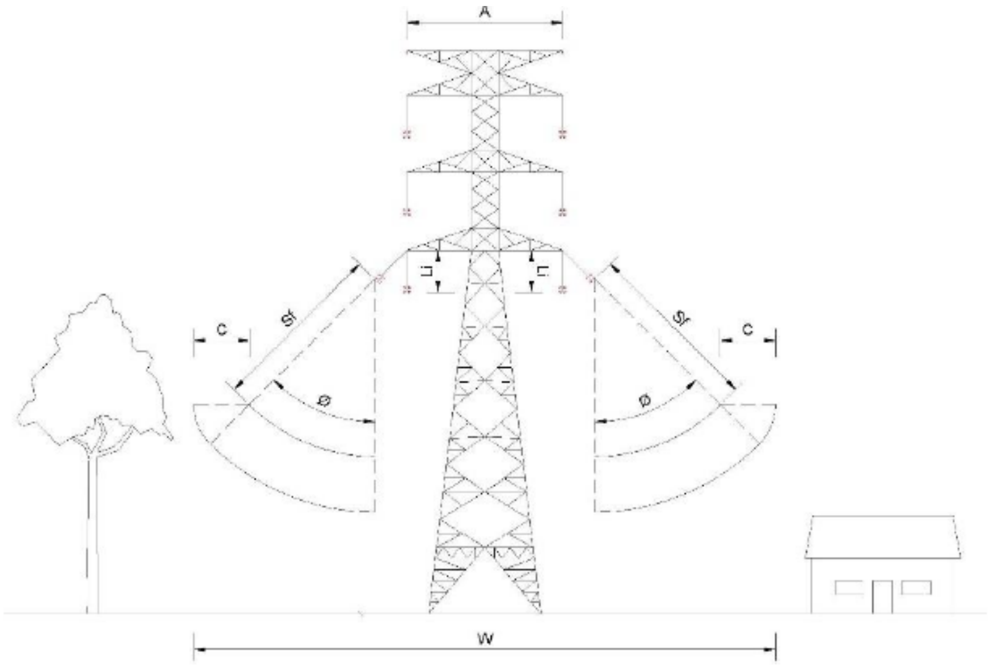


Figure 3. Typical tower and wayleave

Construction will be realized using excavators for the foundations, trucks for carrying materials (foundation material, tower material, reels and boxes for insulator and fittings) and machines such as tensioners and pullers for stringing.

The typical foundation will be of the pad and chimney type, 3-4m deep. Towers will be typically installed at 400m distances, depending on the local topography. The footprint of typical towers is as follows:

- Suspension tower: about 8 x 8 m, height of about 45m
- Tension tower: 9 x 9 m height of about 42m

Assembly of towers will be made by line's men working at be tower base and lifting equipment by gin pole, typically. However, the Contractor can propose different tools according to his experience.

0.4.3 Substation

The Chipata West substation is located approximately 10 km west of Chipata town and approximately 1.5 km north of the Great East Road (T4), in the Eastern Province of Zambia, within a relatively flat and semi-urbanized terrain. The substation extension is positioned on the southern side of the existing substation area, in land acquired by ZESCO when the substation was built in 2012 - 2014. This proximity to existing infrastructure significantly facilitates both site development and operational integration.

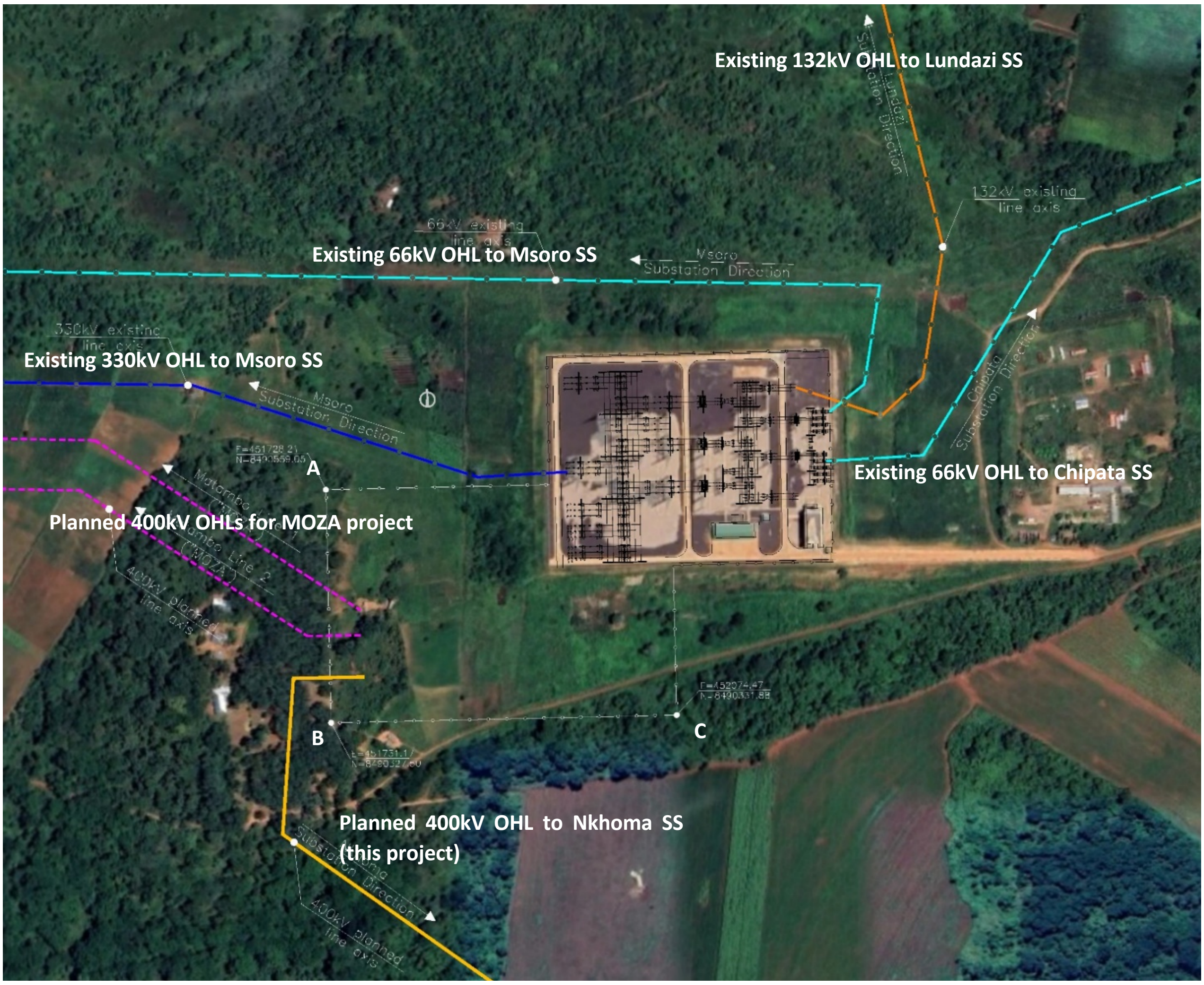


Figure 4. Extension of Chipata West Substation

0.4.4 Access roads

As much as possible, the existing access roads along the transmission line route will be used for construction purposes. The Lusaka – Chipata Road (T4), which also connects Chipata to Lilongwe, is a good bituminous road and will be useful in the transport of heavy project equipment like transformers and other substation equipment, and construction materials like steel and cement. The Contractor will be responsible to construct additional access roads as necessary.

0.4.5 Operation and maintenance

The transmission line, including the substation, shall be operated and maintained by ZESCO, in accordance with standard procedures designed to ensure the integrity of the transmission system. Routine inspections will be conducted on the transmission line to ensure line security and public safety. The vegetation along the wayleave will be controlled to ensure safety of the OHL and ground clearances are not to be exceeded. ZESCO currently uses mechanical bush clearing control of vegetation according to the ZESCO wayleave maintenance guidelines.

0.4.6 Decommissioning

The Project is designed for an operational lifespan of approximately 50 years. Decommissioning activities would take place at the end of the Project life and would involve dismantling and removal of transmission line and substation components, as well as rehabilitation of affected areas. A Decommissioning and Rehabilitation Plan has been prepared as part of the ESIA to provide a framework for managing potential environmental and social impacts during this phase.

0.5 Baseline conditions

0.5.1 Physical environment

Climate: The project traverses the Chipata and Vubwi Districts in Zambia's Eastern Province, which are characterized by a tropical savanna climate, also known as a Tropical Wet and Dry climate. This type of climate is defined by a distinct seasonal contrast between a wet season (November to April) and a dry season (May to October). The area experiences warm temperatures throughout the year, with an average annual temperature of 25.34°C, slightly higher than the national average for Zambia. Prevailing winds are easterly to south-easterly, with the maximum average hourly wind speed from approximately 14 km/h in early May to a peak of around 17.7 km/h by late July.

Air Quality & Noise: Baseline monitoring (April 2025) indicated pollutant levels well within ZEMA and World Health Organization (WHO) standards, with only minor particulate matter (PM) and total volatile organic compounds (TVOC) elevations near settlements. Ambient noise is generally low (36–43 dB(A)) except for occasional peaks near villages, due to transient events such as passing vehicles, livestock sounds, and occasional community activities such as loud music.

Water Resources: Several streams and rivers intersect the corridor (i.e. Lutembwe River, Chibila River, Mwami and Lubwe Rivers, Nyongo and Choli streams) used by communities for domestic water supply and livestock. Baseline water quality assessments show good compliance with Zambia Bureau of Standards (ZABS) standards for pH, conductivity, and dissolved oxygen, though turbidity levels in Nyongo Stream and Lubwe River exceeded thresholds. Groundwater depth typically varies between 10 to 40 meters below ground level (mbgl) depending on location, geology, and topography.

Topography & Soils: The project area traverses a varied terrain that includes rolling hills, expansive plateaus, and river valleys, with hills rising to elevations between 1,000 - 1,300 meters above sea level (m asl). Soils vary from sandy loams and clays to erosion-prone Fersiallitic soils and Leptosols, particularly vulnerable on slopes.

0.5.2 Natural environment

The biodiversity baseline was informed by a combination of desktop research, field surveys and meetings with communities. The field surveys were conducted in the period December 14, 2024, to January 15, 2025. The surveys focused on assessing vegetation types, species diversity, habitat structure, and faunal presence across multiple taxa—namely, birds, mammals, reptiles, amphibians, and insects.

Habitats: The surveys identified six distinct habitat types along the proposed transmission corridor. Although all habitats fall within the **Miombo Woodland biome**, they exhibit varying degrees of human modification. In specific, from a total of 233 ha occupied by the OHL wayleave, only **9.74% comprise forest area** (i.e. 1.5% thicket habitat and 8.24% wooded vegetation habitat). The majority of the rest comprises agricultural fields (64.6%) and degraded vegetation areas.

Flora: Vegetation along the corridor is dominated by **Miombo woodland** species such as *Brachystegia boehmii*, *Julbernardia paniculata*, and *Uapaca kirkiana*, interspersed with grasslands and cultivated fields. While some areas are degraded by charcoal production and farming, patches of intact woodland and riparian zones retain ecological value. No threatened flora species were identified.

Fauna: Mammals such as vervet monkeys, civets, duikers, and hares are present, along with reptiles, amphibians, and insects using ground cover and riparian habitats. Bird surveys confirmed the presence of resident and migratory species. No threatened species were recorded, with the exception of the Pancake Tortoise (*Malacochersus tornieri)* listed as Critically Endangered by IUCN. This species has not been reported in this part of Zambia before and its presence needs to be confirmed.

Protected areas: The proposed project does not traverse any designated protected area (national park, game management area, or forest reserve). The closest such areas are the Msipazi Forest Reserve, which is about 320 m south of the proposed transmission line while Mkwawe Forest Reserve is about 3.6 km north of the proposed line. The Mbewule Ranch and Nature Conservation Reserve (private) is approximately 2.4 km away from the transmission line.

0.5.3 Socioeconomic environment

The OHL crosses Chipata and Vubwi districts, with Chipata situated approximately 567 km east of Lusaka. Chipata district has a population of 327,059, with a population density of 193.4 persons per square kilometre. In contrast, Vubwi district has a total population of 53,118 and a much lower population density of 54.1 persons per square kilometre. Both districts experience a steady population growth.

Most of the population in the project area reside in rural areas and lives in small villages (family homesteads/ household groups). A village is made up of many households in a defined geographical area under the leadership of a village headman / headwoman. A group of villages in each defined geographical area make up a Chiefdom, which is headed by a Chief. The OHL route crosses 11 villages in the Chiefdom of Mpezeni in Chipata District and 4 villages in the Chiefdom of Pembamoyo in Vubwi District.

In both Chipata and Vubwi districts, the main source of formal employment is the government which employs teachers, health workers, agricultural workers and other civil servants; Parastatal companies such as ZESCO, Zamtel, NAPSA and Zambia Revenue Authority; Banks such as ZANACO, ABSA, Atlas Mara in Chipata and privately owned companies in various sectors and NGOs. In the immediate project area, being a rural set-up, farming is the main occupation. During the farming season, from October to February, people are engaged in cultivations to earn some income for their families. After harvesting, most people get involved in agricultural produce trading in Zambia and neighbouring Malawi.

Customary land is the most prevalent form of land tenure in the Chipata and Vubwi districts, managed under the authority of traditional leaders, including chiefs, headmen, and local village councils. Under this system, land is held communally, with individuals granted user rights through traditional allocation processes. Customary land is generally not formally titled, making it crucial for the project to engage with traditional authorities to secure access and obtain consent for the right-of-way.

Local economy in Chipata is based on agriculture and agro-trade. Cross-border trade with Malawi (especially in goods like maize, clothing, and household items) is also rife. Retail, transport, and hospitality sectors are vibrant. Local economy in Vubwi largely depends on subsistence farming. Crops grown include maize (as the main staple food and as a cash crop), sunflower, millet, ground nuts, sorghum and sweet potatoes. Charcoal production and firewood trade are also dominant. Livestock farming is also practiced in both districts, with cattle, goats, pigs and chickens.

Literacy rate in Chipata was 54.4% in 2010, much lower than the country average of 70.2%. Nowadays, the literacy level is expected to be higher because more educational infrastructure including primary, secondary schools, and colleges have been built over the last 15 years. The literacy rate for Vubwi is not available but it is also expected to be below national average, due to challenges in access to education.

Health services are provided by Hospitals, Health Centres and Health Posts. Chipata has 33 facilities in total (only 4 hospitals) and Vubwi has 14 facilities (only 1 hospital). Especially in rural areas, there are challenges with the distribution of health facilities and the lack of qualified medical personnel.

0.5.4 Cultural heritage

Cultural heritage resources include sacred groves and graveyards, outside the OHL corridor. The wider area contains significant archaeological sites from the Late Stone Age and Early Iron Age, including Chaingo Hills, Chinjela/Kalemba Hills, Chamfishi, Mkoma Rock Shelter, and Zawi Hill, all with rock paintings depicting prehistoric life. All sites are located more than 6 km from the proposed transmission line corridor.

0.6 Impacts and mitigation measures

0.6.1 Physical environment

The potential impacts of the project's construction phase on physical environment include dust and noise emissions caused by earthworks and operation of machinery and vehicles for the clearance of the RoW of the transmission line; rainwater or wastewater discharges to surface waters or groundwater; soil erosion, compaction or pollution from construction works and vehicles; changes to the landscape and to the aesthetic values of residents and visitors. In specific:

- Noise: noise emissions are expected due to earthworks, machinery and transport of personnel and materials. Noise emissions will affect mostly nearby settlements located within 300 m of construction sites as well as workers on site. Such impacts will be temporary and limited during the construction period. During operation, they will be occasional and minor noise emissions for regular maintenance works. Noise exposure for workers will be managed with the use of protective equipment.
- Dust/air emissions: also generated by earthworks, vehicle movements, and material handling, especially during dry and windy periods. Settlements close to the OHL route may experience temporary air quality reduction, but impacts are expected to be minor and localized, solved by best engineering practices, such as water sprinkling to suppress dust emissions particularly near the settlements, covering trucks during soil transport, using properly tuned vehicles and machinery to minimize exhaust emissions, etc.
- Water quality: Risks include accidental discharges of rainwater, wastewater or construction-related pollutants into surface or groundwater. These impacts could affect local rivers/streams and soils if not controlled. With management measures (such as the controlled disposal of rainwater to surface waters, the collection and treatment of wastewater, the immediate response to potential leaks, etc.) in place, impacts are expected to be minor and temporary.
- Soil: Construction works and heavy machinery may cause erosion, compaction, or localized pollution (e.g.,

fuel leaks) to soils. This mainly affects the project sites, with minor, short-term impacts if managed properly (i.e. disposal of excess spoil materials to designated locations approved by the authorities, minimizing the footprint of the project components to the extent possible, deep ploughing of soil as part of reinstatement, maintenance of vegetation as far as possible, etc.).

- Landscape and visual values: Temporary changes to the landscape will occur during construction due to cleared areas, equipment, and material storage. This may reduce the visual quality for residents (some houses/settlements along the OHL route) and visitors, but the impact will be moderate and limited to the construction period. After construction, the wayleave will be revegetated with the exception of tall trees.

During operation and maintenance, the impacts to the physical environment are much more limited. Noise impacts during operation of the OHL and the substation are generally limited to the RoW of the OHL and the footprint of the substation, and are effectively monitored and controlled by ZESCO – therefore they are not expected to disturb the local population living nearby. Waste discharges (including electric and electronic waste) will be handled by ZESCO in line with the project Waste Management Plan.

0.6.2 Natural environment

The construction and operation of the Project may result in impacts on the natural environment, including vegetation clearance, habitat fragmentation, disturbance to fauna, introduction or spread of invasive alien species, and bird collision risks associated with the overhead transmission line.

The project has planned a series of specific avoidance, mitigation and compensation measures to reduce such impacts as much as possible, including:

- To compensate for the loss or fragmentation of forest (thickets) and river crossing habitats, the project will avoid construction of access roads and gravel or sand extraction from such areas; while vegetation clearing will be avoided or minimised wherever possible
- To compensate for the loss of vegetation and flora species, the project will separately store topsoil during excavation in order to re-apply it during site restoration in order to facilitate natural regeneration; it will also prohibit the illegal collection of medicinal or decorative plants by project staff
- To avoid the loss of reptiles, the project will minimize the interaction with project staff and vehicles, avoid working close to ponds and water bodies, especially during April and May
- To avoid disturbance / displacement of mammal species, the project will preserve natural vegetation as much as possible, avoid working at night, control lighting and nuisance

For the operation and maintenance phase, the most significant potential impact is the loss of bird species due to collision of birds at the OHL wires. Such risks will be minimized via the installation bird diverters on the ground wire of the OHL section from km 19 to km 28. A post-construction ornithological study will be commissioned to monitor flight behaviour of bird species in the presence of the line, record bird collision incidents and identify line segments that present most impacts.

0.6.3 Occupational Health and Safety

Occupational health and safety (OHS) hazards for the construction staff and other project site personnel are manifested as risks during earthworks; transportation of heavy loads; working at height for tower erection, substation assembly; stringing OHL conductors at road and existing transmission line crossings as well as risks of electric shocks and electrocution during electrical works. Health risks may also be experienced at worker camps and accommodation.

In order to mitigate OHS risks, training and education will be provided to all workers involved in earthworks; effective PPE's will be provided and ensured to be used during all works; machines will be checked and maintained to ensure risk free operations; safety guidelines will be prepared on how heavy loads will be transported safely; site specific hazards will be identified and preventive measures will be devised accordingly, especially fall protection and excavation works safety measures, and safe working conditions will be ensured, including during electrical works. Worker camp water supply, sanitation and housing conditions must be ensured to be safe.

Risks of unfair or otherwise inappropriate labour and working conditions (unacceptable employment contracts or lack of contracts, corrupted recruitment practices, etc.) must be managed through appropriate human resource management procedures, contractual clauses in the ZESCO -main contractor's contracts and main contractors-subcontractors agreements, workers' grievance mechanism, among others.

The contractor will also prepare and implement a management plan to ensure that safety hazards for the communities are minimized. To address the risks of any social tension, or incidents of gender-based violence or harassment, a code of conduct will be prepared, that all site personnel will be required to follow. In addition, a grievance redress mechanism will be established.

During operation and maintenance, the potential OHS risks are minimum, since maintenance will be carried out by well-trained and equipped professionals.

0.6.4 Socioeconomic environment

The project is expected to strengthen electricity supply in Zambia and Malawi, reduce power shortages and promote regional energy trade under the SAPP. In addition, the project has the potential to generate employment opportunities during construction, some of which will be for local communities in un-skilled and semi-skilled positions.

The most significant social impact of the project is the permanent acquisition of land for the construction of the towers as well as the temporary acquisition of land for stringing of the wires. A total of 233 hectares of land will be occupied by the power line under the wayleave and 12.69 hectares at the substation belonging to 243 households. In addition, there will be a permanent uptake of land on tower locations. There is potential loss of crops during construction, if construction works comment before harvest time.

Seven (7) households whose dwelling structures are affected by the proposed power line will require relocation. A total 10 dwelling structures and 14 ancillary structures are affected by the project. All damages to crops along the OHL route will be compensated. After construction, this land will be reinstated and the landowners will be able to continue using it as before construction, with the exception of the land which will be permanently occupied by the towers, which will be compensated at replacement value. There will also be restrictions on wayleave land use as planting of tree crops and construction of structures in the wayleave will not be accepted. All structures in the RoW will also be removed and compensated at replacement value.

Other potential impacts of the project's construction on the local communities include project-related traffic on local roads, including risks of traffic accidents, additional load on local resources, competition for already limited public service provision, increased risk of communicable diseases and burden on local health services, water resources, construction camp related land use, access roads, noise, dust (due to heavy loads transport), lights and impacts on local customs and culture.

To address social risks and impacts on local communities, the development of code of conduct for local and in-migrant workers is planned. To mitigate the impacts of noise generation, the contractor will use machinery and vehicles equipped with standard noise reduction arrangements (such as silencers and canopy), will avoid nighttime work to the extent possible, and will maintain liaison with the communities. For increased traffic on local roads, the contractor will prepare and implement a traffic management plan. A grievance management mechanism will also be implemented to enables community members raise concerns and have these addressed appropriately.

During operation, the project will exhibit minimal social impacts. ZESCO will maintain the right to access the transmission line for maintenance purposes. Maintenance of the project components may result in increased traffic of project personnel or vehicles, which in turn may generate some noise or dust. However, all such impacts will be localized, temporary and minimal. Any damage to third party crops or other assets during these activities will be compensated.

0.6.5 Cultural heritage

Excavation works and vibrations can potentially have an impact on currently unknown cultural sites in the project area. A Chance Finds procedure is prescribed to be developed and implemented during construction, to address potential findings.

0.7 Environmental and Social Management Plan (ESMP)

An Environmental and Social Management Plan (ESMP) has been prepared as part of the project's ESIA in order to define the implementation mechanism for the above-described mitigation measures and preventive actions. The ESMP includes the preparation of Construction Environment and Social Management Plan (C-ESMP) and Occupational Health and Safety (OHS) Plan by the Contractor, requirement of Job Hazard Analysis (JHA) at construction sites to identify hazard risks, inclusion of Environment, Social, Health & Safety (ESHS) chapter in each Method Statement, mitigation and prevention plans, monitoring plan, a training and capacity building plan, documentation protocols, and a grievance redress mechanism (GRM).

ZESCO will set up one or more field level Construction Camp Offices for monitoring the implementation of C-ESMP and OHS Plan. ZESCO will also engage a Construction Supervision Consultant, who will be responsible for supervising the contractor during the construction phase. The Consultant will also be responsible for supervising the implementation of C-ESMP and OHS Plan at the field level.

Two levels of monitoring and evaluation (M&E) are envisaged for the ESIA implementation. At the first tier, internal monitoring will be carried out by ZESCO, whereas at the second tier, external monitoring will be carried out by an independent M&E Consultant. The purpose of these monitoring activities is to ensure that ESMP is implemented in a timely manner, in accordance with the procedures described in the present document, and in compliance with the national as well as EIB/WB environmental and social standards.

0.8 Consultations and disclosure

ZESCO has already undertaken extensive stakeholder engagement during the ESIA Scoping phase, the preparation of the ESIA as well as the contacts with traditional leaders and landowners during the land acquisition stage.

ZESCO will continue to actively engage with stakeholders during the next project stages. Stakeholder engagement will be guided by the Stakeholder Engagement Plan (SEP) which was prepared to meet EIB/WB requirements. This plan summarizes engagement to date and calls for regular communications with key stakeholders throughout the planning, construction, and operation stage of the project.

ZESCO has established a grievance redress mechanism (GRM) to collect and respond to stakeholders' concerns addressed to ZESCO (as well as the Contractor once construction starts), and to facilitate the resolution of stakeholders' grievances. The GRM will address concerns promptly and effectively, using an understandable and transparent process that is culturally appropriate and readily accessible to all segments of the affected parties, at no cost and without retribution.

The grievance mechanism is available to all, free of charge, and will not result in any form of retaliation. The GRM will be available in the local language commonly spoken in the project area (ChiChewa).

Complaints in writing can make use of the dedicated Grievance Reporting Form annexed to the SEP. The use of the form has been explained to stakeholders during stakeholder engagement activities.

All complaints, written or in oral form, are to be submitted for consideration to the competent individuals which may include ZESCO management and specialists, consultants, etc. Written responses will be provided to those who submitted complaints, after internal decision-making and resolution of complaints. A summary of all comments and decisions on how they were addressed will be analysed periodically to enable prevention of reoccurrence.

0.9 Conclusions

The ESIA has demonstrated that the **environmental impacts** of project construction, operation, maintenance and decommissioning phases are largely **minor to moderate** in significance and can be effectively prevented or mitigated through robust mitigation and monitoring measures. **Socioeconomic and cultural impacts**—notably physical and economic resettlement, livelihood disruption, occupational and community health and safety risks—are also manageable through the implementation of the **Resettlement Action Plan (RAP)**, the **Occupational Health and Safety Plan**, **community health and safety plans**, and **labour and safety protocols**.

The Project is associated with positive outcomes such as improved energy security and reliability, support to economic growth, employment, climate change mitigation, and enhanced regional energy integration.

Adverse environmental and social impacts are also identified and assessed in this ESIA, together with corresponding mitigation and management measures.

With full implementation of the Environmental and Social Management Plan (ESMP) and stakeholder engagement measures, the Malawi–Zambia 400 kV Interconnector Project should proceed. It represents a **strategically significant, socially beneficial, and climate-aligned investment** with long-term benefits for Zambia, Malawi and the Southern African region.

0.10 ESIA Study Team

This ESIA study was undertaken by a multidisciplinary team comprising the following experts:

Table 1. ESIA Study Team

Name and Qualifications	Role	Signature	Date
Kostas Batos	Project Director		27.11.2025
Gvantsa Janikashvili	Lead Environmental Expert		27.11.2025
Mrityunjay Jha	Lead Social Planner		27.11.2025
Robam Musonda	ESIA Country Coordinator		27.11.2025
Edwin Matokwani	Ecology / ESIA Expert		27.11.2025
Stella S. Sakala	Socioeconomic Expert		27.11.2025
Charity Moonga	Communication Expert		27.11.2025
Godfrey Chileshe	Gender / GBV Expert		27.11.2025
Lewis Chisenga	Valuation Expert		27.11.2025
Donald Chikumbi	Archaeology & Cultural Heritage Expert		27.11.2025
Benson Kabungo	GIS Expert		27.11.2025

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ACRONYMS AND ABBREVIATIONS

AoI	Area of Influence
ACSR	Aluminium Conductor Steel Reinforced
DRC	Democratic Republic of Congo
EHS	Environment, Health and Safety
EIB	European Investment Bank
ESHS	Environmental, Social, Health and Safety
ESIA	Environmental and Social Impact Assessment
ESCOM	Electricity Supply Corporation of Malawi Limited
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standards
FS	Feasibility Study
GBV/SEA	Gender Based Violence/Sexual Exploitation and Abuse
GIS	Geographic Information System
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
kV	Kilovolt
NGO	Non-Governmental Organization
NHCC	National Heritage Conservation Commission
OHL	Overhead Line
PAP	Project Affected Persons
PIU	Project Implementation Unit
PM	Project Manager
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
RoW	Right of Way
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SEP	Stakeholder Engagement Plan
S/S	Substation
ToR	Terms of Reference
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WB	World Bank
WHO	World Health Organization
ZEMA	Zambia Environmental Management Agency
ZHDS	Zambia Health Demographic Survey

1 Introduction

1.1 Background of the project

The Southern African Development Community (SADC) was established in 1992 to foster socio-economic integration, political stability, and security cooperation. Spanning nearly 9.09 million square kilometers, the SADC region is home to over 280 million people across 16-member countries.

A critical challenge in Southern Africa is inadequate electricity access, which hampers efforts to end extreme poverty and boost shared prosperity. The Region's electricity access rate is around 50% (SADC, 2019) and this rate drops to 32% for rural areas. In comparison, north African countries have reached access rate of 100%. Countries like Angola, Madagascar, Mozambique, Tanzania and Zimbabwe have less than 50 percent of their populations with electricity access, with DRC and Malawi are reporting rates at or below 20 percent (SADC Statistics Database, 2021). Expanding electricity access is essential for poverty reduction and is central to national development plans in these Countries.

In Zambia, according to the 2023 National Energy Access Survey conducted by the Zambia Statistics Agency in collaboration with the Rural Electrification Authority, 53.6% of the households at national level had access to electricity. Access to electricity in urban areas was higher at 80.3% compared to 34.0% of the households in rural areas. This means that 66% of the households in rural areas and 19.7% in urban areas had no access to electricity. The power shortages in the country, arising from the drought experienced in recent years, have led to extensive load shedding. Increased electricity access requires a substantial boost in power supply. Therefore, enhancing energy access and availability is key to SADC's developmental agenda. This necessity has driven the plan for the Malawi-Zambia Interconnector, which aims to improve the Region's energy sector, by enhancing grid interconnectivity and increasing power supply.

The Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) for the Malawi-Zambia 400 kV Interconnector Project is financially supported by Swedfund. The project is under the auspices of the two electricity utility companies ESCOM of Malawi and ZESCO of Zambia, based on an Inter-Utility Memorandum of Understanding (IUMoU) signed between them, which is in turn based on an Inter-Governmental Memorandum of Understanding (IGMoU) signed between the Governments of Malawi and Zambia.

This document is the **Environmental and Social Impact Assessment (ESIA) study report** for the Zambian component of the project and it has been prepared in accordance with the Zambian Environmental Regulations, the European Union EIA Directive and other international standards. According to Zambia Environmental Management Act No. 12 of 2011, Statutory Instrument No. 28 of 1997 –The EIA Regulations, Second Schedule (Regulation 7(2), Section 8(b), all transmission power lines above 220kV and more than 1 km long, require an EIA study before undertaking the project. The European Union (EU) EIA Directives were also taken into consideration in this project. The EU EIA Directive 2011/92/EU, Articles 2 and 3 demands that projects which are likely to have significant environmental and social impacts, by virtual of their nature, size and location, be subjected to an EIA study, and Annex II Section 3(b) lists infrastructure projects for the transmission of electrical energy by overhead cables as one of the types of project that require an EIA study.

As part of the ESIA process, environmental screening was conducted during the selection of alternative power line routes. An environmental and social scoping exercise was also conducted. The Scoping Report was submitted in December 2024, During the scoping process, scoping meetings were held at district level and in the communities along the power line corridor in Chipata and Vubwi districts – at the end of November 2024. The Scoping Report and the ToRs were approved by the Zambia Environmental Management Agency (ZEMA) in February 2025 authoring the undertaking of the ESIA study for this project and approving the Terms of Reference (ToRs) for the ESIA.

1.2 Summary description of the project including project rationale

The project envisages the construction of a 400kV Interconnection Line between eastern Zambia (the existing Chipata West 330/132 kV Substation located west of Chipata, the largest city in eastern Zambia) and central Malawi (the existing Nkhoma 400/132 kV Substation located south-east of Lilongwe, the capital and largest city of Malawi), see Figure 1-2.

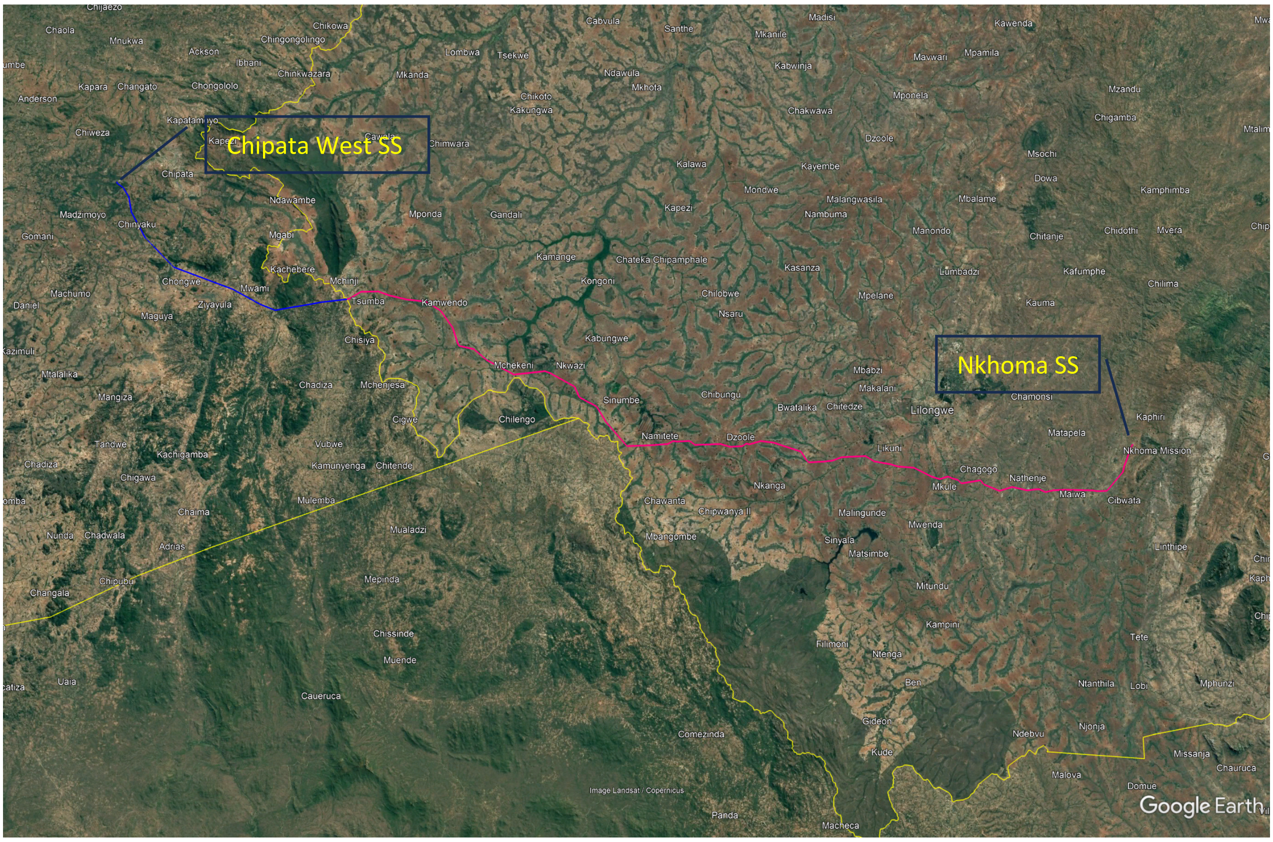


Figure 1-1 OHL route in Zambia (blue) and Malawi (purple)

The Project will be managed by the respective national power utilities, ZESCO Limited in Zambia and ESCOM in Malawi, reinforcing regional cooperation and integration. This Interconnector will not only facilitate electricity trading between Malawi and Zambia but also support broader regional integration and stability. It will help address the critical power shortages in Southern Africa, fostering economic growth, improving living standards, and reducing environmental impacts through a more reliable and interconnected power grid.

1.3 Objectives the project

The objective of the Project is to promote regional integration and to facilitate electricity trading between the two countries and other countries in the region.

1.4 Brief description of the location

The project area for the Malawi-Zambia 400kV Transmission Interconnector (Zambian part) is geographically situated in the Chipata and Vubwi Districts of Zambia. The area is located between the coordinates of latitudes 13°39’7.626” South to 13°50’50.673” South and longitudes 32°33’27.619” East to 32°54’18.967” East. The OHL from Chipata West SS until the border with Malawi is 46.6km long, with a wayleave width of 50m (25 m on both sides of the centreline). The OHL is shown in Figure 1-2.

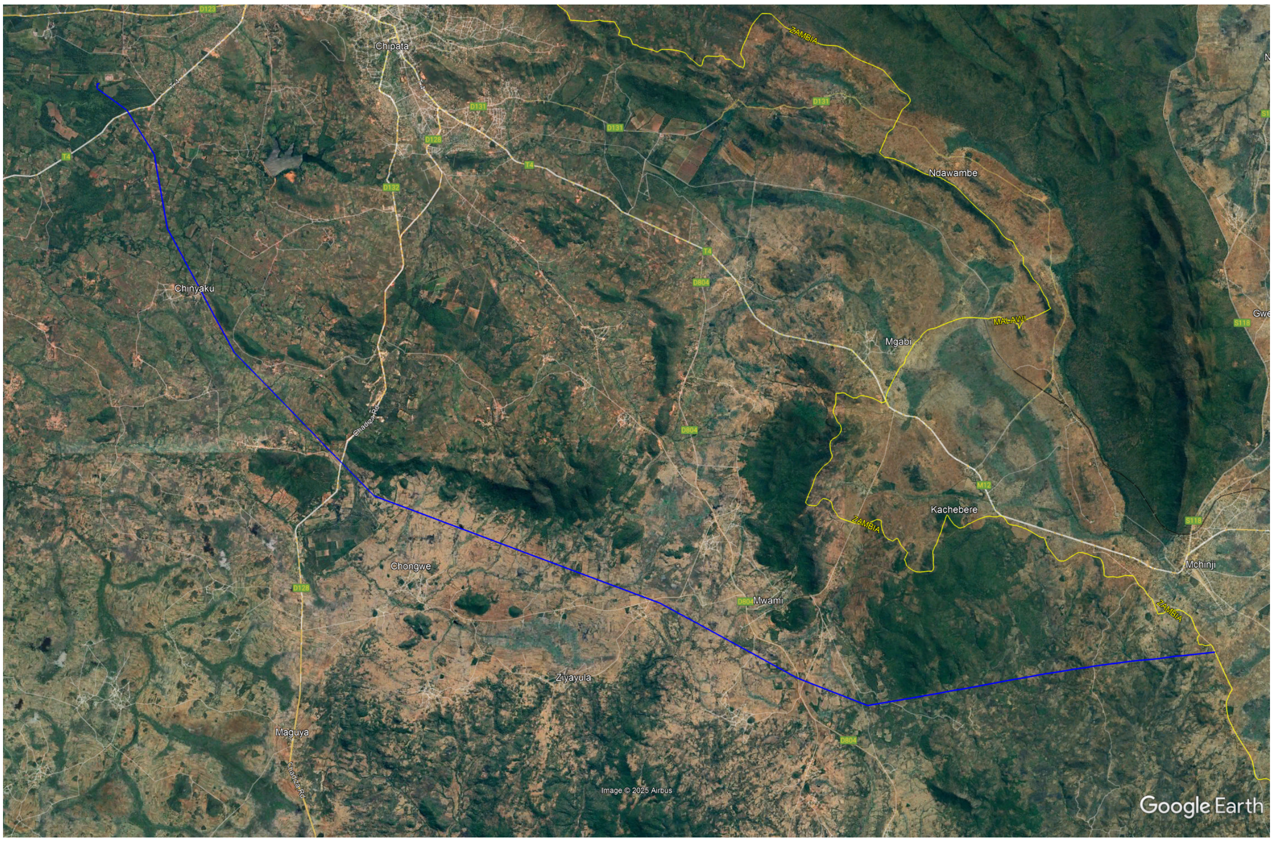


Figure 1-2 Location of the proposed project area in the eastern part of Zambia, from Chipata substation to the international border to Malawi.

The topography of the project area is relatively uniform, with gently rolling flatlands that are interspersed with occasional hills. These flatlands are primarily utilized for small-scale, family-run farms, which dominate the local landscape. These farms are a vital component of the local economy, providing livelihoods for a significant portion of the population. The agricultural activities in this region are typically subsistence-based, focusing on crops such as maize, groundnuts, and various vegetables, which are grown for both local consumption and sale in nearby markets.

The landscape is also marked by the presence of small streams and seasonal rivers that traverse the area. These water bodies are crucial for the agricultural activities, providing necessary irrigation for crops, particularly during the dry season. However, the streams are often seasonal, with water levels fluctuating significantly between the wet and dry seasons. The hills that partially surround the farmland contribute to the area's natural drainage system, influencing both the flow and availability of water in the region.

The natural vegetation in the project area consists largely of miombo woodlands, a type of savanna woodland common in the Southern Africa region. These woodlands are characterized by a mix of deciduous trees and shrubs, which provide important ecosystem services, including charcoal, fuelwood, non-timber forest products, and habitat for local wildlife. However, much of the original vegetation has been cleared for agricultural purposes, leading to a landscape that is a mosaic of cultivated fields and patches of natural vegetation.

The human settlement pattern in the Chipata and Vubwi Districts is typically rural, with scattered homesteads and small villages dotting the landscape. These settlements are often closely associated with the agricultural plots they depend on, leading to a dispersed population density. The local communities are primarily engaged in farming, with some involvement in small-scale trading and other informal economic activities.

In terms of infrastructure, the area has basic road networks that connect the villages and farms to larger towns and markets. However, these roads are often unpaved and can become difficult to navigate during the rainy season. Access to services such as electricity, clean water, and healthcare is limited in many parts of the project area, reflecting the broader challenges of rural development in the region.

The project area is culturally rich, with a population that includes various ethnic groups, each with its own traditions, languages, and social practices. These communities have a deep connection to the land, and their cultural practices are often closely tied to the agricultural calendar and the natural environment.

The general map of the project is shown in Figure 1-3 below.

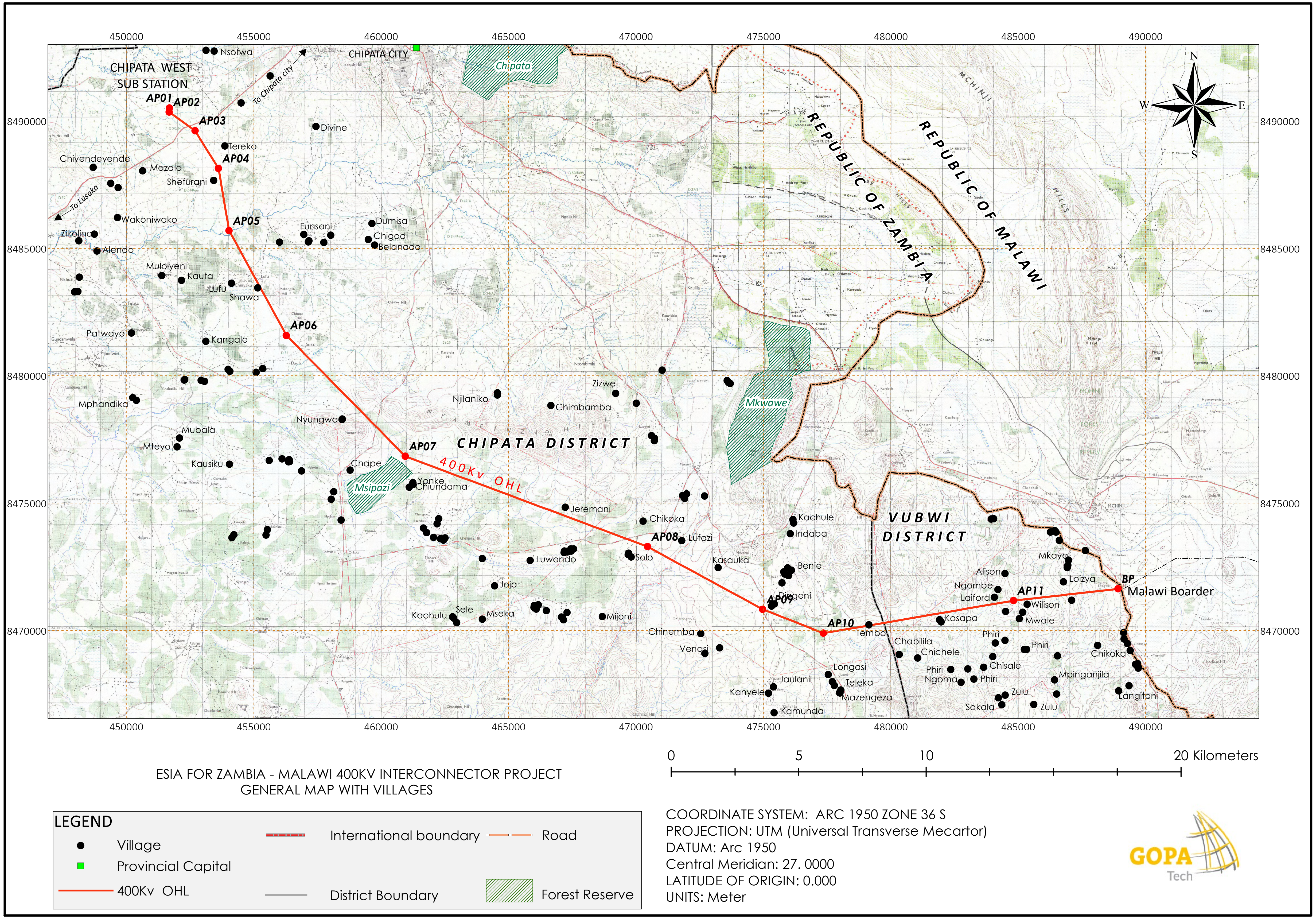


Figure 1-3 General map of the project

The Zambia–Malawi interconnector originates at the Chipata West Substation, located at coordinates **13°39′0″S, 32°33′0″E**. From this point, the line proceeds **westward** for **0.07 km** to **Placemark Point AP01** at coordinates **13°39′0″S, 32°36′0″E**. From AP01, the line turns **85° east** and extends **0.16 km** to **AP02** at **13°40′30″S, 32°39′0″E**. It then turns **72° southeast** for **1.25 km** to **AP03** at **13°40′30″S, 32°43′30″E**. Continuing, the line turns **70° southeast** for **1.75 km** to **AP04** at **13°42′0″S, 32°46′30″E**. From AP04, it turns **68° southeast** for **2.48 km** to **AP05** at **13°43′30″S, 32°48′0″E**. The line then turns **70° southeast** for **4.69 km** to **AP06** at **13°45′0″S, 32°49′30″E**. From AP06, it turns **72° southeast** for **6.66 km** to **AP07** at **13°46′30″S, 32°51′0″E**. It continues **70° southeast** for **10.14 km** to **AP08** at **13°48′0″S, 32°52′30″E**. Near the Mwami Mission area, the line turns **72° southeast** for **5.15 km** to **AP09** at **13°49′30″S, 32°53′0″E**. From AP09, it turns **70° southeast** for **2.56 km** to **AP10** at **13°49′30″S, 32°54′0″E**. Finally, the line proceeds directly east for **7.57 km** to **AP11** at **13°51′0″S, 32°54′0″E**, which marks the **exit point into Malawi**.

1.5 Particulars of Shareholders/Directors

The project under consideration will be developed by ZESCO. ZESCO Limited is a national power utility that is wholly owned by the Government of the Republic of Zambia and is registered under the Companies Act of the laws of Zambia. The Company was established in 1970, and its mandate is to supply electricity and energy solutions within Zambia and the Sub-Saharan region.

The following constitute the Board of Directors of ZESCO Limited as of November 2025:

- Mr. Vickson N'cube - Board Chairperson
- Mwapa B. Chipala
- Ms. Edna Mudenda
- Dr. Christopher Mubemba
- Mr. Charles Kaisala
- Eng. Justin Loongo

1.6 Percentage of shareholding by each shareholder

ZESCO Limited is a national power utility that is wholly owned by the Government of the Republic of Zambia.

1.7 The developer's physical address and the contact person's details

The physical address and contact details for ZESCO are given below.

ZESCO Limited,
Stand No.6949, Great East Road,
P.O. Box 33304
Lusaka

Contact Person:
Mr. Justine Loongo
Managing Director, ZESCO Limited
Email: jloongo@zesco.co.zm
Tel: +260 211 362710

1.8 Track Record/Previous Experience of Enterprise Elsewhere

ZESCO Limited is an electricity utility created in 1970 which is wholly owned by the Government of the Republic of Zambia and falls under the jurisdiction of the Ministry of Energy. The company's main objective is to generate, transmit, distribute and supply electricity to all its clientele in Zambia and the southern African region. Currently, over 99% of ZESCO's electricity is generated using hydro power.

ZESCO Limited has successfully undertaken and continues to undertake a number of projects in generation, transmission and distribution as listed below:

- **The Power Rehabilitation Project (PRP)** - The Zambia Power Rehabilitation Project's overall objective was to support the Government's objectives of enhancing the ability of the country's electricity supply industry to provide electricity at least cost and in an efficient and sustainable manner to stimulate more and inclusive growth in the economy. The works involved rehabilitation of generation, transmission and distribution infrastructure that included power line repairs and replacements, and reinforcement of substations. Upon completion of the rehabilitation works at the power stations there was an additional 210MW added to the total generation capacity.

- **Kafue Gorge Lower Hydro Power Project (750 MW)** - The Kafue Gorge Lower (KGL) Hydro Power Project with a capacity of 750 MW was commissioned in 2021 utilising the Itezhi Tezhi dam water storage. The project included the construction of a 330kV transmission line from the KGL power station into the National Grid at Lusaka West Substation.

- **Itezhi Tezhi Hydro Power Project (120 MW)** - ZESCO signed a Memorandum of Understanding (MoU) with Tata Africa to develop the Itezhi Tezhi 120MW hydro power project. The two companies formed a joint venture company known as Itezhi Tezhi Power Company (ITTPC). The power plant utilised water from the existing Itezhi Tezhi Dam constructed in the 1970s. The power that is generated is fed into the National grid through a high voltage line, the Itezhi Tezhi - Mumbwa - Lusaka West 330kV transmission line. The power plant has since been commissioned.

- **Kariba North Bank Extension Project (360 MW)** - The project is aimed at increasing the generation capacity of Kariba North Bank Power Station by adding two generating units of 180MW each to the existing four units. A dam with sufficient capacity exists and provision for the addition of two machines to the existing four was made. For this project, a transmission line was constructed to evacuate the power and feed into the national grid at the Kafue west substation. The power plant has since been commissioned.

- **Itezhi Tezhi 330kV Transmission Line** - The project, which is now commissioned, was aimed at constructing a 273 km long transmission line from the Itezhi Tezhi Power Station to the existing Lusaka West Substation, with a 220kV/330kV Substation in Mumbwa. The objective is to transmit the 120MW from Itezhi Tezhi Power Station into the national grid.

- **Kariba North Bank Extension 330kV Transmission Line** - The project involved constructing a 130km long line from the Kariba North Bank Extension Power Station to the existing Kafue West Substation. The objective of the project is to evacuate the 360MW generated by the new power station into the national grid.

- **Muzuma Upgrade 220kV- 330kV Transmission Line** - The project involved upgrading the existing Livingstone – Kafue Town 220kV transmission line to a 330kV line. The objective of the project is to increase the line's voltage capacity in order to transmit more power to meet various developmental need.

- **Leopards Hill – Luangwa 132kV Transmission Line** - The project involved constructing a 187km long 132kV line from the existing Leopards Hill Substation east of Lusaka to the new 132/33kV Chitope substation in Luangwa District, with a 132/33kV substation in Rufunsa District. The Project also included a 33kV reticulation line in Rufunsa and another 33kV line from the Chitope substation to Luangwa Town (62km) and to the Great East Road at Luangwa Bridge (25km). The objective of the project is to connect Rufunsa and Luangwa Districts to the National Grid to support economic development in the two rural districts. The Project also led to the decommissioning of the less environmentally friendly Luangwa diesel powered power plant.

- **Pensulo - Kasama 330kV Transmission Line** - The project involved constructing a 400km long transmission line from the existing Pensulo substation in Serenje to the new Kasama Substation, through the new 330/66kV Substation in Mpika. The project was aimed at extending the 330kV network in order to provide reliable supply to Luapula, Muchinga and Northern Provinces.

- **Pensulo – Chipata 330kV Transmission Line** - The project involved constructing a 285km long transmission power line from the existing Pensulo substation in Serenje District to the new Chipata West 330kV substation, through the new 330kV substation in Msoro. The Project was aimed at extending the 330kV network to Chipata in order to provide reliable supply to the Eastern Province to boost development in the region.

- **Transmission Networks Developed** - ZESCO Limited constructed the Luano – Kansanshi Mine 330kV and the Kansanshi Mine – Lumwana Mine 330kV transmission lines in order to support economic activities in the mineral rich North Western Province. ZESCO also constructed the Victoria Falls – Katima Mulilo 220kV transmission line to facilitate electricity trading between Zambia and Namibia.

To ensure environmental compliance in all its projects and operations, ZESCO established the Environment and Social Affairs Unit in 1996. Over the years, the Unit evolved into a department and has undertaken numerous EIA studies for generation, transmission and distribution projects, some of which are mentioned above.

1.9 Total Project Cost/Investment

The project involves the extension of the existing Chipata West substation to accommodate the substation infrastructure and equipment of the new 400kV transmission power line. The substation works will cost USD 29.74 million. The project also involves the construction a 46.6 km long 400kV transmission power line from Chipata West substation to the Zambia / Malawi border at an estimated cost of USD 17.95 million. The total project capital cost on the Zambian side is estimated at USD 47.69 million and the works are expected to be undertaken over a period of 22 months.

1.10 Proposed Project Implementation Date

Subject to the availability of funds, the project is expected to commence by 2027 and will be executed over a period of 22 months.

2 Policy, Institutional and Organizational Framework

2.1 Policy and institutional framework

This Chapter provides an overview of the national legislation and regulations as well as the related institutional frameworks relevant to environment and social assessment, occupational health and safety, and workers' rights of the proposed project. Also discussed are the Swedfund Sustainable Policy as well as EIB's Environmental and Social Standards and the World Bank Environmental and Social Standards relevant to the proposed project.

2.1.1 Environmental Policy Framework

(a) National Environmental Policy 2007

In view of the various environmental challenges the country faces, Zambia launched its National Policy on Environment (NPE) in 2007. The environmental policy document identifies deforestation, land degradation, wildlife depletion, soil erosion, loss of land productivity, inadequate sanitation and air and water pollution as the main environmental challenges the country is facing.

The NPE calls upon all institutions, Non-Governmental Organizations (NGOs), and community based or people's organizations whose activities affect the environment in any way to carry out their activities judiciously to maintain the productivity and integrity of the environment. **Further, the NPE recognizes the need for EIA studies in all development projects to eliminate or mitigate adverse environmental impacts and enhance the benefits of the projects.**

The National Policy on Environment states that "EIAs will be required as deemed necessary to ensure that public and private sector development options are environmentally sound and sustainable and that any environmental consequences are recognized early and taken into account during project design and implement."

The Zambian National Policy on Environment (NPE) was developed to safeguard the environment and to ensure the sustainable use of natural resources. The policy is premised on the basic principle of "Polluter pays and the need to conserve resources, reduce consumption and recycle and reuse materials to the maximum extent possible" while the main purpose of the policy is "to create an umbrella policy for the welfare of the Nation's environment so that socio-economic development will be achieved effectively without damaging the integrity of the environment or its resources". Specific objectives of the NPE include, but are not limited to:

- Promote the sound protection and management of Zambia's environment and natural resources in their entirety, balancing the needs for social and economic development and environmental integrity to the maximum extent possible while keeping adverse activities to the minimum;
- Accelerate environmentally and economically sustainable growth in order to improve the health, sustainable livelihoods, income and living conditions of the poor majority with more significant equity and self-reliance;
- Ensure that plans for the development and construction of industries have adequate and appropriate waste disposal and pollution control facilities organised to meet international standards;
- Ensure that plans and incentives for voluntary waste disposal are enshrined in the production plans of all industries and
- Promote environmental guidelines and EIA before sites are developed and ensure the application of a monitoring and auditing system for operating industries.

Relevance: This ESIA study for the Malawi – Zambia 400kV interconnector project has been prepared in accordance with the environmental policy requirements.

(b) The National Resettlement and Compensation Policy Guidelines

Regarding land acquisition for electricity infrastructure, the Electricity Act No. 11 of 2019 provides a number of guidelines for the acquisition of land and rights over land for the development of electricity infrastructure. Part III (Sections 22 to 29) of the Act provides clear guidance on land acquisition and compensation to entities or persons affected by electrical infrastructure development such as distribution, transmission and generation projects. Section 22 of the

Electricity Act makes reference to the Lands Acquisition Act Cap 189, Part III (Sections 10, 11 and 12), that deals with the principles of assessing the amount of compensation for the affected assets and the management of disputes. In addition, this Act also stipulates conditions that can lead to compulsory acquisition of land through the office of the Republican President. This Act provides the legal authority to acquire land and for the land to be compensated. The Resettlement Policy of 2024 ensures livelihood restoration and social protection.

However, both the Electricity Act and the Land Acquisition Act do not provide detailed guidance on the resettlement process. Compensation for customary land is guided by the Lands Acquisition Act (CAP 189), which requires payment to persons with interests in land, supported by constitutional provision on prop erty rights and the Resettlement Policy (2024) in livelihoods restoration.

(c) The National Lands Policy of 2021

The National Lands Policy recognises land as a resource of prime importance on which national development depends. Hence, the need to manage it judiciously. Land in Zambia is vested in the Republican President, who holds it in trust for and on behalf of the people. The President may, through the Commissioner of Lands, alienate land to citizens or non-citizens. The vision of the National Lands Policy is to implement an efficient and effective land administration system that promotes the security of tenure, equitable access and utilisation of land for the sustainable development of the country. However, most of the land in Zambia is traditional land under the jurisdiction chiefs.

Relevance: The project under consideration affects about 233 hectares of land and land acquisition will be undertaken in accordance with the National Lands Policy.

(d) The National Health Policy of 2012

The main objective of the National Health Policy is to reduce the burden of disease and increase life expectancy of the Zambian people through the provision of quality and effective health care services. The Policy identifies communicable diseases, such as HIV/AIDS and TB as significant contributors to the disease burden in the country. Occupational Health and Safety is also addressed in the Policy since occupational injuries and health hazards have profound effects on the productivity of the workers as well as their economic and social well-being.

Relevance: Since the Malawi – Zambia 400kV interconnector project is anticipated to have impacts related to communicable diseases and occupational health and safety, the policy measures provided in the National Health Policy will be taken into consideration during project design and implementation.

(e) The National Forest Policy 2014

The vision of the National Forest Policy of 2014 is to attain sustainable management of all types of the forests to enhance forest products and services utilisation that will contribute to climate change mitigation, income generation, poverty reduction, job creation and protection and maintenance of biodiversity. The main objectives of this policy are:

- Manage the country forests to maximize productivity and the developmental potential of the forest resources;
- Empower local communities and traditional leaders to ensure adequate protection and management of forests;
- To improve the role of forests in addressing climate change in order to contribute to reducing its impacts through appropriate mitigation and adaptation measures;
- To increase the participation of the private sector in the development of the forest industry to enhance the contribution of the sector to the growth of the economy;
- To enhance the processing and marketing of forest products and services in order to ensure the optimal contribution of the forest sector to the national economy and the forest industry;
- To put in place measures that will promote sustainable harvesting of wood and production of charcoal to reduce deforestation;
- To strengthen research institutional capacity to provide informed decision-making;
- To strengthen and develop human capacity with extension skills and a service delivery mindset to effectively meet stakeholders' needs;
- To develop and broaden the skills and knowledge of personnel involved in forest management and

development and support training.

Relevance: The project is expected to have impacts to forest resources, thus the Policy is considered relevant.

(f) National Policy on Climate Change, 2016, and the National Adaption Plan, 2023

This National Policy on Climate Change (NPCC) (2016) recognises climate change as a serious challenge to the development of the nation as it affects important sectors of the economy such as energy, agriculture, infrastructure, water, health, fisheries, wildlife and forestry. The Policy was developed to support and facilitate a coordinated response to climate change issues in the country. It enables Zambia to realign its climate-sensitive sectors of the economy, and its society, to meet development goals through adaptation and mitigation interventions.

The National Adaptation Plan (2023) was developed by the Government of the Republic of Zambia to address identified climate related risks and vulnerabilities in various sectors to enhance the country's resilience to the effects of climate change. It also identifies primary hazards and develops medium and long-term adaptation actions to minimise the impacts. The National Adaptation Plan seeks to integrate climate change adaptation measures into the national, sectoral and sub-national planning and budgeting processes.

The **Nationally Determined Contribution (NDC)** (2021) provides an update on Zambia's contribution to achieving the objectives of the Paris Agreement on climate change and it is submitted every five years. It highlights the efforts being made by Zambia to address climate change issues and contribute to the global efforts of limiting global warming. The NDC provides guidance to all levels of governance structures regarding the necessary actions that need to be taken to reduce greenhouse emissions and adapt to climate change impacts by the year 2030.

Relevance: The project under consideration involves clearing vegetation along the OHL corridor. Therefore, appropriate mitigation measures need to be put in place to avoid or minimise its contribution to climate change. The electricity that will be transmitted through this project will help to reduce demand for firewood and charcoal, thereby reducing deforestation, carbon emissions and climate change. In addition, the interconnector is expected to facilitate the discharge of power from renewable energy sources, thus facilitate RE generation in the region.

(g) National Water Policy (2024)

The National Water Policy of 2024 identifies water as a basic natural resource, which sustains all sectors to foster socio-economic development and supporting ecosystems. Water resources provide enormous support to agricultural production, energy generation, mining activities, tourism, domestic use, industrial activities as well as the ecosystem. The Policy identifies several challenges which the country faces in attaining water security and universal access to water supply and sanitation services, in the face of the increasing population. The challenges identified include inadequate water harvesting infrastructure, inadequate water supply and sanitation infrastructure, inadequate legislative and structural reforms, inadequate sector financing, and climate change.

The main objective of the National Water Policy is to achieve national water security and universal access to sanitation services. To achieve these objectives, the Policy aims to promote cross sectorial water resources planning and resource mobilization, water resources and supply infrastructure development, protection of watersheds and legal and institutional reforms.

Relevance: Water resources are not likely to be affected by the project activities, under normal circumstances. However, accidental spills, mainly during construction, may affect water quality. Thus the Policy is discussed here.

(h) National Policy on Wetlands (2018)_

This Policy was formulated in response to the fragmented sectoral policies and Acts. It aims to provide a holistic programme of action to promote the conservation and prudent use of wetland ecosystems. It acknowledges the importance of wetland ecosystems in Zambia in providing major fisheries, and important habitats for various wildlife species.

Relevance: The Policy identifies the spread of Invasive Alien Species, expansion of human settlement, pollution, mining, river damming for hydropower generation and other uses, climate change, genetically modified organisms and uncontrolled water abstraction as the major threats to the wetlands.

(i) The National Gender Policy (NGP) (2023)

The NGP is aimed at ensuring the attainment of gender equality in the development process by redressing the existing gender imbalances. It also provides for equal opportunities for women and men to actively participate and contribute to national development. The policy emphasizes issues of poverty, noting that women and children are differentially affected compared to men. Females are singled out as experiencing more poverty than any other social group in the country, while the HIV and AIDS pandemic and violence against women are exacerbating the situation. The policy addresses gender issues such as poverty, decision making, gender-based violence, HIV and AIDS.

The measures presented in the Policy will enhance equitable distribution of opportunities and national resources between women and men, girls and boys for poverty reduction and national development. This is in line with international, continental and regional commitments which Zambia is a party to.

Zambia has signed the following international governing documents on gender:

- The Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW) in 1984;
- The Beijing Declaration and Platform of Action in 1995;
- The Millennium Development Goals (MDGs) in 2000.

Relevance: The project will aim to provide balanced employment opportunities to women during construction and operation, while it will ensure that the likely influx of foreign personnel during construction will not have negative impacts to women and the local population in general.

2.2 National Environmental Legislation Framework

The legislative responsibility of administering the EIA process is vested in ZEMA, formerly known as the Environmental Council of Zambia (ECZ). This is in line with the Environmental Management Act No. 12 of 2011, Statutory Instrument No. 28 of 1997 –The EIA Regulations. The Agency is mandated to:

a) Identify types of projects, plans and policies for which environmental impact assessments are necessary and to undertake or request relevant institutions to undertake such assessments for consideration by the agency.
b) Monitor trends in the use of natural resources and their impact on the environment.
c) Request information on the quantity, quality, and management methods of natural resources and environmental conditions from any individual or organization anywhere in Zambia.
d) Consider and advise the Government on all major development projects at the initial stage and on the effects of any sociological or economic development on the environment.

In addition to the above, and the Ministry of Green Economy and Environment in consultation with ZEMA, is empowered to make regulations by statutory instrument for any matter that could be prescribed under the Act on the protection of the environment.

Environmental Management Act, N°. 12 of 2011

The principal legislation governing environmental management in Zambia is the Environmental Management Act (EMA) of 2011. The Act provides for the sustainable management of natural resources, protection of the environment, and the prevention and control of pollution. It establishes and empowers the Zambia Environmental Management Agency to provide for and demand for environmental assessments for projects, and to carry out monitoring and inspections.

Relevance: Of particular significance to the project is Section 29 of the Act, which demands that development projects that have an effect on the environment shall not undertake without a written approval of the Agency and shall be implemented in accordance with any conditions imposed in the approval letter. This has necessitated the preparation of this ESIA to key out the impacts of the project and put in place mitigation measures.

Compliance: The ESIA reports for the Malawi- Zambia 400kV Transmission Interconnector project is being prepared before the commencement construction works.

Environmental Management (Amendment) Act, No.8 of 2023

This Act amends several sections of the principal Environmental Management Act of 2011 to enhance environmental protection and management in Zambia. The amendments include:

- Expansion of the functions of the Zambia Environmental Management Agency (ZEMA) in the management of pesticides and toxic substances.
- Domesticates the Kigali Amendment to the Montreal Protocol on substances that deplete the ozone layer to align with internation environmental standards.
- Licensing requirements for manufacturers, exporters and importers of pesticides.
- New penalties for failure to conduct Environmental Impact Assessment (EIA) studies, including potential imprisonment.
- Revises the composition of the ZEMA Board.

Relevance: The Act emphasises the need to undertake the EIA and get ZEMA written approval before any project is undertaken. The Act also deals with substances that deplete the ozone layer and other toxic substances.

Compliance: The ESIA study for the Malawi- Zambia 400kV Transmission Interconnector project has been undertaken in compliance to this Act and the associated environmental regulations. The project needs to ensure that ozone layer depleting substances and other toxic substances are not used during project implementation and operation.

The Environmental Management (Environmental Impact Assessment), Regulations, 2026, SI No. 3 of 2026

TThe Environmental Management (Environmental Impact Assessment), Regulations, Statutory Instrument (SI) No. 3 of 2026, Part II (Section 4) states that "A developer who intends to undertake a project that is likely to have an adverse effect on the environment shall submit to the Agency an (a) environmental and social project brief; or (b) environmental and social impact statement". The Zambia Environmental Management Agency evaluates the project scope and the sensitivity of the project area to determine whether an Environmental and Social Project Brief or an Environmental and Social Impact Statement is required.

Relevance:
According to the Environmental Management (Environmental Impact Assessment), Regulations, SI No. 3 of 2026, First Schedule, Class I (B), all transmission power lines above 220kV and more than 1 km long in an environmentally sensitive area or more than 10 km in length in a non-environmentally sensitiv require an ESIA study before undertaking the project.

Compliance: The project has already prepared a Scoping Study which presented the project, identified potential environmental and socioeconomic impacts of the project and proposed Terms of Reference (ToR) for a detailed ESIA to study such impacts and propose the necessary mitigation measures. The ToR was approved by ZEMA. In the present ESIA, all the negative environmental and social impacts likely to result from the project are identified and mitigated in accordance with these regulations.

The Environment Management (Licensing) Regulations (SI 112 of 2013)

There are several parts in this SI giving regulatory powers to ZEMA to control the discharge of water pollutants, air emission pollutants, pesticides and other toxic substances, waste (both municipal and hazardous) and ozone depleting substances in order to safeguard the general health, safety or welfare of persons, animal life, and plant life.

The portions of the regulations that are of relevance to the project are listed below.

a) Part II: Air and Water Pollution Regulations

Relevance*:* During project implementation, the contractor will be handling fuel, oils and other chemical substances, which have to be managed in accordance with the provisions of this Statutory Instrument to avoid emissions into water resources and the ambient environment.

Compliance: The project shall endeavour to prevent and minimise effluent discharge into the environment. Measures to prevent and minimize emissions to the ambient environment shall include servicing of vehicles to ensure minimal exhaust fumes are emitted, periodic dust suppression using water bowsers and limiting on extent of area for vegetation clearing to limit dust emissions.

b) Part III: Waste Management Regulations

Relevance: Section 12 (1) declares that a person who intends to reclaim, re-use, recover, recycle, transport, dispose of, transit, trade in, export waste or collect and dispose of waste from industrial, commercial, domestic or community activities or own, construct or operate a waste disposal site or facility for the permanent disposal or storage of waste shall apply to the Agency for a waste management licence. Section 13 (1) directs that a holder of a waste management licence shall (e) ensure that generated waste is treated and disposed of in an environmentally sound manner. The project will generate construction waste materials such as rock waste, cement bags, plastics, food debris and faecal waste from the construction camps.

Compliance: The project shall ensure that measures for the management of biodegradable and non-biodegradable waste are in compliant with these Regulations and international best practice principles such as the re-use, recycle and reduce principle, where necessary. The project will seek to engage a licensed waste management contractor to transport and dispose the waste.

c) Part IV: Hazardous Waste Regulations

Relevance: Section 21 recognizes that a holder of a hazardous waste licence who stores hazardous waste shall (b) comply with the requirements for storage of dangerous waste prescribed in the Eighth Schedule. The project will generate used oils, oil filters and batteries from construction equipment which will need to be managed in line with these Regulations.

Compliance: Hazardous waste shall be stored in a well bundled, secure and labelled area. Further, a licensed hazardous waste transporter will be engaged to transport hazardous waste to a licensed disposal facility.

Environmental Management (E-Waste Management) Regulations, 2024

The main objectives of these Regulations are to promote the sound management of e-waste to safeguard human health and the environment The regulations call for adherence to established standards and practices in the management of various types of e-waste.

Relevance: It is a requirement under these regulations that any individual or entity that intends to engage in the generation, collection, export, import, storage, transportation, refurbishment, recycling, dismantling or disposal e-waste must obtain an e-waste management license from ZEMA. In addition, it is a requirement that people handling e-waste are provided with appropriate personal protective equipment. It is anticipated that the project will generate e-waste during construction, operation and decommissioning.

Compliance: E-waste shall be stored in a bundled, secure and labelled area. Further, a licensed e-waste transporter will be engaged to transport e-waste to a licensed disposal facility.

The Public Roads Act, CAP 12 of 2002

The Public Roads Act provides for the establishment of the Road Development Agency responsible for the planning, management, and coordination of the road network in Zambia. Part III of this law prohibits road infringement by stipulating dimensions of road reserves within which no construction of any structures is allowed.

Relevance: The project will use existing access roads, where they exist, and open up new access, where necessary.

Compliance: The developer is required to meet road safety standards in the design and implementation of the project. Height clearance at road crossing points as well as the transportation of construction materials and equipment should adhere to the national road safety standards.

The Petroleum Act, CAP 435

This Act, among other things, regulates the conveyance and storage of petroleum, inflammable oils and liquids.

Relevance: During construction, the contractor will transport and store petroleum and inflammable oils and liquids, whose handling is governed by this Act.

Compliance: The ESIA will propose measures to comply with regulations under this law during the transportation of fuel for construction equipment and generators located. The handling of re-fuelling activities will require adherence to environmental, health and safety legal requirements.

The Urban and Regional Planning Act, No. 3 of 2015

This piece of legislation establishes procedures for integrated urban and regional planning in a devolved system of governance so as to ensure multi-sector cooperation, coordination and involvement of different levels of ministries, provincial administration, local authorities, traditional leaders and other stakeholders in urban and regional planning. It also seeks to ensure sustainable urban and rural development by promoting environmental, social and economic sustainability in development initiatives and controls at all metropolitan and regional planning levels.

Relevance: The Act provides for the appointment of regional planning authorities, provincial planning authorities and local planning authorities whose main responsibilities are the preparation, approval of layout plans and revocation of development plans. Section 19 (1) affirms that a planning authority shall prepare an integrated development plan for its area. Section 19 (3) states that an integrated development plan shall be the principal planning instrument to guide and inform all planning and development in the area of the local authority and in all planning decisions of a planning authority. Among other objectives, an integrated development plan shall provide for local economic development to alleviate poverty; environmental management; and protection of ecologically sensitive areas, heritage and cultural sites.

Compliance: Route selection for the proposed OHL will take into consideration all planned developments in Chipata and Vubwi districts. The project site layout plans will need to be approved by the Town Councils in consultation with the respective Provincial Planning Authorities before construction commences in accordance with the provisions of this Act.

The Lands Act, No. 27 of 1995

The Lands Act is the statute governing land administration in Zambia. Land in Zambia is vested in the Republican President, who holds it in trust for and on behalf of the people. The President may, through the Commissioner of Lands, alienate land to citizens or non-citizens. However, most of the land in Zambia is traditional land under the jurisdiction chiefs.

Relevance: The power line traverses both traditional land and state land and consent is required from the land owners, including the chiefs.

Compliance: ZESCO will approach all the relevant institutions and private land owners to acquire the land along the power line corridor.

The Lands Acquisition Act (Chapter 189) of the Laws of Zambia

This Act gives power to the President to compulsorily acquire any property of any description, where deemed desirable or expedient in the interests of the Republic. Part II of the Act describes the procedure for compulsory land acquisition, including notifications to the affected parties, while Part III describes the process for assessing the affected property for compensation purposes.

Relevance: The power line traverses both traditional land and state land and consent is required from the landowners, including the chiefs. However, where channels for amicable negotiation are exhausted, the President may use the provisions of this Act to compulsorily acquire land for the project.

Compliance: ZESCO will approach all the relevant institutions and private landowners to acquire the land along the power line corridor and compensation will be paid to the affected people.

The Local Government Act, No. 2 of 2019

The Act provides for the establishment of Councils in districts, the functions of local authorities and the local government system. Some of these functions relate to pollution control and protection of the environment. The main functions of the Public Health Department of the local authority include solid waste management, food control services, and disease control.

Relevance: The proposed transmission project will pass through Chipata and Vubwi districts. Hence, the developer and the contractors are required to observe all the applicable by-laws related to food safety, disease control, workers living conditions and environmental protection.

Compliance: The project shall recognise the authority of the local authorities and will comply with the specifications and any relevant by laws set up by the affected local authorities.

Occupational Health and Safety Act of 2010

The Act establishes the Occupational Health and Safety Institute and provides for its functions; provides for the establishment of health and safety committees at workplaces and for the health, safety and welfare of persons at work. Most important is the provision regarding the protection of persons, other than persons at work, against risks to health or safety arising from, or in connection with, the activities of persons at work.

Relevance: Section 16(1) declares that an employer shall ensure, so far as is reasonably practicable, the health, safety and welfare of the employees at a workplace by, among other measures;

- **a)** providing for measures to deal with emergencies and accidents, including adequate first-aid arrangements;
- **b)** providing at the employer's expense all appropriate protective clothing or equipment to be used in the workplace by employees, who in the course of employment, are likely to be exposed to the risk of bodily injuries, and adequate instructions in the use of such protective clothing or equipment.

Construction activities shall expose workers to occupational health and safety risks due to factors such as operation of equipment, handling of materials and exposure to construction site hazards.

Compliance: The project will develop, as part of the Environmental Management Plan, occupational health and safety procedures to minimise occupational health and safety risks and promote employee welfare at the workplace. The contractor will be obliged to provide his workers with appropriate Personal Protection Equipment (PPEs).

The Public Heath (Infected Areas) (Corona Virus Disease 2019) Regulations, SI Number 22 of 2020

The Public Health (Infected Areas) (Corona Virus Disease 2019) Regulations provides, among many others, the definition of Covid-19, conveyance, infected area, and unsanitary conditions.

Relevance: The project will be employing different types of people from various backgrounds and locations where the disease might have occurred, thereby causing a severe threat of transmitting the disease to other workers.

Compliance: The project will ensure adherence to all the provisions of the statutory instrument in order to provide the health of all the employees on the project site.

The Forests Act, No. 4 of 2015

An Act to provide for the establishment and declaration of National Forests, Local Forests, joint forest management areas, botanical reserves, private forests and community forests; provide for the participation of local communities, local authorities, traditional institutions, non-governmental organizations and other stakeholders in sustainable forest management; provide for the conservation and use of forests and trees for the sustainable management of forests ecosystems and biological diversity; establish the Forest Development Fund; provide for the implementation of the United Nations Framework Convention on Climate Change and Convention on International Trade in Endangered Species of Wild Flora and Fauna.

Relevance: The Act promotes the sustainable management of forest resources for the sustainability, conservation and preservation of ecosystems and biological diversity in forest areas and open areas.

Compliance: The ESIA report shall recommend appropriate measure to promote and enhance the conservation of forest resources and clearing of vegetation shall only be confined to the wayleave. Tree planting shall be encouraged during project implementation.

The Water Resources Management Act, No. 21 of 2011

The Water Resources Management Act No.21 of 2011 establishes the institutional regulatory framework, including the creation of; the Water Resources Management Authority (WARMA), Catchment Councils and Water Users Associations in line with decentralised governance system. The Act provide for the management, development, conservation, protection and preservation of the water resources and its ecosystems and promotes the adaptation to climate change. The WRMA is also responsible for the domestication and implementation of the basic principles and rules of international law relating to the environment and shared water resources as specified in the treaties, conventions and agreements to which Zambia is a State Party.

Relevance: The Act guards against the discharge or disposal of any pollutant into a water resource.

Compliance: The ESIA report will propose measures that will be undertaken to ensure that activities during the construction and operation of the project do not result in pollution and degradation of water resources in the project area.

The Employment Code Act, No. 15 of 2019

This Act provides legislation relating to the employment of persons. It also spells out the terms of employment (permanent or contractual) and forbids gender discrimination in the recruitment process.

Relevance: The construction and operation phases of the project will involve the employment of skilled and unskilled manpower, and their engagement should follow the provisions of this Act.

Compliance: The project shall ensure that individuals who are employed on the project are of the right age, not forced labour, and there will be no gender discrimination.

The Workers Compensation Act, No. 10 of 1999

This Act makes provision for the establishment and administration of a Fund for the compensation of the workers disabled by accidents to, or diseases contracted by, such Workers in the course of their employment, and for the payment of compensation to dependents of Workers who die as a result of such accidents or diseases; for the payment of contributions to such Fund by employers; for the grant of pensions and allowances to certain dependents of Workers who, being in receipt of pensions for such disablement, die from causes not connected with such accidents or diseases.

Relevance: Many employment opportunities will be created and work will involve the use of machinery and equipment that may cause injury to workers during their use or operation.

Compliance: The contractor will make contributions to the Fund on behalf of the workers. In the event of any injury to any person, due compensation shall be provided.

The Public Health Act, No. 22 of 1995

This Act provides for the prevention and suppression of diseases and the general regulation of all matters connected with public health in Zambia. Amongst other things, the Act prohibits anyone from causing a nuisance, where nuisances are given to include amongst others, any collection of water or any cesspit, latrine or urinal found to contain mosquito larvae. In addition, any collection of water, sewage or waste which permits or facilitates the breeding of parasites, insects or other agents which may lead to the infection of people or domestic animals.

Relevance: Temporary camps will be erected during the construction period and adherence to heath regulations is required.

Compliance: Management will ensure that the project site and the construction camps areas are provided with toilets, adequate water supply and other facilitates to keep them in clean and sanitary conditions.

The Factories Act, 1999

The Act regulates the conditions of employment in factories and other places of work as regards the safety, health and welfare of persons employed therein. The Act also provides for the examination and inspection of specific plant and machinery in order to ensure safety. The Factories Inspectorate under the Ministry of Labour and Social Security is the mandated authority under the Act.

Relevance: All places of work as defined under this Act will be deemed a 'factory' where safety, health and general welfare of employees will be required to be upheld.

Compliance: To ensure that the occupational health and safety of employees is upheld during the construction and operational periods, all employees will be trained in health and safety protocols. All employees will be equipped with adequate and appropriate personal protective equipment and the devices, tools and equipment that will be used by the employees will be regularly inspected, maintained and repaired if found to be defective.

The National Heritage Conservation Act No. 23 of 1989 and National Heritage Conservation Commission Amendment Act No. 13 of 1994

The National Heritage Conservation Act establish the National Heritage Conservation Commission (NHCC) and provides for the conservation of ancient, cultural and the natural heritage, relics, and objects of aesthetic, historical, pre–historical, archaeological, or scientific interest. The NHCC is also responsible for enforcing the World Heritage Convention 1992, under which the heritage sites (such as significant waterfalls) are included in the World Heritage list as World Heritage Sites.

Relevance: Construction works on the project may lead to the discovery of ancient heritage or relics which have to be reported to the Commission for identification and conservation

Compliance: During the ESIA study the Consultant shall pay particular attention to establishing the presence of any artefacts or objects of archaeological significance along the project corridor. The Commission will be informed about any findings.

The Roads and Traffic Act No. 2 of 2011

The Act makes provision for the care, maintenance and construction of roads in Zambia, for the control of motor traffic, for the licensing of drivers and motor vehicles, for the compulsory third party insurance of motor vehicles, for the licensing and control of public service vehicles and public services, and for other miscellaneous provisions relating to roads and motor traffic.

Relevance: It is inevitable that during the different phases of the project, a number of vehicles (haulage) will be in operation delivering construction related material, which risk accidents.

Compliance: The Developer and Contractor will ensure that all the vehicles used on the project are licensed, certified to be roadworthy, and insured. All drivers must have the necessary competences and valid licences for the type of vehicles they are driving.

The Standards Act No. 4 of 2017

This is an Act to continue the existence of the Zambia Bureau of Standards and re-define its powers and functions; provide for standardization and quality assurance of products and services through the setting of national standards and provision of conformity assessment services for products and services.

Relevance: The development will require that materials (pipes, sand, stone, cement, machinery and other finished materials), food stuff and drinking water be transported to the site meet the prescribed national standards.

Compliance: All raw materials, drinking water and food staff and pipe works procurement, and all designs and layouts will be in compliance with the Zambia Bureau of Standards.

The Zambia Wildlife Act No. 14 of 2015

This Act provides for the establishment, control and management of National Parks, bird and wildlife sanctuaries and for the conservation and enhancement of wildlife eco-systems, biological diversity and objects of aesthetic, pre-historic, historical, geological, archaeological and scientific interest in National Parks; provide for the establishment, control and co-management of Community Partnership Parks for the conservation and restoration of ecological structures for non-consumptive forms of recreation and environmental education; provide for the sustainable use of wildlife and the effective management of the wildlife habitat in Game Management Areas; enhance the benefits of Game Management Areas to local communities and wildlife; involve local communities in the management of Game Management Areas; provide for the development and implementation of management plans; provide for the regulation of game ranching; provide for the licensing of hunting and control of the processing, sale, import and export of wild animals and trophies; provide for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the Convention on Wetlands of International Importance especially as Waterfowl Habitat, the Convention on Biological Diversity, the Lusaka Agreement on Cooperative Enforcement Operations Directed at Illegal Trade in Wild Fauna and Flora and other international instruments to which Zambia is party; repeal the Zambia Wildlife Act, 1998; and provide for matters connected with, or incidental to, the foregoing.

Relevance: There may be wildlife species in the project area. Hence, the provisions of the Act need to be followed for the conservation of wildlife in the project area.

Compliance: Appropriate measures will be recommended in the Environmental Management Plan to boost wildlife conservation in the project area

Mines and Minerals Development Act (MMDA) NO.11 of 2015

The MMDA provides for the administration of the mining industry through the Ministry of Mines and Mineral Development. The Act outlines the different mining permits that can be obtained under this act i.e. small- and large-scale exploration or mine licenses, small or large-scale gemstone licenses, artisanal and mineral processing licenses. The Act also provides for royalties and taxes applicable to the sector.

Relevance: Project implementation will involve establishment of borrow pits and quarrying for aggregate stones by the contractor, which have to comply with the MMDA.

Compliance: The mining of borrow pits and quarrying for aggregate stones by the contractor for construction works have to comply with the MMDA.

Anti-Gender Based Violence Act (2011)

The Anti-Gender Based Violence Act of 2011 is a major step towards the fight against gender-based violence (GBV) in Zambia. GBV is defined as a hindrance to the attainment of gender equality and the realisation of the social and economic goals of Zambia, as it erodes the confidence of the survivors that they can contribute to development efforts. Gender-based violence (GBV) in Zambia takes the form of physical, mental, social or economic abuse against a person because of that person's gender and includes violence that may result in physical, sexual or psychological harm and suffering to the victim. It may also include threats or coercion, or the arbitrary deprivation of liberty, whether in public or private life.

Relevance: There is the possibility of GBV and sexual abuse to occur among the workers. Hence, this Act is relevant.

Compliance: The project will enforce the provisions of the GBV Act to ensure that issues of GBV are adequately addressed at construction sites among the workers and between the workers and the communities.

Arbitration Act No. 19 of 2000

This Act provides for arbitration in cases where the landowner/occupier does not agree with the amount of compensation being offered. Under section 12 (2) of the Act, the parties to arbitration are free to determine the procedure for appointing the arbitrator or arbitrators. Section 12 (3) (b) states that if the parties are unable to agree on the arbitration, another arbitrator shall be appointed, upon request of a party, by an arbitral institution.

Relevance: There may be cases where the developer and the affected entity or person fail to agree on compensation. Such cases will be handled according to the provisions of this Act.

Natural Resources Conservation Act, Cap 315, 1970

The Act relates to the monitoring of natural resource conservation and utilization outside forest reserves and national parks, as well as control of bush fires and powers of Minister to make regulations.

Relevance: The Act calls for the conservation and sustainable utilisation of all natural resources, including forests and wildlife.

Compliance: Appropriate measures will be put in place by the project to ensure the protection and conservation of natural resources in the project area.

Gender Equity and Equality Act, 2015

The Act promotes gender equality and elimination of economic and social discrimination in Zambia. The Minister, through consultations with relevant Ministers, implements special measures on gender equity and equality to meet challenges faced by women living in rural and peri-urban areas. As the Anti-Gender-Based Violence Act, this Act describes the type of discrimination that women face, including GBV, and describes the rights of GBV victims and the procedure for filing complaints.

Relevance: The Project implementation will involve men, women, the youth and physically challenged people. All the people should be treated equally without economic and social discrimination and abuse.

Compliance: All the people shall be treated equally without economic and social discrimination and abuse (GBV).

The Electricity Act No. 11 of 2019

The Electricity Act of 2019 repeals and replaces the Electricity Act of 1995. It provides for the regulation of the generation, transmission, distribution and supply of electricity in order to enhance the security and reliability of electricity supply.

Part III (Sections 22 to 29) of the Act gives clear guidance on land acquisition and the provision of fair and adequate compensation to entities or persons affected by development of electrical infrastructure such as distribution, transmission and generation projects. The Act indicates the need to notify the affected parties and obtain their consent before any works are undertaken on private property.

Relevance: The project involves acquiring land and other property to pave way for the construction works. Therefore, land acquisition and compensation will be done according to the provisions of this Act.

Compliance: The project involves acquiring land and other property to pave way for the construction works. Therefore, land acquisition and compensation will be done according to the provisions of this Act.

The Energy Regulation Act No. 12 of 2019

The Energy Regulation Act of 2019 repeals and replaces the Energy Regulation Act of 1995. The Act provides for the regulation and licensing of enterprises in the energy sector.

Relevance: The project under consideration involves construction and operating a transmission power line, which is subject to the provisions of this Act.

Compliance: The project involves wayleave acquisition and maintenance, which shall be undertaken in accordance with the Energy Regulation Board Wayleave Code of Practice of 2022.

Green Economy and Climate Change Act (2024)

The Green Economy and Climate Change Act provides the legal framework for climate change adaptation and disaster risk reduction, while promoting climate change mitigation, low-emission development, and the transition towards a green economy.

The Act also regulates carbon markets, provides for environmental and social safeguards in climate change actions, and establishes the Climate Change Fund.

A summary of legal and institutional framework is illustrated in the Table 2-1S below.

Table 2-1 Summary of Legal and institutional Management Framework

Legal Instrument	Main Provisions	Responsible Institution	Relevance to the Project
Environment and Natural Resources Management			
Environmental Management Act No.12 of 2011, Environmental Management (Amendment) Act No. 8 of 2023, and all associated regulations	To protect the environment and control pollution, to provide for the health and welfare of persons, animals, plants, and the environment. The Act covers water, air, waste, pesticides and toxic substances, noise, ionizing. radiation, and natural resources, etc.	Zambia Environmental Management Agency (ZEMA), Ministry of Green Economy and Environment	EIA approval decision letter is necessary for project implementation and environmental monitoring to continue throughout the project phases
The Petroleum Act, CAP 435	This Act, among other things, regulates the conveyance and storage of petroleum, inflammable oils and liquids in a safe and environmentally friendly manner.	Energy Regulation Board (ERB), Ministry of Energy	The contractor will transport and store petroleum and inflammable oils and liquids as prescribed.
Lands Management and Local Administration			
The Lands Act Cap. 288 of 1995	Controls the alienation of land for various uses by developers.	Ministry of Lands and Natural Resources	Governs the acquisition of land to be used for the development of the transmission line
The Lands Acquisition Act (Chapter 189) of the Laws of Zambia	Part II of the Act describes the procedure for compulsory land acquisition, including notifications to the affected parties, while Part III describes the process for assessing the affected property for compensation purposes.	Ministry of Lands and Natural Resources	All the landowners will be approached to acquire the land along the power line corridor and compensation will be paid to the affected people.
The Urban and Regional Planning Act, No. 3 of 2015	Promotes environmental, social and economic sustainability in development initiatives and controls at all metropolitan and regional planning levels.	Ministry of Local Government and Rural Development	All development projects should fit into the development plans of the district and have to be approved by the district authorities.
The Local Government Act, No. 2 of 2019	Mandates the local authorities with the functions related to pollution control, protection of the environment, including solid waste management, food control services, and disease control	Ministry of Local Government and Rural Development	The Project will observe all the applicable by-laws related to food safety, disease control, workers living conditions and environmental protection.
Health and Safety			
Occupational Health and Safety Act of 2010	The Act provides for the protection of persons, other than persons at work, against risks to health or safety arising from, or in connection with, the activities of persons at work.	Ministry of Labour and Social Security	Measures to deal with emergencies and accidents, including adequate first-aid, personal protective equipment will be put in place to safeguard the welfare of the workers.
The Public Health Act, No. 22 of 1995	Any collection of water, sewage or waste which permits or facilitates the breeding of parasites, insects or other agents which may lead to the	Ministry of Health	Camp sites will be provided with toilets, adequate and safe water supply and other

Legal Instrument	Main Provisions	Responsible Institution	Relevance to the Project
	infection of people or domestic animals is prohibited.		facilitates.
The Factories Act, 1999	The Act promotes the safety, health and welfare of the workers. It also provides for the examination and inspection of specific plant and machinery in order to ensure safety.	Ministry of Labour and Social Security	All work sites will ensure that the occupational health and safety of employees is upheld. All employees will be provided with appropriate personal protective equipment.
The Public Roads Act, CAP 12 of 2002 and The Roads and Traffic Act No. 2 of 2011.	Provides for the planning, management, and coordination of the road network in Zambia. It also prescribes the road reserves within which construction of any structures is not allowed. The_Roads and Traffic Act No. 2 of 2011 provides for the licensing of drivers and motor vehicles and the compulsory insurance of motor vehicles.	Road Development Agency under Ministry of Infrastructure, Housing and Urban Development	The Project will meet road safety standards, such as height clearance at road crossing points. All the project vehicles shall be licensed and insured. All the drivers will be licensed.
Natural Resources Management			
Natural Resources Conservation Act, Cap 315, 1970	The Act relates to the monitoring of natural resource conservation and utilization outside forest reserves and national parks, as well as control of bush fires.	Ministry of Lands and Natural Resources	Appropriate measures will be put in place to ensure the protection and conservation of natural resources in the project area, including water bodies, forests and wildlife.
The Forests Act, No. 4 of 2015	Provide for the establishment, management and protection of National Forests, Local Forests, joint forest management areas, botanical reserves, private forests and community forests. It promotes the participation of all stakeholders in sustainable forest management.	Department of Forestry, under Ministry of Green Economy and Environment.	The project shall put in place appropriate measures to promote and enhance the conservation of forest resources and clearing of vegetation shall only be confined to the wayleave.
The Zambia Wildlife Act No. 14 of 2015	To control and manage National Parks, Game Management Areas (GMAs) and bird sanctuaries for the purposes of conserving and enhancing wildlife ecosystems.	Department of National Parks and Wildlife under Ministry of Tourism	The Project will follow the provisions of the Act to the conservation and protection of wildlife and forest resources in the project area.
Mines and Minerals Development Act No.11 of 2015	It provides for the administration of the mining industry and outlines the different mining permits that are applicable. It also provides for royalties and taxes applicable to the sector.	Ministry of Mines and Mineral Development	The contractor will acquire the necessary permits for the establishment of borrow pits and quarries for sand and aggregate stones.
Employment and Employee Welfare			
The Employment	The Act spells out the terms of	Ministry of Labour	The project shall ensure

Legal Instrument	Main Provisions	Responsible Institution	Relevance to the Project
Code Act, No. 15 of 2019	employment (permanent or contractual) and forbids gender discrimination in the recruitment process.	and Social Security	that workers on the project are of the right age, not forced labour, and there will be no gender discrimination.
The Workers Compensation Act, No. 10 of 1999	Provides for the compensation of the workers disabled by accidents or diseases contracted in the course of their employment. It also makes it mandatory for employers to pay contributions to the Fund for the above purpose.	Workers' Compensation Fund Control Board under Ministry of Labour and Social Security	The contractor shall make contributions to the Fund. In the event of any injury, sickness or death, due compensation shall be provided by the Fund from the employer's contributions
The National Pensions Scheme Act No.7 of 2015	Obliges all employers to register and make pension contributions to the National Pension Scheme Authority (NAPSA).	National Pension Scheme Authority under Ministry of Labour and Social Security	All the workers to be employed on the project will be registered and paid up on their contributions to NAPSA.
Standards			
The Standards Act No. 4 of 2017	Provides for standardization and quality assurance of products and services through the setting of national standards and provision of conformity assessment services for products and services.	Zambia Bureau of Standards, Ministry of Commerce, Trade and Industry	All raw materials, drinking water and food staff and pipe works, and all designs and layouts will be incompliance with the prescribed Standards.
Energy Regulation			
The Energy Regulation Act No. 12 of 2019	The Act provides for the regulation and licensing of enterprises in the energy sector.	Energy Regulation Board under Ministry of Energy	Wayleave acquisition and maintenance shall be undertaken in accordance with the Energy Regulation Board Wayleave Code of Practice of 2022.
The Electricity Act No. 11 of 2019	It regulates the generation, transmission, distribution and supply of electricity in order to enhance the security and reliability of electricity supply. It gives guidance on land acquisition and the provision of fair and adequate compensation to entities or persons affected by the project.	Ministry of Energy	Land acquisition and compensation will be done according to the provisions of this Act.
Gender			
Gender Equity and Equality Act, 2015	Promotes gender equality and elimination of economic and social discrimination.	Ministry of Community Development and Social Services	All the workers shall be treated equally without economic and social discrimination and abuse.
Anti-Gender Based Violence Act (2011)	The Act is aimed at eliminating all forms of GBV and abuse in work places and in the communities.	Ministry of Community Development and Social Services	The project will ensure that issues of GBV are adequately addressed among the workers and between the workers and the communities.
Cultural Heritage			

Legal Instrument	Main Provisions	Responsible Institution	Relevance to the Project
The National Heritage Conservation Act No. 23 of 1989	Provides for the conservation of ancient, cultural and the natural heritage, relics, and objects of aesthetic, historical, pre–historical, archaeological, or scientific interest.	National Heritage Conservation Commission, Ministry of Tourism	Construction works may lead to the discovery of ancient heritage or relics which have to be reported to the Commission for identification and preservation.

2.3 Organisational Framework

The key national regulatory institutions and agencies pertinent to this project include:

- Ministry of Green Economy and Environment
- Ministry of Lands and Natural Resources
- Ministry of Labour and Social Security
- Ministry of Health
- Ministry of Local Government and Rural Development
- Ministry of Community Development and Social Services
- Ministry of Infrastructure, Housing, and Urban Development
- Zambia Environmental Management Agency (ZEMA)
- Energy Regulation Board (ERB)
- Local Authorities (Chipata and Vubwi Councils) and District Administration
- Department of National Parks and Wildlife
- Department of Forestry
- Department of Mines and Mineral Development
- National Heritage Conservation Commission
- Civic and Traditional leaders along the transmission line corridor
- The Contractor
- ZESCO

The roles and responsibilities of each of these statutory bodies, as they relate to this project, are detailed below.

a) Ministry of Green Economy and Environment

The Ministry of Green Economy and Environment is mandated to promote the effective and sustainable use of the environment, while at the same time, facilitating support for adaptation to, and mitigation of the effects of climate change. It is responsible for coordinating and facilitating the development and implementation of policies, programs and projects for the management and conservation of the environment in order to ensure sustainability. All project activities shall abide by the Ministry's policies to minimise pollution and deforestation, which contribute to climate change.

b) Ministry of Lands and Natural Resources

The Ministry is responsible for managing land resources and ensuring sustainable utilization of natural resources in Zambia. The Ministry oversees land registration, allocation, and management to ensure equitable access to land for all citizens and promotes the protection Zambia's biodiversity and natural resources, including wetlands and other critical ecosystems. The project will ensure adherence to the appropriate policies and legislation for the protection and conservation of natural resources in the project area, including water bodies, forests and wildlife.

c) Ministry of Labour and Social Security

The Ministry of Labour and Social Security (MLSS) is responsible for formulating and administering of policies as well as regulating activities in the labour and employment sector in order to enhance the sectors' contribution to sustainable social and economic development for the benefit of the people of Zambia. It is responsible for the administration and management of labour issues through its departments, i.e. Labour Inspectorate, Productivity, Social Security, Labour and Employment, Industrial Relations, and Occupational Health. The project is required to comply with all the legal provisions relating to labour and employment.

d) Ministry of Health

The core mandate of the Ministry is to improve the health and wellbeing of the Zambia population. It has programmes for prevention of morbidity and mortality. It also operates health care facilities in all the districts in the country. The project will benefit from the health facilities in the project area and will also comply with the health regulations for the wellbeing of the project workers and the local communities.

e) Ministry of Local Government and Rural Development

The Ministry is charged with the responsibility of promoting a decentralised and good local governance system, facilitating delivery of quality municipal services in order to contribute to sustainable socio-economic development. The Ministry oversees the implementation of delegated functions and responsibilities by the local authorities and oversee. The Ministry is also responsible for Urban and Regional Planning in local authorities. The project activities and infrastructure shall not adversely interfere with the integrated development plans of the Chipata and Vubwi districts.

f) Ministry of Community Development and Social Services

It provides basic social protection services (livelihood and empowerment) to the poor and the vulnerable people of the society aimed at enhancing human development and accelerating national development through the provision of equitable social protection services for inclusive sustainable human and community development, adhering to its core values of human dignity, confidentiality, teamwork and partnership, integrity, and impartiality. The project will complement the efforts of the Ministry by providing basic social assistance to the project affected persons and communities.

g) Ministry of Infrastructure Housing and Urban Development

The Ministry of Infrastructure, Housing and Urban Development (MIHUD) is responsible for overall policy formulation and monitoring of the infrastructure developments. The Ministry oversees the construction and civil engineering activities to the extent that they should not adversely affect the environment. The Government Valuation Department (GVD), located in the Ministry of Infrastructure, Housing and Urban Development. GVD is responsible for the preparation of Valuation Reports upon request from a user Ministry or Institution such as ZESCO. The Valuation reports form a basis for the fair compensation of project affected persons that may have their structures affected by the construction of the transmission line project. Further GVD will play a big role in the resolution of disputes relating to the valuation amounts as part of the grievance redress mechanism.

h) Zambia Environmental Management Agency (ZEMA)

ZEMA is empowered under the Environmental Management Act (EMA), No. 12 of 2011 to ensure that major developmental activities in Zambia adhere to the provisions of the Environmental Impact Assessment (EIA) Regulations of 1997. In accordance with the Second Schedule (Regulation 7(2)), Item 8 on Electrical Infrastructure, an EIA is required for transmission lines at 220 kV and above and exceeding 1 km in length. Upon the successful conclusion of the EIA, ZEMA issues a Decision Letter to either approve or disapprove such a project. During project implementation, ZEMA is mandated to inspect the project site to check for compliance to the provisions of the Environmental Management Plan of the project and EIA Regulations.

i) The Department of National Parks and Wildlife

The mandate of the Department is to protect and conserve Zambia's wildlife and improve the quality of life among communities in the wildlife estates, and it is under the Ministry of Tourism and Arts. The presence of the project contract workers could provide a market for game meat; therefore, the Department will play an important role to mitigate against illegal wild animals' offtake through sensitisations to the workforce on the provisions of the Wildlife Act and prevention of the contractor workers providing a market for illegal game meat. The Department will also be available to rescue which wildlife (mammals, birds and reptiles) that may require refuge.

j) The Department of Forestry

Forestry Department is responsible for the management, protection and conservation of forests and forest resources in order to ensure their sustainable utilization and management for socio-economic development. The Department is under Ministry of Green Economy and Environment. The project activities will result in the removal of some vegetation (including trees), which will have to be compensated for by planting replacement trees. The Department of Forestry will play a key role in raising of tree nurseries, work with the community and other stakeholders who will be involved in the compensatory tree planting programme.

k) Mines and Minerals Development Department (MMDD)

The cadastre Office at the Ministry of Mines and Minerals Development, under the Department of Mines and Minerals is responsible for issuing mining licences. The project will require industrial minerals inputs like gravel, laterite and stone aggregate for the civil works on the project. These materials have to be sourced locally and mined under licences for borrow material extraction and quarrying operations. The mining licence stipulates the environmental clearance, mining methods and the safe use of explosives and other hazardous substances.

l) Energy Regulation Boards

Before commissioning the proposed transmission power line, ZESCO is required to obtain an operating licence from the Energy Regulation Board.

m) National Heritage Conservation Commission

The Commission is mandated to monitoring and management of all identified cultural and archaeological sites in the area as well as to manage chance-find heritage artefacts.

n) Local Authorities (District Councils) and District Administration

Local Councils and the District Administration offices are responsible for local policy matters, economic development, resolution of local conflicts and the provision of leadership in their respective areas. City and District councils and District Administration are key players in the mobilisation of local people's participation in developmental programmes such as the proposed project. Further, the local authorities and the District Commissioner's office may play an important role in the recruitment of workers on the project.

o) Civic Leaders and Traditional Leaders

Civic leaders (Ward Councillors and Members of Parliament) and traditional leaders (Chiefs, Headmen and Indunas will play an important role in the resolution of local conflicts that may arise during the project life cycle. They provide leadership on various aspects such as community mobilisation of the local people's participation in developmental programmes such as the proposed project. Further, the civic and traditional leaders will play an important role in the recruitment of workers on the project.

p) ZESCO Limited

ZESCO will be responsible for the overall management, supervision and execution of the Project through a Project Implementation Unit (PIU) that will be established. ZESCO shall hire a Project Management Consultant (PMC) for the design and supervision of the proposed construction works. ZESCO will procure the Contractor following the Zambian Government and financiers' procurement policies for carrying out the construction activities of the Project. The specific role of the PIU shall be to:

- Preparing the Environmental, Social, Health and Safety management plans in accordance with the ESMP;
- Supervise the contractor's work to ensure compliance with the environmental, social, health and safety requirements of the ESMP and that the Contractor develops its own ESMP - consistent with ZESCO's requirements and ESMP - including more detailed procedures, where appropriate, that are tailored to the specific construction methods and equipment the Contractor plans to use. Provide recommendations for implementation of corrective actions for any non-compliances and suggest improvements for contractor's

performance;
- Prepare quarterly progress reports on the implementation of the ESMP for transmission to ZESCO Management and the financiers throughout the project implementation period; and
- ZESCO will implement the RAP in conjunction with respective district local governments of Chipata and Vubwi.

q) Contractor

The Contractor will be responsible for the execution of the construction works and commissioning. Specific roles of the Contractor include, but not limited to, the following:

- Preparing the Environmental, Social, Health and Safety management plans for implementation in accordance with the project ESMP;
- Implement the management plans and corrective actions for any non-compliances that may be identified during monitoring; and
- Prepare quarterly progress reports on the implementation of the project for transmission to ZESCO Management and the financiers throughout the project implementation period;

2.4 International Agreements and Conventions

Zambia has the mandate to ensure that all activities being implemented within the country do not only comply with the local legislation but also fits well with international requirements. Zambia is party to more than thirty International and Regional Conventions and Protocols. The most relevant environmental conventions in relation to the undertaking include:

- Convention dealing with the Protection of the World Cultural and Natural Heritage (1972) and ratified by Zambia in 1982.
- Statutes of the International Union for the Conservation of Nature and Natural Resources (IUCN).
- Convention on International Trade in Endangered Species of the wild fauna and flora (CITES), 1993.
- Ramsar Convention on wetlands of international importance (1971) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979).
- Zambia has also ratified the Basel Convention (1994) which regulates transboundary movements of hazardous wastes.
- Zambia has ratified all 10 International Labor Organization's (ILO) Fundamental Conventions, on:
  - Freedom of association (convention 87)
  - Elimination of forced and compulsory labour (conventions 29 and 105)
  - Elimination of discrimination in respect of employment and occupation (conventions 100 and 111)
  - Abolition of child labour (conventions 138 and 182)
  - Occupational Health and Safety (conventions 155 and 187)
  - Right to organise and collective bargaining (convention 98)

Some of the conventions are discussed below.

(a) African Convention on the Conservation of Nature and Natural Resources, 1968 (revised 2003)

This convention advocates for the conservation and sustainable management of biodiversity, with a particular focus on critical ecosystems such as lakes and rivers.

Relevance: The project has significant implications for soil preservation, water resources, and the protection of local flora and fauna.

Compliance: The project will implement mitigation measures in line with the convention's principles to prevent project-induced soil erosion and anthropogenic impacts that could lead to the dominance of single species.

(b) The Convention on Biological Diversity, 1992

Originating from the Rio Agenda 21, this convention emphasizes the conservation and protection of biodiversity globally. It establishes principles for biodiversity management strategies, including specific measures to address the threat of invasive species. The convention also integrates principles of equity and intellectual property rights in line with Agenda 21.

Relevance: The project's construction phase involves the clearing of vegetation, which directly impacts the local biodiversity.

Compliance: The project will strictly adhere to the convention's provisions, ensuring that biodiversity in the area is preserved and protected throughout its lifecycle.

(c) United Nations Framework Convention on Climate Change, 1992, and the Kyoto Protocol and Paris Agreement

The Convention rallies parties to take action to reverse anthropogenic factors responsible for the accelerated climatic variations seen through changing temperatures due to an accelerated build-up of Green House Gases (GHGs) resulting from unsustainable industrialization models or technologies.

Relevance: Evidence of climate change is now common knowledge. The project may contribute to climate change due to increase in the emissions from the machinery, dust generation and tree removal during construction phase.

Compliance: The project will act responsibly starting from the design stage to void carbon dioxide emissions and use best technologies to reduce its emissions and impacts in regard to climate change. Most importantly, the removal of trees will be avoided, and were necessary minimised and trees removed compensated for.

(d) Stockholm Convention on Persistent Organic Pollutants, 2004

Stockholm Convention on Persistent Organic Pollutants is an international environmental treaty, signed in 2001 and effective from May 2004, that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs). POPs are defined as “chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment”. Key elements provided for in Articles 1, 3, 5, 6, and 11 of the Convention include the requirement that developed countries provide new and additional financial resources and measures to eliminate production and use of intentionally produced POPs, eliminate unintentionally produced POPs where feasible, and manage and dispose of POPs wastes in an environmentally sound manner.

Relevance: Transformers and other electrical equipment use industrial oil for cooling and lubrication, which may contain POPs.

Compliance: The project will ensure that use of POPs in electrical equipment is not allowed to meet the requirements of this protocol.

(e) Ramsar Convention

The general objective of the Ramsar Convention is to curtail the loss of wetlands and to promote prudent use of all wetlands. The convention addresses one of the most important issues in Southern Africa, namely the conservation of water sources and use of the natural and the human environments in an intergenerational equitable manner.

Relevance: The project may bring about surface and underground water pollution and, therefore the convention will be adhered to.

Compliance: The effluent prone areas will be made of concrete to ensure that all the spillages are contained before contaminating the underground water. The machines will be installed and maintained on concrete bases.

(f) Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal

The objective is to control import and export of hazardous wastes. It also aims at ensuring that any trans-boundary movement and disposal of hazardous waste, when allowed, is strictly controlled and takes place in an environmentally sound and responsible manner.

Relevance: Hazardous wastes may be generated and disposed of during the construction and operation phases of the project.

Compliance: Maximum control measures shall be put in place to ensure that their transportation and disposal is done in accordance with provisions of this Convention.

(g) Convention on Migratory Species and the African – Eurasian Water Bird Agreement

Like other migratory species, water birds cross several international borders during their migration, facing a wide range of threats. Without international cooperation, conservation efforts of one country can be meaningless if these birds are not protected in another country.

Relevance: - These species require protection in accordance with this Convention.

Compliance: Maximum measures will be put in place to ensure that workers do not kill any birds around on the project site.

(h) International Labour Organisation (ILO) Conventions:

Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87): The Convention provides rights to labour unions to organise and operate autonomously for furthering and defending workers' interests through collective bargaining and collective action.

Right to Organise and Collective Bargaining Convention, 1949 (No. 98): Provides freedom and protection to the workers to join a trade union and it also promotes voluntary collective bargaining and taking collective action.
Forced Labour Convention, 1930 (No. 29): Obliges all member states to completely stop forced or compulsory labour in all forms.
Abolition of Forced Labour Convention, 1957 (No. 105): It gives an obligation to member states to ensure that forced labour is abolished by enacting local legislations that outlaws forced labour.

Minimum Age Convention, 1973 (No. 138): It prescribes a minimum age of 15 years for employment and encourages member states to set a minimum age according to the prevailing socio-economic set up in their respective countries.

Worst Forms of Child Labour Convention, 1999 (No. 182): It gives member states the duty to identify and take steps to prohibit the worst forms of child labour such as slavery, prostitution, drug trafficking and other dangerous jobs.

Equal Remuneration Convention, 1951 (No. 100): It provides the right to equal renumeration for work of equal value, without any discrimination on grounds of gender.

Discrimination (Employment and Occupation) Convention, 1958 (No. 111):It gives member states the duty to fight discrimination in workplaces on grounds of race, colour, sex, religion, political opinion, place of origin or social status.

Occupational Safety and Health Convention, 1981 (No. 155): It calls for the promotion of safety and health and a conducive working environment. It aims at preventing accidents and injury in workplaces by taking appropriate preventative measures.

2.5 International Environmental and Social Standards

This section establishes the foundation for conducting the Environmental and Social Impact Assessment (ESIA) for the Malawi-Zambia 400 kV Transmission Interconnector Project. The project is committed to meeting international best practices in environmental and social performance by adhering to standards set by key international stakeholders, including Swedfund, the European Investment Bank (EIB), the EU and the World Bank. These standards provide a framework for identifying, assessing, and managing environmental and social impacts and implementing mitigation measures to minimize adverse effects on the environment and communities.

2.5.1 Swedfund's Policy for Sustainable Development

Swedfund, as a development finance institution, is committed to contributing to sustainable development. This involves promoting economic growth, environmental sustainability, and social inclusion in the markets where it operates.

Vision and Mission

- Vision: To contribute to poverty reduction through sustainable investments.
- Mission: To provide risk capital, expertise, and financial support to businesses in developing countries.

Sustainable Investment Principles

- Economic Viability: Ensuring investments are financially sustainable and contribute to long-term economic growth.
- Environmental Responsibility: Minimizing environmental impact by promoting efficient use of resources, reducing emissions, and supporting renewable energy projects.
- Social Inclusion: Upholding human rights, improving working conditions, and fostering gender equality and community development.

Strategic Objectives

- Impact Measurement: Regular assessment of the social, environmental, and economic impacts of investments.
- Transparency and Accountability: Maintaining open communication and reporting on sustainability performance.
- Capacity Building: Strengthening the capabilities of investees to manage sustainability challenges effectively.

Implementation Framework

- Due Diligence: Rigorous screening and evaluation of potential investments for compliance with sustainability criteria.
- Monitoring and Evaluation: Continuous monitoring and periodic evaluation to ensure adherence to sustainability standards and objectives.
- Stakeholder Engagement: Collaborating with stakeholders, including local communities, governments, and other investors, to enhance the sustainability impact.

Environmental and Social Governance (ESG)

- Policy Integration: Embedding ESG considerations into all investment decisions and management processes.
- Risk Management: Identifying and mitigating potential ESG risks associated with investments.
- Compliance: Adhering to international standards and best practices in ESG.

Commitment to International Standards

Aligning with global frameworks such as the United Nations Sustainable Development Goals (SDGs), Paris Agreement, and International Labour Organization (ILO) standards.

Conclusion

Swedfund is dedicated to fostering sustainable development through responsible investments. By integrating economic, environmental, and social considerations into its investment strategy, Swedfund aims to create lasting positive impacts in the communities where it operates.

Relevance: The Swedfund's Policy for Sustainable Development emphasises stringent environmental and social screening and due diligence to identify adverse effects of a project and to put in place appropriate mitigation measure.

Compliance: A detailed environmental and social impact assessment is required before a project is implemented. The Policy also demands transparency and accountability in the throughout the project cycle and demands open communication and reporting on sustainability performance.

2.5.2 European Investment Bank Environmental and Social Standards

The EIB Environmental and Social Standards (2022) set out the underlying principles for sustainable project management, including impact/risk assessment, mitigation strategies, public consultation and performance monitoring. Their relevance to the Project is briefly summarized below[1]:

STANDARD 1: Environmental and Social Impacts and Risks.
This standard establishes the requirement for environmental and social considerations throughout the life of a project through the initial baseline studies and identification of risks and impacts, establishment of management programmes that describe mitigation and performance improvement measures and actions to address identified risks and impacts, stakeholder engagement and application of management system to monitor and improve performance.

STABDARD 2: Stakeholder Engagement
Stakeholder Engagement is defined as an inclusive and interactive process that involves, in varying degrees, stakeholder analysis and engagement planning, timely disclosure and dissemination of/access to information, public consultations and stakeholder participation, and a mechanism ensuring access to grievance and remedy. It outlines the process of engagement and stresses the value of public participation in the decision-making process throughout the preparation, implementation and monitoring phases of a project. The Standard places responsibility on the project developer to ensure the implementation of a transparent and continuous engagement process with project stakeholders.

STANDARD 3: Resource Efficiency and Pollution Prevention
The EIB defines pollution prevention as avoidance of any deterioration in the quality of human health or the environment, and any loss of biodiversity, by avoiding, reducing and, if possible, compensating/remedying significant adverse effects of projects in line by making use of the best available technologies and good practice. The standard deals with an integrated approach to the prevention and control of emissions into air, water and soil, to waste management, to energy efficiency and to accident prevention for the protection of the environment as a whole and therefore, avoiding the shift of pollution from one environmental medium to another. It also calls for efficient use of resources in order to reduce pressures on the environment and climate change.

STANDARD 4: Biodiversity and Ecosystems
Sets out a commitment approach to development that protects and conserves biodiversity, including habitats, species and communities, ecosystem diversity, and genes and genomes, all of which have potential social, economic, cultural and scientific importance that is compatible with maintaining the resilience of ecosystems and their functions and processes in order to achieve at least no net loss of biodiversity and ecosystem services. The Standard calls for the promotion of human rights of the communities that depend on ecosystem services for their livelihoods.

STANDARD 5: Climate Change
Sets out to promote climate-friendly strategies by promoting climate change mitigation projects in various sectors and promoting the adoption of energy efficient solutions in the projects by mainstreaming climate risk considerations generally into the project cycle and to promote adaptation projects or projects with adaptation components and measures, in the interests of long-term sustainability.

STANDARD 6: Involuntary Resettlement
Outlines a policy to avoid or minimize involuntary physical resettlement as a consequence of the project. Where it is unavoidable, it requires suitable measures to mitigate adverse impacts on affected stakeholders, including appropriate compensation for any economic displacement such as loss of subsistence or commercial livelihood. The Standard

[1] EIB ESS 11 is on Intermediated Finance and therefore not relevant to this project. Only the 10 ESS are presented here.

calls for open communication with the affected persons, disclosure of project information and implementation of a Grievance Redress Mechanism.

STANDARD 7: Vulnerable Groups, Indigenous Peoples and Gender
Within the context of EIB operations, individuals and/or groups who are at a higher risk of being unable to anticipate, cope with, resist and recover from project-related risks and/or adverse impacts are considered vulnerable. Vulnerable individuals or groups may include women, children, the elderly, the poor, ethnic, religious, cultural or linguistic minorities, or indigenous groups who may have their land and resources encroached upon by or significantly degraded by a Project. Their languages, cultures, religions, spiritual beliefs, and institutions may also be under threat. The Standard calls for consideration of gender-differentiated impacts and risks of the projects, considering that men, women and the youth are impacted differently and have different capacities to cope with change. It places responsibility on the project promoter to facilitate equitable access to effective mitigation and/or compensation measures as well as project benefits for all the project-affected individuals and groups.

STANDARD 8: Labour Rights
Highlights the need for good labour practices and the use of appropriate codes of conduct as important elements to protect the reputation of firms and ensure high labour productivity. It calls upon the project promoter to develop fair, safe and healthy working conditions based on respect for workers' rights to foster efficiency and labour productivity. This Standard aligns with the rights and principles of the International Labour Organisation (ILO) conventions and the European standards on labour rights. It sets out minimum requirements that the project's policies and procedures shall address, including the fair treatment, non-discrimination and equal treatment and opportunity of workers; no use of forced labour and child labour; freedom of association and collective bargaining; safety and health at work; a sound worker-management relationship; and availability of an accessible and effective means to raise and address workplace concerns.

STANDARD 9: Health, Safety and Security
Highlights the need for access to health, education or social protection arising from exposure to hazards, risks and negative impacts in terms of public health and safety. The standard promotes the protection of the health and safety of employees at work throughout the project life cycle by ensuring safe, healthy, hygienic and secure working and accommodation conditions and, effectively, a working environment that respects and safeguards the right to privacy, and when appropriate, to the enjoyment of the highest attainable standard of physical and mental health of workers and their families. This Standard requires the Project promoter to put in place measures to prevent project-related occurrences such as increased environmental pollution, elevated noise levels the spread of communicable diseases or disproportionate use of violence by private or public security forces. Considerations should also be given to occupational health and safety issues arising in the context of projects.

STANDARD 10: Cultural Heritage
This standard recognizes the significance of cultural heritage as part of individual and collective identity, its central role in supporting the objectives of sustainable development and the promotion of cultural diversity and aims to protect irreplaceable cultural heritage and to provide guidance for protecting cultural heritage throughout a Project's life cycle.

2.5.3 Environmental, Health and Safety Guidelines

The WB Environmental, Health and Safety (EHS) Guidelines were designed to broadly define 'good international industry practice' and set specific minimum design and operating standards (such as for emissions, discharge or exposure limits) in regard to the environment, occupational health and safety, community health and safety, and life cycle impacts including during construction, operation and decommissioning.

The detail in these standards is generally derived from globally recognised sources (such as the World Health Organisation) and are basically intended for application where host government's legislation is either not available or is potentially deficient in regard to good international practice. Stipulated performance levels and measures are "generally considered to be achievable in new facilities by existing technology at reasonable costs".

The General EHS Guidelines are designed to apply to all projects and all sectors, but the detailed requirements can be superseded by sector guidelines, where factors such as facility size, technology and associated impacts merit specific attention. The specific industry sector EHS Guidelines that are applicable to the proposed project include the guidelines on Electric Power Transmission and Distribution.

2.5.4 World Bank Environmental and Social Standards

The World Bank Environmental and Social Framework (2017) sets out the World Bank's commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards[2] that are designed to support Borrowers' projects, with the aim of ending extreme poverty and promoting shared prosperity. This Framework comprises:

- A Vision for Sustainable Development, which sets out the Bank's aspirations regarding environmental and social sustainability;
- The World Bank Environmental and Social Policy for Investment Project Financing, which sets out the mandatory requirements that apply to the Bank; and
- The Environmental and Social Standards, together with their Annexes, which set out the mandatory requirements that apply to the Borrower and projects.

The World Bank Environmental and Social Framework, sets ten Environmental and Social Standards that the Borrower and the project will meet through the project life cycle, as follows:

Environmental and Social Standard 1: **Assessment and Management of Environmental and Social Risks and Impacts**: ESS1 sets out the Borrower's responsibilities for assessing, managing and monitoring environmental and social risks and impacts associated with each stage of a project supported by the Bank through Investment Project Financing, in order to achieve environmental and social outcomes consistent with the Environmental and Social Standards (ESSs).

Environmental and Social Standard 2: Labour and Working Conditions: ESS2 recognises the importance of employment creation and income generation in the pursuit of poverty reduction and inclusive economic growth. Borrowers can promote sound worker management relationships and enhance the development benefits of a project by treating workers in the project fairly and providing safe and healthy working conditions.

Environmental and Social Standard 3: Resource Efficiency and Pollution Prevention and Management: ESS3 recognises that economic activity and urbanisation often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services and the environment at the local, regional, and global levels. The current and projected atmospheric concentration of greenhouse gases (GHG) threatens the welfare of current and future generations. At the same time, more efficient and effective resource use, pollution prevention and GHG emission avoidance, and mitigation technologies and practices have become more accessible and achievable. This ESS sets out the requirements to address resource efficiency and pollution prevention and management throughout the project life cycle consistent with GIIP.

Environmental and Social Standard 4: Community Health and Safety: ESS4 addresses the health, safety and security risks and impacts on project-affected communities and the corresponding responsibility of Borrowers to avoid or minimise such risks and impacts, with particular attention to people who, because of their particular circumstances, may be vulnerable. ESS4 is relevant to the project.

Environmental and Social Standard 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement: ESS5 recognises that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons. Project-related land acquisition or restrictions on land use may cause physical displacement (relocation, loss of residential land or loss of shelter), economic displacement (loss of land, assets or access to assets, leading to loss of income sources or other means of livelihood), or both. The term "involuntary resettlement" refers to these impacts. Resettlement is considered involuntary when affected persons or communities do not have the right to refuse land acquisition or restrictions on land use that result in displacement.

Environmental and Social Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources: ESS6 recognises that protecting and conserving biodiversity and sustainably managing living natural

[2] https://www.worldbank.org/en/projects-operations/environmental-and-social-framework

resources are fundamental to sustainable development. Biodiversity is defined as the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems. Biodiversity often underpins ecosystem services valued by humans. Impacts on biodiversity can therefore often adversely affect the delivery of ecosystem services[3].

Environmental and Social Standard 7: Indi**genous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities**: This standard ensures that the development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods of Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities. ESS7 is also meant to avoid adverse impacts of projects on Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities, or when avoidance is not possible, to minimize, mitigate and/or compensate for such impacts..

Environmental and Social Standard 8: Cultural Heritage: ESS8 recognises that cultural heritage provides continuity in tangible and intangible forms between the past, present and future. People identify with cultural heritage as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. Cultural heritage, in its many manifestations, is important as a source of valuable scientific and historical information, as an economic and social asset for development, and as an integral part of people's cultural identity and practice. ESS8 sets out measures designed to protect cultural heritage throughout the project life cycle.

Environmental and Social Standard 9: Financial Intermediaries: This standard is not applicable as the project does not envision involvement of financial intermediaries.

Environmental and Social Standard 10: Stakeholder Engagement and Information Disclosure: ESS10 recognises the importance of open and transparent engagement between the Borrower and project stakeholders as an essential element of good international practice. Effective stakeholder engagement can improve the environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.

2.6 Triggering of Standards

The Table below demonstrates the relevance of the EIB and WB Environmental and Social Standards to the project.

Table 2-2 Relevance of IFI Environmental and Social Standards to the project

EIB Environmental and Social Standards (2022)	WB Environmental and Social Standards (2017)	Triggering of Standards
ESS 1: Environmental and Social Impacts and Risks	ESS 1: Assessment and Management of Environmental and Social Risks and Impacts	Triggered. The project is likely to have impacts to physical, natural and socioeconomic environment during construction and operation. The present ESIA is prepared to identify, assess and mitigate such impacts.
ESS 2: Stakeholder Engagement	ESS 10: Stakeholder Engagement and Information Disclosure	Triggered. The project needs to engage with stakeholders in a number of occasions in order to inform on project activities, collect necessary information and discuss the concerns of stakeholders. Project information will be disclosed via the Scoping Report and the ESIA. A Stakeholder Engagement Plan (SEP) has been prepared to manage the engagement with stakeholders during project execution
ESS 3: Resource Efficiency and Pollution Prevention	ESS 3: Resource Efficiency and Pollution	Triggered. The project will use resources and materials during its construction phase and will generate emissions and waste

[3] Requirements related to ecosystem services are set out in ESS1

EIB Environmental and Social Standards (2022)	WB Environmental and Social Standards (2017)	Triggering of Standards
	Prevention and Management	streams, which will need to be managed effectively in order to avoid/minimize impacts to the environment.
ESS 4: Biodiversity and Ecosystems	ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Triggered. The project is likely to have impacts to the natural environment during construction and operation.
ESS 5: Climate Change	ESS 3: Resource Efficiency and Pollution Prevention and Management	Triggered. The Project will create infrastructure that enables the integration of future renewable energy projects into the electricity grid, thereby contributing to climate change mitigation. In addition, the project may be affected by climate change (i.e. acute climatic phenomena) and will have to take adaptation measures.
ESS 6: Involuntary Resettlement	ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Triggered. The project is likely to cause physical and economic resettlement to the population along the RoW of the transmission line. A Resettlement Action Plan (RAP) is being prepared under a separate cover.
ESS 7: Vulnerable Groups, Indigenous Peoples and Gender	ESS 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	There are no groups in the Project area that meet the World Bank definition of Indigenous Peoples; therefore, WB ESS 7 is not triggered. However, the Project area includes vulnerable groups and gender-related risks, which are addressed under the relevant provisions of EIB ESS7. In addition, ESS7 protects the rights and livelihoods of vulnerable communities without formally labelling them as indigenous peoples.
ESS 8: Labour Rights	ESS 2: Labour and Working Conditions	Triggered. Several hundred of staff will work on project construction. The project will need to ensure that their labour rights are respected.
ESS 9: Health, Safety and Security	ESS 2: Labour and Working Conditions ESS 4: Community Health and Safety	Triggered. The Health, Safety and Security of project staff and neighbouring communities will need to be safeguarded during project construction.
ESS 10: Cultural Heritage	ESS 8: Cultural Heritage	Triggered. While no known cultural heritage sites are located within the wayleave, construction activities may affect previously unknown archaeological or cultural resources.
ESS 11: Intermediated Finance	ESS 9: Financial Intermediaries	Not triggered. No financial intermediaries are involved in the project.

2.7 Gap Analysis

The gap analysis between the national legislative framework and the international requirements has the objective to define specific topics where stricter requirements and limit values need to be applied, including:

- For environmental issues, if the international framework is stricter in limit values than the national framework, the international standards need to be adopted, and vice versa.
- For resettlement issues, the safeguards which are more beneficial to Affected Persons need to be applied, even if this goes beyond the national requirements, and vice versa.

In such cases, a clear and specific agreement between development partners needs to be defined on how to bridge the gaps.

The EIB ESS and WB ESS applicable to the project and the gap analysis between them and the Zambian legislation are described in the table below.

Table 2-3 Gap analysis between international environmental, social, health and safety (ESHS) safeguards and Zambian legislation

Issue	EIB ESS	WB ESS	Provision of Zambian legislation	Identified gaps	Measures to bridge the gaps
Environmental Impact Assessment	**1. Assessment and Management of Environmental and Social Impacts and Risks:** An ESIA and ESMP need to be prepared according to EIB ESS standards.	**1. Assessment and Management of Environmental and Social Risks and Impacts:** An ESIA and ESMP should be developed to assess the environmental and social risks and impacts of a project throughout the project life cycle	**Environmental Management Act No 12, of 2011,** as amended by **Environmental Management (Amendment) Act, No.8 of 2023** ESIA and ESMP need to be prepared based on the decision by ZEMA (approval of Terms of Reference - ToR).	No gaps.	ESIA and ESMP are being prepared in line with both EIB ESS and WB ESS guidelines and in compliance with ToR approved by ZEMA
Prevention of Pollution	**3. Pollution Prevention and Abatement** All EIB- financed operations should comply with local regulations; but when the EU standards are the most restrictive, the EU regulations should be embraced	**3. Resource Efficiency and Pollution Prevention and Management** WB ESS3 Promotes avoiding or minimizing pollution from project activities and the sustainable use of resources, including energy, water, and raw materials.	**Environmental Protection and Pollution Control Act No. 12 of 1990;** **Environmental Protection and Pollution Control Act No. 13 of 1994;** **Environmental Management (Licensing) Regulations, Statutory No. 112 of 2013;** **Environmental Management Act No. 12 of 2011**	No significant gaps, with the exception of setting noise standards for residential areas	Both EIB ESS and WB ESS have been applied for assessing environmental impacts and formulating management measures. With regards to noise levels, it has been considered not to exceed 55dB from 07:00 to 22:00 and 45 dB from 22:00 to 07:00 for the residential areas.
Protection of Biodiversity	**4. Biodiversity and Ecosystems** Promotes maintaining the integrity of areas important for biodiversity as well as the natural functions, processes, and resilience of ecosystems, with the aim of achieving no net loss or a net gain of biodiversity and ecosystem	**6. Biodiversity conservation and sustainable management of living natural resources:** Fosters the conservation of biodiversity and habitats, the sustainable management of living natural resources and suitable practices that integrate conservation needs and development priorities.	**Zambia Wildlife Act of 2015;** **The Forestry Act of 2015;** **National Biodiversity Strategy and Action Plan**	No significant gaps.	ESIA and ESMP include mitigation measures to minimise risks and impacts to biodiversity.
Climate change	**5. Climate-Related Standards** Require that the project is aligned with EU climate policy.	**3. Resource Efficiency and Pollution Prevention and Management**	**National Policy on Climate Change; National Adaptation Plan (2023); Green**	Minor gap identified. Zambia's climate change policy, planning framework, and	Climate change mitigation and adaptation considerations are addressed through the ESIA, including

Issue	EIB ESS	WB ESS	Provision of Zambian legislation	Identified gaps	Measures to bridge the gaps
		Focuses on avoiding and/or minimizing project-related emissions of short- and long-lived climate pollutants.	**Economy and Climate Change Act (2024)**	legislation provide the overarching basis for climate change adaptation, mitigation, disaster risk reduction, and the transition to a green economy. However, EIB ESS 5 places additional emphasis on the explicit assessment and documentation of project-level climate change mitigation and physical climate risk considerations within project studies.	the assessment of climate-related risks and identification of relevant resilience and mitigation measures. These considerations are reflected in the project design and incorporated into the Environmental and Social Management Plan (ESMP), in line with national legislation and EIB ESS 5 requirements.
Culture and Heritage	**10. Cultural Heritage:** The EIB recognises the significance of cultural heritage as part of individual and collective identity, and its central role in supporting the objectives of sustainable development and the promotion of cultural diversity.	**8. Cultural Heritage** Requires the protection of cultural heritage from adverse impact and suggests it is an integral aspect of sustainable development.	**National Heritage Conservation Commission Act of 1989.**	No gaps	ESIA and ESMP include mitigation measures to minimise risks and impacts to cultural heritage.
Resettlement and Compensation	**6. Involuntary Resettlement:** Projects often necessitate land acquisition, expropriation and/or restrictions on land use, resulting in the temporary or permanent resettlement of people from their original places of residence or their economically affected persons and communities do not have the choice to refuse such displacement, this process is known as involuntary resettlement.	**5. Land acquisition, restrictions on land use and involuntary resettlement (ESS5)** When projects cause involuntary resettlement, they are required to prove timely compensation for loss of assets at replacement cost and assist displaced persons in their efforts to improve, or at least restore their livelihoods and living standards.	**Zambia National Resettlement Policy**	Both EIB and WB standards give consideration to people who do not formally own the piece of land or property while the Zambian guidelines require proof of ownership for the compensation to be fully effected. Both EIB ESS and WB ESS consider economic displacement as a form of involuntary resettlement, requiring the implementation of a RAP. WB ESS require projects to prepare an	Both international guidelines are being followed and squatters will be assisted in resettling by means of a RAP. An additional plan for addressing livelihood restoration will be developed as part of the RAP.

Issue	EIB ESS	WB ESS	Provision of Zambian legislation	Identified gaps	Measures to bridge the gaps
				additional plan when economic displacement is caused, relating to livelihood restoration. Both standards take into consideration minorities and other vulnerable groups requesting that they are effectively consulted and their views are taken into account.	
Rights and Interests of vulnerable groups	**7. Rights and Interests of Vulnerable Groups** Some individuals or groups may be less resilient to the risk and adverse impacts than others. Within the context of EIB operations, individuals and/or groups who are at a higher risk of being unable to anticipate, cope with, resist and recover from project- related risks and/or adverse impacts are considered vulnerable. Vulnerable individuals or groups may include women, children, the elderly, the poor, ethnic, religious, cultural, or linguistic minorities or indigenous groups.	**1. Assessment and Management of Environmental and Social Risks and Impacts:** Requires projects to adopt differentiated measures so that adverse impacts do not fall disproportionately on the disadvantaged or vulnerable so that they are not disadvantaged in sharing development benefits and opportunities resulting from the project.	**Human Rights Commission Act of 1996** Provide for the functions and powers of the Human Rights Commission; to provide for its composition and to provide for matters connected with or incidental to the foregoing. **Gender Equity and Equality Act (2015);** **Anti-Gender-Based Violence Act (2011).**	EIB ESS 7 is specifically for people deemed vulnerable to risks and impacts of the project while the human rights commission protects the rights of all people affected by the project.	EIB ESS 7 will be followed during the preparation of the ESMP and RAP, including in relation to gender issues.
Labour Rights and Protection	**8. Labour Standards** Sound management of human resources and worker relations is key to sustainable business practices.	**2. Labor and Working Conditions:** Fosters the fair treatment, non- discrimination, and equal opportunity of project workers	**The Employment Code Act of 2019;** **Occupational Health and Safety Act (2010);** **workers' compensation act (1999);** **Minimum Wages and Conditions of Employment Act (2012)**	No significant gaps identified. Zambian labour legislation establishes requirements for employment conditions, occupational health and safety, workers' rights, and compensation for work-related injuries. International standards place additional emphasis on	Labour and working condition risks are addressed through the ESIA and ESMP, including requirements for Contractors to prepare and implement an Occupational Health and Safety Plan, Codes of Conduct, worker grievance

GOPA Tech

Issue	EIB ESS	WB ESS	Provision of Zambian legislation	Identified gaps	Measures to bridge the gaps
				contractor management, monitoring of labour conditions throughout the project lifecycle, and formalised grievance mechanisms for workers.	mechanisms, and monitoring of labour conditions during construction.
Health and Safety of employees and the community	**9. Occupational and Public Health, Safety and Security:** Embraces ILO's Guidelines on occupational safety and health management systems, the OSH Framework Directive as well as the UN Guidelines on Business and Human Rights. Stresses the employers' duty of care towards project workers and society, in safeguarding occupational and public health, safety and wellbeing within the area of influence of their operations and at associated facilities.	**2. Labor and Working Conditions** Promotes safety and health at work. **4. Community Health and Safety** Promotes safety and health at work and anticipates and avoids adverse impacts on the health and safety of project-affected communities during the project life cycle, such as minimize community exposure to project-related traffic and road safety risks,	**Occupational Health and Safety Act of 2010; Factories Act; The Public Health Act of 1995; Disaster Management Act No. 13 of 2010**	No significant gaps	ESIA and ESMP include mitigation measures to minimise risks and impacts in terms of health and safety for workers and local communities.
Public Participation	**2. Stakeholder Engagement:** Promotes the right to access to information, as well as public consultation and participation; the right to access to remedy, including through grievance resolution.	**10. Stakeholder Engagement and Information Disclosure:** Requests to build and maintain a constructive relationship with stakeholders by means of effective and inclusive engagement.	**Environmental Management Act No. 12**	There are no significant gaps between these guidelines	All guidelines have been embraced with the development of a Stakeholder Engagement Plan and engagement of stakeholders during both the Scoping and the ESIA phase.

2.8 Corporate Standards and Guidelines

The ESIA Study will take into consideration the following Corporate environmental and social standards developed by ZESCO.

(a) Environmental and Social Impact Assessment, No: BD.15100.SPPR.00002 of 23/05/2016.

The purpose of this Procedure is to provide guidance on how to conduct an effective environmental and social impact assessment study on all ZESCO projects. The Assessment is aimed at prudent identification of positive and negative impacts so as to avoid or mitigate negative impacts, while enhancing the positive ones. This Procedure highlights the various steps taken to assess environmental and social impacts, risks and opportunities of projects. It also provides a planning framework for the following:

i. The possible integration of environmental and social considerations throughout the life cycle of projects (from planning to operation, and even decommissioning);

ii. Provides a framework for effective dialogue with stakeholders through engagement, consultation and disclosure of project-related information on matters that directly affect them;

iii. Offers a framework for the systematic consideration of the environmental and social effects and the formulation of measures to mitigate the negative and enhance the positive ones; and

iv. Identifies mechanisms aimed at implementing management/mitigation measures.

(b) **Resettlement and Compensation Action Plan, No: BD.15100.SPPR.00003 of 23/05/2016**

The purpose of this Procedure is to provide guidance in the planning and execution of involuntary resettlement associated with ZESCO projects and operations. The Procedure will apply to any project and operation that may result in the loss of assets, the impairment of livelihood, or the physical relocation of an individual, household, or community. This Procedure identifies the socio-economic impacts of projects and operations and provides guidance on the mitigation options. It also provides a planning framework for the following:

i. Compliance with local and international resettlement and compensation management regulations and procedures on how to deal with Project Affected Parties (PAPs);

ii. Full and fair compensation of all PAPs where involuntary resettlement is unavoidable; and

iii. Consultation and involvement of all parties affected by involuntary resettlement in the resettlement planning process to ensure that the mitigation of adverse effect as well as the benefits of resettlement are appropriate and sustainable. The ultimate goal of a RCAP is to enable those affected or displaced by a project to be fairly and adequately compensated to improve their standard of living—a goal that requires an examination of social, environmental, and economic conditions beyond simple physical inventories.

(c) **Environmental and Social Management Plan No: BD.15100.SPPR.00005 of 23/05/2016**

The purpose of this Procedure is to provide guidance on how to develop and implement comprehensive Environmental and Social Management Plans (ESMPs) for all ZESCO projects and operations. It also outlines the duties and responsibilities of the Developer and the Contractor with respect to environmental management and protection during construction and operation phases of Projects. The procedure ensures compliance with local and international environmental and social laws, regulations and guidelines. Further, the Procedure provides a framework for the planning, preparation, implementation, monitoring and review of the ESMP.

3 Project Description

3.1 Location

The project area is geographically situated within the Chipata and Vubwi Districts in Eastern Province of Zambia. The area is located between the coordinates of latitudes 13°39'7.626" South to 13°50'50.673" South and longitudes 32°33'27.619" East to 32°54'18.967" East. The proposed power line covers a distance of 46.6 km until the border with Malawi, with a wayleave width of 50m (25 m on both sides of the centre line).

The OHL route in Zambia is shown in the Figure overleaf.

3.2 Nature of the Project

3.2.1 Project Components

The proposed transmission line project will have the following components:

- Construction of the 400kV overhead transmission line between Chipata West Substation and the Malawi border at Mwami, for a length of 46.6 km.
- Expansion of Chipata West Substation to accommodate a new busbar arrangement and associated infrastructure.
- Construction of access roads, where necessary, to allow access of personnel and machinery to the construction corridor.

In addition to the above, the contractor will establish **construction camps** for the workers and **storage yards** for storage of equipment and materials. The location and size of the workers' camps and the yards will be determined by the contractor and ZESCO.

The type of towers proposed for the project is a double circuit lattice tower arranged on a traditional vertical configuration (staked) for both suspension and tension towers (Figure 3-2). The RoW for the line is 50m, 25m each side from the centre of the tower.

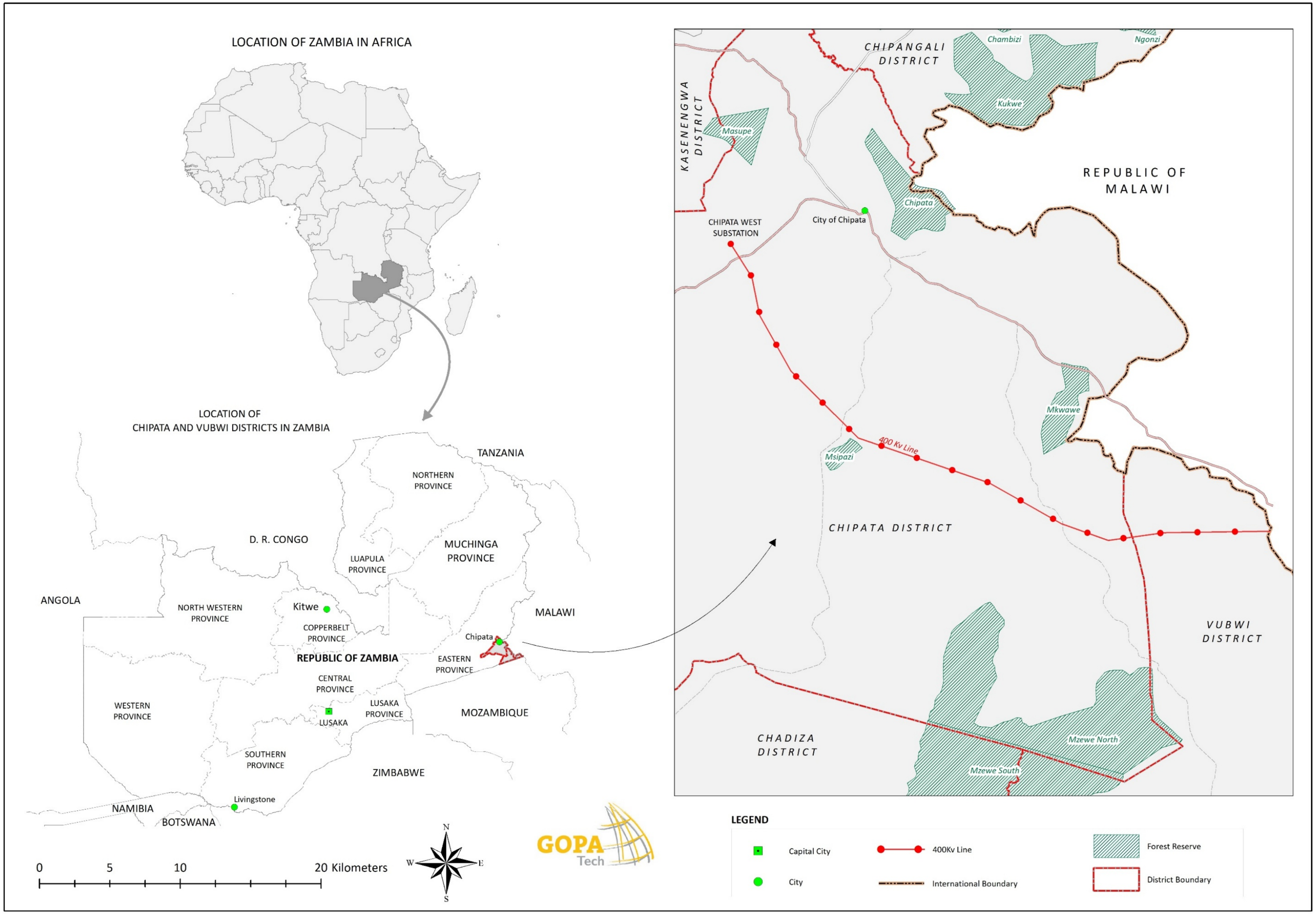


Figure 3-1 Proposed alignment of the Malawi-Zambia 400kV Interconnector Project in Zambia

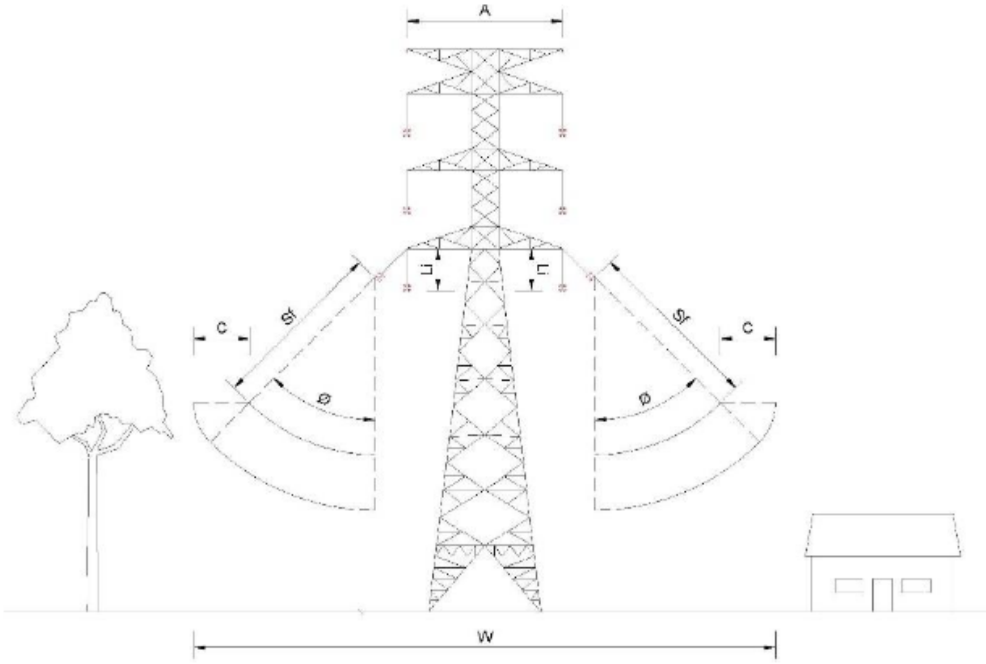
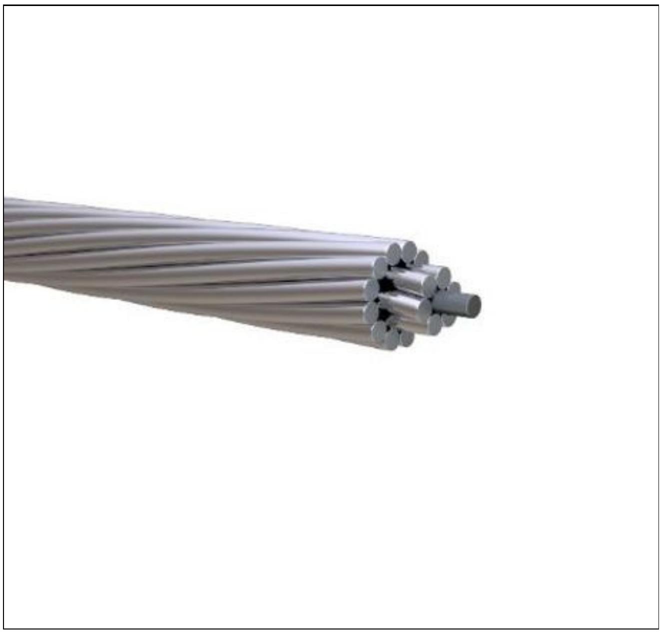


Figure 3-2 Typical tower proposed for the project (showing also the 50m wayleave, 25m each side from the centre of the tower)
(*Source: Feasibility Study, SP, 2025*)

The conductor selected for the project is "Tern" ACSR in triple bundle configuration.



(Source: Aluminum Conductor Steel Reinforced (ACSR) #Tern | OmniCable)
Figure 3-3 Tern ACSR conductor

The Chipata West substation is located approximately 10 km west of Chipata town and approximately 1.5 km north of the Great East Road (T4), in the Eastern Province of Zambia, within a relatively flat and semi-urbanized terrain.

Figure 3-4 Existing Chipata West SS looking north-northwest

The project site is positioned on the southern side of the existing substation area, which is already earmarked for extension under the Mozambique-Zambia (MOZA) Interconnection Project. However, the land for the MOZA had not been acquired at the time of the ESIA studies. Therefore, 10 hectares of land will be acquired under the MAZA project to facilitate the extension of the substation. Consents to acquire the land have been obtained from the two families that own land near the substation. This proximity to existing infrastructure significantly facilitates both site development and operational integration.

The scope of works under the project includes:

- No.2 400kV line bays in double busbar double breaker configuration;
- No.2 line-connected 400kV shunt reactors with relevant bay, one per each circuit of the line;
- Balance of plant for substation automation, protection and metering system, civil works, etc. for bays integration into the MOZA scope of works.

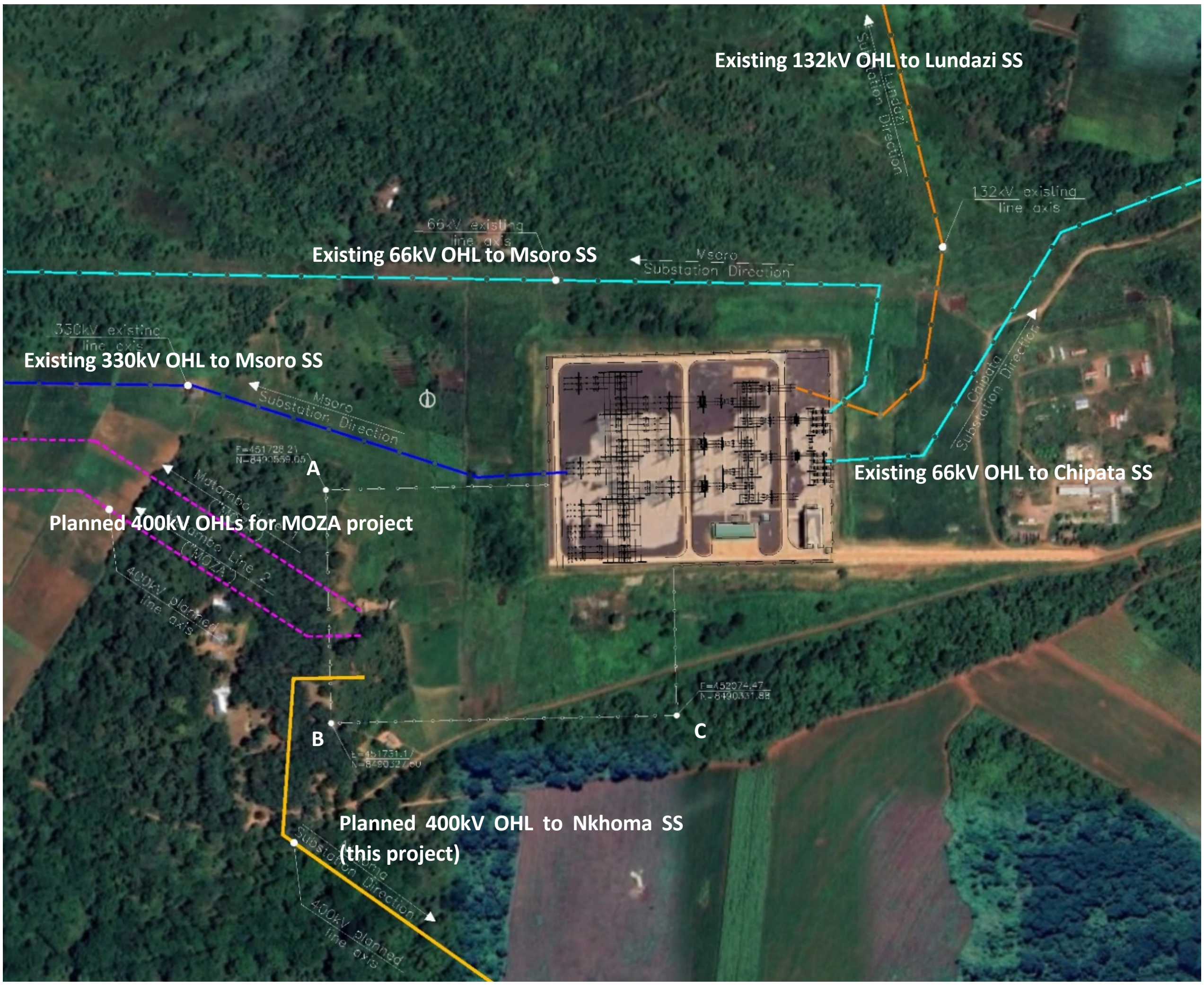


Figure 3-5 Expansion area for the Chipata West SS

The expansion area has the following coordinates:

A: 452728.21 E; 8490559.05 N
B: 451731.17 E; 8490327.50 N
C: 452074.47 E; 8490331.88 N

3.2.2 Access Roads

As much as possible, the existing access roads along the transmission line route will be used for construction purposes. The Lusaka – Chipata Road (T4), which also connects Chipata to Lilongwe, is a good bituminous road and will be useful in the transport of heavy project equipment like transformers and other substation equipment, and construction materials like steel and cement. Chipata West substation is located about 2km from T4, which makes the transportation of substation equipment easy (see Figure 3-6). Access to the Chipata West substation is granted by existing main and secondary roads.

Figure 3-6 Existing access road of 1.9 km (red line) from the Great East Road (T4) to the Chipata West Substation

In addition, the project area has two district roads which will serve as access roads. The Chipata – Lundazi Road (D128) and the Chipata – Vubwi Road (D804) are all-weather gravel roads and will be used for the transportation of construction materials. In most parts of the project area, there are earth roads which will serve as access roads, but they may need grading and widening to accommodate the anticipated traffic. In the places where access roads do not exist, temporal access roads will be constructed. The contractor will determine the temporary access roads required, their locations as well as any needs to upgrade them, with due consideration of the need to minimise environmental and social impacts of the project.

3.2.3 Raw Materials

The main construction materials on the project will include, but not limited to, the following:

1. Steel tower parts of various sizes and shapes;
2. Steel for concrete reinforcement, fencing and other works;
3. River sand and cement for concrete works;
4. Stones and stone aggregate of various sizes for concrete mix;
5. Soil and laterite for various works;
6. Timber of various sizes;
7. Insulators, cables, bolts, nuts and conductors; and
8. Electrical equipment such as busbars, transformers, control equipment, etc.

3.2.4 Products and By-products

The main product of the project is electric power that will be transmitted through the constructed transmission power line.

The resulting by-products from the project shall include: waste materials from the construction process such as empty cement bags and other packaging materials, stone aggregates, leftover cement concrete, construction rubble, steel off-cuts, bolts & nuts, wood, and waste (domestic) from camp sites. Other types of by-products include excess laterite and soil from construction sites.

3.2.5 Production capacity

The proposed Malawi – Zambia interconnector project will transmit electric power at 400kV.

3.2.6 Schedule and life-time of the project

The proposed 400kV Malawi – Zambia transmission power line will be constructed over a period of 22 months. In specific, 18 months are foreseen for the construction of the SS expansion and 22 months for the construction of the OHL – however construction activities will run in parallel.

The project will have a lifespan of at least 50 years.

3.3 Main activities

The following main activities are envisaged.

3.3.1 Site Preparation

The site preparation activities include:

1. Detailed line survey;
2. Identification and clearing of campsites for project personnel and workers;
3. Identification and clearing of bulk materials storage sites;
4. Identify the sources of stone aggregated and laterite.
5. Upgrading of access roads and establishment of any new access roads (temporary or permanent) as necessary.

3.3.2 Construction

a) Overhead Transmission Line

The works for the proposed construction of the 400kV transmission line on the Zambian side include the following activities:

- Carrying out bush (vegetation, trees and anthills) clearing, route survey and profiling, tower spotting, conductor profiling;
- Excavation, supplying and erection of all foundations complete with stubs;
- Supplying and erection of suspension towers;
- Supplying and erection of tension towers;
- Supplying and erection of insulators, fittings and hardware;
- Supplying and stringing of conductors, one per phase complete with vibration dampers;
- Supplying and stringing of earth wires and optical ground wire (OPGW) complete with vibration dampers;
- Supplying and installation of earthling counterpoise wire; and
- Supplying bolts, nuts, washers and other materials as specified in Bill of Quantities, to the extent required to complete the line installation.
- Testing and commissioning.

Construction will be realized using excavators for the foundations, trucks for carrying materials (foundation material, tower material, reels and boxes for insulator and fittings) and machines such as tensioners and pullers for stringing.

The typical foundation will be of the pad and chimney type, 3-4m deep. Towers will be typically installed at 400m distances, depending on the local topography.

Assembly of towers will be made by line’s men working at be tower base and lifting equipment by gin pole, typically. However, the Contractor can propose different tools according to his experience.

The footprint of typical towers is as follows:

- Suspension tower: about 8 x 8 m, height of about 45m
- Tension tower: 9 x 9 m height of about 42m

The RoW can be used for tower installation and stringing activity. However, additional space can be required at spots where tensioners and pullers for stringing are placed. The location and relevant area depend on Contractor stringing arrangement and line angle.

Stringing will be made using Tension Stringing method using tensioners and pullers:

1. Pulling a Pilot Rope: A rope is installed along the towers of the section to be stringed.
2. Pulling Conductors: The pulling rope is used to pull the conductors onto the towers.
3. Sagging and Clamping: The conductors are allowed to sag, and then they are clamped to the insulators.

b) Substation

Chipata West Substation will be extended to accommodate a new busbar arrangement and associated infrastructure. The works shall include the following:

- Line Bay and Transformer Bay;
- Transformers and Busbars;
- Auxiliary AC and DC Supply Systems;
- Earthing System;
- Control system;
- Protection System;
- Metering system

Structural Steelwork shall include supports for the isolating switches, circuit breakers, current and voltage transformers, operating cubicles, etc., including foundations bolts and other fixing material; and b) (one) complete set of gantry towers and support structures for the busbars, line bay, bus coupler and transformer bays.

Civil works for the Substation shall include the following:

- Vegetation clearing and earthworks on the platform;
- Complete soil testing and results for engineering foundations;
- Necessary drainage works;
- Transformer oil pits, bund walls, fire walls and foundations;
- Support and Gantry foundations, including holding-down bolts;
- Cable ducts and covers;
- Control building, with battery room, Relay and Control Room
- Perimeter fence;
- Stone chippings in the extended substation area;
- Landscaping and replanting of vegetation (trees and grass);
- Erecting a perimeter fencing.

Decommissioning of any of the existing substation infrastructure or equipment is not anticipated during construction.

3.3.3 Operation and Maintenance

The Project shall be declared operational once all pre-commissioning tests and activities are completed and the line energized. Routine operation and maintenance of the transmission line, the wayleave (vegetation control) and other technical inspections (line patrols), general line performance and normal switching shall constitute the operational phase of the Malawi – Zambia 400kV transmission line.

The transmission line, including the substation, shall be operated and maintained by ZESCO, in accordance with standard procedures designed to ensure the integrity of the transmission system. Routine inspections will be conducted on the transmission line to ensure line security and public safety. During operation, routine maintenance of the transmission line will be carried out during annual wayleave maintenance by ground patrol. The vegetation along the wayleave will be controlled to ensure safety of the OHL and ground clearances are not to be exceeded. Construction of houses and other structures and planting of trees under the power line are not permitted. However, low-height seasonal crops may be grown under the power line.

ZESCO currently uses mechanical bush clearing control of vegetation according to the ZESCO wayleave maintenance guidelines.

3.3.4 Decommissioning

The transmission line and associated infrastructure will be designed, operated, and maintained to ensure long-term safe and efficient service. When components of the power line infrastructure eventually reach the end of their lifecycle, the decommissioning process will aim to address essential environmental, social, health and safety considerations and meet all regulatory requirements at that future time.

Decommissioning and abandonment plans will be developed in accordance with ZEMA regulations. Key environmental, social, health and safety aspects to consider in the decommissioning plan include:

- **Soil and Land Quality**: Potential risks to soil quality, including contamination from materials or components, must be evaluated, with specific attention to ensuring the site is left clean and safe for future use.
- **Vegetation Restoration**: Where necessary, restoration of vegetation will help return the site to a condition similar to its pre-project state, facilitating natural habitat recovery where feasible. Providing land to local people based on agreements established in the future will also be considered.
- **Waste Management**: Plans for managing decommissioned materials will prioritize re-use and recycling where feasible to minimize waste and environmental impact.
- **Water Resources**: Protection of any nearby water sources will be essential to prevent contamination during the removal of structures and materials.
- **Health and Safety**: Specific procedures will be developed for decommissioning with priority on high-risk work operations to ensure occupational health and safety.

3.4 Anticipated Wastes from the Project Cycle

The proposed project will produce several by-products (waste), may require careful management to minimize negative impacts.

1. **Vegetation Clearance and Habitat Disturbance:** The construction of the transmission line will involve the clearance of vegetation along the right-of-way, which may result in habitat disturbance for local wildlife and loss of biodiversity. This by-product of the project will need to be managed through careful planning and the implementation of mitigation measures, such as reforestation and habitat restoration programs, to minimize environmental impacts. Woody biomass will be disposed of in consultation with local people, including giving preference for project-affected persons to access trees that need to be cut.
2. **Soil Erosion and Sedimentation:** The earthworks associated with the construction of the transmission line and substations may lead to soil erosion, particularly in areas with steep slopes or loose soils. This could result in increased sedimentation in nearby water bodies, affecting water quality and aquatic ecosystems. Erosion control measures, such as the installation of silt fences and the stabilization of exposed soils, will be necessary to manage this by-product.
3. **Construction Waste and Debris:** The construction activities will generate waste materials, including scrap metal, concrete, packaging, and other debris. Proper waste management practices, including recycling and the safe disposal of non-recyclable materials, will be essential to prevent environmental contamination and ensure compliance with environmental regulations.
4. **Noise and Dust Generation:** During the construction phase, activities such as excavation, transportation of materials, and the operation of heavy machinery will generate noise and dust. While these impacts are temporary, they may affect the quality of life for nearby residents and wildlife. Mitigation measures, such as dust suppression techniques and noise barriers, will be implemented to minimize these by-products.
5. **Sewerage Waste:** Sewerage waste will be generated in the residential camps and workstations during construction phase and will be managed by the use of toilets. During operation phase all sewage will be

discharged through appropriate pit latrines, underground sewer lines into the proposed septic tank and soak away system.

6. **Hazardous waste:** During construction, operation and commissioning of the project, hazardous waste generated, which includes material contaminated with oil, will be stored in a hazardous waste site and will be disposed of in accordance with ZEMA guidelines. If hazardous waste cannot be safely disposed in Zambia, it shall be exported via a licensed contractor.

4 Project Alternatives

In the ESIA study, the consideration of alternatives is a vital component that shapes the overall direction of a project and is an essential element in implementing the mitigation hierarchy. This section focuses on identifying and evaluating various options that can meet the project's objectives while avoiding and minimizing potential environmental and social impacts. This includes analysis of different designs, routes, and technologies related to the project. The systematic assessing these alternatives enables the project to make informed decisions on the preferred alternative.

4.1 Identification and Description of Alternatives

Three alternative line routes were considered for the project in Zambia as shown in the map below. A detailed site investigation exercise was undertaken to identify and evaluate the environmental/ecological and socio-economic (including archaeological and cultural) constraints associated with each alternative and to recommend the optimal route that minimizes environmental and social economic impacts.

Alternative Line 1

Alternative 1 (Alt 1) is the northernmost route, begins at the Chipata West substation and traverses through the Malandula farm, which features approximately one kilometer of well-preserved miombo primary vegetation. The farm is earmarked for subdivision for residential housing development.

The route then crosses the Lusaka - Chipata Road (T4) into farmland impacting several houses and mango trees before crossing the Lutembwe stream. The line takes a south-east direction to avoid the south-western periphery of Chipata City. It continues into an undulating terrain featuring hills and flat arable land characterized by a mixture of primary vegetation and secondary miombo woodland. The line follows T4 passing through Mashanga area and makes a turn in the south-eastern direction at Chilumbu and crossing into Malawi at Mgabi for about 10km and re-enters Zambia in Vubwi District. Eventually the line crosses back into Malawi in Mwami border area, stretching a distance of approximately 45.6km with a wayleave width of 50m.

In terms of settlements, there are few and scattered settlements in the first half of the corridor while the second half is characterized by a high concentration of villages because of the good accessibility provided by the paved (T4) and small gravel roads. Between the villages, there are agricultural fields of various size and small portions of secondary (disturbed) vegetation.

Towards the Malawi border, Alt 1 passes through a hilly area with a primary (undisturbed) vegetation cover which provide prime habitat for mammals and reptiles.

Alternative Line 2

Similar to Alternative 1, the proposed route for Alternative 2 (Alt 2) begins at the Chipata West substation and passes through Malandula Farm for about 1km, an area notable for its primary miombo vegetation. The farm is earmarked for subdivision for residential housing development.

Alt 2 then crosses the Lusaka - Chipata Road and following Alternative 1 for about 6km. It makes a south-eastern turn into farmland impacting several houses and mango trees before crossing the Lutembwe stream. The line continues into an undulating terrain featuring hills and flat arable land characterized by a mixture of primary vegetation on the hills and secondary miombo woodland.

The line continues through hilly terrain punctuated with flat arable land crossing D128 (Chadiza Road) and passing through Nyamfinzi Hill near Feni Village, which is the headquarters for Paramount Chief Mpezeni. It crosses RD 403 near Feni and joins the corridor for Alt 3 and follow the corridor to Mwami for about 17km. It crosses D804 (Vubwi Road) and continues in the eastern direction, enters Vubwi District and passes between Mkoma and Satwe hills. Thereafter, the line heads towards the border with Malawi and passes through a hilly terrain characterized by primary (undisturbed) vegetation cover which provides prime habitat for mammals and reptiles.

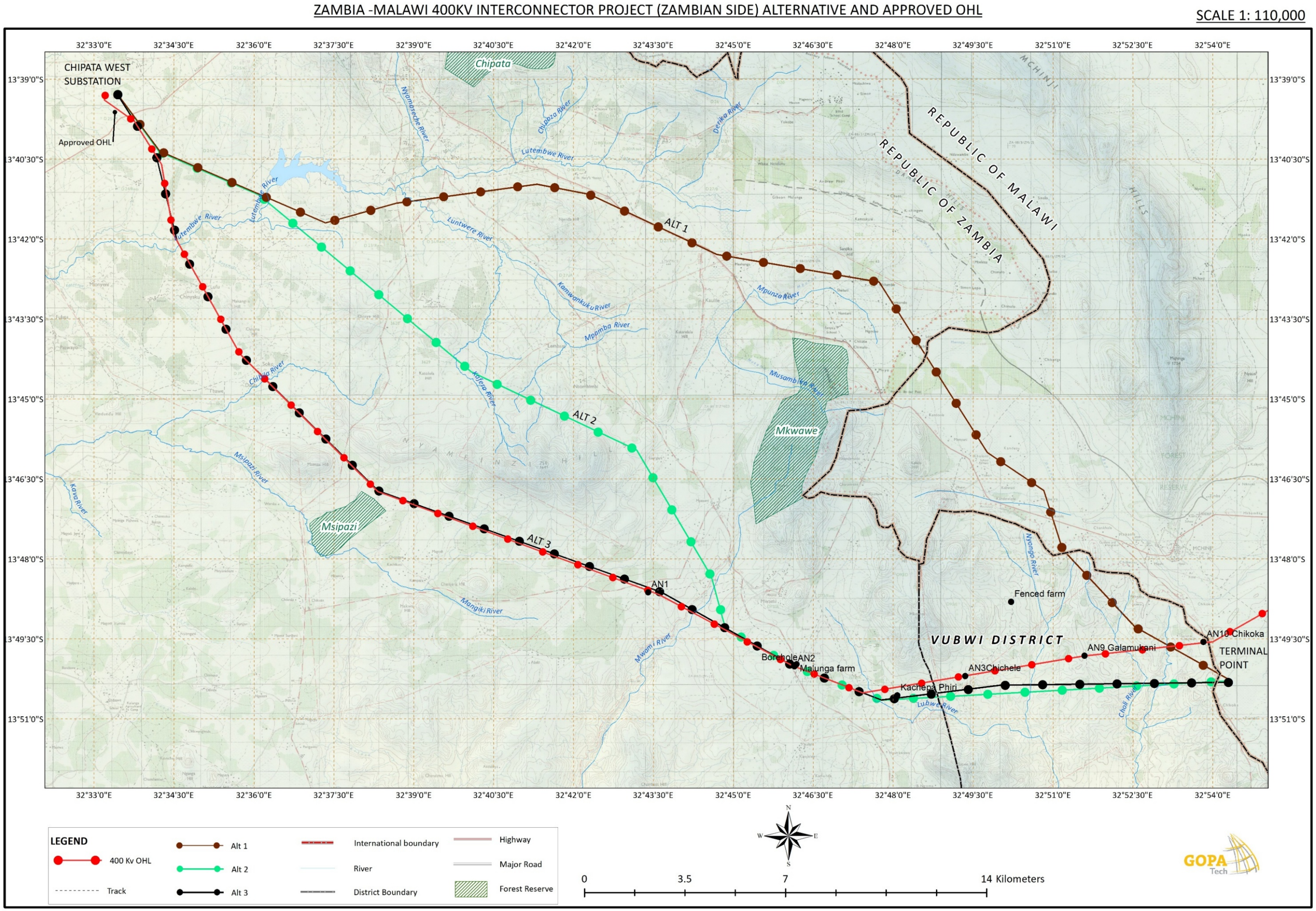


Figure 4-1 Proposed Alternative Line Routes of the Zambia section of the Malawi-Zambia 400kV Project

In terms of settlements, the section between Chipata and Mwami is characterized by scattered settlements separated by extended areas more sparsely populated than Alt 1. The settlements consist of villages of various sizes located along the feeder roads to be used as access to the OHL route. After Mwami, settlements are almost absent up to the Malawi border.

The power line will be 45.7km with a wayleave width of 50m.

Alternative Line 3

Like Alternatives 1 and 2, the proposed route for Alternative 3 (Alt 3) begins at the Chipata West substation and traverses through Malandula Farm, an area with primary miombo vegetation. The farm is earmarked for subdivision for residential housing development.

Leaving Chipata West substation the route runs almost parallel to that of alternative 1 and 2 for about 6km and heads southeast direction passing between Chinyaku and Lafu villages and avoids Makangila Hill. This is the southernmost route of the three alternatives. The line corridor avoids Msenza Hill and Msipasi Forest Reserve in the south and Nyamfinzi Hill in the north and crosses D128 and RD 403. Thereafter, the corridor for Alt 3 merges with Alt 2 until the border with Malawi. Alt 3 avoids Mbewule Ranch and Nature Conservation area located on Nkoma Hill between Mwami and the border with Malawi.

The area along the line route is characterized by a mixture of cultivated fields and small portion of woodlands up to Mwami. Thereafter, there is an extended woodland with primary (relatively undisturbed) vegetation cover between Mwami and the Zambia/Malawi border.

In terms of settlements, the section between Chipata and Mwami is characterized by scattered settlements separated by extended empty areas, with lower density compared to Alt 1 and Alt 2. After Mwami, settlements are almost absent up to the Malawi border.

Unlike Alternatives 1 and 2 which cut through some of the hills, Alt 3 avoids the hilly terrain with dense stands of primary miombo woodland, thus minimizing potential damage to the ecosystem and prime habitat for wildlife. This alignment avoids ecologically sensitive hills and traverse through predominantly agricultural land with minimal impact on settlements.

Line 3 is 46.6 km long with a wayleave width of 50m.

Table 4-1 Land Occupied by Each Alternative Line and the Number of Structures Affected

	Length (km)	RoW Width (m)	Land Occupied (ha)	Built Structures in the RoW
Alt-1	45.6	50	228.0	26
Alt-2	45.7	50	228.5	33
Alt-3	46.6	50	233.0	9

4.2 Evaluation of Identified Alternatives

4.2.1 Environmental and Socioeconomic Evaluation

The power line route alternatives were evaluated on the basis of a number of parameters. The parameters used for the evaluation and the results of the evaluation are presented below.

Table 4-2 - Parameters for Environmental and Socioeconomic Evaluation

No.	Constraint	Alt 1	Alt 2	Alt 3
A	**Socio-economic / Cultural**			
1.	Settlements	Moderate concentration of settlements	Moderately low concentration of settlements	Low concentration of settlements
2	Number of structures affected	26	33	9
3	Agriculture (including commercial farms)	High number of agricultural fields	Moderate	Low
4	Public service facilities (schools, health centres, recreation centres)	None	None	None
6	Border crossings	3	1	1
8	Archaeological sites	None	1 graveyard	None
9	Land occupied by the power line (hectares)	228	228.5	233.0
B.	**Environmental / Ecological**			
10	National Parks / Game Management Areas	None	None	None
11	Forest Reserves	None	None	None
12	Primary vegetation on the Hills	High	High	Low
13	Secondary vegetation on flat land	Low	Low	Moderate
14	River crossings / Wetlands	Moderate	Low	Low
14	Impact on wildlife	Moderate	Moderate	Low
16	Mines and Quarries	None	None	None
17	Dumpsites	None	None	None
18	Terrain	Moderately hilly	Moderately hilly	Fairly flat
19	Accessibility (existing)	Good	Moderate	Low

In terms of environmental and socioeconomic footprint, Alt 3 performs better than Alt 1 and Alt 2. Although it is slightly longer (approx. 1.5%) than the other two Alternatives, it affects much less built structures, and it has less impact to biodiversity as it avoids crossing hilly areas with primary vegetation. In contrast, it is less accessible (in terms of existing access roads) than the other two Alternatives.

Consequently, Alt 3 is the preferred alternative OHL route in environmental and socioeconomic terms.

4.2.2 Overall Evaluation using Multi-Criteria Decision Analysis (MCDA) Methodology

The overall evaluation of the OHL alternatives (including technical, environmental and socioeconomic parameters) is based on the Multi Criteria Decision Analysis (MCDA) methodology. The methodology works with quantitative parameters which are normalized in order to be comparable. The normalization is carried out using the formula below:

Normalised value = -value/max(value) + 1

Therefore, the preferred alternative presents the highest sum of the individual parameters.

Several technical parameters were considered for the technical evaluation. Such parameters included the following:

- Transmission grid capacity improvement
- Renewable Energy Sources (RES) integration
- Reliability margins
- Planned Developments
- Crossing of roads, railways and other infrastructure

Only a selection of the full set of technical parameters were used. The reason is that some of the parameters showed no differentiation among the alternatives. In other cases, some parameters were dependent on other parameters. For instance, the specific costs depend on the length of the line, and the length along inaccessible areas or hilly terrain – parameters that are already considered.

A final list of parameters was selected, which:

1. Are independent variables.
2. Are significant for the project.
3. Differentiate among the alternatives, and
4. Can be quantified (i.e. represented by a number)

The list of parameters used for the overall evaluation are shown below.

Table 4-3 List of Parameters for Overall Evaluation

Parameter	Comment
Technical	
Length (km)	The overall length is very important as it affects the cost of the construction, the losses of the line as well as indirectly, the environmental and socioeconomic footprint during construction and operation
Length along inaccessible areas (km)	Crossing inaccessible areas increases the cost of the construction as well as the environmental and socioeconomic footprint of the project since it is related with the construction of access roads
Crossing of roads, railway crossings and other infrastructure	Crossings of infrastructure increases the complexity of construction and the cost
Length along hilly terrain (km)	Difficult terrain may increase the cost of construction as well as the time necessary for construction
Socioeconomic	
Number of built structures affected	Physical resettlement is the most important socioeconomic impact, which according to international standards needs to be demonstrably avoided or minimized
Area of agricultural land crossed (ha)	The area of agricultural land crossed by the OHL affects the cost of the line, as it is a measure of the compensation costs that will to be paid to PAPs
Environmental	
Primary vegetation on hills affected (km)	In lack of any other evidence of biodiversity constraints in the project area, the preservation of the primary miombo vegetation on the hills is an important consideration from the environmental as well as cultural perspective (there is no significant primary vegetation left in the lower and flatter areas)

The results of the overall evaluation are presented in Table 4-4. Both the actual and normalised values are shown. The results of the evaluation show that the overall performance is maximized for Alt 3, which is the preferred alternative.

Table 4-4 Results of Overall Evaluation

	actual value			max value	normalised value		
	Alt 1	Alt 2	Alt 3		Alt 1	Alt 2	Alt 3
Technical							

	actual value			max value	normalised value		
	Alt 1	Alt 2	Alt 3		Alt 1	Alt 2	Alt 3
length (km)	45.6	45.7	46.3	46.3	0.015	0.013	0.000
length along inaccessible areas (km)	5.6	24	11	24	0.767	0.000	0.542
crossings of roads, etc.	4	2	2	4	0.000	0.500	0.500
length along hilly terrain (km)	5	20	10	20	0.750	0.000	0.500
Socioeconomic							
number of built structures affected	26	33	9	33	0.212	0.000	0.727
area of agricultural land crossed (ha)[1]	169.95	192.5	146.85	192.5	0.117	0.000	0.237
Environmental							
primary vegetation on hills affected (km)	12.2	28.8	0.25	28.8	0.576	0.000	0.991
					2.437	**0.513**	**3.497**

The length of OHL crossing primary miombo vegetation is 12.2 km, 28.8 km and 0.25 km for Alt-1, Alt-2 and Alt-3 respectively, as resulted from the GIS analysis of the OHL route.

4.3 List of Alternatives in Order of Preference

The three alternative line routes are listed below in the order of preference. For this project, Alternative 3 is the preferred route based on the factors discussed above.

a. Alternative 3
b. Alternative 1
c. Alternative 2

4.4 Reasons for Choosing the Preferred Alternative

In terms of environmental and socioeconomic footprint, Alt 3 performs better than Alt 1 and Alt 2. Although it is slightly longer (approx. 1.5%) than the other two Alternatives, it affects much less built structures, and it has less impact to biodiversity as it avoids crossing hilly areas with primary vegetation. In contrast, it is less accessible (in terms of existing access roads) than the other two Alternatives.

Therefore, Alt 3 is the preferred alternative OHL route in environmental and socioeconomic terms. Alternative 3 is also the preferred after the combined assessment of multiple technical, environmental and socioeconomic criteria.

4.5 Process and Technology Alternatives

(a) Towers

The selected support structure for the transmission line is the **lattice steel tower**, chosen for its optimal balance of technical performance, cost-effectiveness, and regional compatibility. Other types of towers considered include:

- Tubular steel supports
- Lattice tower with different cross-arm arrangement (Danube type)
- Other supports, such as composite tower, surely more expensive

While tubular steel supports offer certain aesthetic and structural benefits, they are significantly more expensive in terms of both fabrication and erection. Their manufacturing requires specialized facilities and higher material volumes, leading to increased capital expenditure. In addition, tubular supports are more challenging to transport and install, particularly in remote or difficult-to-access areas, which increases construction time and logistics costs.

The Danube-type tower configuration, although technically viable, has been deemed unsuitable for this project because its adoption is not spread in the region, which would hinder harmonization with existing infrastructure. Morover, the Danube design requires a wider Right-of-Way (RoW) due to its broader base and larger horizontal clearances. This results in increased land acquisition costs and greater environmental and social impact, particularly in densely populated or ecologically sensitive areas.

Finally, lattice steel towers present a proven, reliable, and cost-efficient solution since:

- There are not particular reasons to consider other alternatives that are surely more expensive.
- They are widely used across the region, ensuring compatibility with existing transmission infrastructure.
- Their design facilitates easier transport and faster on-site assembly, even in challenging terrains.

In terms of environmental and social considerations, there are no significant differences between the different types of towers, although, a) lattice steel towers have a slight advantage over tubular steel towers in transportation and ease of installation and b) lattice steel towers have an advantage of the Danube-type towers due to a narrower RoW and therefore less social impacts.

Given these advantages, lattice steel towers are the most appropriate choice for this project, ensuring long-term reliability, maintainability, E&S considerations and cost efficiency while aligning with regional standards and practices.

(b) Conductor

For the conductor selection, the chosen configuration—triple ACSR Tern—represents the most technically and economically balanced solution for the long-term operation of the transmission line.

To support this choice, a comparative analysis was conducted among the following ACSR conductor options:

- “Cardinal” ACSR, S_{tot} = 546mm^2, S_{al}= 483.3mm^2, Al/St ratio = 7.7, d= 30.38mm, $r_{DC20°}$ = 0.0587Ohm/km
- “Tern” ACSR, S_{tot} = 430.3mm^2, S_{al}= 402.8mm^2, Al/St ratio = 6.4, d= 27.01mm, $r_{DC20°}$ = 0.071Ohm/km
- “Bluejay” ACSR, S_{tot} = 603mm^2, S_{al}= 564mm^2, Al/St ratio = 6.4, d= 31.97mm, $r_{DC20°}$ = 0.0507Ohm/km.

The technical assessment considered several parameters, including:

- Joule and corona losses
- Current density
- Line investment cost per kilometer
- Power and energy costs
- Expected load duration (hours/year)
- Compatibility with existing conductors in the region

Special consideration was also given to standardization with conductors already used in the country or region. The **3xTern (ACSR)** configuration is recommended, as it aligns with conductors commonly used in SAPP (Southern African Power Pool) regional interconnectors. This harmonization simplifies spare parts management and maintenance activities, contributing to operational efficiency over the line’s service life.

In terms of E&S considerations, there are no significant differences between the different types of conductors.

4.6 The No-Project Scenario

This scenario explores the potential consequences of not constructing the Malawi - Zambia 400 kV Transmission Interconnector.

If the project is not undertaken, ZESCO and ESCOM will not be able to import electricity during the periods of scarcity arising from lower power generation due to different factors such as variation in rainfall for generation mixes heavily dominated by hydropower, climate change and equipment failure. This would result in continued load shedding and low voltage supply, which would further compromise reliability of electricity supply to customers. In times of excess power, the two utilities will be unable to export electricity to each and other countries. This will hinder cooperation in the energy field as well as economic development in the two countries.

The absence of reliable electricity will have a detrimental socioeconomic impact. It will slow down progress in key social sectors like education, healthcare, several economic activities and overall quality of life, particularly in urban and peri-urban areas where people depend on electricity.

The absence of the Malawi-Zambia 400 kV interconnector will have adverse environmental impacts as well. Existing electricity supply challenges will persist, exacerbating environmental pressures. Continued reliance on charcoal will accelerate deforestation and habitat loss, while a lack of transmission infrastructure will prevent the development of renewable energy sources, locking both countries into an unsustainable energy trajectory with severe environmental consequences.

For all these reasons, the no-project scenario is not a sustainable option in both environmental and socioeconomic terms.

5 Environmental Baseline Study

5.1 Introduction

This chapter presents the environmental baseline conditions for the Zambian section of the Malawi–Zambia 400 kV Interconnector Project, covering a 46.6 km corridor across Chipata and Vubwi Districts in Eastern Province. The purpose of the baseline study is to characterize the existing biophysical and socio-environmental attributes of the project area, evaluate the sensitivity of environmental components, and provide a benchmark against which potential project impacts can be assessed.

The baseline assessment has been informed by a combination of field investigations, stakeholder consultations, scientific literature review, and geospatial analysis. The study describes the key environmental parameters relevant to the project's design and implementation, with a focus on identifying areas of ecological, hydrological, and social sensitivity.

The components covered in the environmental baseline include climatic conditions (rainfall, temperature, humidity, and sunshine), air quality and noise, geology, hydrology, hydrogeology, topography, soil characteristics and biodiversity. Together, these parameters provide the contextual framework required to understand the physical and natural environment in which the transmission infrastructure will be developed[4]. This understanding is essential for predicting potential impacts and developing sound environmental management strategies.

5.2 Climate

The Malawi-Zambia 400kV Interconnector Project traverses the Chipata and Vubwi Districts in Zambia's Eastern Province. These districts are characterized by a tropical savanna climate, also known as a Tropical Wet and Dry climate, classified under the **Köppen-Geiger climate classification system as "Aw."** This type of climate is defined by a distinct seasonal contrast between a wet season and a dry season, which significantly influences the region's ecological processes, agricultural productivity, and overall environmental and socio-economic conditions.

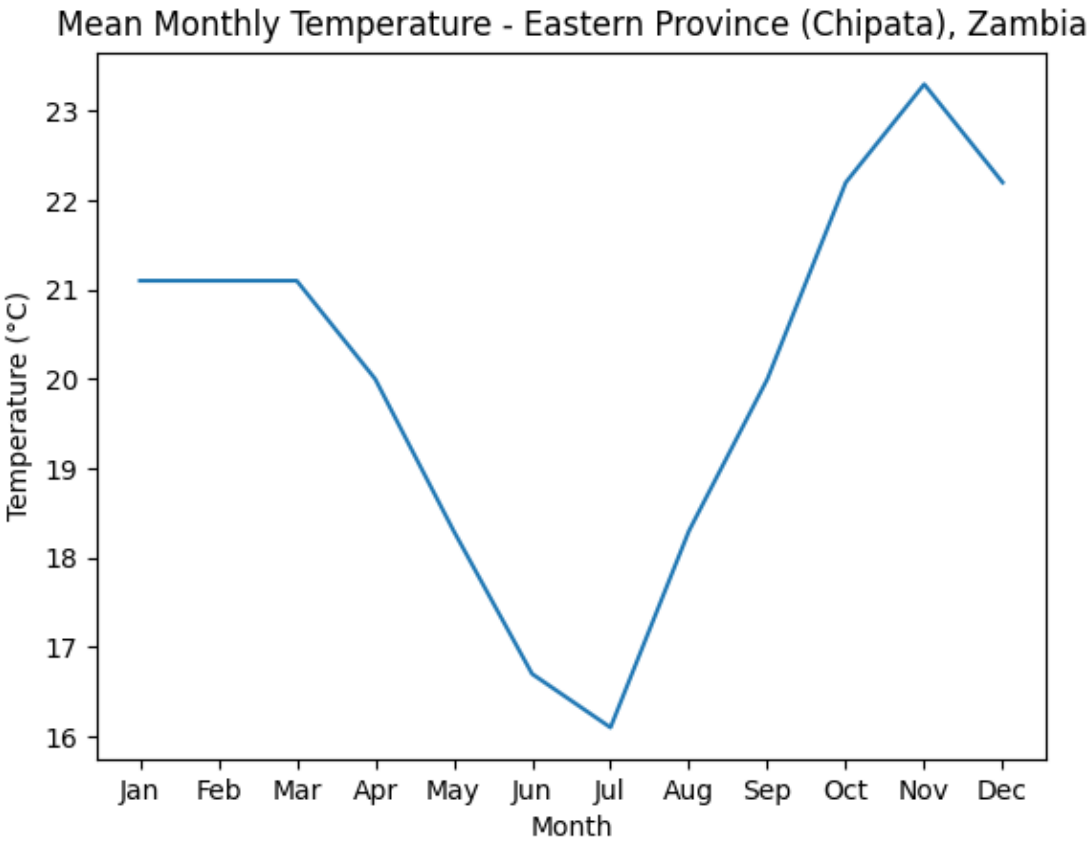
5.2.1 Temperature

The Chipata and Vubwi Districts experience relatively warm temperatures throughout the year, with an **average annual temperature of 25.34°C (77.61°F)** (Figure 5-1). This temperature is slightly higher—by about **2%—than the national average for Zambia**, which is attributed to the region's geographical location and elevation.

- **Hottest Months:** The hottest period typically occurs between **September and November**, with maximum daytime temperatures often exceeding **30°C (86°F)**, while nighttime temperatures remain warm, rarely falling below **20°C (68°F).**
- **Coolest Months:** The coolest months are between **June and August**, during which temperatures may drop to an average of **15°C (59°F)** at night, though daytime temperatures generally remain pleasant at around **25°C (77°F).**

The warm temperatures throughout the year create favourable conditions for agricultural activities, supporting the cultivation of crops such as **maize, tobacco, groundnuts, and cotton**, which are vital to the local economy. However, the region's warm climate also necessitates effective water management, particularly during the dry season, to mitigate the risks of drought and water scarcity.

[4] The socioeconomic environment is presented in Section 6



Source: Climate Data.org-Chipata Climate table (Monthly averages) Accessed 21Feb 2026

Figure 5-1 Monthly average temperature in project area

5.2.2 Rainfall and Seasonal Distribution

The rainfall at the Chipata and Vubwi Districts is marked by a clear distinction between the **wet and dry seasons**, which have a profound impact on the local environment, agriculture, and water availability.

Wet Season (November to April)

- The wet season spans from **November to April**, with the peak rainfall occurring between **December and March**.
- Average annual rainfall is 1000 - 1200 **mm**, which is considered moderate for the region.
- The area experiences **128.29 rainy days per year**, accounting for **35.15% of the time annually.**
- Rainfall during this period is often intense, with heavy downpours that can cause temporary flooding of low-lying areas, particularly along riverbanks and floodplains.
- The wet season is essential for agricultural production, replenishing soil moisture, recharging groundwater, and supporting river flows. It is during this period that most farmers in the region engage in crop cultivation, relying on the rainfall for their agricultural activities.

Dry Season (May to October)

- The dry season is characterized by significantly reduced rainfall, with some months experiencing **little to no precipitation.**
- Temperatures during this period can be high, especially between **September and October**, when dry, warm

winds are common.

- The extended dry conditions can lead to water scarcity, affecting both agricultural activities and the availability of potable water for local communities.
- The lack of moisture also increases the risk of **bushfires**, which can impact local ecosystems, agricultural lands and infrastructure.
- Stream flows in the region's rivers and streams decrease significantly, with some seasonal streams drying up completely.

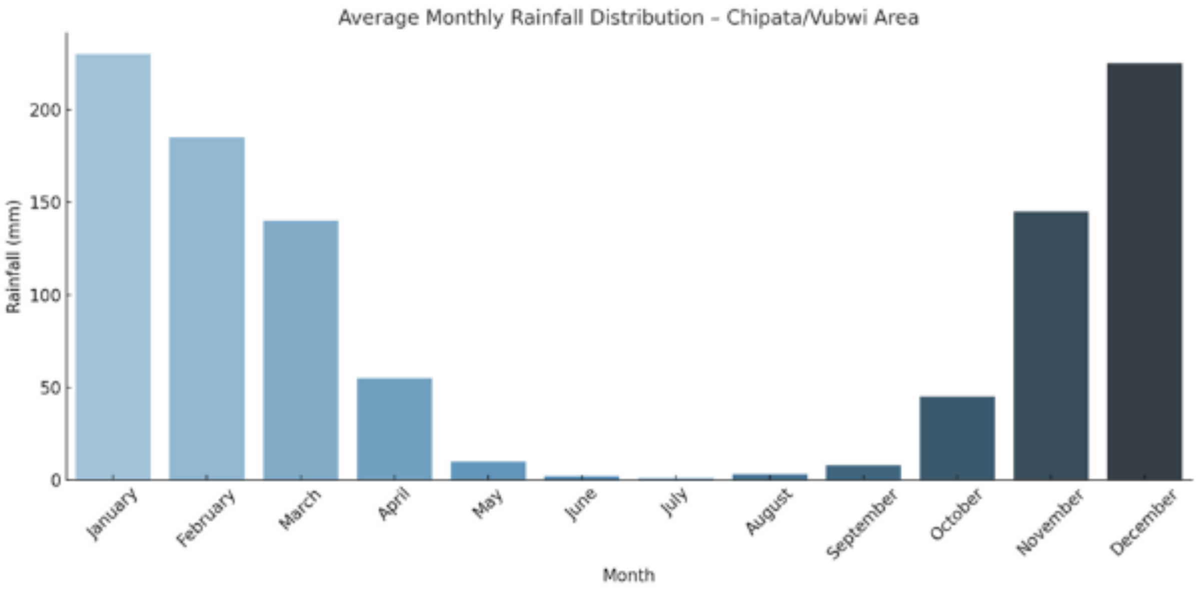


Figure 5-2 Monthly average precipitation in the project area

5.2.3 Winds

The wind regime in the Zambian section of the Malawi - Zambia 400 kV Interconnector corridor plays an important role in influencing local climate dynamics, dust dispersion, pollutant transport, and construction safety. Understanding the wind characteristics - both in terms of speed and direction - is critical for planning construction activities, designing erosion control measures, and assessing potential air quality and noise propagation impacts.

The prevailing wind conditions are represented by **wide-area hourly average wind vectors**, measured at a standard height of **10 meters above ground level**. These averages offer a regional view of wind behaviour but do not fully capture short-term, localized fluctuations, which can be influenced by microclimatic variables such as terrain, vegetation, and land use. In the project area- encompassing Chipata and Vubwi Districts - terrain features such as undulating hills and forested areas contribute to spatial variability in wind exposure.

Seasonal Wind Patterns

The wind profile exhibits a **distinct seasonal variation**, with higher average speeds occurring during the **dry winter months (May to August)**, driven by large-scale atmospheric circulation patterns associated with the Southern Hemisphere's subtropical high-pressure systems. During this period, the average **hourly wind speed increases progressively from approximately 14 km/h in early May to a peak of around 17.7 km/h by late July**.

By contrast, wind speeds tend to decline in the **wet summer months (December to March)** due to atmospheric stabilization and increased surface moisture, which dampen air movement. The **calmest conditions** are typically observed in **mid-February**, with daily average wind speeds dropping to as low as **9.7 km/h**, based on long-term meteorological records (Red Cross Climate Centre, 2021).

The **windiest day on record** within the region, **October 12, 2023**, registered an average daily wind speed of **19.6 km/h**, indicative of transitional seasonal conditions with intensified thermal gradients and localized convection (**Red Cross Climate Centre, 2021**).

Wind Direction and Implications

Although prevailing wind direction data are not explicitly documented at the microscale for this corridor, regional patterns indicate a dominance of **easterly to south-easterly winds**, particularly during the dry season.

5.3 Air quality

There is currently no systematic air-quality monitoring network in Zambia, including within the Malawi–Zambia 400 kV Interconnector project area. Consequently, site-specific baseline air-quality measurements were undertaken for this study using portable field instruments, namely a **PCE-MPC 20 particulate counter** for measuring $PM_{2.5}$ and PM_{10} concentrations, and a **QRAE 3 multi-gas analyser** for measuring gaseous pollutants such as NO_2, SO_2, CO, and VOCs (World Health Organization [WHO], 2021).

5.3.1 Baseline measurements

As part of the baseline environmental assessment for the Malawi-Zambia 400kV Interconnector Project, a comprehensive air quality monitoring network was established, comprising eleven strategically selected monitoring points (AQ1–AQ11) along the OHL corridor. These monitoring sites were carefully positioned to capture a representative range of environmental conditions, human settlements, and ecological features, ensuring a robust assessment of ambient air quality:

- **On-Site Monitoring Locations:** Several monitoring points were established directly within the project corridor to capture air quality conditions associated with potential construction and operational activities. Key on-site locations included:
  - **AQ1 (ZESCO Substation):** Positioned within the substation area to monitor air quality near electrical infrastructure.
  - **AQ4 (Chinyauku):** Located along the transmission corridor to assess ambient air quality in a rural setting.
  - **AQ5 (Daula Village):** Established within the transmission corridor to capture air quality conditions in a community setting.
- **Community and Sensitive Receptor Monitoring Locations:** To ensure that the air quality assessment considered potential impacts on local communities, monitoring points were placed within 40–130 meters of key community areas, including:
  - **AQ3 (Kauzu Primary School):** Positioned near an educational facility to monitor air quality exposure for children.
  - **AQ10 (Galamukani):** Located near a rural settlement, providing data on ambient air quality in residential areas.
- **Ecologically Significant Monitoring Locations:** Certain sites were positioned in or near regenerating forest zones and agricultural areas to evaluate the potential impact of dust, emissions, and other pollutants on vegetation and soil quality.

The location and characteristics of the sampling points are shown below, refer to Table 5-1 and Figure 5-3.

Table 5-1 Air quality sampling points

Site Code	Description	Coordinates		Distance from Activity	Community Nearby
		Latitude	Longitude		
AQ1	Near ZESCO substation - Chipata West	-13.654374	32.557004	0 m (on-site)	Yes, 471 m on the East side
AQ2	Great East Road (Leeward)	-13.664082	32.563096	0 m (on-site)	No
AQ3	Kauzu Village (near Kauzu Primary)	-13.683094	32.570319	130m	Yes
AQ4	Chinyauku (clustered rural Huts) village settlements	-13.718171	32.585565	0 m (on-site)	Yes
AQ5	Daula Village (Access road)	-13.741106	32.600861	0 m (on-site)	Yes
AQ6	Chadiza road (Cross Point)	-13.769164	32.628706	0 m (on-site)	No
AQ7	Chibwe Village (Scattered rural huts nearby)	-13.811408	32.7204	88 m	Yes
AQ8	Near regenerating Forest Zone and farms	-13.84166	32.78863	0 m (on-site)	Yes
AQ9	Chichele village (Forest and Farms)	-13.820545	32.83565	105 m	No
AQ10	Galamukani village	-13.821777	32.862824	40 m	yes
AQ11	Chikoka Village	-13.823116	32.877842	0 m (on-site)	yes

NOTE: The GPS datum in the above table was configured to record data on a planar surface, referenced to the Arc 1950 coordinate system within Zone 36S.

ZAMBIA -MALAWI 400KV INTERCONNECTOR PROJECT (ZAMBIAN SIDE) AIR QUALITY POINTS

SCALE 1: 110,000

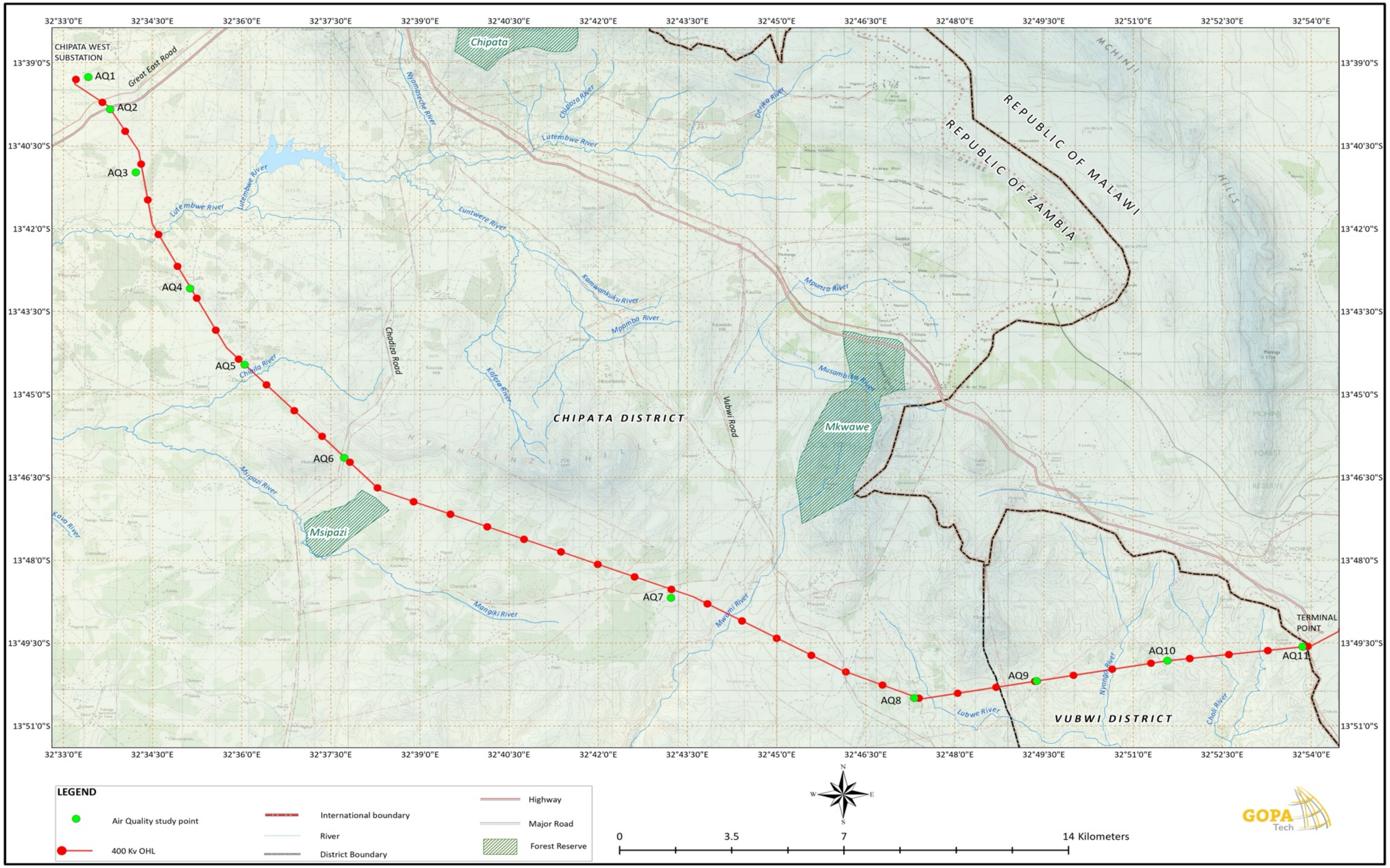


Figure 5-3 Air quality sampling points

Ambient air quality sampling was conducted from April 3 to April 11, 2025. The guidelines used were WHO air quality guidelines, US EPA National Air Quality Standards (NAAQS), and the ZEMA Emissions Limits for Ambient air pollutants, Second Schedule regulation 5,6 and 7(1). The samples were taken at more than one meter height above ground (see Figure 5-4.

Figure 5-4 Air Quality and Sound Pollution Monitoring

- **Monitoring Schedule:** Sampling was conducted twice daily—during the morning (08:00–12:00 hrs) and afternoon (13:00–18:00 hrs) sessions.
- **Sampling Intervals:** Each monitoring session consisted of 15-minute intervals for a minimum duration of 30 minutes at each site.
- **Target Pollutants:** The following gaseous pollutants were measured:
    - **Sulphur Dioxide (SO_2)**
    - **Nitrogen Dioxide (NO_2)**
    - **Carbon Monoxide (CO)**
    - **Formaldehyde (HCHO)**
    - **Total Volatile Organic Compounds (TVOC)**

Table 5-2 Results of selected atmospheric pollutants in the project area

Monitoring Period	April 3 - 11, 2025															
Time Range	Morning Each Day: 08:00 - 12:00 hrs; Afternoon: 13:00 - 18:00 hrs; Monitoring was conducted in 15-minute intervals for a minimum duration of 30 minutes per session															
Parameters	POLLUTANTS															Remarks
	Sulphur Dioxide			Nitrogen Dioxide (NO_2)			Carbon Monoxide			Formaldehyde (HCHO)			TVOC			
WHO	20 µg/m³ (per 24 hours)			120 µg/m³ (per hour)			30 mg/m³ (per hour)			0.5 mg/m³ (8 hours)			0.5 mg/m³ (8 hours)			
ZEMA	350 µg/m³ (per hour)			400 µg/m³ (per hour)			30 mg/m³ (per hour)									
	Measured average Values															
Time	Morn	Aft	Avg	Morn	Aft	Avg	Morn	Aft	Avg	Mom	Aft	Avg	Morn	Aft	Avg	
Sampling Point																
AQ1	ND	ND	ND	2	ND	1.5	ND	ND	ND	0.011	0.009	0.01	0.058	0.035	0.047	Normal
AQ2	ND	ND	ND	8	3	5.5	ND	ND	ND	0.02	0.009	0.029	0.08	0.038	0.059	Normal
AQ3	ND	ND	ND	ND	3	1.75	ND	ND	ND	0.01	0.016	0.013	0.043	0.063	0.053	Normal
AQ4	ND	ND	ND	8	ND	4.25	ND	ND	ND	0.007	0.008	0.008	0.008	0.033	0.021	Normal
AQ5	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.008	0.03	0.02	0.032	0.12	0.08	Normal
AQ6	ND	ND	ND	10	ND	5.25	ND	ND	ND	0.008	0.014	0.011	0.035	0.06	0.047	Normal
AQ7	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0073	0.03	0.019	0.03	0.097	0.064	Normal
AQ8	ND	ND	ND	2.5	4	3.25	ND	ND	ND	0.015	0.01	0.013	0.037	0.056	0.046	Normal
AQ9	ND	ND	ND	18	5.25	11.63	ND	ND	ND	0.015	0.017	0.016	0.06	0.08	0.07	Normal
AQ10	ND	ND	ND	2.3	1.3	1.82	ND	ND	ND	0.014	0.04	0.027	0.056	0.172	0.114	Normal
AQ11	ND	ND	ND	1.5	1.67	1.58	ND	ND	ND	0.013	0.016	0.015	0.053	0.07	0.062	Normal

ND: Not Detected

Table 5-3 Results of PM measurements in the project area

Monitoring Period Time Range		April 3 - 11, 2025 Morning Each Day: 08:00 - 12:00 hrs; Afternoon: 13:00 - 18:00 hrs; Monitoring was conducted in 15-minute intervals for a minimum duration of 30 minutes per session							
Air Quality Standards		PM 2.5 (µg/m3)			PM 10 (µg/m³)			AQI	Remarks
U.S EPA	Good	0 - 15.4			0 -54			0 - 50	
	Moderate	15.5 - 40.4			55 - 154			51 - 100	
	Unhealthy for sensitive Groups	40.5 - 65.4			155 - 254			101 - 150	
	Unhealthy	65.5 - 150.4			255 - 354			151 - 200	
	Very Unhealthy	150.5 - 250.4			355 - 424			201 - 500	
	Hazardous	250.5 - 500.4			425 - 604			301 - 500	
WHO		25			50				
ZEMA		15 (12 months)			70 (24 hours)				
Time		Morning	Afternoon	Average	Morning	Afternoon	Average		
Sampling Points									
AQ1		2.1	5	3.6	3.6	8.5	6.1	13	Normal
AQ2		2.7	2.6	2.7	4.2	4.2	4.2	12	Normal
AQ3		2.6	3.9	3.3	4.3	6.6	5.5	15	Normal
AQ4		5.6	5.7	5.7	9	9.4	9.2	16	Normal
AQ5		3.7	5.2	4.5	6	8.5	7.3	18	Normal
AQ6		3	2.9	3	4.8	4.6	4.7	16	Normal
AQ7		2.6	4	3.3	4.4	7.1	5.6	11.3	Normal
AQ8		2.1	2.9	2.5	3.7	4.5	4.1	15	Normal
AQ9		4.6	4	4.3	7.3	6.6	7	16	Normal
AQ10		4.2	2.9	3.6	6.8	4.9	5.6	17	Normal
AQ11		2.8	3.1	3	5	8.9	7	18	Normal

5.3.2 Key Findings

Key findings include the following:

- **Particulate Matter (and PM_{10}):** Concentrations across all monitoring sites ranged from 2.1 to 5.7 µg/m³ for $PM_{2.5}$ and 3.6 to 9.4 µg/m³ for PM_{10} - remained within the permissible limits set by the Zambia Environmental Management Agency (ZEMA) and World Health Organization (WHO). Slightly elevated PM values were recorded at AQ4, AQ5, AQ10, and AQ11, primarily located near settlements, agricultural zones, and areas with cleared vegetation. These values, however, were well within safe exposure thresholds.
- **Nitrogen Dioxide (NO_2):** Detected at trace levels, with all measurements falling below ZEMA and WHO standards. The highest readings were observed near active community areas but remained compliant.
- **Sulphur Dioxide (SO_2) and Carbon Monoxide (CO):** Not detected (ND) at any of the monitoring sites, indicating an absence of significant combustion-related emissions within the project corridor.
- **Formaldehyde (HCHO) and Total Volatile Organic Compounds (TVOC):** Concentrations varied across the sites but consistently remained below WHO's 8-hour exposure limits. Elevated TVOC levels were noted at AQ4, AQ5, AQ10, and AQ11, likely influenced by localized human activities, vegetation decay, or minor agricultural burning.

Overall, the baseline air quality assessment confirms that the ambient air quality along the OHL corridor is within acceptable environmental and health standards. The absence of detectable SO_2 and CO, coupled with compliant levels of PM, NO_2, HCHO, and TVOC, indicates a generally clean air environment across the project area.

5.4 Noise and vibration

5.4.1 Approach

Noise levels were recorded using short-term measurement sessions of 15 to 60 minutes, conducted three times daily at 06:00, 12:00, and 18:00 hours. This approach aligns with international best practices outlined by the World Health Organization (WHO) for environmental noise monitoring, providing a representative assessment of both daytime and transitional sound levels.

Noise measurements were captured using a calibrated digital sound level meter, IEC 61672-3:2006, model CR 831C configured to record the following acoustic values:

- **LAeq (Equivalent Continuous Noise Level):** The average noise level over the monitoring period.
- **Lmax (Maximum Noise Level):** The highest recorded noise level during each session.
- **dBC (Peak Noise Level):** A measure of short-duration, high-intensity noise events.

The digital sound level meter was configured for high sensitivity to capture even subtle noise variations, ensuring accurate representation of the acoustic environment.

5.4.2 Site Selection

Noise monitoring locations were strategically selected along the transmission corridor to ensure a comprehensive representation of the project's acoustic environment.

Table 5-4 Noise Pollution Monitoring Locations

Site Code	Description	Latitude	Longitude	Distance from Activity	Community Nearby
NSP1	Near ZESCO substation – Chipata West	-13.654374	32.557004	0 m (on-site)	Yes, 471 m on the East side
NSP2	Great East Road (Lee-ward)	-13.664082	32.563096	0 m (on-site)	No
NSP3	Kauzu Village (near Kauzu Primary)	-13.683094	32.570319	130 m	Yes
NSP4	Chinyaku (clustered rural huts) village settlements	-13.718171	32.585565	0 m (on-site)	Yes
NSP5	Daula Village (Access road)	-13.741106	32.600861	0 m (on-site)	Yes
NSP6	Chadiza Road (Cross Point)	-13.769164	32.628706	0 m (on-site)	No
NSP7	Chibwe Village (Scat-tered rural huts nearby)	-13.811408	32.7204	88 m	Yes
NSP8	Near regenerating forest zone and farms	-13.84166	32.78863	0 m (on-site)	No
NSP9	Chichele Village (Forest and Farms)	-13.820545	32.83565	105 m	No
NSP10	Galamukani Village	-13.821777	32.862824	40 m	Yes
NSP11	Chikoka Village	-13.823116	32.877842	0 m (on-site)	Yes

The selection of these sites was guided by the following criteria:

- **Proximity to Noise-Generating Sources:** Such as roads, community gathering points, and areas of agricultural or commercial activity (NSP2, NSP4)
- **Noise-Sensitive Receptors:** Including residential areas, schools, health facilities, and community centers, where the potential impact of noise could be significant (NSP3, NSP4, NSP7, NSP 9, NSP10, NSP11)
- **Quiet Baseline Zones:** Remote or vegetated areas, providing a natural acoustic reference for comparative

analysis (NSP8, NSP9)
- **Topographic and Vegetative Influence:** Locations where natural features such as hills, valleys, and tree cover may influence noise propagation (NSP8, NSP9)

These locations mirrored the air quality monitoring points for consistency in environmental data collection, enhancing the assessment's reliability.

5.4.3 Safety and Operational Measures

- Noise monitoring was restricted to daytime hours to ensure personnel safety in remote areas.
- Equipment was securely mounted and shielded from environmental interference during measurements.
- Monitoring schedules were designed to prevent fatigue and ensure consistent data quality.

5.4.4 Standards Used

In the absence of specific **ZEMA** noise-exposure limits for rural environments, the assessment followed the **World Health Organization (WHO) Environmental Noise Guidelines for the European Region (1999) for community noise**, which establish health-based thresholds for community and occupational noise exposure. These guidelines provide for 55 dB(A) to avoid serious annoyance for outdoor living area (day/evening) for a 16 h period. This is a robust framework for evaluating ambient noise conditions and ensuring compliance with internationally recognized best practices (**WHO, 1999**).

5.4.5 Results Summary

General Noise Levels

The baseline noise assessment across the transmission corridor revealed that ambient noise levels were generally low to moderate, reflecting the predominantly rural and peri-urban character of the project area. The key findings are as follows:

- **Average Noise Levels:** Across all monitoring points, average ambient noise values remained below 60 dB(A), indicating a quiet to moderately quiet acoustic environment.
- **Minimum Recorded Noise Levels:** Ambient noise levels ranged between 36 and 43 dB(A), typical of rural settings where natural sounds and limited human activity are the primary noise sources.
- **Maximum Recorded Noise Levels:** The highest sustained noise levels recorded were up to 97 dB(A) at selected points (NSP2, NSP3 and NSP7). These peak values were attributed to transient events such as passing vehicles, livestock sounds, and occasional community activities such as loud music.

Peak Noise Events

Short-term, high-intensity noise spikes (dBC) were also recorded, with values reaching up to 97 dBC at some monitoring points. These peaks were associated with sudden, localized noise sources such as:

- **Vehicle Movements:** Especially along access roads and community pathways.
- **Livestock and Agricultural Activities:** Including cattle herding, ploughing, and local market gatherings.
- **Community Events:** Such as music from nearby bars, social gatherings or public announcements.

These transient noise events were brief and did not constitute sustained noise exposure, ensuring that the general ambient conditions remained well within acceptable limits.

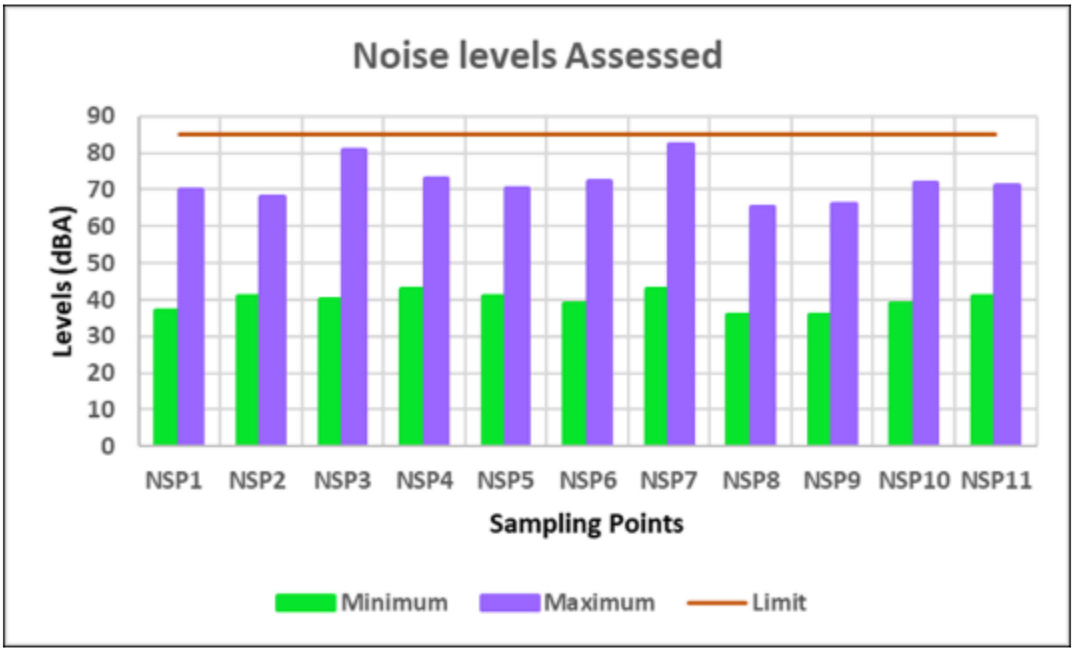


Figure 5-5 Noise levels

5.4.6 Compliance with Regulatory Standards

All recorded noise levels were below the ZEMA daytime noise limit of 85 dB(A), with the majority of monitoring points maintaining noise levels below 60 dB(A). On the other hand, maximum and average noise levels are above the WHO guidelines for community noise exposure, which is 55 dB(A), especially close to communities and road crossings.

Spatial Distribution of Noise Levels

- **Rural and Vegetated Zones:** Monitoring sites located in forested or open rural areas exhibited the lowest noise levels, with average values ranging between 36 and 43 dB(A) (NSP8, NSP9).
- **Community Proximity:** Sites near settlements or active areas (e.g., NSP2, NSP3, NSP7) recorded higher transient noise peaks, though these were brief and not persistent.
- **Transport Corridors:** Sites adjacent to main roads or access paths experienced occasional high noise spikes due to passing vehicles (NSP2).

5.4.7 Conclusion

The baseline noise assessment for the Malawi-Zambia 400kV Interconnector Project reveals a generally quiet acoustic environment along the transmission corridor, with average noise levels well below the ZEMA guideline of 85 dB(A) – but higher than the WHO guidelines. Transient noise peaks were observed at a few locations, primarily due to passing vehicles, livestock movement, and community events. These peaks were momentary and did not result in sustained elevated noise exposure.

5.5 Geology

The Malawi-Zambia 400kV Transmission Interconnector project is located within a geologically diverse region characterized by its position along an east-northeast to west-southwest (ENE-WSW) trending segment of the Neoproterozoic mobile belt. This tectonic corridor is a product of a complex geological history, marked by multiple phases of deformation, metamorphism, and igneous intrusion. The geological framework of the project area is predominantly defined by the Basement Complex, which is overlain by metasedimentary rocks of the Katanga Supergroup (*Geology of Eastern Province, Zambia; JICA, 2015*).

Basement Complex

The Basement Complex forms the foundational geological unit of the project area, comprising some of the oldest and most structurally complex rock formations. These rocks have experienced extensive metamorphism and deformation, which have shaped their current lithological and structural characteristics. Key rock types within the Basement Complex include:

Granulites:

- These are high-grade metamorphic rocks that constitute the core of the Basement Complex.
- Granulites are characterized by a gneissic texture and are predominantly found in the northern sections of the project area.
- They typically exhibit mineral assemblages of quartz, feldspar, garnet, and pyroxene, reflecting their high-temperature metamorphic origin.

Migmatites:

- Migmatites represent a transitional rock type that embodies features of both metamorphic and igneous processes.
- These rocks are formed through partial melting and recrystallization, resulting in a heterogeneous mix of gneissic and granitic textures.
- Migmatites are often interlayered with granulites and granitoids, highlighting the complex metamorphic history of the region.

Amphibolites:

- These are metamorphosed mafic rocks that typically occur as bands, lenses, or pods within the more felsic units of the complex.
- Amphibolites are characterized by their dark green to black coloration, with dominant minerals including hornblende and plagioclase.
- They are indicative of medium to high-grade metamorphic conditions, reflecting a history of significant tectonic and thermal events.

Schists:

- Schists are medium- to high-grade metamorphic rocks that exhibit a well-developed foliation, which is defined by the parallel alignment of platy minerals.
- Common mineral constituents include biotite, muscovite, quartz, and feldspar, which impart a characteristic layered appearance to the rocks.
- Schists are widely distributed in the project area and serve as important indicators of the region's metamorphic evolution.

Granitoids:

- This term encompasses a variety of granitic rocks, including true granites, syenites, and marginal charnockites, which have intruded the older metamorphic units.
- The granitoids in the project area are significant as they represent various intrusive episodes, each reflecting a distinct phase of magmatic activity.
- These rocks are generally coarse-grained, with compositions ranging from quartz-rich granites to more feldspar-dominated syenites.

Geological Evolution and Tectonic History

The Basement Complex of the project area has been subjected to multiple phases of tectonic deformation, including folding, faulting, and regional metamorphism. These processes have resulted in the complex structural geometry observed today, with prominent foliation, schistosity, and gneissic banding. The region's geological history is further enriched by successive magmatic events, as evidenced by the emplacement of granitoid bodies, which mark significant phases of crustal evolution.

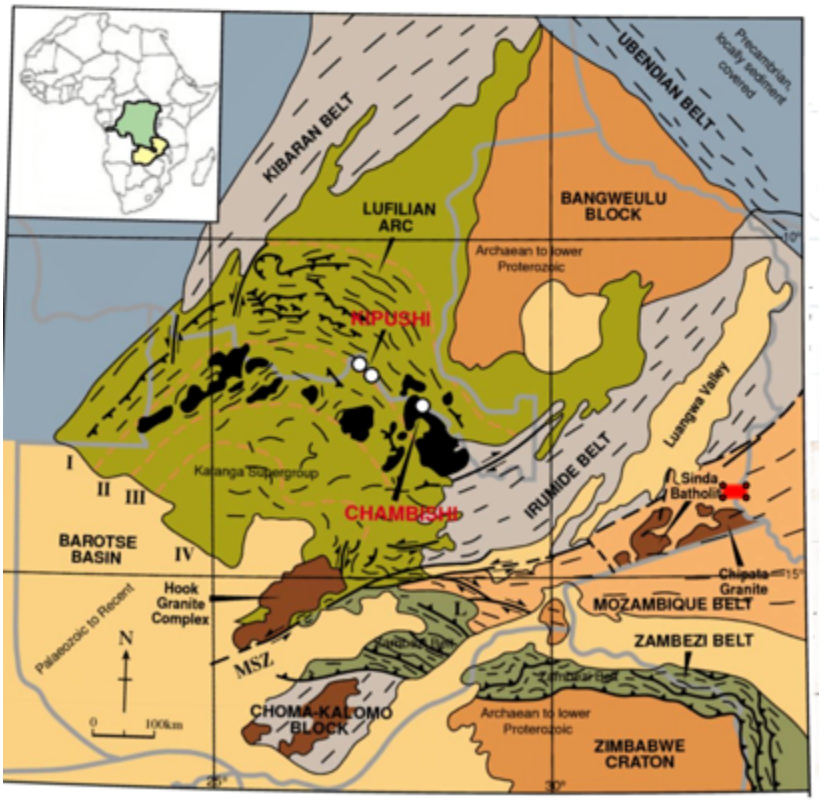
This geological diversity not only defines the physical characteristics of the terrain but also has implications for soil formation, groundwater occurrence, and the stability of the transmission line foundations. Understanding this complex geological setting is essential for informed engineering design and environmental management of the Malawi-Zambia 400kV Transmission Interconnector Project.

Katanga Super Group

Overlying the Basement Complex unconformably are the younger rocks of the Katanga Super Group. This sequence of rocks, which is typically of greenschist facies, represents a significant period of sedimentation and tectonic activity in the region. The Katanga Super Group rocks in the Vubwe general area are characterized by:

- **Metasedimentary Rocks:** These rocks have undergone low-grade metamorphism and are often associated with narrow mylonitic fault zones, which are indicative of significant tectonic shearing and deformation. The presence of phyllonitization, a process where rocks are converted into fine-grained foliated rocks known as phyllonites, highlights the intensity of deformation that these rocks have experienced.

- The Katanga SuperGroup rocks are crucial in understanding the tectonic evolution of the project area, as they record the younger sedimentary and structural history that overlays the more ancient Basement Complex (Geology of Eastern Province, 1995). Refer to Figure 5-6 below.



Symbol Colour	Geological Unit / Tectonic Feature
Orange	**Bangweulu Block** (Archean to Lower Proterozoic rocks)
Brown	**Mozambique Belt** (High-grade metamorphic terrain)
Beige	**Zambezi Belt** (Deformed Proterozoic terrain)
Dark Brown	**Choma–Kalomo Block** (Archean basement complex)
Light Blue	**Barotse Basin** (Paleozoic to Recent sedimentary cover)
Olive Green	**Katanga Supergroup** (Lufilian Arc sediments and metasediments)
Purple-Grey	**Kibaran Belt** (Proterozoic folded belt)
Grey-Brown	**Ubendian Belt** (Proterozoic sheared and metamorphic terrain)
Red	**Lusaka Granite Complex** and **Sinda Batholith** (Granitoids)
Pale Yellow	**MSZ (Mwembeshi Shear Zone)** (Major tectonic lineament)
Black Shaded Zones	**Major Ore Bodies** (e.g., Chambishi, Kipushi)

Project Reference Points:

Red Square – Project-specific geological markers (e.g., project area).

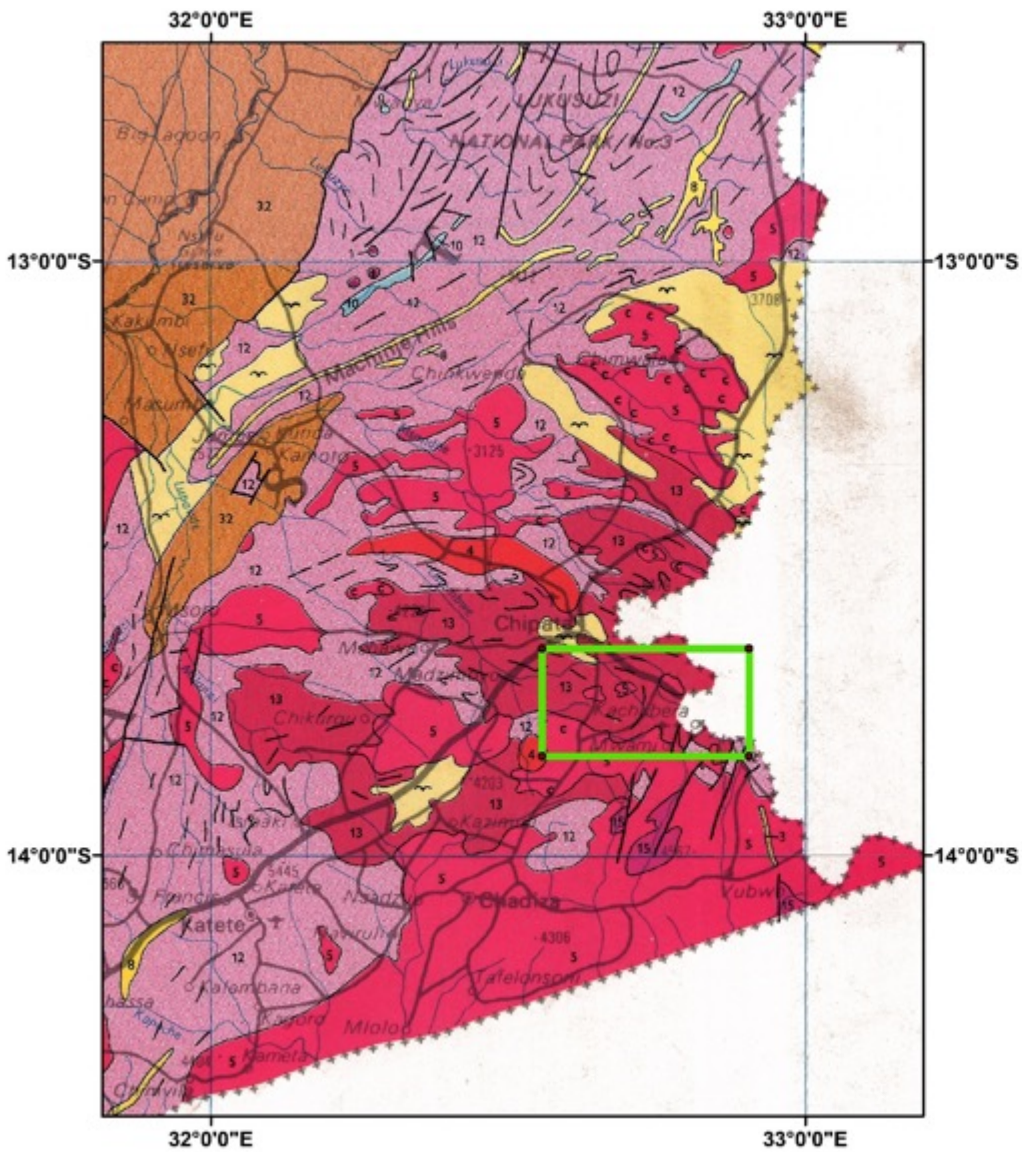
Figure 5-6 Tectonic setting of the project area

Regional Geology

The regional geology of the project area, as illustrated in Figure 5-7 below, reveals a stratigraphic sequence dominated by rocks of the Basement Complex, which can be divided into three main types based on their age and lithology (geology of Eastern Province, 2012):

1. **Granulitic Facies Rocks (excluding charnockites):** These high-grade metamorphic rocks form the bulk of the northern part of the area. Their granulitic texture indicates a history of deep burial and high-temperature metamorphism, making them some of the oldest and most stable rocks in the region.
2. **Precambrian Granitic Gneiss, Migmatites, and Granites:** Exposed primarily in the southeastern part of the area, these rocks represent a diverse suite of metamorphic and igneous processes. The gneissic and migmatitic textures suggest a history of intense deformation and partial melting, while the granites indicate episodes of igneous intrusion.
3. **Granite Pods:** These occur as small, localized bodies in the central parts of the area. The granites are younger than the surrounding metamorphic rocks and have influenced the structural trends in their vicinity, suggesting that they were emplaced during a later phase of geological activity.
4. **Charnockitic Granite:** Covering approximately 30% of the area, particularly in the southern region, these rocks are contemporaneous with the other granitic bodies but exhibit a higher grade of metamorphism. The charnockitic granite is indicative of a unique metamorphic environment that was distinct from the conditions that formed the surrounding rocks.

The geology of the Malawi-Zambia 400kV Transmission Interconnector project area is a testament to the region's complex geological history. The interplay between the ancient Basement Complex rocks and the overlying Katanga SuperGroup reflects a dynamic tectonic environment that has shaped the landscape over hundreds of millions of years. Understanding this geological setting is crucial for the successful planning and implementation of the interconnector project, as it informs decisions related to construction, resource management, and environmental impact mitigation.



Colour	Geological Unit	Description
Brown	**Katanga Supergroup (Upper Unit)**	Sedimentary rocks (quartzites, schists, slates), associated with copper-bearing strata.
Light Purple	**Katanga Supergroup (Lower Unit)**	Dolomitic marbles, phyllites, and schists formed under low-grade metamorphism.
Red	**Basement Complex – Gneisses & Granites**	Ancient crystalline rocks including banded gneisses and granitic intrusions.
Yellow	**Quartzite & Conglomerates**	Resistant ridges composed of coarse-grained clastic rocks.
Orange	**Gneissic Complexes (Irumide Belt)**	High-grade metamorphic terrains comprising migmatites and amphibolites.
Black	**Shear Zones/Faults**	Tectonic structural features indicating zones of crustal weakness and past movement.
Green Box	**Project Area (Zambia Section)**	Approximate location of the Malawi-Zambia 400kV Interconnector transmission corridor.

Figure 5-7 Regional geological map (with the project area highlighted)

5.6 Seismicity

According to the seismicity map developed by the Geological Survey Department of Zambia, the project area is located within a region that exhibits relatively low seismic activity, with a historical record of earthquake magnitudes in the range of 4 to 5 on the Richter Magnitude Scale within a 20-30 km radius. However, it is important to note that no earthquake epicentres have been directly recorded within the immediate vicinity of the project site itself.

Seismic Risk Considerations

While the project area is not situated in a high-seismicity zone, it is geographically proximate to the East African Rift Valley System, a tectonically active region that extends through parts of eastern Africa, including Zambia's northern and northeastern regions. The Rift Valley system is associated with the ongoing tectonic divergence of the African Plate, leading to the formation of several large lakes, including Lake Tanganyika, Lake Mweru, and Lake Malawi. This tectonic activity is a significant source of seismic events in the region, with occasional earthquakes of varying magnitudes.

Given the proximity of the project area to this tectonic feature, there is a recognized need to consider the potential effects of seismic events originating from the Rift Valley. Seismic hazard assessments indicate that areas within this tectonic regime have a 10% probability of experiencing peak ground accelerations (PGA) ranging from 0.4 to 0.8 m/s^2 over a 50-year period (Mileji and Mulenga, 2020). Although the project area itself is not expected to experience significant seismic activity, the influence of regional seismic events cannot be entirely discounted.

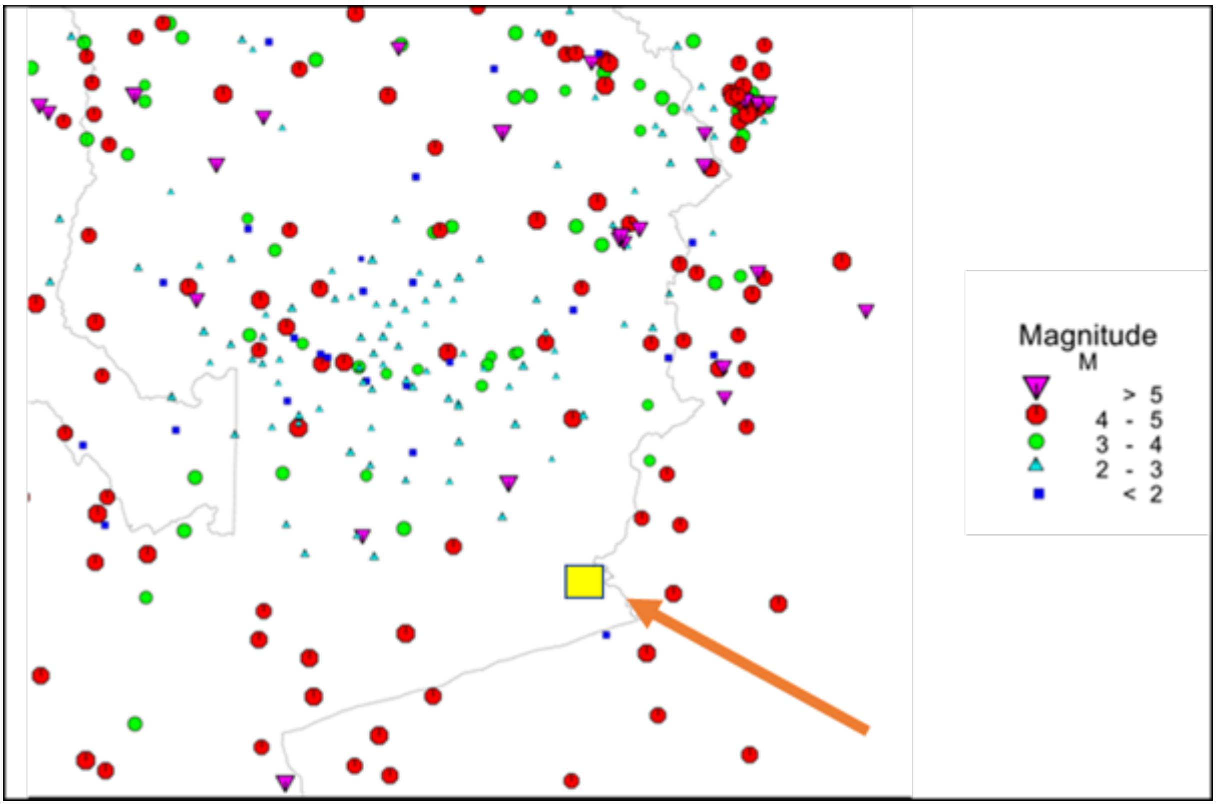


Figure 5-8 Map of recent (last 50 yrs) earthquake epicenters around the project area

5.7 Hydrology

The hydrology of the Malawi-Zambia 400kV Interconnector project area, spanning the Chipata and Vubwi districts, is defined by a dynamic interplay between surface water and groundwater systems. The region is characterized by a network of seasonal rivers, perennial streams, and significant groundwater resources, all of which are influenced by local climatic patterns, topography, and vegetation cover.

5.7.1 Surface Water Systems

The project corridor intersects a network of seasonal rivers and streams (Refer to **Error! Reference source not found.**), which exhibit distinct flow patterns governed by the region's tropical savanna climate. Key watercourses along the transmission line route include:

- **Lutembwe River:** Crossed by the OHL at 6.3km from the Chipata West Substation. This is an important perennial river in the Chipata district, originating from the eastern range of hills near the Mwami Border. The Lutembwe River follows a dendritic drainage pattern and is a vital water source for the City of Chipata, with its flow regulated by the Lutembwe Dams 1 and 2, located approximately 20 km from the border post and 3.5 to 5 km from the OHL centreline. These dams supply potable water to the city. As a tributary of the Msandile River, which ultimately joins the Luangwa River, the Lutembwe River maintains an average flow rate of 0.634 m^3/s, with historical flow values ranging from a minimum of 0.062 m^3/s to a maximum of 2.335 m^3/s (Banda, 2015).
- **Chibila River:** Is crossed by the OHL at 11.6km from the Chipata West Substation. This is another significant watercourse along the project route, characterized by a highly seasonal flow regime. During the rainy season (November to April), the river swells due to surface runoff, supporting local agricultural activities and providing habitat for aquatic species. In the dry season (May to October), flow rates decline sharply, with many tributaries drying up.
- **Mwami and Lubwe Rivers:** These rivers are located within the Vubwi district and are also subject to seasonal flow variations. They are crossed by the OHL at 28.5 and 34.9km respectively from Chipata West Substation. They provide essential water resources for domestic use, livestock watering, and small-scale irrigation in the surrounding communities.
- **Other Streams (Nyongo and Choli):** Crossed by the OHL at 40.6km and 45.3km respectively from the Chipata West Substation, these smaller, ephemeral streams experience pronounced seasonal fluctuations, becoming active during the wet season and often drying out completely during the dry months. Their contribution to local hydrology is primarily during peak rainfall periods.

Seasonal Flow Patterns

The hydrological regime of the project area is strongly influenced by seasonal rainfall, which is concentrated between November and April. During this period, the region receives substantial precipitation, which drives surface runoff and replenishes rivers and streams. This seasonal flow is critical for maintaining ecological functions, supporting agricultural irrigation, and ensuring water availability for local communities.

In contrast, the dry season, which spans from May to October, is marked by a sharp decline in surface water availability. Smaller streams dry up entirely, while larger rivers like the Lutembwe maintain minimal flow, primarily sustained by residual groundwater discharge and soil moisture from the preceding wet season. This variability underscores the importance of sustainable water management, especially for communities that rely on surface water sources for domestic use and irrigation.

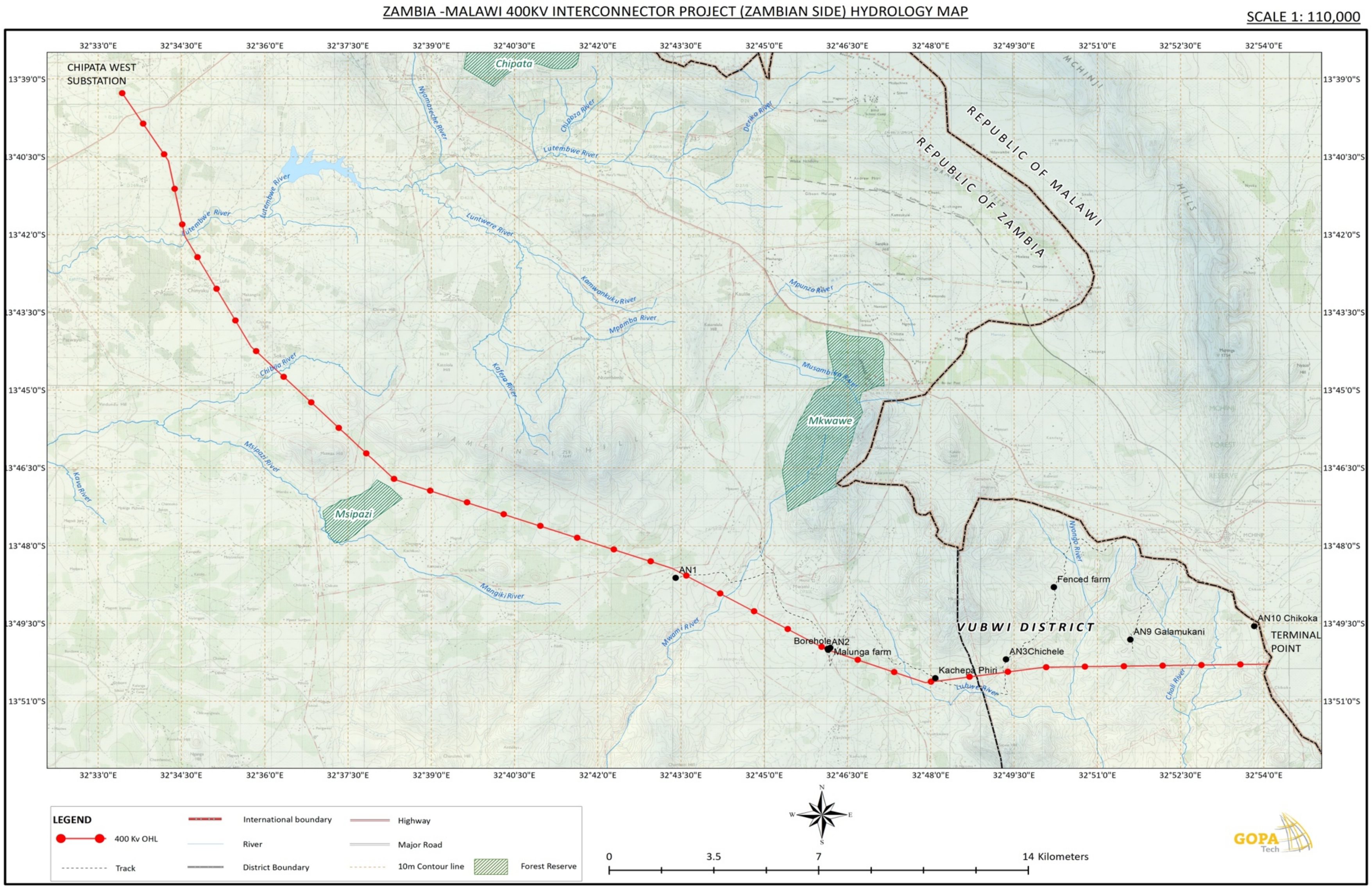


Figure 5-9 Hydrology of the Malawi-Zambia 400kV Interconnector Project Area

5.7.2 Groundwater Systems

The groundwater resources of the Malawi-Zambia 400kV Interconnector project area are intimately connected to the region's topography and vegetation cover. The landscape is characterized by rolling hills, many of which are covered with primary and secondary miombo woodland. These elevated areas play a crucial role in **groundwater recharge**, as they enhance infiltration and regulate subsurface water flow (*British Geological Survey [BGS], 2020; Hydrogeology of Zambia*), with the following key characteristics:

- **Groundwater Recharge Zones:** The miombo woodlands, with their deep-rooted vegetation, enhance groundwater recharge by promoting the infiltration of rainwater into the soil. This natural process is critical for maintaining aquifer levels, which serve as a reliable source of water during the dry season.
- **Aquifer Characteristics:** The underlying geological formations, composed of weathered basement rocks and fractured zones, provide a porous medium for groundwater storage and flow. Boreholes and wells in the area tap into these aquifers, providing a vital water supply for rural communities.
- **Community Water Sources:** Groundwater is a primary source of drinking water for local residents, with boreholes and protected wells commonly found in villages along the project corridor. These sources are generally reliable throughout the year, but their sustainability is closely linked to the effectiveness of natural recharge processes.

Groundwater depth typically varies between **10 to 40 meters below ground level (mbgl)** depending on location, geology, and topography:

- **Shallow Groundwater in Valleys and Lowlands**: In low-lying areas, such as **village valleys or near seasonal rivers**, the water table tends to be **shallower**, often ranging from **10 to 20 mbgl**. Boreholes in such zones, like those at **Makangila Primary School (BH2)** and **Kauzu (BH3)**, reported water strikes at depths between **12–18 meters**.
- **Deeper Aquifers in Upland or Forested Areas**: In upland areas, especially along ridges and hills dominated by **miombo woodland** and rocky terrain, groundwater tends to be deeper. Borehole drilling logs from areas such as **Lufazi County (BH1)** and **Lubwe** indicated water strikes at **30–40 mbgl**, consistent with fractured aquifers within **gneissic or granitic basement rock**.

5.7.3 Baseline Water Quality Assessment

A comprehensive baseline water quality assessment was conducted along the Zambian section of the Zambia–Malawi 400 kV Interconnector corridor from 1st April, 2025 to 14th April 2025. This was during the early dry season when the water levels in the rivers were relatively low. This assessment aimed to evaluate the physicochemical characteristics of both surface and groundwater sources within the project area, providing critical baseline data for understanding the current water quality status. The primary objective was to identify sensitive receptors, assess potential water quality risks, and establish a reference point for future monitoring during and after the project’s construction phase.

Sampling locations

Water quality samples were collected from eight strategically selected sites representing both surface water bodies and groundwater sources in the project area. These sites were chosen based on their proximity to the proposed transmission corridor, their importance as community water sources, and their potential sensitivity to project activities.

The selected sampling sites included:

- **Mwanza Village Well (Groundwater)** – A community water source commonly used for domestic purposes.
- **Lufazi County BH1 (Groundwater)** – A borehole supplying water to the local community.
- **Makangila Primary School BH2 (Groundwater)** – A borehole located within a school compound, serving both the school and surrounding community.
- **Kauzu BH3 (Groundwater)** – Another critical groundwater source providing water to nearby households.
- **Nyonga Stream (Surface Water)** – A seasonal stream with significant flow during the rainy season.
- **Mkaya SN2 (Surface Water)** – A small seasonal stream, influenced by agricultural runoff.

- **Lubwe (Surface Water)** – A larger stream crossing the project area, with a mix of forested and agricultural catchments.
- **Lutembwe SW6 (Surface Water)** – A perennial river that supports local water needs and is critical for maintaining downstream ecological health.

The location of sampling points with reference to the OHL route is shown in Figure 5-10 below.

Sampling Procedure

At each site, water samples were collected following standard procedures to ensure the integrity and representativeness of the samples as follows:

Standard Procedures for Water Sample Collection

To ensure the integrity, representativeness, and quality of both surface and groundwater samples, standardized field protocols were followed during the baseline water quality assessment. The procedures applied were consistent with international best practice and aligned with Zambia Bureau of Standards (ZABS) and World Health Organization (WHO) guidelines.

1. Surface Water Sampling

Site Selection: Sampling points were identified at midstream locations to minimize bank influences and ensure representative conditions of flowing water.
Sampling Depth: Samples were collected at a depth of approximately 30 cm below the water surface to avoid surface films, debris, or floating contaminants.
Equipment Preparation: Clean, pre-sterilized sampling bottles (HDPE) were used. Bottles were rinsed three times with site water prior to collection to condition them and reduce contamination risk.
Collection Method: The sample bottle was submerged with the opening facing upstream to avoid disturbance from the sampler's presence. Care was taken to prevent inclusion of air bubbles or disturbance of sediments.
Labelling: Bottles were immediately sealed, labelled with site code, date, time, and collector's initials.

2. Groundwater Sampling (Boreholes and Wells)

Purging: Each borehole or well outlet tap was opened and allowed to run freely for 2–3 minutes (or until field parameters such as temperature, pH, and conductivity stabilized) to ensure stagnant water was flushed out and only fresh aquifer water was sampled.
Collection Point: Samples were collected directly from the outlet tap using clean, pre-rinsed sampling bottles. Bottles were held close to the outlet to prevent contact with air or external surfaces.
Field Conditioning: Bottles were rinsed three times with the water to be sampled prior to collection.
Sealing and Labelling: After filling, bottles were capped securely to prevent leakage, labelled appropriately.

3. Sample Preservation and Handling

Preservation: Samples were preserved by cooling for general chemistry and microbiological samples.
Temperature Control: All samples were stored in cooler boxes with ice packs, maintaining a temperature of approximately **4°C** until delivery to the laboratory.
Holding Times: Samples were delivered to an accredited laboratory within the prescribed holding times for each parameter to ensure analytical reliability.

Portable, calibrated instruments SULMILE AZ-86031 5-in1 Water Quality Meter were used for on-site measurement of key water quality parameters, including:

- **pH:** Measured using a portable pH meter to assess the acidity or alkalinity of the water.
- **Electrical Conductivity (EC):** Measured using a portable conductivity meter, providing an indication of the total dissolved ions in the water.

- **Total Dissolved Solids (TDS):** Calculated from EC values, representing the concentration of dissolved substances in the water.
- **Turbidity:** Measured using a portable turbidity meter, indicating the clarity of the water, which is influenced by suspended particles.
- **Temperature:** Recorded using a digital thermometer to account for temperature variations that can affect chemical reactions in water.
- **Dissolved Oxygen (DO):** Measured using a portable DO meter to determine the amount of oxygen available for aquatic life.

Water samples were transported under controlled conditions to an accredited laboratory for detailed chemical analysis. The Zambia Agriculture Research Institute (ZARI) - National Soil/Plant/Water/Fertilizer Research Laboratories is a **nationally recognized and internationally accredited laboratory**. As a National Laboratory, ZARI is certified to handle all laboratory-related samples, including soil, water, plant, and fertilizer analysis. The laboratory adheres to standard laboratory procedures and maintains strict compliance with international best practices. The following parameters were measured:

- **Nutrients:** Nitrates, Nitrites, and Phosphates, which are essential indicators of nutrient enrichment and potential eutrophication risks.
- **Trace Metals:** Including Copper (Cu), Lead (Pb), Manganese (Mn), Zinc (Zn), Cadmium (Cd), and Iron (Fe). These metals were analyzed using atomic absorption spectrophotometry (AAS) to ensure accurate detection of low concentrations.
- **Microbial Indicators:** Total Coliforms and Faecal Coliforms were analyzed using the multiple tube fermentation method, providing a measure of potential microbial contamination.
- **Other Parameters:** Sulphates, Chlorides, Fluorides, and other chemical characteristics were analyzed to provide a comprehensive understanding of the water quality status.

The results of the water quality analysis were compared against the following standards to assess compliance:

- **Zambian Bureau of Standards (ZABS) Drinking Water Standards:** Specifying maximum allowable limits for various chemical, physical, and microbiological parameters in drinking water.
- **World Health Organization (WHO) Drinking Water Guidelines:** Providing international benchmarks for safe drinking water quality.

It is important to note, however, that untreated surface water—particularly in areas with human activity—is rarely expected to meet drinking water standards, especially for microbiological indicators (e.g., faecal coliforms) and parameters such as turbidity. Therefore, direct comparison to drinking water benchmarks for untreated water sources primarily serves as a **risk assessment tool** rather than an indication of suitability for immediate consumption without treatment.

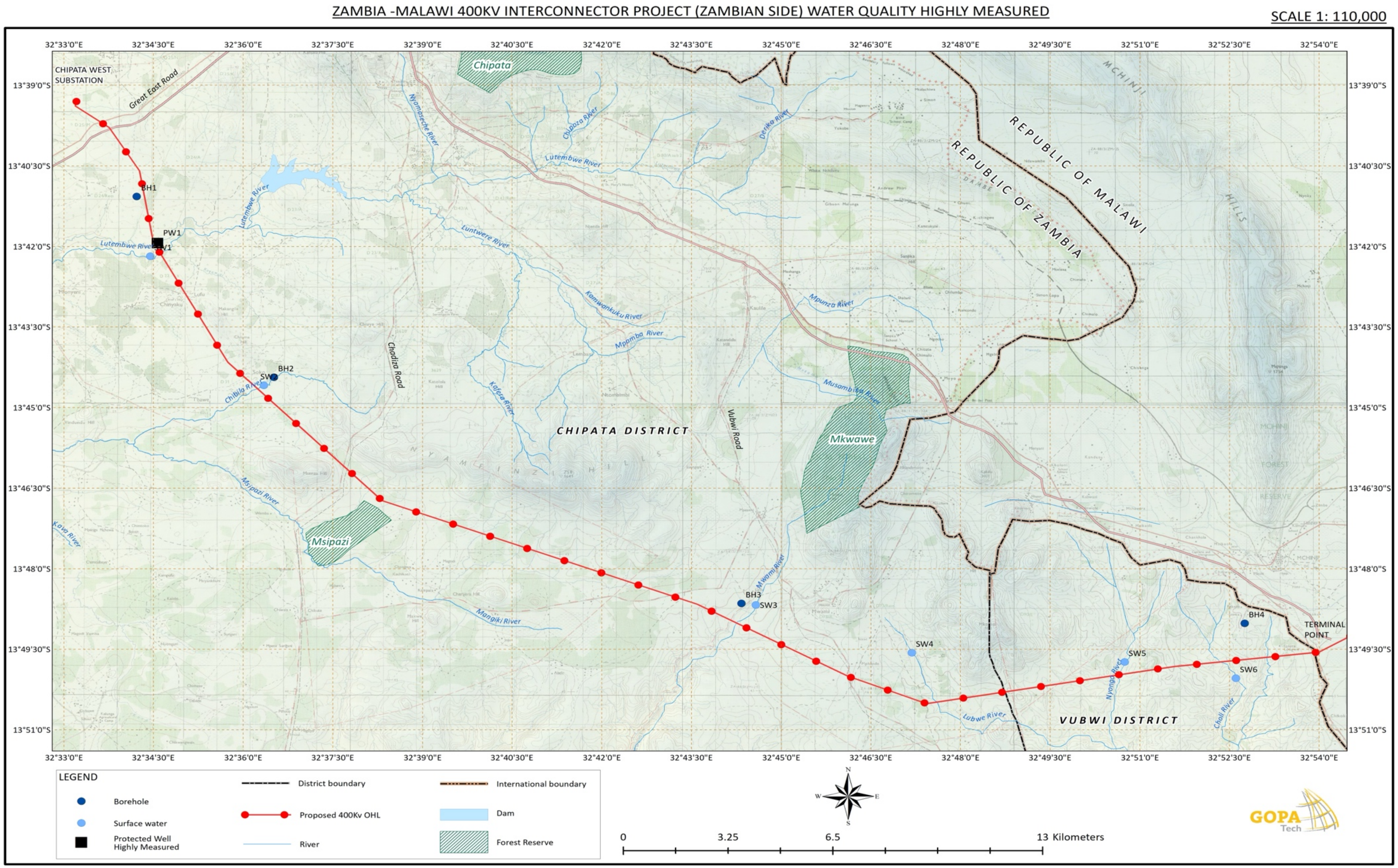


Figure 5-10 Location of Surface and Groundwater sampling points

Results of the analysis

Surface water quality monitoring was undertaken at six representative points along the Zambia–Malawi 400 kV Interconnector corridor. These points include Lubwe River, Chibila Stream, Nyongo Stream, Mwami Stream, Choli Stream, and the Lutembwe River. The monitored parameters were compared to ZABS ambient water quality standards to assess suitability for ecological integrity and potential community use (domestic, agricultural, or livestock). The results are shown in **Error! Reference source not found.** below.

Table 5-5 Water quality of surface waters

SURFACE WATER											
Parameters				pH	EC	TDS	D.O	Turbidity	Eh	Temp.	Salinity
Sampling Point Name	Ambient Standards	Coordinates		6 - 8.5	400	180		50		25	
		Latitude	Longitude		µS/cm	ppm	mg/l	NTU	mV	(°C)	
Lubwe River		-13.843093	32.793774	7.47	116.4	58.04	6.3	88.1	-8.9	21	0.05
Chibila Stream		-13.746241	32.606331	7.53	168.7	84.13	6.5	16.6	-7.3	24	0.07
Nyongo Stream		-13.8392	32.843451	6.88	136.2	67.4	6.3	126	-2.1	21.6	0.07
Mwami stream		-13.816337	32.738778	6.99	154.8	74.5	6.6	8.21	-8.5	22.6	0.07
Choli stream		-13.834084	32.876671	7.57	189	94	6.1	14.5	-8	24.2	0.09
Lutembwe River		-13.70215	32.576249	7.66	234	118	6.2	15.2	-7.3	23.2	0.11

The following can be commented on surface water quality:

- **pH (Range: 6.88 – 7.66);** All sites fall within the acceptable pH range (6–8.5), indicating neutral to slightly alkaline conditions. This suggests minimal acidification and a stable aquatic environment, supportive of aquatic life and community use.
- **Electrical Conductivity (EC: 116.4 – 234 µS/cm);** EC values were well below the 400 µS/cm limit, with the Lutembwe River recording the highest value (234 µS/cm). These values reflect moderate mineral content and no indication of salinity intrusion or industrial effluent.
- **Total Dissolved Solids (TDS: 58.04 – 118 ppm);** TDS levels were well within the 180-ppm threshold, suggesting good water clarity and low contaminant load. The Lutembwe River again had the highest concentration, potentially due to natural erosion or nearby agricultural activity.
- **Dissolved Oxygen (DO: 6.1 – 6.6 mg/L);** All sites demonstrated adequate DO concentrations, supporting healthy aquatic ecosystems. DO levels above 6 mg/L indicate sufficient oxygenation for fish and macroinvertebrate populations.
- **Turbidity (8.21 – 126 NTU);** Turbidity values varied significantly:
  - Nyongo Stream (126 NTU) and Lubwe River (88.1 NTU) exceeded the recommended 50 NTU limit, indicating potential sediment runoff or upstream disturbance, possibly due to vegetation clearance, agriculture, or natural erosion.
  - Other sites like Mwami and Choli streams were within acceptable levels.
- **Redox Potential (Eh: -8.9 to -2.1 mV);** Redox values were generally negative, suggesting anaerobic to weakly reducing conditions typical of natural stream environments with organic inputs. Nyongo Stream showed less reduction (-2.1 mV), possibly due to flow dynamics or vegetation cover.
- **Temperature (21 – 24.2°C);** Temperature values were consistent with seasonal norms for Eastern Province streams, with slight variation influenced by time of day, shading, and stream flow.
- **Salinity (0.05 – 0.11 ppt);** All measured salinity values were low, indicating freshwater conditions with no evidence of salt intrusion or chemical contamination.

Groundwater samples were collected from eight representative boreholes and protected wells situated near the Zambia–Malawi 400 kV interconnector corridor, namely Mwanza Village Well, Lufazi County BH1, Makangila Primary BH2, Kauzu BH3, Nyonga Stream, Mkaya SN2, Lubwe, and Lutembwe SW6. These water points serve surrounding communities for drinking, domestic use, and livestock watering.

Table 5-6 Location of groundwater samples

Groundwater Source	Coordinates (Lat, Long)
Mwanza Village Well	-13.62974, 32.63958
Lufazi County BH1	-13.63782, 32.64721
Makangila Primary BH2	-13.64498, 32.65432
Kauzu BH3	-13.65124, 32.66145
Nyonga Stream	-13.65789, 32.66891
Mkaya SN2	-13.66478, 32.67536
Lubwe	-13.67152, 32.68294
Lutembwe River SW6	-13.67941, 32.69024

In addition to the parameters measured for surface water, groundwater sources were also analysed for nutrients (nitrates and phosphates), trace metals (copper, manganese, iron, zinc, cadmium, and lead), and microbial contamination (faecal and total coliforms). The results are shown in Table 5-7 and **Error! Reference source not found.** below.

Table 5-7 Water analysis of groundwater

Parameter	Range Observed	Ambient Standard (ZABS)	Remarks
pH	6.77 – 7.76	6 – 8.5	All sites within acceptable range, indicating neutral to slightly alkaline water.
Electrical Conductivity (EC)	156.4 – 434 µS/cm	<400 µS/cm	All but Mwanza Well (434 µS/cm) complied. Higher EC may reflect mineral-rich aquifer or water-rock interaction.
Total Dissolved Solids (TDS)	78.5 – 220 ppm	<180 ppm	Four sites met the standard; Mwanza BH exceeded slightly at 220 ppm. Indicates mild mineral enrichment.
Turbidity	5.17 – 8.9 NTU	<50 NTU	Well within limits across all sites. Low turbidity implies good filtration in subsurface.
Redox Potential (Eh)	–7.9 to +22 mV	Not specified	Variability observed; positive Eh at Kauzu and Mwanza BH indicates more oxidizing conditions.
Temperature	23 – 26.3°C	~25°C (reference)	Slightly above the ambient reference, consistent with typical groundwater profiles.
Salinity	0.09 – 0.20 ppt	Not regulated	All samples showed very low salinity, indicating freshwater conditions.

Table 5-8 Chemical analysis of groundwater

Parameter	Mwanza Village	Lufazi County BH1	Makangila Primary BH2	Kauzu BH3	Nyonga Stream	Mkaya SN 2	Lubwe	Lutembwe SW6
Nitrate mg/L	12.4	9.28	15.06	24.93	19.54	26.2	20.28	14.99
Nitrite mg/L	<0.001	0.07	<0.001	0.02	0.03	0.01	0.01	<0.001
Phosphates mg/L	0.07	0.08	0.06	0.09	0.11	0.1	0.07	0.06
Copper mg/L	0.03	0.13	0.01	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese mg/L	0.05	0.07	0.01	0.07	0.04	0.03	0.03	0.01
Iron mg/L	<0.001	<0.001	0.01	<0.001	4.72	<0.001	2.31	0.3
Zinc mg/L	<0.001	0.07	0.05	0.04	0.05	0.03	0.02	<0.001
Cadmium mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	<0.001	<0.001
Lead (Pb) mg/L	0.16	0.01	0.07	0.11	0.12	0.03	0.07	<0.001
Feacal Coliform (CFU/100 mL)	600	680	1200	9400	50	400	0	20
Total Coliform (CFU/100 mL)	20	200	1400	3600	10	10	60	20

Nitrate (NO_3^-) Concentrations – [WHO Standard: <6.0 mg/L, ZABS Standard: 10 mg/L]

Results: Nitrate values exceeded the standard at all sites:

- Mwanza Village Well: 12.4 mg/L
- Lufazi County BH1: 9.28 mg/L
- Makangila Primary BH2: 15.06 mg/L
- Kauzu BH3: 24.93 mg/L
- Nyonga Stream: 19.54 mg/L
- Mkaya SN 2: 26.20 mg/L
- Lubwe: 20.28 mg/L

- Lutembwe SW6: 14.99 mg/L

Implications: These high nitrate values indicate potential contamination from agricultural runoff, sewage, or leaching fertilizers, posing a health risk.

Nitrite (NO_2^-) Concentrations – [WHO Standard: <0.06 mg/L, ZABS Standard: 1.0 mg/L]
Results: Nitrite values were generally compliant, except:

- Lufazi County BH1: 0.07 mg/L
- Nyonga Stream: 0.03 mg/L

Phosphate Levels – [WHO Standard: <0.4 mg/L, ZABS Standard: Not provided by ZABS]
Results: Phosphate values were generally compliant, with minor exceedances:

- Nyonga Stream: 0.11 mg/L
- Mkaya SN 2: 0.10 mg/L
- Kauzu BH3: 0.09 mg/L

Copper Levels – [WHO Standard: <0.003 mg/L, ZABS Standard: 1.0 mg/L]
Results: Copper values exceeded the standard in several locations:

- Mwanza Village Well: 0.03 mg/L
- Lufazi County BH1: 0.13 mg/L

Lead (Pb) Concentrations – [WHO Standard: <0.0015 mg/L, ZABS Standard: 0.01 mg/L]
Results: Lead levels were significantly high in some locations:

- Mwanza Village Well: 0.16 mg/L
- Kauzu BH3: 0.11 mg/L
- Nyonga Stream: 0.12 mg/L

Implications: Lead is a toxic metal, and its presence above standard limits can pose serious health risks, particularly to children.

Manganese Levels – [WHO Standard: <0.2 mg/L, ZABS Standard: 0.1 mg/L]
Results: Manganese values were compliant, except for:

- Kauzu BH3: 0.07 mg/L

Zinc Levels – [WHO Standard: <0.2 mg/L, ZABS Standard: 3 mg/L]
Results: Zinc levels were within the standard range across all sites.

Microbial Contamination (Faecal and Total Coliforms) – [WHO Standard: <0 CFU/100 mL, ZABS Standard: 0 CFU/100 mL]
Results: High levels of microbial contamination were detected at most sites:

- Mwanza Village Well: 600 CFU/100 mL (Faecal), 20 CFU/100 mL (Total)
- Lufazi County BH1: 680 CFU/100 mL (Faecal), 200 CFU/100 mL (Total)
- Kauzu BH3: 9400 CFU/100 mL (Faecal), 3600 CFU/100 mL (Total)
- Nyonga Stream: 50 CFU/100 mL (Faecal), 10 CFU/100 mL (Total)

Implications: This indicates potential contamination from human or animal waste, increasing the risk of waterborne diseases.

The analysis of water quality parameters revealed notable exceedances of recommended standards for several chemical and microbiological indicators, including:

- **Turbidity**: Elevated turbidity levels were recorded at multiple sites, indicating the presence of suspended particles and potential contamination from surface runoff, especially during the rainy season.
- **Nitrate Contamination**: Nitrate concentrations exceeded recommended limits (**WHO Standard: <6.0 mg/L**) across all sites, with particularly high levels observed at Mwanza Village Well, Nyonga Stream, and Kauzu

BH3. This suggests potential contamination from agricultural runoff, leaching of nitrogen-rich soils, or inadequate wastewater management.

- **Heavy Metals** (Lead and Copper):
  - Lead: High concentrations of lead (**WHO Standard: <0.0015 mg/L**) were detected at Mwanza Village Well, Kauzu BH3, and Nyonga Stream. These levels exceed safe drinking water standards, presenting severe health risks, particularly for children. Potential sources of lead contamination include corrosion of old pipes, agrochemicals, and natural geological deposits.
  - Copper: Elevated copper levels (**WHO Standard: <0.003 mg/L**) were observed at select sites, potentially originating from corroded plumbing, agricultural inputs, or natural mineral deposits within the geological formations of the area.
- **Iron Contamination**: Elevated iron levels were recorded in certain groundwater sources, likely influenced by the region's mineral-rich geological formations. While iron is not a primary health risk, excessive concentrations can affect water taste, appearance, and suitability for domestic use.
- **Microbial Contamination** (Faecal and Total Coliforms, **WHO Standard: 0 CFU/100 mL**): Microbial contamination was a significant concern, particularly at Kauzu BH3, where faecal and total coliform counts were extremely high. Such contamination is indicative of direct pollution from sewage, animal waste, or other sources of faecal matter, posing a serious risk of waterborne diseases, including cholera, typhoid, and dysentery.

5.8 Topography and Landscape

The landscape of the Malawi-Zambia 400kV Transmission Interconnector project area is characterized by a diverse topography and distinct natural features, reflective of the broader geographical and ecological setting of the Eastern Province of Zambia (*Geography of Eastern Province, Zambia; Wikipedia, n.d.*).

Topographical Features
The project area traverses a varied terrain that includes rolling hills, expansive plateaus, and river valleys. The eastern part of the region, where the interconnector line is proposed, is marked by a series of isolated hills, some rising to elevations between 1,800 and 2,100 meters. These hills form part of the broader highland system that defines the border between Zambia and Malawi, contributing to the region's striking visual and geological diversity. The hills gradually descend into the Luangwa Valley, a notable geological feature resulting from rifting, which further accentuates the topographical contrast within the area.

Vegetation and Land Use
The landscape is predominantly covered by miombo woodland, a type of savanna woodland that is typical of the region. This vegetation type is characterized by a mix of Brachystegia, Julbernardia, and Isoberlinia tree species, which create a dense canopy in some areas, particularly on the hills and higher elevations. The woodland gives way to more open grasslands and cultivated lands in the lower-lying areas, especially near settlements and along river valleys where agricultural activities are concentrated. The interconnector project area, therefore, encompasses a mosaic of natural and human-altered landscapes, reflecting the dual pressures of conservation and land use.

Water Features
The landscape is interspersed with several seasonal rivers and streams that flow through the project area, particularly during the rainy season. These watercourses, such as the Lutembwe, Lubwe, Mwami, Chibili and Nyongo rivers, not only shape the physical landscape but also play a crucial role in supporting local ecosystems and communities. The river valleys are often lined with riparian vegetation, which contrasts with the drier woodland areas, adding to the visual and ecological diversity of the landscape.

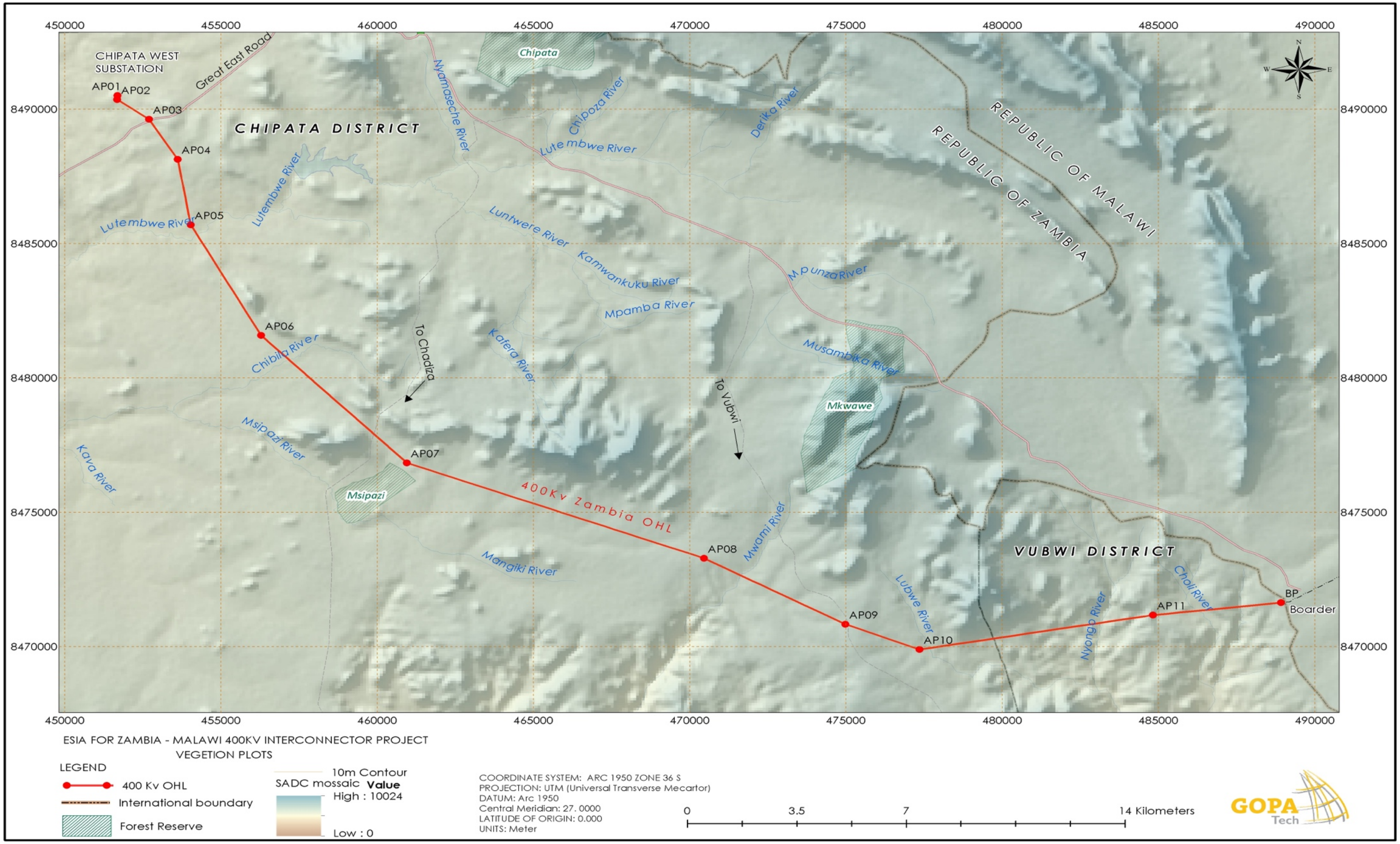


Figure 5-11 Topographic Features of the Malawi-Zambia 400kV Interconnector Project Area

5.9 Soils

5.9.1 Overview

The project area traverses a geologically and pedologically diverse landscape, encompassing the Chipata and Vubwi Districts in Zambia's Eastern Province. The soils along the 46.6 km Zambian section of the Malawi–Zambia 400 kV Interconnector are varied in structure, composition, and agricultural suitability. These soil types significantly influence vegetation distribution, hydrology, foundation stability, and construction logistics (*Geology of Eastern Province, Zambia; JICA, 2015*).

According to the official Zambian Government Soils Map, refer to **Error! Reference source not found.** below, the dominant soil types identified within the project corridor are:

- **Fersiallitic Soils**
- **Gleysols**
- **Leptosols**

These soil classes are distributed in a spatial mosaic along the corridor and reflect distinct physicochemical characteristics that bear direct relevance to project design, construction, and environmental performance.

5.9.2 Soil types

The following soil types are identified along the OHL corridor.

1. Fersiallitic Soils

Distribution
Fersiallitic soils are dominant in the northwestern and southwestern parts of the project area, particularly near the Chipata West Substation and scattered areas within Chipata and Vubwi districts.

Characteristics
- **Texture & Drainage:** Typically loamy to clayey, well-drained, with good moisture retention.
- **Color:** Reddish to reddish-brown due to high iron oxide content.
- **Fertility:** Moderate natural fertility but prone to nutrient depletion without management.

Implications for the Project
- **Construction Suitability:** Well-structured soils that are generally favourable for foundation excavation and structural support.
- **Erosion Risk:** Moderate, especially on sloping terrain, requiring slope stabilization and proper drainage controls.
- **Spill Contamination Risk:** Moderate – the clay content can slow infiltration, allowing time for remediation.
- **Compaction Potential:** Moderate under heavy equipment; requires soil ripping during rehabilitation.

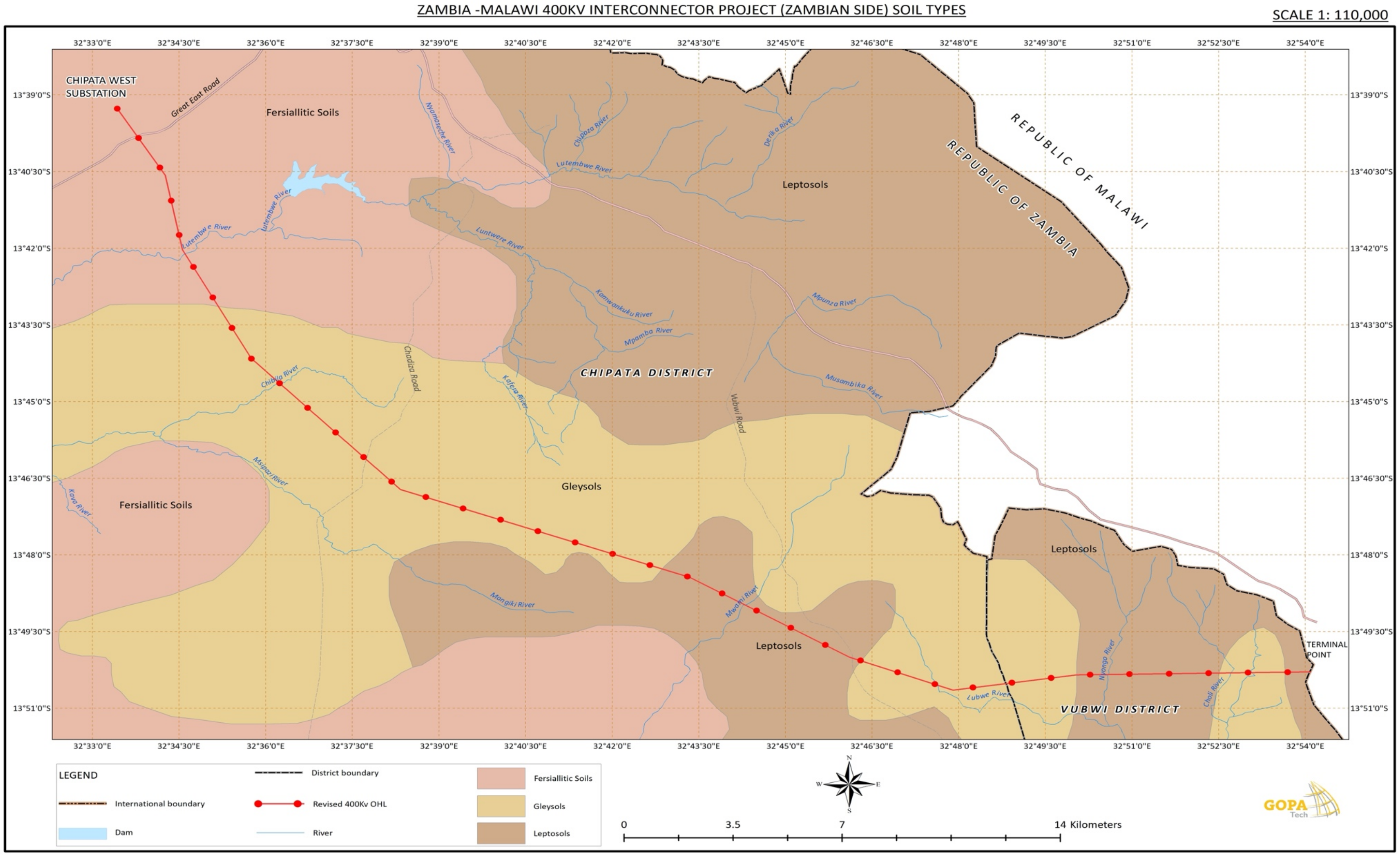


Figure 5-12 Soil types along the Malawi-Zambia 400kV Interconnector corridor

2. Gleysols

Distribution
Gleysols dominate the central section of the corridor, especially in low-lying, poorly drained areas between Chipata and Vubwi Districts.

Characteristics
- **Texture & Drainage:** Poorly drained, hydromorphic soils often found in wetland or floodplain areas.
- **Color:** Grayish or mottled, indicating prolonged water saturation.
- **Fertility:** Variable; can be fertile in the topsoil but limited by waterlogging.

Implications for the Project
- **Construction Suitability:** Poor – prone to waterlogging and unstable for heavy infrastructure; pile foundations or soil stabilization may be required.
- **Erosion Risk:** Low in saturated state, but susceptible during dry–wet transition periods.
- **Spill Contamination Risk:** High – poor drainage can lead to long-term pollutant residence and shallow aquifer contamination.
- **Compaction Potential:** High; vulnerable to compaction under machinery in moist conditions.

3. Leptosols

Distribution
Leptosols occur extensively along the eastern and southeastern parts of the route in Vubwi District, and in higher elevation areas of Chipata District.

Characteristics
- **Texture & Depth:** Very shallow soils with coarse fragments and underlying rock close to the surface.
- **Drainage:** Well-drained but with limited water-holding capacity.
- **Fertility:** Low due to thin soil layer and limited organic matter.

Implications for the Project
- **Construction Suitability:** Difficult – shallow depth and exposed bedrock complicate drilling, anchoring, and excavation.
- **Erosion Risk:** High on exposed slopes, especially post-clearance.
- **Spill Contamination Risk:** Moderate to low – limited infiltration capacity.
- **Compaction Potential:** Low due to inherent stoniness but susceptible to topsoil displacement.

5.10 Biodiversity

5.10.1 Methodology

The biodiversity assessment for the Malawi–Zambia 400kV Interconnector Project was undertaken to establish a comprehensive ecological baseline for the transmission line corridor. The survey focused on assessing vegetation types, species diversity, habitat structure, and faunal presence across multiple taxa—namely, birds, mammals, reptiles, amphibians, and insects. This baseline is intended to inform impact prediction, mitigation planning, and conservation monitoring in line with international standards and best practice.

Sampling Design and Plot Selection

A **systematic and stratified sampling strategy** was applied to ensure representative data coverage across varying ecological zones. The OHL corridor was divided into **five evenly spaced 5 km² biodiversity plots**, placed at ~4.5 km intervals. Plot 5 was adjusted slightly due to terrain inaccessibility, but remained ecologically comparable, capturing similar vegetation and land use patterns.

Each plot was surveyed using **five randomly established transects**, strategically positioned to sample a variety of habitat types including:

- **Wooded vegetation**
- **Thicket**
- **Degraded Miombo woodland**
- **Agricultural fields**
- **Riverine crossings**
- **Built-up zones**

This method allowed for comprehensive spatial sampling and detection of dominant, rare, or cryptic species across both disturbed and semi-natural landscapes.

Survey Duration and Human Resources

- **Survey Period:** 30 days (December 14th, 2024 –January 15th, 2025)
- **Team Composition:**
    - **2 Biodiversity Experts** (specializing in flora and fauna)
    - **1 Field Assistant**
    - **2 Local Villagers** (for pitfall trap installation and logistical support)

Vegetation and Tree Survey Methodology

- Vegetation structure was assessed through **line transects** and **quadrats** to estimate tree density, species dominance (via DBH analysis), canopy cover, and ground flora.
- Tree DBH (Diameter at Breast Height) was measured using diameter tapes.
- GPS coordinates were recorded at sample points for spatial referencing.
- Species identification was supported by botanical field guides and photographic records.

Faunal Survey Methods by Taxonomic Group

Birds (Avifauna)

- **Point Count Method**: Conducted at regular intervals along each transect.
- Observers recorded all birds seen or heard over a **10-minute observation period** per point.
- Environmental conditions (e.g. weather, time of day) were also documented.
- **Binoculars** and **bird field guides/apps** were used for identification.

Mammals

- **Direct Observations** during dawn and dusk patrols.
- **Indirect Evidence** collection (scat, tracks, burrows, feeding signs) along transects.
- Observations recorded with handheld **GPS units** and field datasheets.

Insects

- **Pitfall Traps**: Installed in microhabitats across all five plots. Each trap was left open for **24 hours**.

- **Sweep netting** and **manual collection** supplemented data in edge habitats.
- Specimens classified by order and, where possible, by species using field guides.

Reptiles and Amphibians

- **Visual Encounter Surveys (VES)** were conducted systematically along transects.
- **Drift Fence Arrays with Pitfall Traps** were deployed to passively collect small and cryptic species.
- Traps were checked daily; habitat and weather data were recorded.

Community Knowledge Integration

To supplement field data, a **Community Biodiversity Survey** was conducted in local villages along the corridor. Through structured interviews and participatory mapping:

- **Traditional knowledge** on faunal presence and trends (especially mammals and reptiles) was collected.
- **Human-wildlife conflict zones**, local hunting areas, and seasonal species patterns were documented.

5.10.2 Habitats

A comprehensive biodiversity and GIS spatial analysis identified six distinct habitat types along the proposed transmission corridor. Although all habitats fall within the Miombo Woodland biome,[5] they exhibit varying degrees of human modification. These include:

1. **Thicket Vegetation**
2. **Wooded Vegetation**
3. **Agricultural Fields**
4. **Built-up Areas**
5. **River Crossings**
6. **Degraded Vegetation**

The area occupied by each habitat type is shown in the table below.

Table 5-9 Habitat types and Area Coverage in the 50 m wide wayleave (46.6 km)

Habitat Types	Area (ha)	Coverage
Thicket Habitat	3.5	1.50%
Wooded vegetation Habitat	19.2	8.24%
Agricultural fields Habitat	150.5	64.59%
Built up area Habitat	1.9	0.82%
Degraded vegetation Habitat	57.7	24.76%
River Crossings Habitat	0.2	0.08%
TOTAL	**233.0**	**100.00%**

5.10.2.1 Thicket Habitat

The thicket habitat occupies approximately 3.5 hectares, representing 1.5% of the total 50m wayleave area of the OHL. It consists of miombo woodland with a well-developed tree layer and high canopy cover (99.3%), indicating

[5] The Project area lies within the Southern Miombo Woodlands ecoregion, a distinct subdivision of the Miombo woodland biome that extends across parts of Zambia, Malawi, Mozambique, and Zimbabwe (Burgess et al., 2004).

substantial foliage density and structural maturity. The tree density in this habitat is estimated at 502.2 trees per hectare, signifying a moderately dense woodland.

The dominant tree species recorded in this habitat include:

- ***Bauhinia petersiana*** (35.4%) – its prevalence is indicative of historical anthropogenic disturbances in the area.
- ***Julbernardia paniculata*** (22.1%) – a characteristic species of Miombo woodlands.

The grass layer is well-established, with key species including:

- ***Setaria sphacelata*** (31.3%) – the most dominant grass species, contributing to ground cover stability.
- ***Setaria verticillata*** (26.1%) – collectively with *S. sphacelata*, these species account for more than 57% of total grass cover.
- ***Setaria hirta*** (19.4%) – a secondary dominant species providing habitat for invertebrates and small fauna.
- Less common species such as ***Setaria viridis*** (3.7%) and ***Hyarrehenia filipendula*** (1.5%) contribute to the structural diversity of the habitat.

Despite the high canopy cover and tree density, the presence of *Bauhinia petersiana* in significant numbers suggests past disturbances, potentially from selective tree cutting, livestock grazing, or firewood harvesting. This habitat plays a crucial role in maintaining microclimatic conditions, providing shelter for avifauna, and supporting ground-dwelling species. However, its proximity to human settlements makes it vulnerable to further degradation.

5.10.2.2 Wooded Vegetation Habitat

The wooded vegetation habitat within the Malawi-Zambia 400kV OHL wayleave spans approximately 19.2 hectares, accounting for 8.24% of the total project area. This habitat is characterized by Miombo woodland, exhibiting a canopy cover ranging between 15% and 30% and a tree density of 350 to 451 trees per hectare. The structural and species composition of this habitat reflects varying levels of ecological stability, with some areas representing relatively mature woodland, while others show evidence of past disturbances and successional recovery.

The wooded vegetation is dominated by characteristic Miombo tree species, which define its ecological function and structure. Key species include:

- ***Brachystegia boehmii, Brachystegia floribunda, Brachystegia bussei***, and ***Julbernardia paniculata*** – These species contribute significantly to the overall canopy structure, reinforcing the Miombo woodland identity of the area. Their dominance suggests a relatively stable and mature ecosystem, with well-established tree cover that provides habitat for associated flora and fauna.
- ***Uapaca kirkiana* and *Parinari curatellifolia*** – These species are indicators of nutrient-poor soils, often thriving in Miombo woodlands where they contribute to ecosystem stability and resilience.
- ***Bauhinia petersiana*** and ***Piliostigma thonningii*** – The abundance of these species highlights areas where past disturbances, such as firewood collection, selective logging, or shifting cultivation, may have influenced vegetation dynamics. Their presence suggests elements of woodland regeneration.
- ***Dichrostachys cinerea* and *Pseudolachnostylis maprouneifolia*** – These pioneer species indicate ongoing successional processes, often colonizing degraded areas or disturbed secondary woodland patches.
- ***Diplorhynchus condylocarpon*** and ***Uapaca kirkiana*** – The presence of these fire-resistant and nitrogen-fixing species suggests adaptations to periodic fires and nutrient-poor soils, which are common ecological features in Miombo landscapes.

The wooded vegetation habitat represents a critical component of regional biodiversity, providing essential ecosystem services such as carbon sequestration, soil stabilization, and habitat provision for various wildlife species. The dominance of *Brachystegia* and *Julbernardia* species (all of them categorized as of Least Concern, LC) suggests that large sections of the habitat retain characteristics of a healthy Miombo woodland, while the presence of secondary successional species points to areas of ecological recovery following past land-use changes.

This habitat supports a diverse range of faunal species, including insects, birds, and small mammals, which rely on the structural complexity of Miombo woodland for shelter and food resources. The presence of pioneer and nitrogen-fixing species further enhances soil fertility and ecological resilience, allowing for gradual regeneration in areas previously impacted by human activities.

5.10.2.3 Agricultural Fields Habitat

The agricultural fields habitat is the most extensive land cover type within the Malawi-Zambia 400kV OHL wayleave, occupying 150.5 hectares (64.59%) of the total surveyed area. This habitat has undergone significant anthropogenic modification, primarily through subsistence and commercial farming activities. The dominant crops cultivated in these areas include maize (*Zea mays*), groundnuts (*Arachis hypogaea*), and soybeans (*Glycine max*), with smaller portions allocated to cassava (*Manihot esculenta*) and various horticultural crops.

The transition from natural miombo woodland to farmland has led to substantial vegetation clearance, resulting in reduced tree density and a predominance of fragmented tree patches along field boundaries. The remaining tree species, primarily *Brachystegia boehmii, Julbernardia paniculata*, and *Piliostigma thonningii*, serve as shade trees and windbreaks, providing limited ecological functions. Grass cover is largely replaced by crop stubble and weedy species such as *Bidens pilosa* and *Cynodon dactylon*, which thrive in disturbed environments.

The conversion of woodland to farmland has altered the habitat's biodiversity, reducing the abundance of larger mammals and avifauna dependent on forested areas. However, it continues to support various generalist bird species such as Red-billed Quelea *(Quelea quelea*, LC), Fork-tailed Drongo *(Dicrurus adsimilis*, LC), and African Pied Wagtail *(Motacilla aguimp*, LC), which forage in open agricultural landscapes. Insect populations, particularly pollinators like honeybees (*Apis mellifera*) and butterflies, remain present, albeit at reduced densities compared to undisturbed habitats.

5.10.2.4 Built-up Area Habitat

Built-up areas occupy 1.9 hectares (0.82%) of the total wayleave and primarily consist of settlements, commercial centers, and infrastructure developments such as roads and service areas. These areas exhibit the highest degree of anthropogenic modification, with natural vegetation largely replaced by man-made structures, open yards, and cultivated gardens.

The built-up environment hosts a mix of exotic and native vegetation, often dominated by ornamental and drought-tolerant species such as Mango (*Mangifera indica*), Guava (*Psidium guajava*), and Neem (*Azadirachta indica*), interspersed with remnant miombo species in less-developed zones. Roadside verges and undeveloped plots support scattered grasses and herbaceous species, including *Cynodon dactylon* and *Tridax procumbens*, which thrive in compacted soils and disturbed settings.

Wildlife diversity in built-up areas is significantly reduced, with only highly adaptable species persisting. Common bird species include the House Sparrow (*Passer domesticus*, LC), Speckled Pigeon (*Columba guinea*, LC), and Village Weaver (*Ploceus cucullatus*, LC), which exploit human-altered environments for food and nesting. Small mammals such as striped mice (*Lemniscomys striatus*, LC) and African giant rats (*Cricetomys gambianus*, LC) are occasionally observed in abandoned structures and cultivated gardens.

5.10.2.5 Degraded Vegetation Habitat

Degraded vegetation covers 57.7 hectares (24.76%) of the total wayleave area, representing habitats that have been subjected to varying degrees of disturbance, primarily due to deforestation, shifting cultivation, uncontrolled grazing, and firewood collection. This habitat is characterized by a sparse tree canopy (often below 15% cover) and a dominance of secondary regrowth vegetation, including fast-growing pioneer species such as *Dichrostachys cinerea, Combretum molle,* and *Pseudolachnostylis maprouneifolia.*

Grass species in degraded areas tend to be fire-resistant and drought-tolerant, with *Hyparrhenia filipendula* and *Sporobolus pyramidalis* being the most observed. The ground layer exhibits exposed soil patches, increasing susceptibility to erosion and nutrient depletion.

Biodiversity in degraded habitats is significantly lower compared to intact woodland, with faunal assemblages shifting towards disturbance-tolerant species. Birds such as the Laughing Dove (*Spilopelia senegalensis*), Fork-tailed Drongo (*Dicrurus adsimilis*), and Crowned Lapwing (*Vanellus coronatus*) are commonly observed, while insect populations primarily consist of termites, ants, and grasshoppers, which play crucial roles in nutrient cycling.

5.10.2.6 River Crossings Habitat

The river crossings habitat along the Malawi-Zambia 400kV Overhead Transmission Line (OHL) corridor are narrow strips along rivers or streams, likely important for hydrological connectivity and wildlife corridors, though limited in spatial extent, it occupies about 0.08% of the wayleave. This represents a critical ecological feature, supporting hydrological functions, aquatic biodiversity, and riparian vegetation. The OHL route intersects several river systems, including the Lutembwe, Chibila, Mwami, Lubwe Rivers, Nyongo and Choli streams, all of which play essential roles in sustaining biodiversity, maintaining water quality, and providing ecosystem services for local communities.

5.10.2.7 Habitat Mapping

To provide a comprehensive spatial representation of the ecological landscape, the project area has been divided into three sections, each represented by a dedicated habitat map (see Figure 5-14, Figure 5-15 and Figure 5-16).

These maps illustrate the distribution of key habitat types along the transmission corridor, offering critical insights into vegetation cover, land use patterns, and ecological features within the project footprint. For the purpose of illustration, the corridor width has been increased to 500m in order to clearly show different habitat types.

Further on, to achieve comprehensive biodiversity coverage, the entire project corridor was divided into five evenly spaced survey plots, each measuring 5 km² (see Figure 5-13). These plots were established at approximately 4.5 km intervals along the transmission corridor, except for plot 5 that was moved further along the same habitat due to inaccessibility of the area, to capture variability in vegetation types, land use patterns, and species composition.

Within each 5 km² plot, five transects were randomly established to collect biodiversity data across different habitat types. This approach ensured that both natural miombo woodlands and modified agricultural landscapes were adequately represented.

The strategic placement of these transects allowed for:

- An accurate representation of species diversity and abundance within the project area.
- The inclusion of both disturbed vegetation and cleared land, ensuring a balanced ecological assessment.
- The detection of species distribution patterns, including dominant and rare species.
- The assessment of ecological connectivity, which is crucial for wildlife movement and conservation planning.

By applying this systematic and stratified sampling approach, the study minimized sampling bias, ensuring that the results are statistically robust and ecologically meaningful.

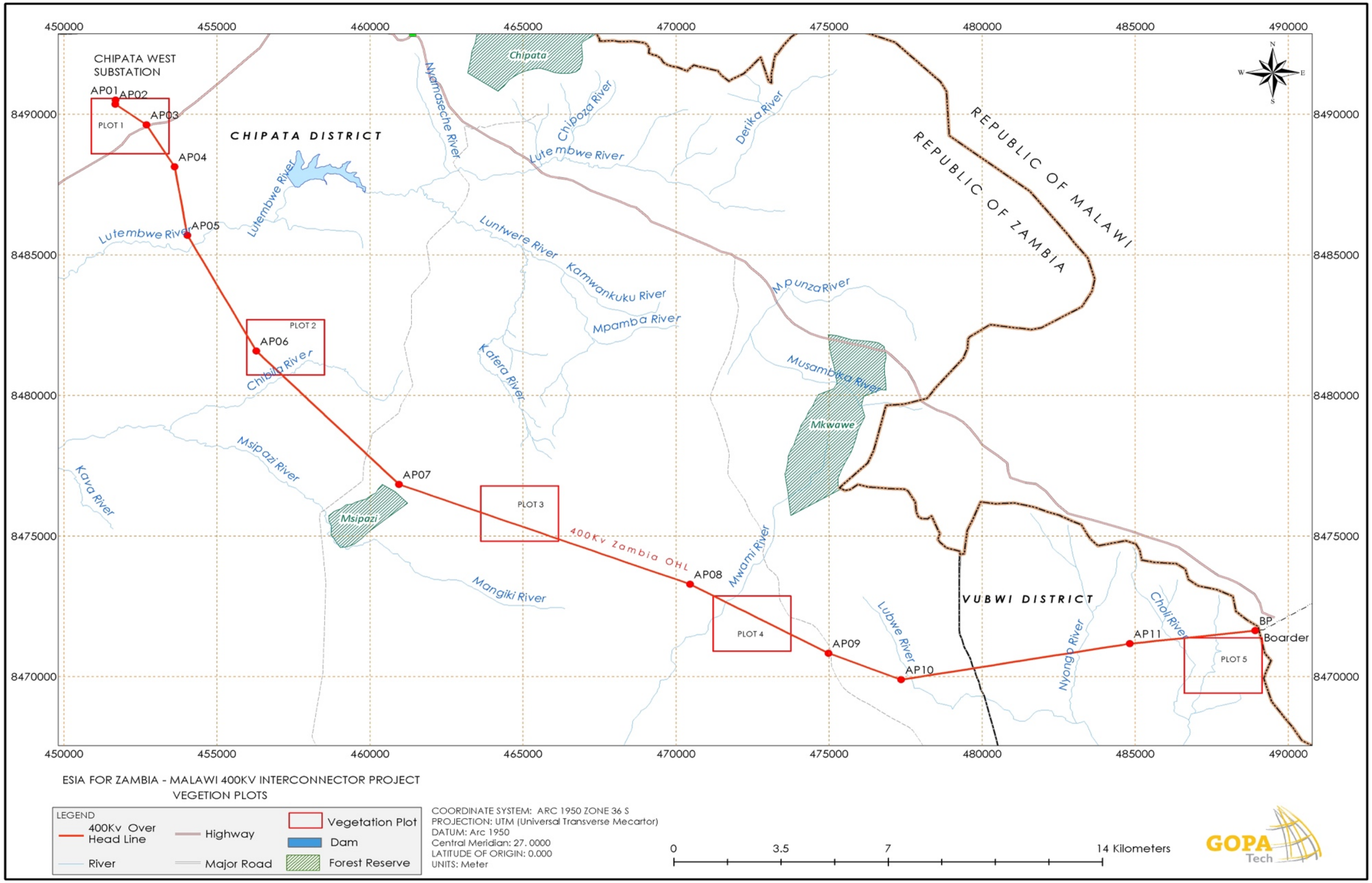


Figure 5-13 Survey plots established to support biodiversity surveys

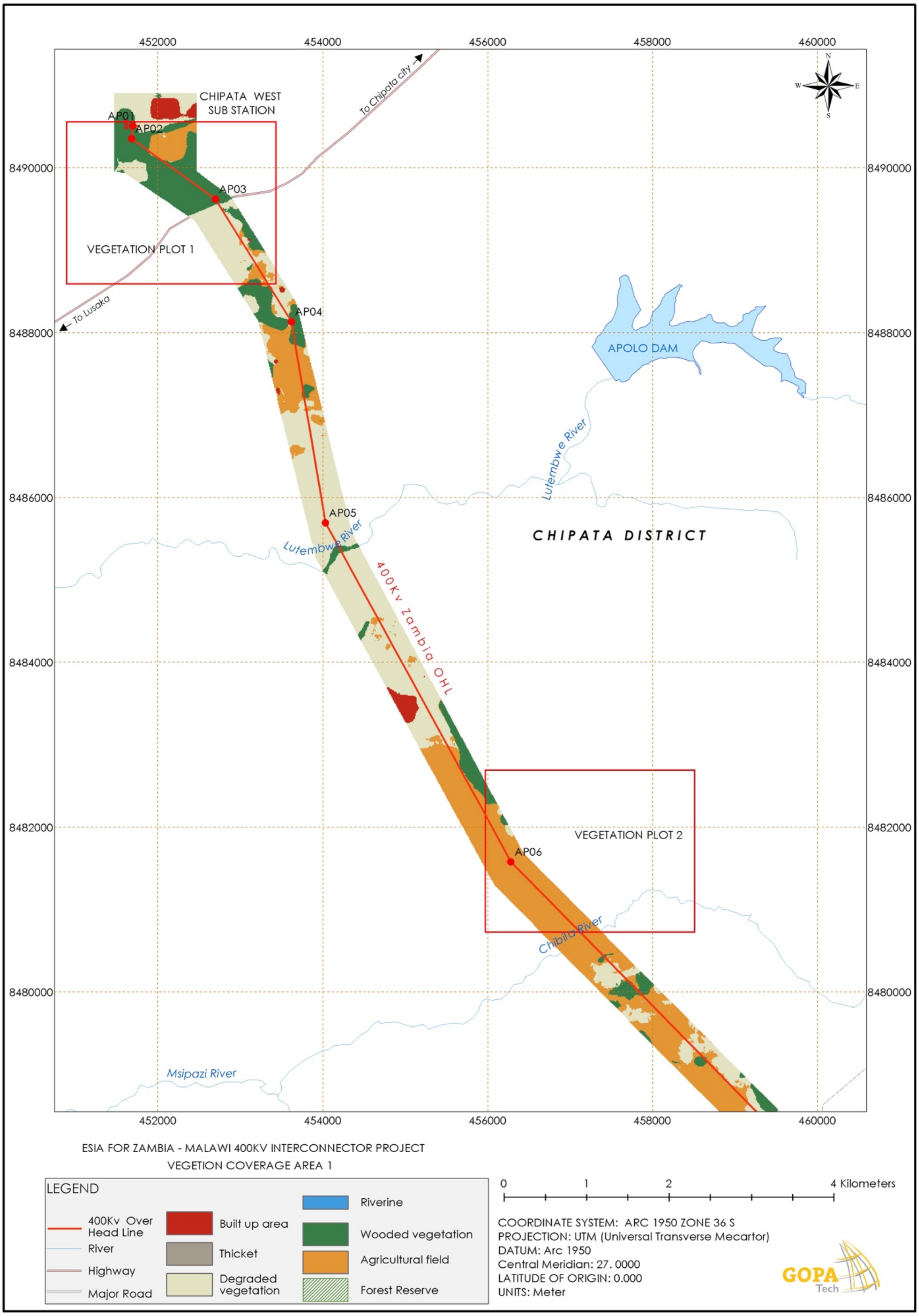


Figure 5-14 Habitat Map of the Project Area Section 1 (from Chipata West Substation to Chibila river)

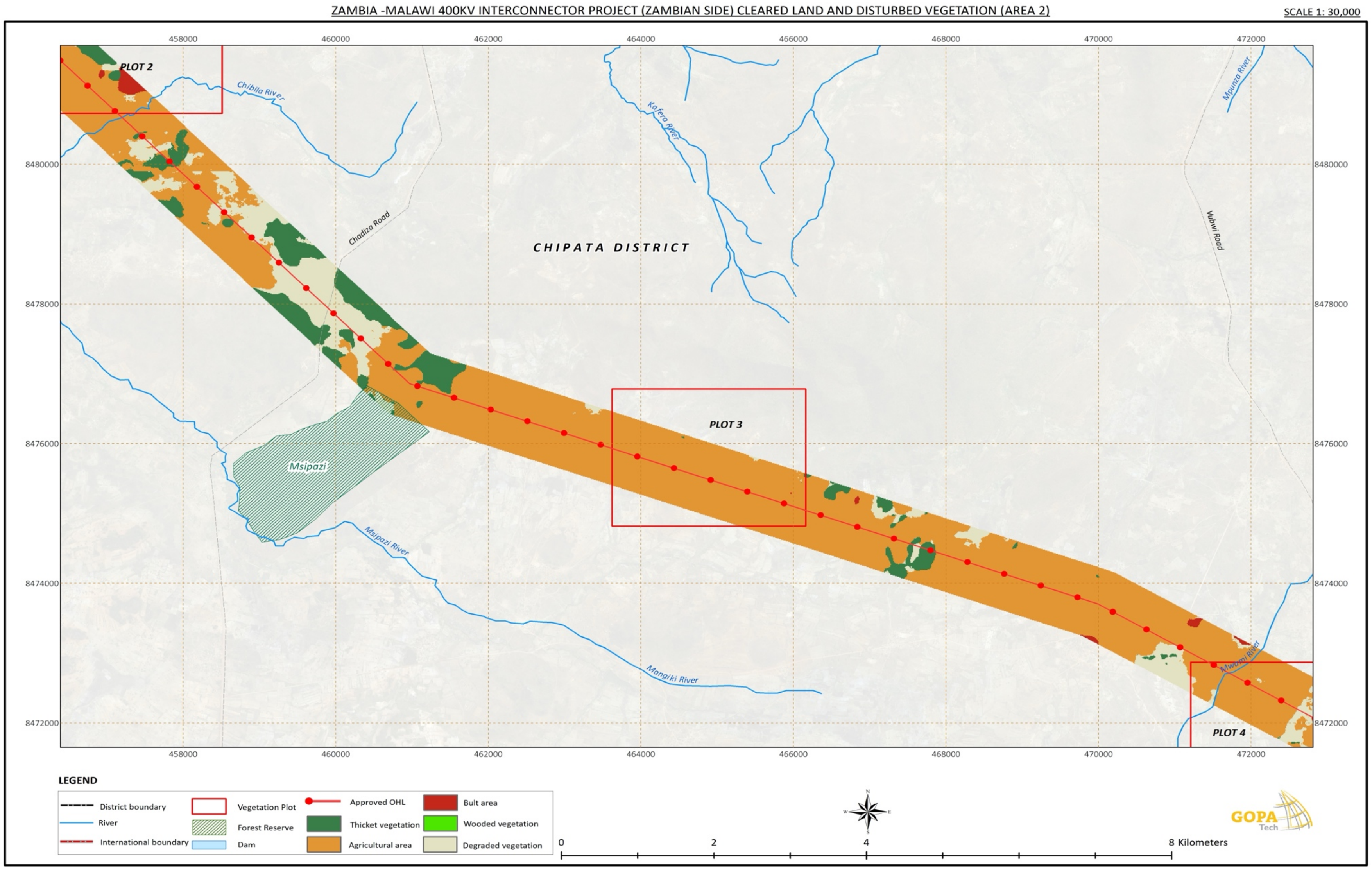


Figure 5-15 Habitat Map of the Project Area Section 2 (from Chibila river to Mwami river)

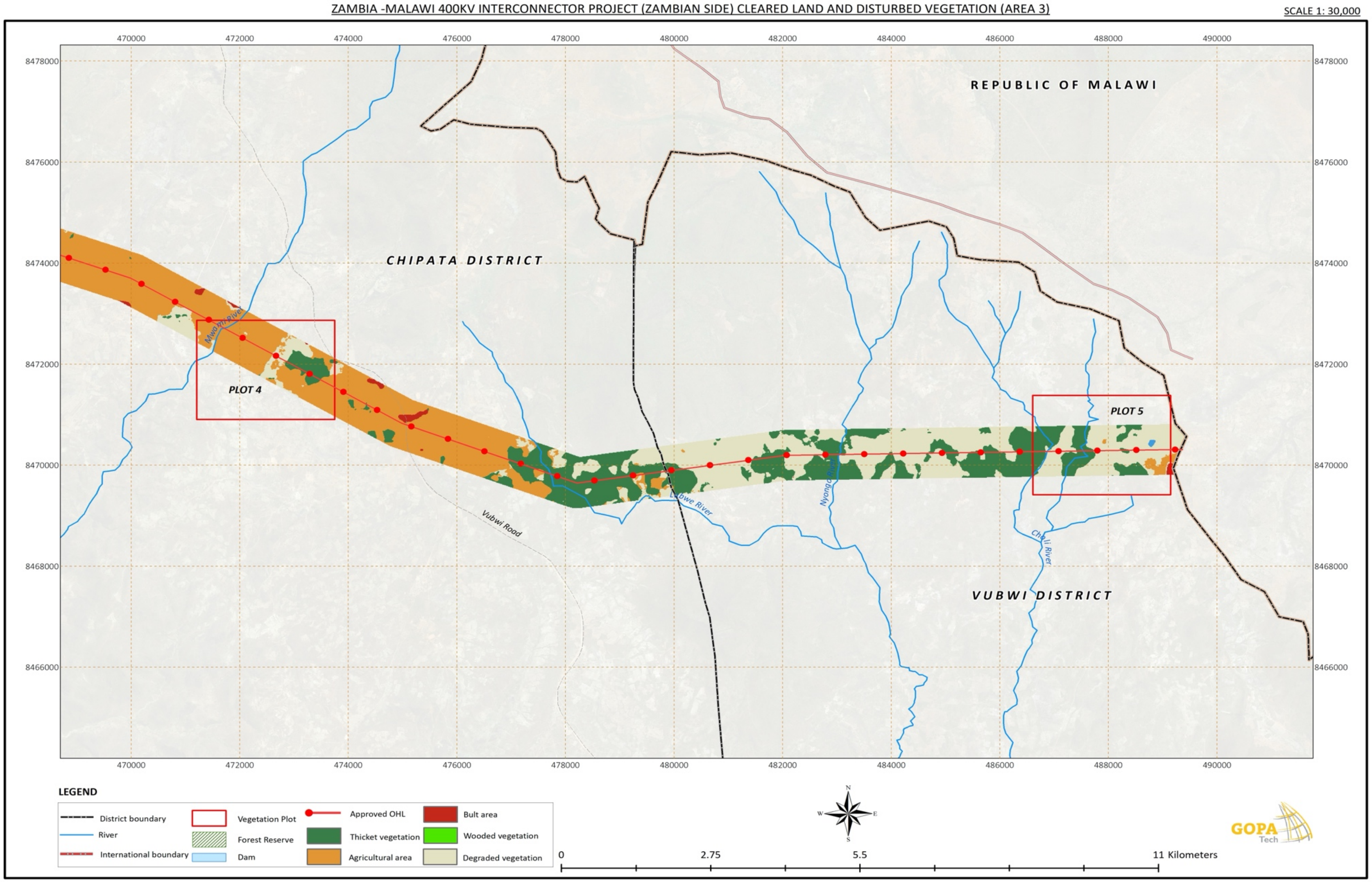


Figure 5-16 Habitat Map of the Project Area Section 3 (from Mwami river to Zambia Malawi border line near Chikoka village)

5.10.3 Flora and Vegetation

The biodiversity assessment of the Malawi–Zambia 400 kV Interconnector Project corridor revealed a moderate diverse assemblage of tree and grass species distributed across the distinct habitat types. These plant communities play a vital ecological role in maintaining landscape stability, supporting terrestrial and aquatic fauna, enhancing soil fertility, regulating hydrological cycles, and contributing significantly to carbon sequestration and climate regulation.

The tables below present the tree and grass species recorded in the project area, along with their corresponding IUCN Global Conservation Status, highlighting their conservation significance.

Table 5-10 Surveyed Tree Species with their IUCN Conservation Status

Species	Nyanja Common Names	IUCN Conservation Status
Azanza garkeana (*Thespesia garckeana*)	Mkole	Least Concern (LC)
Acacia nigrescens (*Senegalia nigrescens*)	Nyamamponombwe	Least Concern (LC)
Annona senegalensis	Msengana	Least Concern (LC)
Acacia sieberana (*Vachellia sieberiana*)	Mutubatuba	Least Concern (LC)
Bauhinia petersiana	Mpondo	Least Concern (LC)
Brachystegia spiciformis	Mputi	Least Concern (LC)
Cassia abbreviata	Nyoka	Least Concern (LC)
Combretum molle	Mkute	Least Concern (LC)
Combretum mossambicense	Lusaka	Least Concern (LC)
Combretum zeyheri	Kalamafupa	Least Concern (LC)
Diospyros batocana	Mdima	Least Concern (LC)
Dichrostachys cinerea	Katenge	Least Concern (LC)
Diplorhynchus condylocarpon	Mtowa	Least Concern (LC)
Erythrophleum africanum	Kawidzi	Least Concern (LC)
Julbernardia globiflora	Kamponi	Least Concern (LC)
Julbernardia paniculata	Mtondo	Least Concern (LC)
Lannea stuhlmannii	Mbale	Least Concern (LC)
Markhamia acuminata	Kasanika	Not Evaluated (NE)
Ochna pulchra	Kachale	Least Concern (LC)
Pericopsis angolensis	Mwanga	Near Threatened
Parinari curatellifolia	Mpundu	Least Concern (LC)
Pseudolachnostylis maprouneifolia	Msolo	Least Concern (LC)
Piliostigma thonningii	Msekese	Least Concern (LC)
Strychnos cocculoides	Mzimbili	Least Concern (LC)
Swartzia madagascariensis (*Bobgunnia madagascariensis*)	Mchelekete	Least Concern (LC)
Senegalia polyacantha	Chifyopola	Least Concern (LC)
Ximenia americana	Kamulebe	Least Concern (LC)
Ziziphus abyssinica	Kankande	Least Concern (LC)
Zanha africana	Chibukuzera	Not Evaluated (NE)
Euclea natalensis	Kalunguti	Not Evaluated (NE)
Acacia polyacantha (*Senegalia polyacantha*)	Ngowe	Least Concern (LC)

Brachystegia boehmii	Msamba	Least Concern (LC)
Brachystegia bussei	Mkongolo	Least Concern (LC)
Brachystegia floribunda	Mvukwe	Least Concern (LC)
Brachystegia longifolia	Mchenga	Least Concern (LC)
Brachystegia manga	Mtuwa	Least Concern (LC)
Cussonia arborea	Mpandanjovu	Least Concern (LC)
Canthium glaucum	Mzembe	Least Concern (LC)
Combretum elaeagnoides	Mtebelebe	Least Concern (LC)
Croton gratissimus	Mukwe	Least Concern (LC)
Diospyros mespiliformis	Mchenja	Least Concern (LC)
Dalbergiella nyasae	Msansale	Not Evaluated (NE)
Flacourtia indica	Chinsense	Least Concern (LC)
Faurea saligna	Chiyele	Least Concern (LC)
Gardenia spatulifolia	Macheba	Not Evaluated (NE)
Maprounea africana	Chigaga	Least Concern (LC)
Monotes glaber	Kanyelele	Least Concern (LC)
Ozoroa reticulata	Mlunga	Not Evaluated (NE)
Peltophorum africanum	Mnyele	Least Concern (LC)
Rhus tenuinervis (*Searsia tenuinervis*)	Chimwamanzi	Least Concern (LC)
Strychnos spinosa	Mzimbili	Least Concern (LC)
Securinega virosa	Mwinda	Least Concern (LC)
Terminalia randii	Gonondo	Least Concern (LC)
Terminalia sericea	Gonondo	Least Concern (LC)
Uapaca kirkiana	Msuku	Least Concern (LC)
Uapaca nitida	Kasokolowe	Least Concern (LC)
Vangueriopsis lanciflora	Mngolovya	Not Evaluated (NE)
Vitex payos	Mfifya	Least Concern (LC)
Croton megalobotrys	Mkorasinga	Least Concern (LC)
Diospyros whyteana	Mvimbe	Least Concern (LC)
Ekebergia capensis	Mzilu	Not Evaluated (NE)
Ficus craterostoma	Mukuyu	Least Concern (LC)
Garcinia livingstonei	Mpule	Least Concern (LC)
Harungana madagascariensis	Mupazupazu	Least Concern (LC)
Isoberlinia angolensis	Msangaza	Least Concern (LC)
Terminalia mollis	Gonondo	Least Concern (LC)

Table 5-11 Surveyed Grass Species with their IUCN Conservation Status

Grass Species	**IUCN Global Conservation Status**
Setaria sphacelata	Least Concern (LC)
Setaria hirta	Not Evaluated (NE)
Setaria parviflora	Least Concern (LC)
Setaria viridis	Least Concern (LC)
Setaria verticillata	Least Concern (LC)
Hyarrehenia hirta	Not Evaluated (NE)

Grass Species	IUCN Global Conservation Status
Hyarrehenia filipendula	Not Evaluated (NE)
Sporobolus africanus	Least Concern (LC)
Pennisetum purpureum	Least Concern (LC)
Aristida stitata	Least Concern (LC)
Eragrostis superba	Least Concern (LC)
Hyparrhania hirta	Not Evaluated (NE)
Andropogon gayanus	Least Concern (LC)
Tristachya rehmannii	Not Evaluated (NE)
Stipagrostis zeyheri	Not Evaluated (NE)
Eragrostis obtusa	Least Concern (LC)
Eriochloa stapfiana	Not Evaluated (NE)
Digitaria eriantha	Not Evaluated (NE)
Digitaria velutina	Not Evaluated (NE)
Digitaria ternata	Not Evaluated (NE)
Chloris mossambicensis	Least Concern (LC)
Panicum volutans	Not Evaluated (NE)
Setaria incrassata	Not Evaluated (NE)
Setaria pallide-fusca	Not Evaluated (NE)
Eragrostis lehmanniana	Not Evaluated (NE)
Eragrostis curvula	Least Concern (LC)

The vegetation within the Malawi-Zambia 400kV Interconnector Project area represents a dynamic and ecologically diverse landscape dominated by **dry miombo woodland** this woodland is primarily dominated by three key genera: *Brachystegia, Isoberlinia*, and *Julbernardia*. These genera are well adapted to the region's climatic conditions and are integral to the structure and function of miombo woodlands.

- **Brachystegia** species, often forming dense canopies, are crucial for providing shade and reducing soil erosion. Their leaves and pods are also an important food source for various herbivorous animals, including insects and, where present, ungulates.
- **Isoberlinia** trees contribute to the biodiversity of the woodland, offering habitat and food sources for a range of species. These trees are known for their resilience to fire, which is a common occurrence in miombo ecosystems, thus playing a role in the ecological succession of these woodlands.
- **Julbernardia** species are equally important, with their seeds serving as a food source for birds and other wildlife. The wood from these trees is also used locally for construction and firewood, highlighting their socio-economic importance.

Further, it is interspersed with grasslands, riparian vegetation, and modified habitats such as agricultural fields and degraded areas. The flora is largely characteristic of Zambia's Zambezian phytogeographic zone, exhibiting species adapted to the region's climatic conditions, soil composition, and historical land-use patterns.

5.10.3.1 Woodland and Tree Species Composition

The woodland areas within the project corridor are dominated by species typical of Miombo woodland, a vegetation type widespread across southern and central Africa. The floristic composition includes a mixture of mature trees, secondary regrowth species, and fire-resistant taxa, reflecting natural succession processes and varying levels of anthropogenic disturbance (*Kent, 2011; Van Wyk & Van Wyk, 1997*).

Key dominant species include:

- *Brachystegia* spp. (*Brachystegia boehmii, B. bussei, B. floribunda, B. spiciformis*) – These species form the ecological backbone of the Miombo woodlands, providing essential ecosystem services such as carbon sequestration, soil stabilization, and habitat for wildlife.
- *Julbernardia paniculata* and *Julbernardia globiflora* – Frequently co-occurring with Brachystegia, these species contribute to the structural and functional integrity of the woodland.
- *Uapaca kirkiana* – A well-established species known for its ecological and socio-economic value, providing fruit to both humans and wildlife as well as shade while supporting soil fertility. The Uapaca fruit is known as Masuku in the local language. When in season it is sold in the markets.
- *Ochna pulchra, Combretum molle, Parinari curatellifolia, Diospyros mespiliformis, Terminalia sericea* – These species contribute to habitat complexity, enhancing biodiversity and providing resources for various fauna.

The woodland areas also contain nitrogen-fixing species such as *Diplorhynchus condylocarpon* and *Erythrophleum africanum*, which play a crucial role in maintaining soil health and fertility, particularly in fire-prone Miombo ecosystems. Additionally, pioneer species such as *Dichrostachys cinerea* indicate previous disturbances, as they tend to colonize degraded lands and open spaces.

5.10.3.2 Grassland and Ground Cover Species

Grasslands play a crucial role in maintaining ecosystem function, particularly in soil stabilization, carbon cycling, and supporting herbivorous wildlife. The project area exhibits a range of grass species, primarily from the genera *Setaria, Sporobolus, Eragrostis, Hyparrhenia, Digitaria, Chloris,* and *Andropogon.*

Notable grass species include:

- *Setaria sphacelata, Setaria hirta, Setaria verticillata* – Dominant in open grasslands and woodland understory, these species provide essential forage for herbivores and contribute to soil stabilization.
- *Sporobolus africanus, Eragrostis superba, Andropogon gayanus, Hyparrhenia filipendula* – Frequently found in semi-arid areas, these species are well adapted to seasonal variations and grazing pressure.
- *Aristida stitata, Tristachya rehmannii, Digitaria ternata, Chloris mossambicensis* – Species that enhance the structural diversity of grassland habitats, supporting various invertebrates and small mammals.
- *Pennisetum purpureum* (Elephant Grass) – Commonly associated with riparian zones, providing an essential habitat for insects and serving as a food source for larger herbivores.

The presence of species such *as Eragrostis obtusa, Eriochloa stapfiana, Stipagrostis zeyheri*, and *Panicum volutans* suggests a landscape capable of supporting diverse ecological interactions, from soil microbial activity to large mammalian grazers (*Oudtshoorn, 1992*).

5.10.3.3 Riparian and Hydrophytic Vegetation

Riparian habitats along key watercourses such as the Lutembwe, Chibila, Mwami, Lubwe Rivers, Nyongo and Choli streams support a distinct assemblage of species adapted to periodic water availability. The flora in these areas provide critical ecosystem functions such as water filtration, erosion control, and wildlife corridors.

Characteristic species include:

- *Syzygium cordatum* (LC) – A common water-loving tree species, often found along riverbanks, contributing to riparian stabilization.
- *Diospyros whyteana* (LC), *Garcinia livingstonei* (LC), *Ficus craterostoma* (LC) – Woody species providing shade and habitat for aquatic and terrestrial organisms.

- *Monotes glaber* (LC)*, Terminalia mollis* (LC)*, Ekebergia capensis* (LC) – Trees contributing to the ecological resilience of riparian zones.

These habitats also contain grasses such as *Panicum* spp., *Chloris mossambicensis*, and *Hyparrhenia* spp., which play a role in preventing sediment runoff and maintaining hydrological stability.

The main characteristics of the riparian habitats are the following:

1. Lutembwe River: The river supports a diverse aquatic ecosystem, with submerged and emergent vegetation along its banks providing habitat for fish, amphibians, and invertebrates. Riparian tree species such as ***Syzygium cordatum (LC)***, ***Ficus*** **species**, and ***Phragmites*** **species (reeds)** dominate the riverbanks, offering shade, habitat, and erosion control.

2. Chibila River: The riparian zone is dominated by species such as ***Ficus sycomorus*** (LC), ***Erythrina abyssinica*** (LC), and ***Ricinus communis*** (LC). The river's substrate is a mix of sandy and muddy sediments, supporting a variety of benthic invertebrates.

3. Mwami River: The riverbanks are lined with ***Phragmites*** **species**, ***Cyperus*** **species**, and various grass species, providing shelter for amphibians, fish, and small mammals. Riparian trees such as ***Syzygium cordatum (LC)*** and ***Ficus*** **species** offer additional habitat complexity.

4. Lubwe (Lubwa) River: The riparian zone is dominated by grasses, sedges, and scattered trees, providing habitat for amphibians, reptiles, and aquatic insects.

5. Nyongo Stream: Vegetation along the banks includes ***Setaria*** **species**, ***Hyparrhenia*** **species**, and various herbaceous plants. The stream provides temporary breeding sites for amphibians and feeding grounds for water-dependent birds.

6. Choli Stream: The stream is fringed by grasses and scattered riparian trees, providing habitat for small fish, aquatic insects, and amphibians.

Aquatic Flora and Fauna

- **Aquatic Plants:** The riparian systems support a variety of aquatic plant species, including ***Phragmites*** **species (reeds)**, ***Typha*** **species (cattails)**, ***Cyperus*** **species (sedges)**, and ***Nymphaea*** **species (water lilies)** in wetter sections.
- **Fish Species:** While the survey did not conduct a detailed ichthyofauna assessment, the rivers are likely to support common freshwater fish species typical of seasonal rivers in Zambia, such as ***Tilapia*** **species**, ***Clarias gariepinus*** **(African catfish**, LC**)**, and various small cyprinids.
- **Amphibians:** Riparian zones provide critical breeding habitats for amphibians, including **Bocage's Burrowing Tree Frog (*Leptopelis bocagii*, LC)**, which was recorded during the survey.
- **Invertebrates:** The streams and rivers support a variety of aquatic invertebrates, including dragonfly larvae, water beetles, and freshwater snails, which play key roles in nutrient cycling and food webs.
- **Bird Species:** Riparian areas are important for a range of bird species, including **Kingfishers**, **Weavers**, **Herons**, and **Abdim's Stork (*Ciconia abdimii*) (LC)**, which are known to utilize these habitats for feeding and nesting.

5.10.3.4 Modified and Disturbed Vegetation

The survey also identified modified habitats, including agricultural fields and built-up areas, where the natural vegetation has been altered due to human activities. These areas are characterized by early successional plant species, ruderal vegetation, and cultivated crops.

Key species found in disturbed habitats:

- *Dichrostachys cinerea* (LC)*, Senegalia polyacantha* (LC) – Tree species frequently found in degraded areas, indicating secondary succession and land-use changes.
- *Peltophorum africanum* (LC)*, Combretum mossambicense* (LC)*, Swartzia madagascariensis* (*Bobgunnia*

madagascariensis), LC – Representing woodland regrowth in transitional landscapes.
- Weedy species such as the grasses *Hyparrhenia hirta* (NE), *Eragrostis lehmanniana* (NE), *Digitaria velutina* (*Digitaria leucites*), LC – Commonly observed in abandoned fields and along roadsides.

These areas retain ecological significance by supporting pollinators, soil regeneration, and potential wildlife corridors, despite the dominance of cultivated landscapes.

5.10.3.5 Invasive Alien Species

There were no floral invasive or alien species that were observed in the project area.

5.10.4 Fauna

5.10.4.1 Mammals

The mammalian community in the project area is characterized by a mix of small to medium-sized species, primarily adapted to the region's grassland and woodland habitats. A total of five mammal species were directly recorded during the survey, including:

- **Vervet Monkey (*Chlorocebus pygerythrus*)** – Commonly observed in forested patches and riparian zones.
- **African Civet Cat (*Civettictis civetta*)** – A nocturnal species occasionally sighted in dense vegetation areas.
- **Common Duiker (*Sylvicapra grimmia*)** – Frequently encountered in open grasslands and woodland edges.
- **Elephant Shrew (*Elephantulus sp.*)** – Identified in grassy patches, a species adapted to dense underbrush.
- **African Savanna Hare (*Lepus microtis*)** – Commonly observed in open fields and grasslands.

Community interviews further confirmed the occasional presence of larger mammals such as bushbucks and hyenas, which were not directly recorded during the field survey. This discrepancy may be attributed to their nocturnal behaviour and avoidance of human activities. No threatened (i.e. endangered, critically endangered or vulnerable) mammal species were identified during the assessment.

Table 5-12 Surveyed Mammal Species with their IUCN Conservation Status

Common Name	Scientific Name	IUCN Status	Zambian National Status
Vervet Monkey	*Chlorocebus pygerythrus*	Least Concern (LC)	Not Listed
African Civet Cat	*Civettictis civetta*	Least Concern (LC)	Not Listed
Common Duiker	*Sylvicapra grimmia*	Least Concern (LC)	Not Listed
Elephant Shrew	*Elephantulus* spp.	Least Concern (LC)	Not Listed
African Savanna Hare	*Lepus microtis* (*Lepus victoriae*)	Least Concern (LC)	Not Listed

5.10.4.2 Reptiles

The reptilian diversity within the project area was relatively low, with only four species directly recorded, reflecting the predominantly open and disturbed habitats along the transmission corridor. The identified species include:

- **Monitor Lizard (*Varanus niloticus*)** – Typically associated with riparian habitats.
- **Side-Striped Chameleon (*Chamaeleo dilepis*)** – Observed in woodland areas.
- **Mozambique Rough-Scaled Lizard (*Ichnotropis squamulosa*)** – Common in grasslands and open fields.

- **Pancake Tortoise (*Malacochersus tornieri*)** – A species of conservation significance, listed as Critically Endangered (CR) under the IUCN Red List and protected under Zambia's Wildlife Act.

The limited diversity of reptiles may be attributed to habitat fragmentation, which reduces the availability of suitable breeding and foraging grounds. The community surveys revealed that some reptiles that were not seen during the survey such as mambas and pythons were present. Riparian areas, in particular, are critical for the persistence of many reptile species and should be given special attention in conservation planning.

Table 5-13 Surveyed Reptile Species with their IUCN Conservation Status

Common Name	Scientific Name	IUCN Status	Zambian National Status
Monitor Lizard	*Varanus niloticus*	Least Concern (LC)	Not Listed
Side-striped Chameleon	*Trioceros bitaeniatus*	Least Concern (LC)	Not Listed
Mozambique Rough-Scaled Lizard	*Ichnotropis squamulosa* (*Meroles squamulosus*)	Least Concern (LC)	Not Listed
Pancake Tortoise (Suspected)	*Malacochersus tornieri*	Critically Endangered (CR)	Protected

5.10.4.3 Amphibians

Amphibian diversity in the project area was also low, with only one species recorded during the survey. The only species identified was the following:

- **Bocage's Burrowing Tree Frog (*Leptopelis bocagii*)** – Identified in a wetland patch within Plot 4.

Amphibians are highly sensitive to environmental changes, particularly to habitat degradation and water quality. The low amphibian diversity may reflect limited availability of suitable breeding habitats such as ponds and seasonally flooded areas. No species of conservation concern were recorded.

Table 5-14 Surveyed Amphibian Species with their IUCN Conservation Status

Common Name	Scientific Name	IUCN Status	Zambian National Status
Bocage's Burrowing Tree Frog	*Leptopelis bocagii*	Least Concern (LC)	Not Listed

5.10.4.4 Insects

Insect diversity was relatively high, with a total of 227 insect species recorded across the five survey plots. Key insect groups included:

- **Ants (Formicidae)** – Representing the most abundant insect group, particularly in grasslands and disturbed areas.
- **Beetles (Coleoptera)** – Recorded in both open and wooded areas, including species such as dung beetles, lady beetles, and ground beetles.
- **Butterflies (Lepidoptera)** – Observed in grassland and woodland habitats, with several species acting as pollinators.
- **Termites (Isoptera)** – Noted in both living colonies and mound structures, playing a critical role in soil aeration

and nutrient cycling.

- **Grasshoppers and Crickets (Orthoptera)** – Particularly abundant in open grasslands.

Insect diversity was highest in areas with intact vegetation cover, where microhabitats such as leaf litter, tree bark, and flowering plants provide essential resources. Pollinators, including bees and butterflies, were particularly prominent in woodland and edge habitats, underscoring the ecological value of maintaining vegetation diversity along the transmission corridor. The community survey also revealed that some insects that were not identified during the survey such as mosquitoes were present in the area.

Table 5-15 Surveyed Insect Species with their IUCN Conservation Status

Common Name	Scientific Name	IUCN Conservation Status
Carpenter Ant	*Camponotus spp.*	Not Evaluated (NE)
Western Honey Bee	*Apis mellifera*	Not Evaluated (NE)
Linnaeus' Cicada	*Cicada orni*	Least Concern (LC)
Common Wasp	*Vespula vulgaris*	Not Evaluated (NE)
Grasshopper	*Caelifera spp.*	Not Evaluated (NE)
Western Thatching Ant	*Messor barbarus*	Not Evaluated (NE)
Sugar Ant	*Camponotus consobrinus*	Not Evaluated (NE)
Giant African Centipede	*Scolopendra gigantea*	Not Evaluated (NE)
House Fly	*Musca domestica*	Not Evaluated (NE)
Cabbage White Butterfly	*Pieris rapae*	Not Evaluated (NE)
Stink Bug	*Halyomorpha halys*	Not Evaluated (NE)
Swallowtail Butterfly	*Papilio machaon*	Least Concern (LC)
Mopane Bee (Sweat Bee)	*Nomia spp.*	Not Evaluated (NE)
Giant African Millipede	*Archispirostreptus gigas*	Not Evaluated (NE)
Widow Spider	*Latrodectus spp.*	Not Evaluated (NE)
Huntsman Spider	*Sparassidae spp.*	Not Evaluated (NE)
Armed Spider	*Gasteracantha spp.*	Not Evaluated (NE)
Recluse Spider	*Loxosceles spp.*	Not Evaluated (NE)
Harvester Ant	*Pogonomyrmex spp.*	Not Evaluated (NE)
Ground Beetle	*Carabidae spp.*	Not Evaluated (NE)
Common Shining Cockroach	*Periplaneta americana*	Not Evaluated (NE)
Argentine Ant	*Linepithema humile*	Not Evaluated (NE)
Water Scavenger Beetle	*Hydrophilidae spp.*	Not Evaluated (NE)
Wolf Spider	*Lycosidae spp.*	Not Evaluated (NE)
Field Cricket	*Gryllidae spp.*	Not Evaluated (NE)
Carcass Beetle	*Silphidae spp.*	Not Evaluated (NE)
Spotted Sugar Ant	*Camponotus spp.*	Not Evaluated (NE)
White Spotted Fruit Chafer	*Pachnoda sinuata*	Not Evaluated (NE)
Harvest Ant	*Messor spp.*	Not Evaluated (NE)
Bal-byter Sugar Ant	*Camponotus fulvopilosus*	Not Evaluated (NE)
Striped Toktokkie	*Psammodes striatus*	Not Evaluated (NE)
Metallic Tree Darkling Beetle	*Omorgus squalidus*	Not Evaluated (NE)
Stick Mantid	*Empusa pennata*	Not Evaluated (NE)
African Black Beetle	*Heteronychus arator*	Not Evaluated (NE)

Common Name	Scientific Name	IUCN Conservation Status
Velvet Ant	*Mutillidae spp.*	Not Evaluated (NE)
Grass Mantid	*Mantodea spp.*	Not Evaluated (NE)
Luck Ant	*Formicidae spp.*	Not Evaluated (NE)
Bark Cockroach	*Periplaneta spp.*	Not Evaluated (NE)
Chequered Beetle	*Cleridae spp.*	Not Evaluated (NE)
Sweat Bee	*Halictidae spp.*	Not Evaluated (NE)
Trilobite Cockroach	*Cryptocercidae spp.*	Not Evaluated (NE)
Grey Coffee Snoot Beetle	*Curculionidae spp.*	Not Evaluated (NE)
Jumping Spider	*Salticidae spp.*	Not Evaluated (NE)
Monarch Butterfly	*Danaus plexippus*	Not Evaluated (NE)
Pentatomid Bug	*Pentatomidae spp.*	Not Evaluated (NE)
Eastern Subterranean Termites	*Reticulitermes flavipes*	Not Evaluated (NE)
Small Yellow Ant	*Solenopsis spp.*	Not Evaluated (NE)

5.10.4.5 Avifauna (Birds)

The project area supports a diverse avifauna community, reflecting the varied habitats traversed by the proposed transmission line. These habitats include miombo woodlands, grasslands, riparian zones, agricultural fields, and scattered human settlements, each providing distinct ecological niches for bird species. The ecological survey conducted along the OHL identified a total of **63 bird species**, distributed across various functional groups, including seed eaters, insectivores, frugivores, and raptors.

Bird diversity was significant, with multiple species identified across different habitat types. The surveyed area supports a mix of resident and migratory species, reflecting the ecological role of the region in avian conservation. The presence of Abdim's Stork *(Ciconia abdimii)*, a migratory species categorized as *Least Concern* by the IUCN, underscores the importance of the area as a seasonal stopover habitat. Other frequently recorded species included Red-necked Francolin *(Pternistis afer*), Black-headed Heron *(Ardea melanocephala),* White-browed Sparrow-Weaver *(Plocepasser mahali),* and Lilac-breasted Roller *(Coracias caudatus).* The diversity of granivores, insectivores, and nectarivores observed suggests that the area provides ample food resources and nesting sites, particularly in wooded and riparian habitats. Raptors such as the African Hawk Eagle *(Aquila spilogaster)* were also recorded, indicating the presence of a functioning predator-prey dynamic within the ecosystem.

Table 5-16 Surveyed Bird Species with their IUCN Conservation Status

Common Name	Scientific Name	IUCN Global Conservation Status
Red-necked Francolin (Spurfowl)	*Pternistis afer*	LC (Least Concern)
Long-tailed Widowbird	*Euplectes progne*	LC (Least Concern)
Ring-necked Dove	*Streptopelia capicola*	LC (Least Concern)
Black-eared Seed-eater	*Crithagra mennelli*	LC (Least Concern)
Swamp Boubou Shrike	*Laniarius bicolor*	LC (Least Concern)
Southern Carmine Bee-eater	*Merops nubicoides*	LC (Least Concern)
Flappet Lark	*Mirafra rufocinnamomea*	LC (Least Concern)
Red-eyed Dove	*Streptopelia semitorquata*	LC (Least Concern)
Red-eyed Bulbul	*Pycnonotus nigricans*	LC (Least Concern)
Collared Sunbird	*Hedydipna collaris*	LC (Least Concern)
African Emerald Cuckoo	*Chrysococcyx cupreus*	LC (Least Concern)
Black-backed Puffback	*Dryoscopus cubla*	LC (Least Concern)
Black-crowned Tchagra	*Tchagra senegalus*	LC (Least Concern)

Common Name	Scientific Name	IUCN Global Conservation Status
Emerald Spotted Dove	*Turtur chalcospilos*	LC (Least Concern)
White-winged Widowbird	*Euplectes albonotatus*	LC (Least Concern)
Black-winged Bishop	*Euplectes nigroventris*	LC (Least Concern)
Southern Masked Weaver	*Ploceus velatus*	LC (Least Concern)
Red-billed Fire Finch	*Lagonosticta senegala*	LC (Least Concern)
Miombo Grey Tit	*Parus griseiventris*	LC (Least Concern)
Blue Waxbill	*Uraeginthus angolensis*	LC (Least Concern)
Tawny-flanked Prinia	*Prinia subflava*	LC (Least Concern)
Grey Go-away Bird	*Corythaixoides concolor*	LC (Least Concern)
Singing Cisticola	*Cisticola juncidis*	LC (Least Concern)
Copper Sunbird	*Cinnyris cupreus*	LC (Least Concern)
White-browed Sparrow Weaver	*Plocepasser mahali*	LC (Least Concern
Black-headed Heron	*Ardea melanocephala*	LC (Least Concern)
African Hawk Eagle	*Aquila spilogaster*	LC (Least Concern)
Harlequin Quail	*Coturnix delegorguei*	LC (Least Concern)
African Green Pigeon	*Treron calvus*	LC (Least Concern)
Red Bishop	*Euplectes orix*	LC (Least Concern)
Abdim's Stork	*Ciconia abdimii*	LC (Least Concern)
Turtle Dove	*Streptopelia lugens*	LC (least Concern)
Burchell's Coucal[6]	*Centropus burchellii*	LC (Least Concern)
Greater Striped Swallow	*Cecropis cucullata*	LC (Least Concern)
Yellow-billed Kite	*Milvus aegyptius*	LC (Least Concern)
Hammerkop	*Scopus umbretta*	LC (Least Concern)
Lilac-breasted Roller	*Coracias caudatus*	LC (Least Concern)
Pied Crow	*Corvus albus*	LC (Least Concern)
Southern Grey-headed Kingfisher	*Halcyon leucocephala*	LC (Least Concern)
Red-billed Oxpecker	*Buphagus erythrorynchus*	LC (Least Concern)
Eastern Kestrel	*Falco rupicoloides*	LC (Least Concern)

The bird species recorded during the survey span a wide range of taxonomic groups, from small passerines to large raptors and waders. These species were documented across all five survey plots, with notable differences in species composition and abundance depending on habitat type. Dominant bird species include:

- **Abdim’s Stork (*Ciconia abdimii*)** – A migratory species commonly observed in grassland and open areas.
- **Southern Masked Weaver (*Ploceus velatus*)** – Commonly found in woodland edges and near human settlements.
- **Lilac-Breasted Roller (*Coracias caudatus*)** – A colorful insectivorous species frequently seen in open woodland habitats.
- **Red-Eyed Dove (*Streptopelia semitorquata*)** – Widespread across the project area, particularly in forested and bushy regions.
- **Blue Waxbill (*Uraeginthus angolensis*)** – A small seed-eating bird recorded in grasslands and thicket edges.

[6] This species is sometime considered belonging to the widespread White-browed Coucal (*Centropus superciliosus*) and sometimes as a separate species.

The diversity of bird species was influenced by the availability of suitable habitats within each plot. Plots characterized by dense vegetation, such as miombo woodlands, supported a higher diversity of species compared to open, cleared areas. The following highlights the avifauna diversity observed across the survey plots:

- **Wooded Vegetation Habitats:** Dominated by seed-eating and insectivorous species, including weavers, doves, and rollers.
- **Grasslands and Thickets:** Preferred by ground-nesting species such as the Red-Necked Francolin (*Pternistis afer*) and open-country species like the Abdim's Stork.
- **Riparian Zones:** Provided important habitats for water-dependent species such as the African Green Pigeon (*Treron calvus*) and occasional sightings of kingfishers.

The avifauna of the project area can be categorized into the following functional groups based on their feeding behavior and ecological roles:

1. **Seed Eaters:** Including species such as the Southern Masked Weaver, Blue Waxbill, and Red-Billed Quelea (*Quelea quelea*). These birds are critical for seed dispersal and maintaining plant diversity.
2. **Insectivores:** Such as the Lilac-Breasted Roller, Black-Backed Puffback (*Dryoscopus cubla*), and Tawny-Flanked Prinia (*Prinia subflava*). These species help control insect populations, maintaining ecological balance.
3. **Frugivores:** Represented by the African Green Pigeon and the Black-Crowned Tchagra (*Tchagra senegalus*), which are important for seed dispersal of fruiting plants.
4. **Raptors and Scavengers:** Although not dominant, species like the Yellow-Billed Kite (*Milvus aegyptius*) and Pied Crow (*Corvus albus*) were observed, playing a role in maintaining ecosystem health by controlling prey populations.
5. **Waders and Waterbirds:** Limited to the riparian zones, with species such as Abdim's Stork frequenting open wetland and floodplain areas.

5.10.4.6 Conservation Significance of Identified Species

The ecological survey conducted along the Malawi-Zambia 400kV Interconnector corridor documented a range of plants, mammals, birds, reptiles, amphibians, and insects, primarily comprising species classified as Least Concern (LC) or Not Evaluated (NE) under the IUCN Red List (2023). No endemic, rare, or threatened species were recorded among mammals, amphibians, except for the suspected pancake tortoise which is Critically Endangered (CR) under the IUCN red list, birds and insects. In specific:

- No bird nesting colonies were observed within the surveyed plots. The project area is highly disturbed by human activities, including agriculture and settlements, which limit suitable nesting sites for large avian species. However, scattered woodland patches still provide foraging and perching sites for a variety of birds.

- The mammal survey recorded no species of conservation concern, with all identified mammals—including the Vervet Monkey, Civet Cat, and Common Duiker—falling under the Least Concern (LC) category. Similarly, the amphibian assessment identified Bocage's Burrowing Tree Frog (*Leptopelis bocagii*), which is not classified as threatened under the IUCN.

- Among reptiles, apart from the Pancake Tortoise, other observed species—including the Monitor Lizard, Side-Striped Chameleon, and Mozambique Rough-Scaled Lizard—are categorized as Least Concern (LC). These species are commonly found in woodland and savanna ecosystems and are not under immediate conservation threats.

- There were no faunal invasive or alien species that were recorded in in the project area.

To ensure compliance with Zambia's Wildlife Act and international conservation standards, all species were screened against both Zambia's National Conservation Status and the IUCN Red List (2023). The results confirmed that most recorded species are not legally protected under Zambia's conservation regulations, except for one reptile species of concern—**the Pancake Tortoise (*Malacochersus tornieri*).**

The Pancake Tortoise was identified by the survey team during the reptile survey in plot 4 and 5. It is classified as Critically Endangered (CR) on the IUCN Red List (2023) due to ongoing population declines caused by habitat destruction and illegal collection for the pet trade. In Zambia, this species is protected under national wildlife regulations, meaning that its capture, trade, or disturbance is strictly regulated.

Figure 5-17 Suspected Pancake Tortoise caught in a pitfall trap

Although the species is not widespread within the project area, its presence signifies an important ecological finding that warrants specific conservation attention. Further assessments are recommended to determine the extent of its distribution along the transmission corridor and ensure that any potential project-related disturbances do not threaten its habitat.

5.10.5 Protected Areas and Internationally Important Biodiversity Areas

The proposed project does not traverse any designated protected area (national park, game management area, or forest reserve). The closest national park in Zambia is Lukusuzi National Park 62 km north of the Chipata West Substation, which is also the nearest Key Biodiversity Area (KBA). The closest game management area (GMA) is Lupande GMA 43 km west of the Chipata West Substation, which is part of the buffer zone for South Luangwa National Park.

Through assessing different project alternatives and careful planning, the proposed transmission line route avoids all nearby forest reserves in order to minimise potential impacts on protected and ecologically sensitive areas. The nearest protected area is Msipazi Forest Reserve, which is about 320 m south of the proposed transmission line while Mkwawe Forest Reserve is about 3.6 km north of the proposed line. The Mbewule Ranch and Nature Conservation Reserve (private) is approximately 2.4 km away from the transmission line.

5.10.6 Modified Habitat, Natural Habitat and Critical Habitat

According to **EIB ESS4 (2022)** and **WB ESS6 (2017)**, critical habitat is defined as a habitat that meets any of the following criteria.

Table 5-17 Criteria for critical habitats as per selected IFIs

	EIB ESS 4 Biodiversity and Ecosystems (2022)	**WB ESS 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources (2017)**
Critical habitat	Critical habitat is the most sensitive of the high-value biodiversity features and is defined as comprising one of the following: a) A highly threatened and/or unique ecosystem; b) A habitat of priority and/or significant importance to Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) species, as defined by the IUCN Red List of threatened species and in relevant national legislation; c) A habitat of priority and/or significant importance to a population, range or distribution of endemic or restricted-range species, or highly distinctive assemblages of species; d) A habitat required for the survival of migratory species and/or congregatory species; e) Biodiversity and/or an ecosystem of significant social, economic or cultural importance to local communities and indigenous groups; f) A habitat of key scientific value and/or associated with key evolutionary processes.	Critical habitat is defined as areas with high biodiversity importance or value, including: a) habitat of significant importance to Critically Endangered (CR) or Endangered (EN) species, as listed in the IUCN Red List of threatened species or equivalent national approaches; b) habitat of significant importance to endemic or restricted-range species; c) habitat supporting globally or nationally significant concentrations of migratory or congregatory species; d) highly threatened or unique ecosystems; e) ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).

According to the European Investment Bank's Environmental and Social Standard 4 (ESS4) on Biodiversity and Ecosystems (2022), *critical habitat* is defined as any area meeting one or more of the following criteria:

- **(a)** A highly threatened and/or unique ecosystem;
- **(b)** A habitat of significant importance to *Critically Endangered (CR)*, *Endangered (EN)*, or *Vulnerable (VU)* species (as per the IUCN Red List or national conservation legislation);
- **(c)** A habitat supporting endemic or restricted-range species, or highly distinctive assemblages of species;
- **(d)** A habitat required for the survival of migratory or congregatory species;
- **(e)** A biodiversity feature of high social, economic, or cultural value to local communities or Indigenous Peoples;
- **(f)** A habitat of key scientific value or associated with key evolutionary processes.

Assessment Results and Critical Habitat Consideration

Based on **field ecological surveys**, **literature review**, and **community consultations** conducted along the Malawi–Zambia 400 kV Interconnector corridor, most habitats along the project alignment do not meet the strict thresholds required to qualify as critical habitat under ESS4. The majority of the transmission route traverses **modified landscapes** dominated by **agricultural fields**, **degraded woodland**, and **patches of secondary Miombo vegetation** with moderate species richness and limited presence of globally threatened taxa.

However, *notable exceptions* were observed particularly within **Plot 4** and **Plot 5**, where the biodiversity team documented the presence of a suspected **Pancake Tortoise (*Malacochersus tornieri*)**, a species that is listed as **Critically Endangered (CR)** on the IUCN Red List. This tortoise is highly specialized in its habitat use, typically confined to fragmented rocky outcrops within thicket or scrubland ecosystems and is globally threatened due to illegal wildlife trade and severe habitat degradation.

If the presence of this species is confirmed through follow-up herpetofauna surveys, the area in question—likely within the **thicket or degraded Miombo woodland habitats of Plot 4 or 5**—would fulfill the **critical habitat criterion (b)** under ESS4, as it would constitute habitat of significant importance to a *Critically Endangered* species.

Implications for Project Design and Management

The potential presence of a CR-listed species such as the Pancake Tortoise necessitates the application of a *precautionary approach* to avoid irreversible impacts. As per ESS4 requirements:

Brief Species-Specific Action Plan (SSAP)

Pancake Tortoise (*Malacochersus tornieri*)

Malawi–Zambia 400 kV Interconnector Project

1. Introduction and Purpose

This Species-Specific Action Plan (SSAP) has been prepared in response to the **suspected presence of the Pancake Tortoise (*Malacochersus tornieri*)**, a **Critically Endangered species** (IUCN Red List) listed under **CITES Appendix I**, within the Malawi–Zambia 400 kV Interconnector Project area, particularly in **Plot 4 and Plot 5**.

The SSAP provides a structured framework to:

- Ensure compliance with **EIB Environmental and Social Standard 4 (ESS4) – Biodiversity and Ecosystems (2022)**;
- Avoid, minimise, and manage project risks to a species of **potential Critical Habitat status**;
- Support scientific verification and conservation planning; and
- Integrate species protection measures into the **Environmental and Social Management Plan (ESMP)**.

2. Regulatory and Policy Alignment (EIB ESS4)

ESS4 Critical Habitat Triggers

Based on available field evidence, the SSAP addresses **ESS4 Critical Habitat Criterion (b)**:

"A habitat of significant importance to Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) species, as defined by the IUCN Red List."

The Pancake Tortoise qualifies as **CR**, and its suspected occurrence outside its previously confirmed Zambian range (Nakonde District) elevates the conservation sensitivity of affected habitats.

Applicable Standards

- EIB ESS4 (2022)

- IUCN Red List
- CITES Appendix I
- Zambian Wildlife Act
- IFC PS6 (guidance reference)
- National Biodiversity Strategy and Action Plan (NBSAP)

3. Species Profile

Attribute	Description
Scientific Name	*Malacochersus tornieri*
Common Name	Pancake Tortoise
Conservation Status	Critically Endangered (IUCN)
CITES Status	Appendix I
Habitat	Granite outcrops, kopjes, exfoliating rock slabs with crevices
Ecological Sensitivity	Very High
Primary Threats	Habitat disturbance, illegal collection, infrastructure development

4. Risk Assessment by Project Phase

Project Phase	Key Risks
Pre-Construction	Incorrect siting of towers and access routes; unverified presence
Construction	Habitat destruction, vibration, accidental mortality, increased poaching risk
Operation & Maintenance	Unauthorized access, gradual habitat degradation
Decommissioning	Disturbance of recolonised habitats

5. Mitigation Hierarchy (ESS4-Compliant)

This SSAP follows the **avoid → minimise → restore → offset (last resort)** hierarchy, with **avoidance as the primary strategy**.

6. SSAP Mitigation and Management Measures

6.1 Avoidance and Design Measures

- Declare confirmed and suspected Pancake Tortoise habitats as **Critical Habitat / No-Go Areas**.
- Micro-site towers and access roads to **avoid rocky outcrops and crevice habitats**.
- Prohibit blasting, rock breaking, or vibration-intensive works in sensitive zones.

6.2 Pre-Construction Measures

- Implement a **targeted verification survey** led by qualified herpetologists.
- GPS mapping and habitat characterisation of all sightings.

- Formal notification and coordination with **Department of National Parks & Wildlife (DNPW)**.
- Integration of findings into final construction layouts.

6.3 Construction Phase Measures

- Appoint an **Ecological Clerk of Works (ECoW)** with authority to halt works where necessary.
- Establish **50–100 m exclusion buffers** around confirmed habitats.
- Enforce a **strict Code of Conduct** prohibiting wildlife handling or trade.
- Restrict worker access to designated areas only.

6.4 Species Handling and Contingency

- Any capture, handling, or relocation only under:
  - DNPW permit,
  - Approved **Capture–Relocate–Release Protocol**.
- No translocation without regulatory approval.

6.5 Monitoring and Research

- Support the **range-verification and genetic study** (Eastern Province vs Nakonde/Tanzania/Kenya).
- Post-construction monitoring for at least **2–3 years**.
- Incident reporting (injury, mortality, illegal activity).

6.6 Community Awareness and Protection

- Worker and community training on:
  - Species identification,
  - Legal status and penalties,
  - Conservation importance.
- Collaboration with local leaders to reduce poaching risk.

5.10.7 Biodiversity Analysis

5.10.7.1 Diversity

To provide a more comprehensive understanding of flora and fauna diversity in the project area, a biodiversity analysis was conducted using the Simpson's Diversity Index, which measures species richness and evenness across the surveyed plots. The index ranges from **0 to 1**, where values closer to **1** indicate higher diversity and values near **0** suggest lower diversity, with greater dominance by a few species (Simpson,1949).

The results of this analysis are summarized below:

Floral Biodiversity Analysis

- Total Species Recorded:
  - 62 Tree Species
  - 32 Grass Species
- Simpson’s Diversity Index for Trees: 0.903
- Simpson’s Diversity Index for Grasses: 0.818

- Dominant Functional Groups:
  - Woody species (trees and shrubs) in miombo woodland habitats.
  - Herbaceous species (grasses) in grassland and agricultural zones.
  - Secondary species (shrubs and fast-growing trees) in disturbed areas.

Mammalian Biodiversity

- Total Species Recorded: 5
- Simpson's Diversity Index: 0.774
- Dominant Species: Vervet Monkey (*Chlorocebus pygerythrus*) and Common Duiker (*Sylvicapra grimmia*).
- Habitat Preference: Woodlands and open grasslands.

Reptilian Biodiversity

- Total Species Recorded: 4
- Simpson's Diversity Index: 0.655
- Dominant Species: Monitor Lizard (*Varanus niloticus*) and Side-Striped Chameleon (*Chamaeleo dilepis*).
- Habitat Preference: Riparian zones, grasslands, and woodland edges.

Amphibian Biodiversity

- Total Species Recorded: 1
- Simpson's Diversity Index: 0.0 (single species recorded)
- Dominant Species: Bocage's Burrowing Tree Frog (*Leptopelis bocagii*).
- Habitat Preference: Wetland patches and seasonal pools.

Insect Biodiversity

- Total Species Recorded: 227
- Simpson's Diversity Index: 0.912
- Dominant Groups: Ants (Formicidae), Beetles (Coleoptera), and Butterflies (Lepidoptera).
- Habitat Preference: Grasslands, woodlands, and riparian areas.

Avifauna Biodiversity

- Total Species Recorded: 63
- Simpson's Diversity Index: 0.894
- Dominant Groups: Seed-eaters (weavers, waxbills, sparrows), insectivores (rollers, sunbirds), and waders (storks).
- Highest Species Richness: Observed in woodland and riparian habitats.
- Lowest Species Richness: Recorded in cleared and heavily disturbed areas.

5.10.7.2 Overall Species Composition Across Taxa

The overall species composition across taxa is shown in the table below.

Table 5-18 Overall Species Composition Across Taxa

Species Category	Count	Composition (%)
Trees	1214	23.822
Grasses	3316	65.070
Birds	324	6.357
Insects	227	4.454
Mammals	5	0.098
Reptiles	9	0.176

Species Category	Count	Composition (%)
Amphibians	1	0.019
	5096	

The biodiversity assessment across all five plots within the project area reveals a total of **5,096** recorded individuals across various taxa, (refer to Table 5-19). The species composition is dominated by **grasses (65.07%)**, followed by **trees (23.82%)**, which together constitute the bulk of the surveyed vegetation.

Among faunal groups, **birds make up 6.36% of the total species count**, indicating a diverse avian population that likely thrives in the varied vegetation types. **Insects contribute 4.45%** to the total composition, playing critical ecological roles such as pollination and nutrient cycling.

The presence of **mammals (0.10%)**, **reptiles (0.18%)**, and **amphibians (0.02%)** suggests a relatively low abundance of larger vertebrates in the surveyed area. This could be attributed to habitat fragmentation, anthropogenic pressures, or naturally low densities of these species in the region.

Table 5-19 Overall Biodiversity Index for the Malawi-Zambia 400kV Interconnector Project Area

Species Category	n	n-1	n(n-1)
Trees	1214	1213	1472582
Grasses	3316	3315	10992540
Birds	324	323	104652
Insects	227	226	51302
Mammals	5	4	20
Reptiles	9	8	72
Amphibians	1	0	0
	5096	5095	12621168

D=1-(∑n(n-1)/(N(N-1))

1-(12621168/5096*5095)

1-0.486100357

D= 0.513899643

The Simpson's Biodiversity Index (D) for the entire project area is calculated at 0.5139, indicating a moderate level of species diversity across the five surveyed plots. This index value suggests that while the area supports a variety of species, certain taxa—particularly grasses and trees—dominate the landscape.

A biodiversity index of 0.5139 indicates that there is a moderate probability that two randomly selected individuals belong to different species, meaning that while species diversity exists, a few dominant species significantly contribute to overall abundance (Simpson, 1949). The relatively lower diversity among faunal groups could be influenced by anthropogenic disturbances, habitat fragmentation, and ecological factors such as predator-prey dynamics and resource availability.

5.10.7.3 Comparative Overview of Simpson's Diversity Index Across Plots

The biodiversity indices calculated for each plot are as follows:

Table 5-20 Comparative Overview of Simpson's Diversity Index Across Plots

Plot	Trees	Grasses	Birds	Insects	Reptiles	Overall Biodiversity Index
Plot 1	0.8187	0.8065	0.9596	0.8609	0.0000	0.6281
Plot 2	0.9231	0.7319	0.4224	0.8714	0.6000	0.5922

Plot	Trees	Grasses	Birds	Insects	Reptiles	Overall Biodiversity Index
Plot 3	0.9400	0.8034	0.7029	0.9254	0.0000	0.4157
Plot 4	0.9800	0.6562	0.4339	0.8862	0.6000	0.4363
Plot 5	0.9336	0.8118	0.9230	0.9098	0.0000	0.4096

Tree Species Diversity

- Highest Tree Diversity: Plot 4 (D = 0.9800) has the most diverse tree population, indicating a well-balanced distribution of species with minimal dominance by any single species.
- Lowest Tree Diversity: Plot 1 (D = 0.8187), while still relatively high, exhibits lower diversity compared to other plots. This suggests some level of species dominance, likely influenced by environmental conditions or human activities.
- General Trend: Tree diversity remains relatively high across all plots, with values exceeding 0.80, indicating a well-distributed tree community across the study area.

Grass Species Diversity

- Highest Grass Diversity: Plot 1 (D = 0.8065) and Plot 5 (D = 0.8118), indicating relatively high species evenness and richness.
- Lowest Grass Diversity: Plot 4 (D = 0.6562), suggesting significant dominance by a few grass species.
- General Trend: The grass diversity index varies widely across plots, with some plots experiencing dominance by specific species. This could be influenced by grazing pressures, soil composition, and climatic variations.

Bird Species Diversity

- Highest Bird Diversity: Plot 1 (D = 0.9596) and Plot 5 (D = 0.9230), reflecting a high level of species evenness, with no single species overly dominating.
- Lowest Bird Diversity: Plot 2 (D = 0.4224) and Plot 4 (D = 0.4339), indicating dominance by a few bird species, possibly due to habitat preferences or limited nesting areas.
- General Trend: Bird diversity is highly variable across plots, with some plots showing higher species richness due to the presence of mixed habitats, while others have lower diversity likely due to environmental constraints or anthropogenic disturbances.

Insect Species Diversity

- Highest Insect Diversity: Plot 3 (D = 0.9254) and Plot 5 (D = 0.9098), indicating a highly diverse insect population with a well-distributed abundance of species.
- Lowest Insect Diversity: Plot 1 (D = 0.8609), though still relatively high, suggesting that a few species may be more dominant.
- General Trend: Insects exhibit consistently high biodiversity across all plots, which is expected due to their adaptability and ecological role as pollinators, decomposers, and prey for other taxa.

Reptile Species Diversity

- Presence of Reptiles: Only Plot 2 (D = 0.6000) and Plot 4 (D = 0.6000) recorded reptile species, while the other plots had no observations. This indicates a patchy distribution likely influenced by habitat suitability, vegetation cover, and prey availability.
- General Trend: Reptiles are less widely distributed compared to other taxa, and their presence is site-specific, emphasizing the need for targeted conservation efforts.

Overall Biodiversity Trends

- Most Biodiverse Plot Overall: Plot 1 (D = 0.6281) recorded the highest overall biodiversity index, suggesting a well-balanced ecological system with diverse species across all taxa.
- Least Biodiverse Plot Overall: Plot 5 (D = 0.4096), despite high bird and insect diversity, had a lower overall

index, possibly due to lower tree diversity and limited reptile or amphibian records.

- General Trend: Biodiversity is generally higher in less disturbed plots and lower in plots with human activity or environmental constraints. The dominance of certain species in some plots suggests localized environmental pressures that may affect ecosystem resilience.

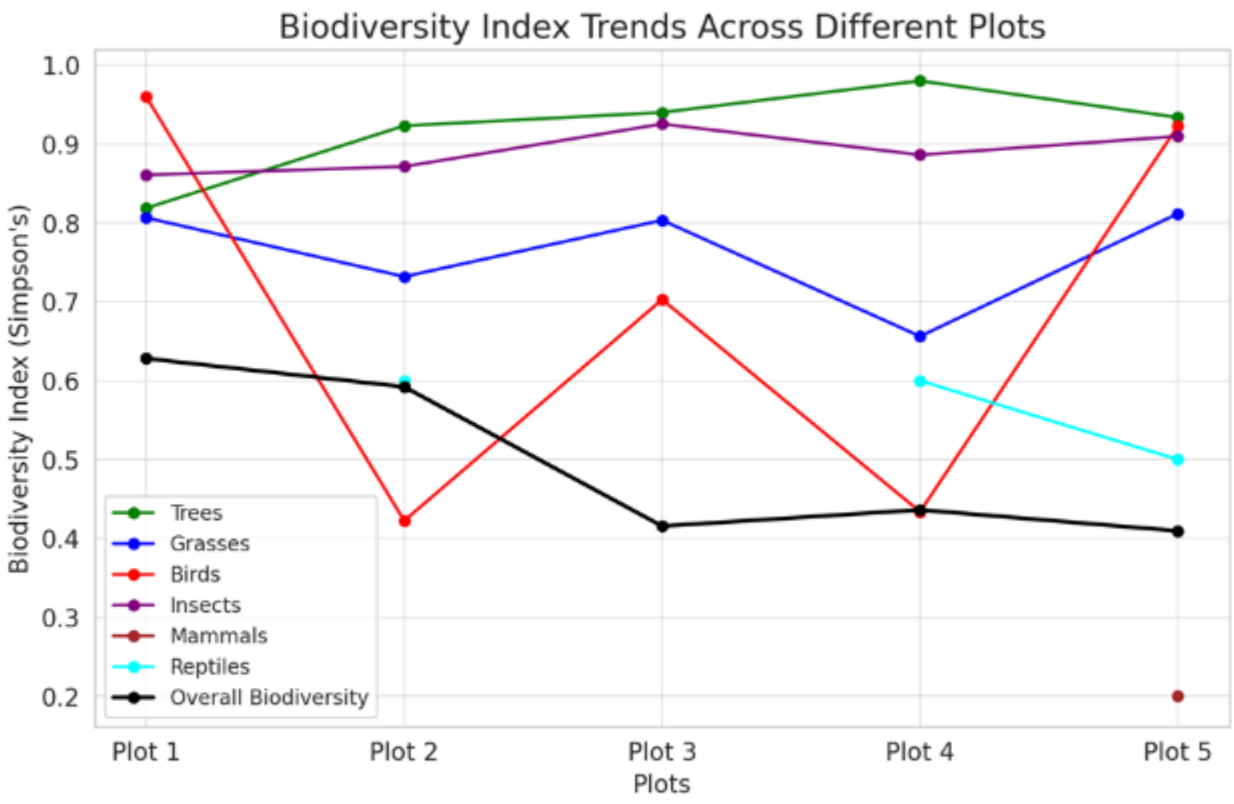


Figure 5-18 Biodiversity Index Trends Across Different Plots

5.10.7.4 Biodiversity Index Trend Analysis

The Biodiversity Index Trend Chart above, provides a comparative visual representation of Simpson's Biodiversity Index (D) across different taxa surveyed within the Malawi-Zambia 400kV Interconnector Project area. The overall biodiversity index, highlighted with a black line, distinctly illustrates the general biodiversity trends across all surveyed groups.

Key observations from the chart include:

- **Grasses and Trees** exhibit the highest biodiversity values across all plots, reflecting their ecological dominance and species richness in the region.
- **Birds and Insects** display moderate biodiversity indices, indicating a diverse yet site-dependent species composition.
- **Reptiles and Mammals**, though observed in lower numbers, still contribute to the overall ecological balance.
- **The overall biodiversity index (black line)** follows a stable yet slightly fluctuating trend, emphasizing that while certain taxa may experience localized variations in diversity, the broader ecosystem maintains a moderate level of biodiversity across the project area.

This analysis is crucial for identifying conservation priorities, ensuring that sensitive habitats and high-biodiversity areas are properly managed and protected throughout the project's implementation.

5.10.7.5 Species Richness Heatmap Across Plots

The Species Richness Heatmap (see Figure 5-19) visually represents the distribution of species diversity across different taxa (Trees, Grasses, Birds, Insects, and Reptiles) in each of the five survey plots. The color gradient indicates relative species richness, with darker shades (deep blue) representing higher richness and lighter shades (pale yellow) indicating lower richness.

Key Observations:

- Trees consistently exhibit the highest species richness across all plots, with Plot 3 showing the highest tree species count (43 species), highlighting its ecological importance.
- Grasses display moderate richness, peaking in Plot 4 (10 species), which may be linked to habitat variability and soil conditions.
- Birds and Insects maintain relatively stable diversity across plots, with the highest bird richness recorded in Plot 1 (21 species) and Plot 3 (19 species).
- Reptile richness is significantly low, with only one or two species recorded per plot, except for Plot 4, where three reptile species were observed.
- Overall Biodiversity Index values (last column) range from 0.41 to 0.63, with Plot 1 exhibiting the highest overall biodiversity index (0.63), suggesting a relatively balanced ecosystem with a mix of species across taxa.

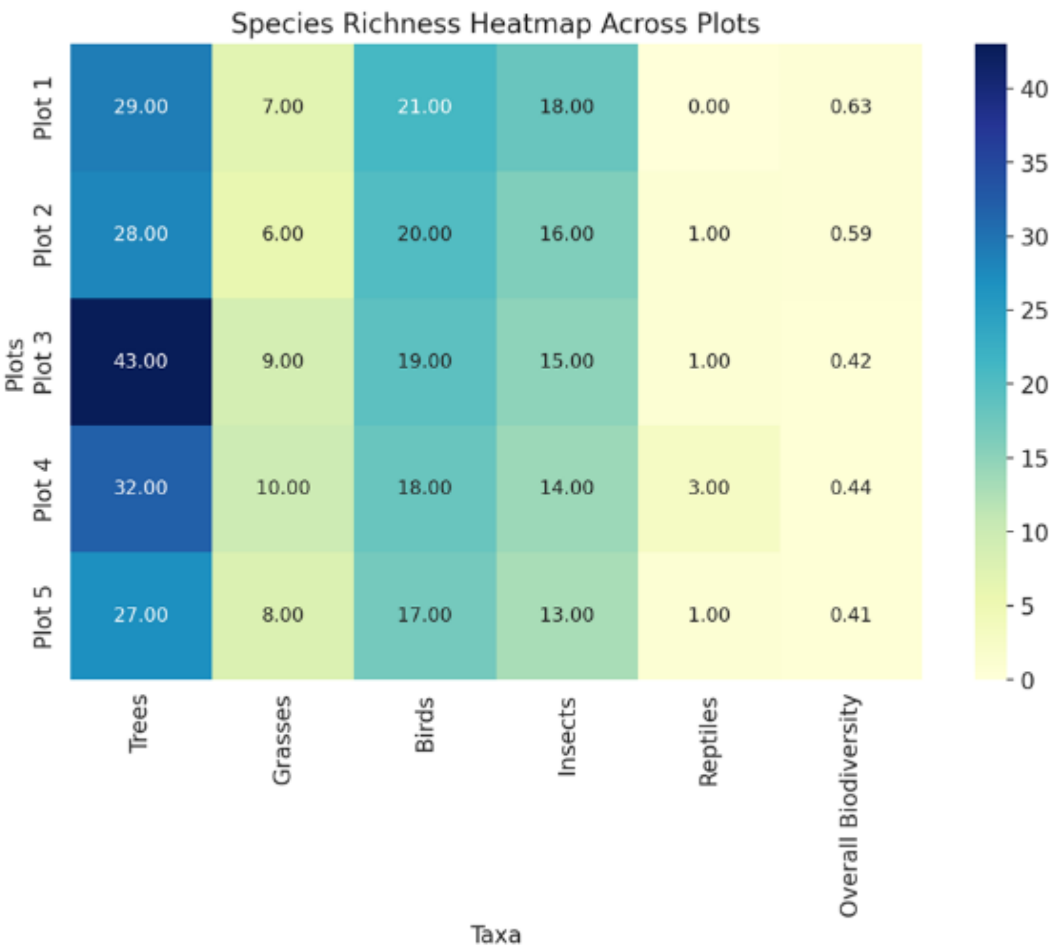


Figure 5-19 Species Richness Heatmap (i.e. distribution of species across different taxa and plots)

6 Socioeconomic Environment

6.1 Overview

Chipata is situated approximately 567 km east of Lusaka. To the east, the district borders Malawi with Lilongwe, the capital city of Malawi, being only 110 km away. The District borders Lundazi to the north, Katete to the south-west, and Chadiza District to the south, and Vubwi District to the south-east. Chipata town is located on high altitude of approximately 1,500 m above sea level and near to the Lake Malawi/ Luangwa River watershed.

Vubwi is a relatively new district, having been recently separated from Chadiza District. It spans an area of 981.7 square kilometers. Vubwi public service infrastructure is still developing, reflecting its recent status as a district.

6.2 Population

Chipata

According to 2022 Census of Population and Housing, Chipata has a population of 327,059 of which 159,643 are males and 167,416 are females. The district has 70,802 households comprising 51,375 male-headed households and 19,427 female-headed households. With an estimated surface of 1,691.1square kilometres, Chipata has a population density of 193.4 persons per square kilometre. The population has been growing speedily from 234,750 in 2010 to 237 059 in 2022 representing a growth rate of 2.8 per cent. Given Chipata's strategic location as a border town surrounding by a rich and productive agricultural sector, this high growth rate is expected to continue over the next 10 to 20 years. Being the provincial capital of the Eastern Province, public infrastructure in Chipata is developed compared to other districts in the province and this attracts migration into the district.

Vubwi

Vubwi is a relatively new district having been separated from Chadiza district in 2012. It spurns an area of 781.7 square kilometres and has a total population of 53,118 resulting in a lower population density of 54.1 persons per square kilometre. This population comprises 26,465 males and 26,653 females, with most residents (approximately 45,643 people) residing in rural areas while 7,475 live in the urban centre. A population's growth rate of approximately 1.5% between 2010 and 2022 has been recorded. Vubwi public service infrastructure is still developing reflecting its recent status as a district.

Table 6-1 Population Distribution in Chipata and Vubwi Districts

District	Total Population	Urban Population	Rural Population	Area (km²)	Population Density (people/km²)	Population Growth Rate (%)
Chipata	327,059	193,288	133,771	1807	193.4	2.8
Vubwi	53,118	7,475	45,643	981.7	54.1	1.5

Source: Zamstat 2022, Census Population and Housing Preliminary Report

6.3 Administration

Chipata

Chipata is the provincial capital of Eastern Province, serving also as an administrative hub. It was elevated to city status in 2017, becoming the fifth city after Lusaka, Ndola, Kitwe and Livingstone. The local authority is responsible for municipal services, infrastructure development and local administration. The City Council is superintended by a mayor for political expedience and administratively run by the Town Clerk. The Council comprises elected councillors representing various wards in the two parliamentary constituencies of Chipata Central and Luangeni.

The District Commissioner is responsible for all government developmental activities in the entire district and supervises all the Government departments at district level. Traditionally, the district, particularly in rural areas, is overseen by two Paramount Chiefs- Mpezeni and Gawa Undi, with delegated powers to the chiefs and headmen under their respective jurisdictions.

Vubwi

Vubwi district_was established in 2012 following its separation from Chadiza district. The District Commissioner acts as the central government's representative at district level, overseeing the implementation of national policies and programmes. The Council comprises elected councillors representing various wards within the single parliamentary constituency of Vubwi.

The project area stretches over two districts and most of the population in the immediate project area reside in rural areas and lives in small villages (family homesteads/ household groups). A village is made up of many households in a defined geographical area under the leadership of a village headman / headwoman. A group of villages in each defined geographical area make up a Chiefdom, which is headed by a Chief.

6.4 Settlement Patterns and Traditional Governance System

Settlement Patterns

Most people in Chipata and Vubwi near the transmission line live in dispersed villages or compounds, often located near farmland or water sources. The development in the project area is linear as settlements follow roads or footpaths, especially near trading centres. The homesteads are clustered closer to schools, clinics, and markets, especially around Chipata urban periphery. In terms of subsistence farming, houses are closely tied to agricultural plots for maize, ground nuts, and other crops.

The proposed transmission line will traverse several villages as outlined in the table below.

Table 6-2 Villages traversed by the proposed transmission line, including the Chiefdom and district for each village

District	Village	Chief
Chipata	Kauzi	Mpezeni
	Chembele	
	Mazonga	
	Chibwe	
	Mphande	
	Pashane	
	Daula	
	Chiundama/Yonke	
	Kaachikoti	
	Jelemani	
	Lufazi/Jojo	
Vubwi	Chichele/Pililani	Pembamoyo
	Chikoti	
	Chikoka	
	Chikoma	

Rural Settlements and Community Infrastructure

Scattered rural settlements are distributed along the project corridor, with traditional villages, schools, churches, and local markets forming the backbone of community life. These settlements are predominantly located along major roads and river valleys, benefiting from access to water sources and fertile soils for cultivation.

Infrastructure Corridors

The region is also characterized by a network of access roads, power lines, and small-scale infrastructure installations that support rural development. These corridors provide critical connectivity for local communities in the project area.

6.5 Land Tenure Systems

Land tenure in the project area is governed by a combination of three main tenure systems—customary, state, and private ownership - each with distinct management frameworks and legal recognition:

Customary Land Tenure

Customary land is the most prevalent form of land tenure in the Chipata and Vubwi districts, managed under the authority of traditional leaders, including chiefs, headmen, and local village councils. Under this system, land is held communally, with individuals granted user rights through traditional allocation processes. The rules for land use are guided by local customs, which emphasize collective land stewardship, inheritance practices, and sustainable use of natural resources. Customary land is generally not formally titled, making it crucial for the project to engage with traditional authorities to secure access and obtain consent for the right-of-way.

State Land Tenure

State land is owned and managed by the government of Zambia, administered under statutory laws and regulations. It includes protected areas, forest reserves, and other lands designated for public purposes. State land is typically surveyed, registered, and titled, with land use governed by national policies such as the Lands Act, the Forests Act, and the Environmental Management Act. The Malawi-Zambia 400kV Interconnector may cross areas under state land, and will require obtaining access permits (consents) from responsible Government agencies.

Private Land Tenure

Private land is held by individuals, organizations, or institutions under a legal title granted by the government. These lands are typically used for commercial agriculture, residential purposes, or private conservation initiatives. Private landholders possess secure land rights protected by the Zambian legal system, and any project activities affecting private land must involve formal negotiations with landowners, compensation agreements, and adherence to legal procedures for land acquisition. Five private farms lands have been impacted; one belonging to Mwami Advertist church and four other individual farms.

6.6 Local Economy

Chipata

Chipata functions as the provincial capital and a commercial hub. Its local economy is based on agriculture and agro-trade. Cross-border trade with Malawi (especially in goods like maize, clothing, and household items) is also rife. Retail, transport, and hospitality sectors are also vibrant. The town boast of one hotel – Protea and several lodges and guest houses. In terms of tourism, North of the city of Chipata is the Lukusuzi National Park which is remote and under-explored area bordering the Luangwa Valley eco-system, home to African wild dogs, spotted hyenas, antelopes, elephants, zebras, hartebeest, buffaloes and common duikers. It is also recognized as an Important Bird Area.

There are several companies that are engaged in agro-processing using locally grown agricultural produce. Community Markets for Conservation (COMACO) is a social enterprise that aims at fighting poverty by training small-scale farmers in climate smart sustainable agriculture practices to increase production. COMACO buys from the small scale farmers groundnuts, soyabeans, cowpeas, sunflower honey and other commodities for processing into various finished products for sale in the country and export to neighbouring counties. These activities contribute to increased family income and the overall development of Chipata and the surrounding districts. There are also growing informal and micro-enterprise activities in various sectors in the district.

Livestock farming is also practiced with cattle, goats, pigs and chickens, which are sold to earn money to meet domestic family needs and investment.

Vubwi

Vubwi is less developed as it is a new rural district bordering Malawi and Mozambique. The local economy largely depends on subsistence farming. Crops grown include maize (as the main staple food and as a cash crop), sunflower, millet, ground nuts, sorghum and sweet potatoes. Cultivation is mainly by hand hoes and oxen. Charcoal production and firewood trade are also dominant.

Small-scale trading, especially in fast common moving consumer goods such as soap, washing powder, salt, sugar etc. is also prevalent as a cross-border activity between Zambia and Malawi.

Livestock farming is also practiced with cattle, goats, pigs and chickens. Cattle and goats are mainly used for income generation, protein ingestion and payment of dowry.

6.7 Industries

Chipata

While agriculture remains the backbone of its economy, the city has seen significant growth in agro-processing by COMACO and other companies engaged in peanut butter production, grain milling, edible oil, cotton ginning by Parrogate Ginneries Limited, Clark Cotton Zambia Limited, and Chipata Cotton Company Limited, manufacturing, and trade-related industries, leveraging its strategic position near Malawi.

The city has an emerging industrial zone in Kagunda aimed at bolstering industrial activities. It is envisioned to host various manufacturing and processing enterprises.

Vubwi

Agriculture is the cornerstone of the town's economy. Additionally, small scale mining does contribute to the local economy. The town has lately emerged as a focal point for small scale gold mining particularly in areas like Chief Pembamoyo. The discovery of gold deposits has spurred artisanal mining activities often conducted informally by residents. There are no mining activities along the proposed transmission line corridor.

6.8 Mining and Minerals

Chipata

In Chipata small mining activities are present particularly in the extraction of gemstones such amethyst, aquamarine, citrine. Notable mines in this area include Dickson mine, Chief Muzyanda's Mine, Mutangula and Kamimbi Mines. Other small scale mining areas within the district include Chikomeni located approximately 40km south of Lundazi and near the main road to Chipata.

Vubwi

Small scale mining is notably active in several villages within Chief Pembamoyo's area with the following villages being identified as centres for gold mining activities: Kachile, Kadyaalendo, Chitumba, and Moffat 1. This artisanal mining is done in an informal manner as most of the miners do not have a legal documentation to this effect.

In the immediate project area, there is no presence of mining activities.

6.9 Social Services and Amenities

6.9.1 Education

The government has introduced a policy of universal free primary education and about 95% of primary school age children are enrolled at schools (national Assembly of Zambia, October 2022). Others continue to secondary level and approximately a modest number continues to tertiary level. The standard of education is hampered by lack of facilities, transport and teachers, particularly in rural areas (Tembo. J, 2024).

Chipata

The total number of schools in Chipata District is 163, comprising of 116 primary schools, 26 secondary schools and 15 community schools. Chipata has a total number of 6 tertiary institutions, all located in Chipata City.

Table 6-3 Education Facilities in Chipata District

District	Primary Schools	Secondary Schools	Tertiary Institutions	Community Schools	Total
Chipata	116	26	6	15	163

Source: Chipata District Education Board Secretary Office, 2025

According to the information obtained from the office of the District Education Board Secretary (DEBS) in Chipata, a total of 64,234 children were enrolled in primary schools as of January 2025, of which 31,276 (48.7%) were boys and 32,958 (51.3%) were girls. The higher enrollment ratio for girls was attributed to two factors. Firstly, the natural phenomena in Zambia and the project area is that there are more girls who are borne every year than boys. The second factor is that parents now understand the importance of providing education to the children, both boys and girls. In the past, parents used to pay more attention to the education of boys than girls due to the belief that the girls' future was secured in marriage.

In terms of secondary enrolled, a total of 16,973 pupils were enrolled in secondary schools as of January 2025, of which 8,548 (50.35%) were boys and 8,425 (49.65%) were girls. The enrollment ratio for girls and boys was almost balanced. However, it was observed that the progression rate from grade 7 (primary) to grade 8 (junior secondary) and from grade 9 (junior secondary) to grade 10 (senior secondary) was higher for boys than girls in Chipata District, a trend that is consistent across Zambia. The information obtained from the office of the District Education Board Secretary (DEBS) showed that the progression rate for 2024 from Grade 7 to Grade 8 was 70% for boys and 69% for girls (almost the same for boys and girls). From G9 to G10, the progression rate was 69% for boys and 68% for girls (almost the same for boys and girls).

In the first quarter of 2023, the Chipata District Education Board Secretary DEBS recorded a total of 186 female dropped out of school, compared to only 27 boys who dropped out of school. In addition, Chipata District recorded a total of 111 teenage pregnancies in the first quarter of 2023 that contributed to the young girls dropping out of school. The dropout rates were higher among rural schools than schools in urban areas.

Vubwi

Vubwi district has a total of 52 schools of which 8 are secondary schools, 34 primary schools, 10 community schools which serve as the foundation for the district's education system. The district has no tertiary institution. Despite its limited facilities, Vubwi public education services are gradually expanding, with ongoing construction of additional classrooms in schools in an effort to improve accessibility and service delivery to meet the growing needs of its population.

Table 6-4 Education Facilities in Vubwi District

District	Primary Schools	Secondary Schools	Tertiary Institutions	Community Schools	Total
Vubwi	34	8	Nil	10	52

Source: Vubwi District Education Board Secretary Office, 2025

According to the information obtained from the office of the Vubwi District Education Board Secretary (DEBS), a total of 14,930 children were enrolled in primary schools as of January 2025, of which 7,133 (47.8%) were boys and 7,799 (52.2%) were girls.

In terms of secondary enrollment, a total of 2,062 pupils enrolled in secondary schools as of January 2025, of which 1,120 (54.3%) were boys and 942 (45.7%) were girls. It was observed that the progression rate from grade 7 (primary) to grade 8 (junior secondary) and from grade 9 (junior secondary) to grade 10 (senior secondary) was higher for boys than girls in Vubwi District, a trend that is consistent across Zambia. The information obtained from the office of the District Education Board Secretary (DEBS) showed that the progression rate for 2024 from Grade 7 to Grade 8 was

74.2% for boys and 67.5% for girls. From G9 to Grade 10, the progression rate was 73.8% for boys and 50.9% for girls. Teenage pregnancies and early marriages are some of the factors affecting the progression of girls in school.

The following challenges were cited during the survey:

- Inadequate accommodation for the teachers makes it difficult to retain teachers in rural schools.
- Inadequate teaching staff, especially in rural schools.
- Inadequate classroom infrastructure, making classrooms crowded in the face of increased enrolment arising from the Free Education Policy implemented by the Government since 2021.

6.9.2 Literacy Levels

Education and literacy levels are expected to go up after education standards have improved due to the Free-Education policy - i.e. from early childhood to senior secondary - that the Government of the Republic of Zambia introduced some three years ago.

Chipata

According to the 2010 Census Population and Housing, Chipata district literacy rate was estimated at 54.4% of the population compared to the national rate of 70.2%. Nowadays, the literacy level is expected to be higher because more educational infrastructure including primary, secondary schools, and colleges have been built over the last 15 years. The Free-Education policy has encouraged more people to enrol in the school, thereby increasing the literacy levels. In the project area, which is mostly rural, nursery schools, primary and secondary schools are accessible but tertiary and higher education are inaccessible as they are in urban areas.

Vubwi

Vubwi district does not have district-specific literacy statistics but suffice to say the literacy rate is lower than the national average. Vubwi faces challenges such as limited number of schools, long distances to classrooms; shortage of trained teachers and learning materials; poor school electrification and infrastructure. In 2013 an initiative by the Department of Community Development aided to address literacy challenges in the district by training volunteer literacy instructors.

6.9.3 Health

6.9.3.1 Number of facilities

The health sector is among the primary sectors that helps in the reduction of both morbidity and mortality rates and contributes to poverty reduction. This requires more equitable access to quality health services by constructing and rehabilitating health facilities and providing diagnostic equipment.

Chipata

Chipata district has 33 facilities comprising four (4) Hospitals; eleven (11) Health Centres; and eighteen (18) Health Posts.

Table 6-5 Heath Facilities in Chipata District

District	No. of Hospitals	No. of Health Centre's	No. of Health Posts	Total
Chipata	4	11	18	33

Source: Chipata District Medical Office, 2025

The health services provided at these facilities include preventive, curative, promotive and rehabilitative care, including activities like: Information Education Communication, case management, ante-natal, post-natal, family planning, environmental health services, youth friendly health service and cross-border initiative.

Other activities provided in the districts include laboratory services, Elimination of Mother to Child Transmission (MTCT) and HIV Counselling and Testing (HCT), while Anti-Retroviral Therapy (ART) activities are being strengthened by Mwami Hospital, Chipata Central Hospital, Chipata District Hospital, and Kapata Urban Hospital. X-Ray and mortuary services are being offered by Mwami and Chipata General Hospitals.

Vubwi

Vubwi District, like many other rural districts, is characterized by inadequate health facilities and services. Vubwi District has 14 health facilities broken down into one District Hospital, nine (9) Health Posts and four Zonal Health Centers. The unequal distribution of health facilities and services, inadequate staffing, and poor infrastructure, among others, have affected the health sector in the district. The challenge with this distribution of Health facilities is that most people must walk long distances to reach the nearest Health facility. Apart from distance, the other challenge faced is the lack of qualified medical personnel in the health centers, especially those located in the remote rural areas where there is inadequate accommodation such that the health officers must live far away from the health center.

Table 6-6 Heath Facilities in Chipata Vubwi District

District	No. of Hospitals	No. of Health Centre's	No. of Health Posts	Total
Vubwi	1	4	9	14

Source: Vubwi District Medical Office 2025

6.9.3.2 Major Diseases in the Project Area

In terms of disease burden and prevalence in the project area, information from the health centres in the study sites indicate that malaria, diarrhoea, Bilharzia, Upper Respiratory Tract Infections (URTI), Skin Rashes and Sexually Transmitted Infections (STIs), including HIV/AIDS, are the most common diseases in the project area. Vulnerability to HIV/AIDS, TB and malaria has continued to threaten the lives and overall well-being of the population. Malaria vectors are widespread in project sites, especially during the rainy season.

Diarrhoea and bilharzia are attributed to the contaminated water from the unprotected wells and streams. Diarrhoea contributes to the high morbidity and mortality among children under 5 years of age. In addition, people rarely chlorinate or boil their drinking water and water from boreholes is not accessible to most households. A critical consequence of the disease burden has been the presence of relatively high morbidity and mortality among children and women.

Based on UNAIDS Report of 2014, Zambia now has a generalized epidemic, with HIV spreading throughout the population as opposed to being concentrated in specific populations. Adult HIV prevalence was estimated at 13.3% with prevalence in women higher than in men (15.1% compared to 11.3%). However, trends indicate a continuous drop in HIV prevalence at a national level. Provincial prevalence levels range from 7% to 21% (2007).

The following challenges were identified during the socio-economic survey:

- Inadequate funding makes it difficult to implement planned health programmes.
- Inadequate transport for outreach programmes. Ambulances are also inadequate.
- Diagnostic services are inadequate.
- Shortage of health personnel in both urban and rural health facilities.

6.9.4 Water and Sanitation

Chipata

The urban part of Chipata district is serviced by Eastern Water and Sewerage Company Limited which is a parastatal organization charged with the responsibility of providing reliable and high-quality portable water and sanitation services to customers in the district, more especially the urban part of the district.

According to ZamSat (2022), 25% of the people in the district use piped water, 40% borehole, 30% shallow wells while 5% use artisanal wells. Most residents in the villages have no formal sanitary facilities and use pit latrines.

Vubwi

According to Vubwi Integrated Development Plan (IDP) 2022, the district relies heavily on boreholes and hand-dug wells and small piped scheme for water supply. The Local Authority in collaboration with community-based organisations oversee the provision of water and maintenance of water supply facilities and sanitation services in the rural part of the district. In the rural part of the project area, pit latrines and refuse pits are used for the disposal of waste. Additionally, according to Zamsats, 60% use boreholes, 30% shallow wells, 5% artesian well and 5% piped water.

Subsequently, the 2024 socio-economic survey conducted under this project indicated that 56% of the people use boreholes, 33% use artisanal wells while 8% of the population use boreholes, and a paltry 3% use tap water in the Project Area.

Most of the people reported that water sources were close to their places of residence and did not have to walk long distances to fetch water.

Figure 6-1 Borehole at Makwelelo Primary School in Vubwi District

The survey revealed that a staggering 94% of the people rely on pit latrines as their primary method of waste disposal and only 3% of the population utilize sewer wells (septic tank with soak away). Additionally, 2% of respondents employ alternative methods for waste disposal, which may include practices not commonly recognized or documented. A mere 1% indicated having access to a centralized effluent disposal line (sewer system).

6.9.5 Transport and Communication

According to Zambia Information and Communications Technology Authority (ZICTA) 2024 Annual Market Report, as of 2024, Zambia had 3,626 telecommunication towers reflecting ongoing efforts to expand network coverage. Both Chipata and Vubwi have mobile telecommunication services. Both districts are linked to the rest of the country through the road network.

Chipata

The Great East Road (T4) is the primary route from Lusaka and going northeast into Chipata while passing through towns like Chongwe, Rufunsa, Nyimba, Petauke, Sinda and Katete. The Chipata-Mchinji Road going southeast connects Chipata to Malawi and further links to the Nacala corridor for access to the Indian Ocean port of Nacala in

Mozambique. By air, Chipata can be accessed through Chipata airport (CIP) and the Mfuwe International Airport in Mambwe District, about 107 km northwest from Chipata. Chipata is only 35 km from Mwami border post, a key crossing point into Mchinji, Malawi. Public transport is available in the district in form of buses, motorbikes and bicycles.

Chipata is also linked to Mchinji town in Malawi by a 36 km rail line, although it was non-operational at the time of preparing this report. However, the Government of the Republic of Zambia intends to operationalise the rail line in collaboration with the governments of Malawi and Mozambique. The Chipata-Mchinji-Nacala rail line will provide a shorter route to the Indian Ocean for Zambia's imports and exports, thereby boosting economic development in the country.

However, the proposed 400kV Malawi – Zambia transmission power line does not cross the rail line and is more than 6 km away at the nearest.

In terms of telecommunication, Chipata has well-established infrastructure for domestic and international telecommunications services operated by the state-owned Zambia Telecommunications Corporation (Zamtel). Cellular phone services are available via Zamtel and privately owned companies, MTN and Airtel. The public owned Zambia National Broadcasting Service (ZNBC) and private-owned players like Multi Choice, Mr. Strong and Muvi TV provide television services in the project area.

ZNBC and private-owned radio stations, Radio Maria and Breeze Radio Station, provide radio communication in form of news, entertainment, education and other forms of service.

Vubwi

Vubwi has an underdeveloped transport network. The Chipata-Vubwi Road (D804) serves as the primary link between the district and the provincial capital, Chipata. As of 2025 only ten (10) kilometres had been upgraded to bituminous standard with the remaining sections being gravel roads and some of them in deplorable conditions. Many of Vubwi's internal roads remain unpaved and become impassable during the rainy season, hindering access to essential services like schools and clinics. The roads in the district are earmarked for rehabilitation under the Improved Rural Connectivity Project (IRCP), which aims to enhance rural road accessibility across Zambia. Public transport is available in the district in form of buses, motorbikes and bicycles.

In terms of telecommunication, Vubwi has domestic and international telecommunications services operated by the state-owned Zambia Telecommunications Corporation (Zamtel). Cellular phone services are available via Zamtel and privately owned companies, MTN and Airtel. The public-owned Zambia National Broadcasting Service (ZNBC) and private-owned players like Multi Choice, Mr. Strong and Muvi TV provide television services in the project area.

ZNBC and private-owned radio stations, Radio Maria and Breeze Radio Station, provide radio communication in form of news, entertainment, education and other forms of service. Although Radio Maria and Breeze are based in Chipata, their coverage includes Vubwi District.

6.9.6 Electricity and Energy

In the study area, firewood is the most dominant source of energy for heating and cooking, and account for 92% of fuel used in the households in the communities surveyed. Six (6%) indicated that they used charcoal and gas to a lesser extent, and electricity plays a very minor role accounting for only 0.66% of energy used in the study area.

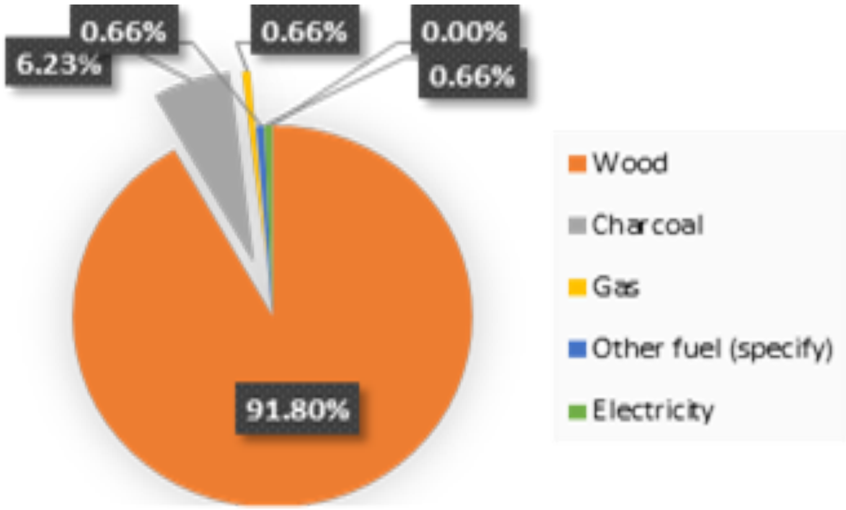


Figure 6-2 Sources of energy used in the project area
Source: GOPA Socio-economic Survey, 2025

Firewood is, therefore, the primary source for cooking and heating in the rural areas, therefore, contributing to deforestation and, climate change. Alternative energy sources need to be introduced in the area to curb deforestation.

Figure 6-3 Use of firewood as a source of energy
Source: GOPA Socio-economic Survey, 2025

6.9.7 Employment

In both Chipata and Vubwi districts, the main source of formal employment is the government which employs teachers, health workers, agricultural workers and other civil servants; Parastatal companies such as ZESCO, Zamtel, NAPSA and Zambia Revenue Authority; Banks such as ZANACO, ABSA, Atlas Mara in Chipata and privately owned companies in various sectors and NGOs.

In the immediate project area, being a rural set-up, farming is the main occupation. During the farming season, from October to February, people are engaged in cultivations to earn some income for their families. After harvesting, most people get involved in agricultural produce trading in Zambia and neighbouring Malawi. Retail trading is a significant form of occupation through the selling of essential commodities. Some people are engaged in commercial charcoal production for sale in Chipata City and Vubwi town. With the increased electricity load shedding, the demand for charcoal has increased in all urban areas across the country. However, measures have been instituted by the Government, in collaboration with traditional leaders, to stop charcoal burning. In Paramount Chief Mpezeni's area, commercial charcoal production is prohibited, and those found selling charcoal are fined.

The socio-economic survey conducted in December 2024 and January 2025 under this project showed that of the 307 participants, 139 respondents, representing 46% of the total participants, are unemployed while 155 (51%) are engaged in various forms of activities to earn an income. Of those who reported to be in some form of employment, 82% are engaged in small-scale farming and 13% in other income generating activities. Meanwhile 1.4% are engaged in casual work such as building construction while 1.9% are involved in seasonal work.

6.9.8 Market Availability of Various Goods

The project area is predominantly rural and people in these areas go to the Central Business District (CBD) located in their respective district centres. However, there are also small grocery shops located within these rural set-ups of the project area where fast moving common consumer goods such as cooking oil, candles, sugar and salt are sold.

Chipata District boasts of large markets such as Kapata Market where locals and visitors purchase fresh farm produce, handmade crafts, traditional textiles and street food. It's a cultural hotspot reflecting the region's agricultural richness. Saturday Market is another big market at town centre where the whole range of agricultural produce is sold (both fresh and dry goods). Mupapa Market is known for traditional Zambian goods offering an authentic shopping experience. It is dotted by modern retail shops like Shoprite, Spar, PEP and Kazulamungu catering for a wide range on consumer needs.

Chipata's economy is predominately agricultural and products such as maize, groundnuts, tomato and meat are sold in the markets.

Vubwi also has open markets and shops where various agricultural goods and groceries and sold and bought. Farmers in both Chipata and Vubwi transport their produce to the markets in town and the community centres in the villages for sale.
According to the 2024/2025 socio-economic survey, out of the 307 respondents, 177 (58%) indicated that they had no difficulty in accessing goods and services, while 129 (42%) reported that they had some difficulty accessing goods and services due to high transportation costs as the markets are far. Further, during focus group discussions, the difficulty to access goods was attributed to inadequate roads meaning the road network in the project area is insufficient and poor in quality.

Of those who indicated that they had challenges in accessing the markets for their agricultural produce, 42% attributed the challenges to the high transportation costs. Twenty-three (23%) mentioned the limited distribution network in the area while another twenty-three (23%) mentioned lack of or poor road infrastructure and the remaining 7% reported lack of entrepreneurial knowledge as the main hinderance to access to the markets for their produce. The absence of a reliable distribution network (channels) for goods and services, including the agricultural produce, was also mentioned as a significant challenge.

These findings resonate with the information obtained from Focus Group Discussions (FGD) that suggested that while there was an extensive road network of feeder roads in some areas, the roads were in poor condition and become impassable during the rainy season. Participants in FGDs and key informant interviews also singled out the major constraints to market access and crop marketing as poor infrastructure like inadequate roads, lack of storage facilities, price volatility due to limited market competition, insufficient access to finance, and a lack of knowledge about market demands, which according to them, often forced farmers to sell their produce at low prices due to limited bargaining power. FGD participants further noted that farmers often lack access to real-time market information regarding prices, demand, and market trends, leading to poor decision-making and potentially selling their goods at unfavourable prices.

The project may benefit from the Compact's road and rural infrastructure work which covers important market routes in Eastern Province and will benefit farmers in districts like Chipata, eg. M12 Chipata – Lundazi segment and D103 and M120 roads covering a distance of 338km.

6.9.9 Cultural Heritage

The archaeological and cultural environment of the project area reflects a deep and diverse heritage that is integral to the identity of the local communities in Chipata and Vubwi Districts, Eastern Province, Zambia. This heritage encompasses historic traditions rooted in the origins and leadership of the Ngoni and Chewa peoples, vibrant cultural practices and sacred sites that shape social cohesion, and archaeological evidence that traces human settlement and technological development from the Stone Age to the Iron Age. Understanding these three dimensions—historic, cultural, and archaeological is essential for appreciating the significance of local heritage resources, safeguarding them from potential project impacts, and ensuring that development activities respect and preserve the communities' tangible and intangible heritage.

6.9.9.1 Archaeological Perspective

The wider area contains significant archaeological sites from the Late Stone Age and Early Iron Age, including Chaingo Hills, Chinjela/Kalemba Hills, Chamfishi, Mkoma Rock Shelter, and Zawi Hill, all with rock paintings depicting prehistoric life. Evidence of early human settlement, toolmaking, pottery, and beadwork dates back over 400 years. **All sites are located more than 6 km from the proposed transmission line corridor.**

The table below shows archaeological sites of national and local significance.

Table 6-7 Location of Archaeological Sites of Local Significance in the Study Area

S/N	Location Name	Resource Type	Key Issue
AC 1	Chaingo Hills	Late Stone Age/Early Iron Age	Rock paintings
AC 2	Chinjela / Kalemba Hills	Late Stone Age/Early Iron Age	Cave with rock paintings
AC 3	Chamfishi	Late Stone Age/Early Iron Age	Cave with rock paintings
AC 4	Mkoma Rock Shelter	Early Iron Age	Rock paintings
AC 5	Rockland Farm	Early Iron Age	Rock paintings
AC 6	Katotola Kopje	Early Iron Age	Rock paintings
AC 7	Thandwe Rock Shelter	Early Iron Age	Rock paintings
AC 8	Zawi Hill	Early Iron Age	Rock paintings

Source. NHCC Heritage Profile 1996

6.9.9.2 Historic Perspective

The project area in Chipata and Vubwi has a rich historical heritage linked to the Ngoni and Chewa peoples. The Ngoni, originating from the Zulu in South Africa, are led by Paramount Chief Mpezeni and celebrate the annual Ncwala Ceremony, a thanksgiving ritual for first fruits. The Chewa, led by Paramount Chief Kalonga Gawa Undi, migrated from the DRC and observe the Kulamba Ceremony, which includes the UNESCO-recognized Gule Wa Mkulu masked dance. Both groups maintain traditions that reinforce identity, leadership structures, and ancestral reverence.

Figure 6-4 Ngoni Warriors Performing during the Ncwala Ceremony in 2024

Figure 6-5 Nyau Dancers in Gule Wa Mkulu Attire
Source: Wahga.com and www.bing.com

Source: Zambia Immigration Portal, picture by Marcus Richards 2024	

6.9.9.3 Cultural Perspective

Cultural resources in the area include graveyards, initiation sites, and performance grounds linked to traditional ceremonies. Fort Jameson Museum located in Chipata showcases historical artefacts and exhibits related to the colonial history of the area. Kapata Market showcases the artisanal talents of local communities offering items like wooden handcrafts and woven baskets.

These sites are valued as links between past and present lifestyles, centers for education and initiation, and symbols of ethnic pride.

Marriage is an important and sacred institution in the project area and young people aspire to get married. Wedding celebrations are held by families when their children get married. Usually, young people must get parental consent before they get married. Divorce is detestable, and the divorce rate is lower in rural areas than urban areas.

In terms of religion, majority of the people in the project area are Christians and have embraced Christian teachings and practices. Common Christian denominations in the project area include Roman Catholic, United Church of Zambia, Baptist, Seventh Day Adventist, Jehovah's Witnesses, etc.

Table 6-8 Cultural and Archaeological Sites in the Project Area

Site Location (Village)	Description	GPS Coordinates E	N	Distance from the centre of OHL	Distance from Chipata West S/S
Kauzu	Graveyard	453470.00	8488024.00	13 meters	2.8Km
Kauzu	Nyau/Gule cultural site	453441.00	8487934.00	114 meters	3.1Km
Pashane	Graveyard	454535.00	8483525.00	606 meters	7.5Km
Chundama	Graveyard	461681.00	8475832.00	747 meters	18.4Km
Yonke	Graveyard	461511.00	8474922.00	1.7 Km	19.3Km
Lufazi	Graveyard	471759.00	8474737.00	1.83 Km	28.7Km
Mpande	Graveyard	475490.00	8470967.00	324 meters	32.34Km
Chikoka	Graveyard	489403.00	8469551.00	544 meters	46.3Km
Chikoka	Initiation area	488716.00	8469713.00	650 meters	46.4Km
Kaunga (Chikoka area)	Nyau/Gule Performing Area.	489091.00	8469660.00	640 meters	46.5Km

Source: GOPA Socio-economic Survey, 2025

It should be noted that the power line has been re-aligned in Kauzu area to avoid the graveyard and cultural ritual site.

6.9.10 Gender and Equity

6.9.10.1 Gender-based Violence

Generally, gender inequalities stem from cultural practices such as early marriage, property grabbing and unequal access to education, with women largely engaged in unpaid domestic and agricultural work while men control most productive resources and income. Limited decision-making power, patriarchal norms, poverty and alcohol abuse contribute to women's financial dependence and vulnerability to Gender-Based Violence (GBV), which commonly takes verbal, physical, financial and emotional forms. Single women, widows and the elderly are particularly at risk, with most GBV cases unreported and resolved through family or traditional structures rather than formal law enforcement.

The GOPA Socio-Economic Survey, 2025, revealed that 63% of the respondents believed there is low incidences of GBV, 16% believed it was moderate, 7% indicated that it was non-existent while the remaining 14% believed that it was high. The perceived low incidences of GBV may be an indication of the overall social and cultural well-being of the community in the project area. However, caution must be taken as studies in the country have shown that incidences of GBV cases seem to be low in rural areas because of gross under-reporting.

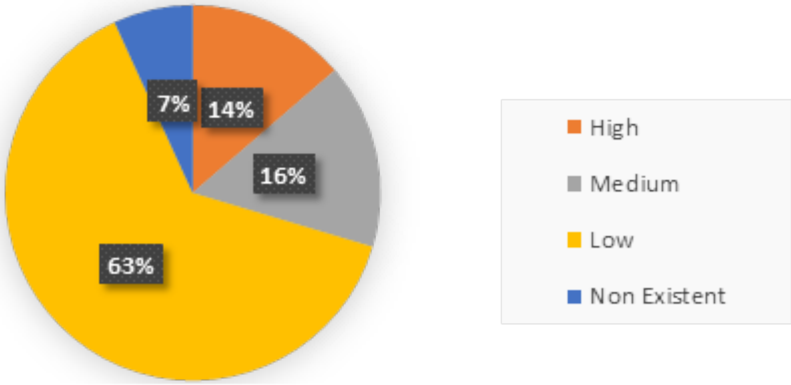


Figure 6-6 Prevalence of GBV in the Community

6.9.10.2 Sexual Exploitation and Harassment

In a large-scale infrastructure project such as the proposed one, a transient, male dominated work force is brought in the project area during construction. The nature of violence related to the influx of foreign workers may include sexual exploitation (e.g. transactional sex for jobs or favours), sexual harassment (verbal, physical, visual) - coercion or abuse of power. Perpetrators may include project staff, supervisors, contractors or security personnel while victims are usually women and girls in surrounding communities or female workers. The drivers for SEAH include, but are not limited to, sudden influx or money and people, weak oversight and reporting mechanisms, lack of gender-sensitive workplace policies, poverty and limited economic opportunities for women.

6.9.10.3 Child Labour

The Children's Code Act No. 12 of 2022, Part II, Sections 13 (1 and 2) of the Laws of Zambia prohibits child labour. The Act states that "A person shall not subject a child to economic exploitation or any work that is hazardous or likely to interfere with the child's education, physical or mental health, spiritual, moral, emotional or social development. The minimum age of a child for the purposes of admission to employment and the number of hours and conditions of employment of a child shall be in accordance with the Employment Code Act, 2019". Part III, Section 16 of The Employment Code Act of 2019 states that "a person shall not, except under prescribed conditions, employ or cause to be employed, a person under the age of fifteen years".

The socio-economic studies conducted earlier in the year showed that there was no child labour in the project area. However, during focus group discussions it was mentioned that children are given simple tasks which are commensurate with their age as part of training to prepare them for adult life. Children are given simple tasks such as sweeping the house, washing their own clothes and cleaning dishes.

6.9.11 Vulnerability Assessment and/or Need for Resettlement and compensation

6.9.11.1 Vulnerability criteria

Under the EIB ESS 7, a vulnerable person or group is anyone who may be disproportionately affected by the project impacts or is less able to access project benefits due to their social, economic, physical or cultural characteristics. The following categories of vulnerability are distinguished.

Table 6-9 EIB Standard 7 Vulnerability Categories

Category	Vulnerable Group	Key Risk Factors
Demographic	Women & Girls (including female-headed households, widows)	Limited land rights, economic dependence, higher GBV risk
	Children & Adolescents	Child labor, school disruption, exploitation

Category	Vulnerable Group	Key Risk Factors
	Elderly Persons	Limited mobility/resources, difficulty adapting to relocation
Socio-Economic	Poor or Landless Households	No secure tenure, loss of livelihood from common resources
	Seasonal & Informal Workers	Unrecognized livelihoods, harder to compensate
	Households with High Dependency Ratios	Increased economic strain when income/livelihood disrupted
Physical & Health	People with Disabilities	Barriers to relocation, access to benefits and services
	Chronically Ill Persons (including HIV/AIDS-affected)	Reduced labor capacity, difficulty adapting to changes
Cultural & Ethnic	Indigenous Peoples / Minority Ethnic Groups	Loss of culturally significant land, risk of marginalization
	Traditional Land Tenure Communities	Lack of recognition in compensation processes
	Communities with Sacred/Cultural Sites	Disturbance or relocation of graveyards, shrines, initiation sites
Social Risk	Migrant / Displaced Populations	Lack of proof of residence, social exclusion
	Households at Risk of GBV	Influx of workers increases GBV risks
	Politically Marginalized Groups	Limited voice in decision-making processes

6.9.11.2 Pre-Project Vulnerability and Compensation

Communities in the project area face pre-existing vulnerabilities, including low income, reliance on subsistence farming, limited access to markets and services, high dependency ratios, and health or disability challenges. The transmission line project adds further impacts, such as loss of land, disruption of livelihoods, relocation, and disturbance of cultural sites, as well as social risks like increased gender-based violence.

To address these combined vulnerabilities, affected households require adequate compensation and resettlement support to restore or improve living standards, rebuild livelihoods, and ensure equitable treatment, in line with Zambian law and international standards (EIB Standards 6 & 7, World Bank ESS5, IFC Performance Standards).

The identified types of vulnerable people include the following:

- Elderly people above 65 years of age.
- Female headed households with a large of children and dependents
- Child-headed households
- Physically handicapped persons
- Widows with large number of children and dependents

For instance, using the Table above, one of the pre-project vulnerabilities identified is lack of income. The findings of the socio-economic survey conducted in the project area revealed that 43% of the households earned a monthly income below K500, 22% earned between K550 and K1,000.00 per month while 11% earned between K1,001 and K2,000 per month. Of the remaining households, 12% earned above K2,000 and another 12% were unable to estimate how much they earned per month.

These findings show the elevated level of poverty prevailing in the project area. About 70% of the households had an average monthly income below the provincial level of K1,307 (USD 0.05) and all the households report an income level below the national average of K3,442 (USD 0.15) according to the 2022 Living Conditions Monitoring Survey conducted by the Zambia Statistics Agency.

According to above national survey, 60% of the Zambian population lived below the national poverty line and there was a significant variation between rural and urban areas. In rural areas, 78.8% of the population lived below the national poverty line compared to 31.9% in urban areas and higher poverty levels were identified among female headed households. In Chipata District 73% of the population lived below the poverty line while in Vubwi District 78.8% lived below the poverty line.

The above amounts are far below the Jesuit Centre for Theological Reflection (JCTR) estimated monthly food and nutrition basket for a family of six at K11,273.00 (USD 405.29) at the time of the study. Income earnings in rural areas are significantly low with many people living below the poverty line[7]. The international poverty line is intended to provide a global comparable threshold of extreme poverty – the minimum resources required for basic subsistence such as food, shelter, clothing in low-income settings.

Zambia is classified as a lower middle-income country by The World Bank. In June 2025, it updated its international poverty line (extreme poverty) to USD 4.20 per person per day. In comparison, this is far higher than the USD 0.05 average monthly income for Zambia and consequently for the communities in the Project area as per the GOPA January 2025 survey findings.

6.9.12 Planned Developments

Chipata

The Chipata-Mchinji-Nacala railway line revitalization is on the drawing board by the Governments of Zambia, Malawi and Mozambique's to enhance connectivity with the Nacala port in Mozambique to boast regional trade and economic integration. Under the Zambia-Farm-Market Compact, the Government plans to rehabilitate the 222km of Chipata-Lundazi-Chasefu Road to bituminous standard. Additionally, the Road Development Agency has commenced improvement works on the Chipata-Lundazi road including heavy grading and installation of drainage structure over a 50-km stretch. The Government has commissioned the Chipata Industrial yard to support the growth of micro, small and medium enterprises focusing on value addition in sector like agro-processing, textiles, carpentry and metal fabrication aiming to promote job creation and economic diversification.

A rent-to-own housing project has been launched by Collins Mutual Limited in partnership with China State Construction and Engineering Cooperation Limited in developing 2,500 housing units on 400 hectares of land in Senior Chief Mzamane's area addressing the housing deficit and promoting affordable home ownership. The Nation Pensions Scheme Authority has empowered 14 women groups with sunflower seed and treadle pumps aiming to enhance women participation in agriculture and improving their economic standing.

In the energy sector, there are plans to extend the electricity distribution network to improve access to electricity services, especially to people in rural areas.

Vubwi

There are several planned developmental activities in Vubwi District. The district has planned to undertake several projects under the Constituency Development Fund (CDF) in various sectors. There are plans to construct a 2x3 classroom block at Mpiru Primary School in Mbozi ward; a maternity annexes at Muzigawa Health Post in Chisiya ward and Matemba Health post in Matemba ward. Further, the construction of a Chief Palace in Mlawe ward is proposed. To improve water supply, a commercial borehole will be drilled and equipped at Likawe Primary School Chipanganje Ward. Furthermore, road infrastructure is also on the drawing board with the proposed acquisition of a bulldozer, excavator and tipper truck to facilitate road maintenance and to improve road conditions. A modern bus-stop and market have been planned and will be undertaken when funds are available.

In the energy sector, there are plans to extend the electricity distribution network to improve access to electricity services, especially to people in rural areas.

To economically empower communities in the District, CDF empowerment loans will be disbursed to Small and Medium Enterprises and cooperatives such as Musaya Agro-business and Joseph Mkunda Farmers Shop. Additionally, cottage industries are also being promoted and supported as part of the development strategy for the district.

[7] JCTR food and nutrition basket

7 Impacts and Mitigation Measures

7.1 Mitigation Hierarchy

According to good practice the management of risks and adverse impacts should be based on the mitigation hierarchy as is required by Environmental Management Act and international standards. This structured way of addressing risks and impacts aims to prevent risks and impacts occurring in the first place. The main steps in this approach can be described as:

- Avoidance: First consider and propose locations for project structures and selection of project technologies and approaches to avoid risks and impacts.
- Minimise: Thereafter, consider and propose project modifications and adaptations, including technological solutions, construction practices and operational procedures, to reduce risks and impacts that cannot be avoided.
- Mitigate: Thereafter, consider and propose mitigation measures to reduce risks and impacts that cannot be avoided or minimised.
- Compensate or offset: Finally, consider and propose potential compensation or offsets where risks and impacts cannot be adequately avoided, minimised or mitigated further, that is, where there are significant residual risks and impacts after the mitigation step in this hierarchy.

Recommendations for adaptations and measures in the mitigation hierarchy should be technically possible and should not make the project economically unviable. The measures should also be effective in meeting intended objectives and they should as much as possible be cost efficient.

Based on the analysis of risks, impacts and opportunities in this ESIA, several measures were identified and assessed to manage risks and adverse impacts in line with the mitigation hierarchy.

7.1.1 Avoidance

Avoidance is the most important and effective means of environmental and social risk management. The proposed project has been able to apply avoidance to a large extent through the alternatives assessment that avoided and minimised physical displacement and avoided impacts on conservation areas and areas of high biodiversity value. This represents the most important risk management decisions and they have already been incorporated into the project design.

7.1.2 Minimise

Minimising risks and impacts has been part of the project design this far and will be undertaken through the specifications developed for the construction contractor and detailed design as well as suppliers of equipment and materials. Contractors, including any sub-contractors, will be required to apply construction methods and equipment that meet national and international standards as well as follow relevant environmental, social, health and safety procedures. Contracts between the client (ZESCO), the main contractor and sub-contractors will include references to ESHS requirements in the national and international requirements and specifically measures in the ESMP.

The construction phase ESMP with specific plans and procedures to manage various risks will need to be detailed by the contractor and approved by ZESCO and the financiers. ZESCO will specify the main requirements for the contractor's ESMP but the detailed ESMP content will be developed by the contractor based on the specific construction methods and equipment that will be used. These specifications of requirements will be important to minimise risks and impacts during construction. Stakeholder engagement and implementing a community grievance management mechanism will also assist in identifying local concerns and addressing these as soon as possible.

For the operations phase, ZESCO will ensure the installed structures are appropriately operated and maintained to ensure the minimisation of ESHS risks as per the project design and specifications. This involves ensuring avoidance of pollution, minimising noise and health and safety risks as well as monitoring performance and managing grievances.

7.1.3 Mitigation

Despite the avoidance and minimising of risks and impacts, there are important mitigation measures that shall be undertaken both during construction and during the long-term operations and maintenance phase. These measures are listed below with further information under the different thematic headings in this section and incorporated into the management and monitoring plans in Section 8.

7.2 Approach and Scope of the ESIA

This chapter presents an evaluation of the potential environmental and socioeconomic impacts associated with the 400kV Malawi-Zambia Interconnector Project. The assessment adheres to globally recognized environmental and social protection standards, including:

- European Union EIA Directive (2014/52/EU): Ensuring comprehensive environmental impact assessments are conducted for projects with significant environmental implications.
- World Bank Environmental and Social Framework (ESF): Providing a framework for managing environmental and social risks and promoting sustainable development.
- European Investment Bank (EIB) Environmental and Social Standards (ESSs): Providing a comprehensive framework for the assessment and management of environmental and social risks and impacts associated with the Project.
- Zambia's Environmental Management Act: Regulated by the Zambia Environmental Management Agency (ZEMA), this act ensures compliance with national environmental laws and regulations.

The impact assessment uses a systematic process that takes into account the following factors:

- The receptor's sensitivity (species, habitats, water bodies, air quality, soils, etc.);
- The potential impact's magnitude (based on its scale, intensity, and duration); and
- The likelihood of occurrence.

The evaluation establishes the overall importance of each impact by combining these factors. The analysis serves as the foundation for suitable mitigation and monitoring strategies by concentrating on important environmental receptors that may be impacted by the project during its construction, operation and decommissioning phases.

An overview of the technical scope of the ESIA (i.e. the resources/receptors to be assessed) is presented in Table 7-1. Further information on the resources/receptors potentially affected by the project activities is provided in Chapters 5 and 6 of the ESIA.

Table 7-1 Technical Scope of the ESIA

Environment	Resource/Receptor
Physical Environment	Ambient Air Quality and Climate
	Noise
	Hydrology and Water Resources (Groundwater and Surface Water)
	Geology and Soil
	Landscape
Biological Environment	Natural Ecosystems (*incl. Habitat, Flora, Fauna*)
Socioeconomic Environment	Economy and Employment
	Land and Livelihoods
	Traffic, Transport as well as social infrastructure and services
	Cultural Heritage
	Labour and working conditions
	Community Health and Safety

The **spatial scope** of this Environmental and Social Impact Assessment (ESIA) varies depending on the nature of the environmental or social receptor. For some environmental components—such as vegetation, soils, and land use—the spatial boundary of the impact assessment is largely confined to the **Project footprint**, particularly the 50 m-wide construction corridor. In contrast, impacts related to air quality, noise, and hydrology may extend well **beyond the immediate construction corridor**, in some cases spanning several kilometres from the source of disturbance, depending on wind direction, topography, and hydrological connectivity.

The **temporal scope** of the assessment covers the three principal phases of the Project lifecycle:

- **Construction Phase:** A sequential process where works at each specific location (e.g., tower site or substation) are typically of short duration—lasting from a few days to several weeks—though the overall construction phase spans approximately 22 months across the full corridor.
- **Operation and Maintenance Phase:** This represents the longest period of project activity. The transmission line infrastructure has a design life of approximately 50 years, with the potential to remain operational for up to 80 years with routine maintenance and periodic equipment replacement. Key impacts during this phase are expected to be minimal but continuous.
- **Decommissioning Phase:** As this will occur far in the future, the nature and magnitude of impacts at that time remain uncertain, though they are likely to resemble those of the construction phase, albeit at a reduced scale and intensity.

Each thematic assessment in the ESIA (e.g., ecology, soil, water quality, social impacts) follows a **resource/receptor-based approach**, structured to include the following:

- Predicted Impacts: An evaluation of the sensitivity of the resource or receptor and the magnitude of the impact prior to the implementation of any mitigation.
- Mitigation Measures: Specific actions proposed to avoid, reduce, or manage identified impacts.
- Residual Impacts: A post-mitigation assessment of significance, classified as Not Significant, Minor, Moderate, or Major based on standard evaluation criteria.

7.3 Methodology for Impact Assessment

7.3.1 Overview

The focus of this section is on the identification of the potential negative and positive impacts of the proposed project on the physical, natural, socio-economic and cultural environment of the project area and on the evaluation of the significance of the identified impacts.

Environmental receptors are the ambient air, the soil, the water resources, the habitats, flora and fauna of the project area. Socio-economic receptors are the individuals, communities, socio-economic / cultural groups in the project area. People or households experiencing direct impacts will be referred to as the Project Affected Households (PAHs). The evaluation of potential environmental and social impacts follows a structured and systematic approach, based on the **magnitude of the potential impact** and the **sensitivity of the environmental or social receptor** affected. It is based on the consultant's views and experience in combination with extensive input from experts in the relevant areas, the respective communities and other stakeholders through surveys and meetings. The impact parameters and evaluation methods are as explained below.

While the impact assessment in this ESIA identifies most impacts as minor to moderate based on magnitude and sensitivity, the World Bank Environmental and Social Framework (ESF) applies a risk-based classification approach.

Considering the nature of the Project (linear, cross-border, involving land acquisition, biodiversity sensitivities, labour influx and cumulative impacts), the overall environmental and social risk may therefore be considered higher (e.g. Substantial).

7.3.2 Impact Magnitude

The magnitude of an impact is a measure of the extent of change in the baseline conditions of the social receptors induced by the Project. The changes experienced by receptors can be positive or negative. The magnitude of the impact may vary according to different parameters as listed in the table below.

Table 7-2 Magnitude Criteria for socioeconomic impacts

Criteria	Description
MAGNITUDE DIMENSIONS	
Intensity/Severity	**Negligible** – there is no perceptible change to resources/people's livelihood **Low** – resources/people/communities are able to adapt with relative ease and maintain pre-impact conditions **Moderate** – resources/people/communities are able to adapt with some difficulty and maintain/regain pre-impact conditions **High** – affected resources/people/communities will not be able to adapt to changes or continue to maintain pre-impact conditions
Geographic Extent	**On-site** – impacts that are limited to the direct area of disturbance (Project footprint) and immediate surrounds **Local** – impacts that affect the area within the Project site **Regional** – impacts that are experienced at a regional scale as determined by administrative boundaries (two districts of Chipata and Vubwi) **National** – impacts that affect a resource that is nationally important/or have macro-economic consequences
Scale	**Negligible** - the number of receptors affected by a particular impact is very low in comparison to the number of receptors in the Project area (less than 1%) **Low -** less than 20% of similar receptors affected by the particular impact **Moderate -** between 20 and 50% of receptors affected by the particular impact **High -** 50% or more of receptors in the Project area affected by the particular impact
Duration/Frequency	**Transient** - impacts are predicted to be temporary and/or intermittent/occasional **Short-term** – impacts that are predicted to last only for a limited period and will cease on completion of an activity e.g. construction period **Long-term** – impacts that will continue for the life of the Project, but cease when the project stops operating **Permanent** – impacts that cause a permanent change for the affected receptor or resource that endure beyond the lifetime of the Project
Likelihood of Occurrence	**Highly Unlikely** - < 5% chance of occurring **Unlikely** - The impact is unlikely to occur or only in a few circumstances (6 - 30%) **Possible** -- The impact may occur sometime during normal conditions (30 - 70% chance of occurring) **Highly Likely:** The impact has a high chance of occurring (70 - 95%) **Certain** - The impact is expected or certain to occur (95 - 100%)
MAGNITUDE GRADING (positive or negative)	
Negligible	An impact that is limited to a specific location within the Project Area, is only temporary or unlikely to occur and/or with no perceptible change to the condition of the receptors
Low	An impact that will affect the conditions, wellbeing or livelihood of a small number of receptors, occurs in exceptional cases or might be detectable but with minor changes to the specific condition assessed, well within accepted standards and limits, mainly within or near the Project Area
Medium	An impact with detectable effect on the specific conditions assessed, resulting in non-fundamental temporary or permanent change, for a moderate number of receptors within accepted standards and limits, within or beyond the local Project Area and/or beyond the Project life
High	An impact that affects a large number of receptors, with fundamental change to the specific conditions assessed resulting in long term or permanent effects, typically widespread in nature, and requiring significant intervention to return to baseline; exceeds accepted standards and limits

7.3.3 Sensitivity of Receptors

Sensitivity of the receptors relates to their vulnerability, measured by the capacity of the resources, individuals, households or communities to cope with the impacts and their resilience to change. Sensitive or vulnerable receptors generally have less means to absorb adverse changes, might take a longer time to adapt to adverse changes, or have more difficulties benefiting from positive changes.

Criteria for determining sensitivity of social receptors are presented in the table below.

Table 7-3 Definition of Sensitivity

Sensitivity of Receptors	Definition
Negligible	A non-vulnerable receptor with good capacity or means to absorb changes, or take advantage of opportunities, within an acceptable time frame
Low	A non-vulnerable receptor with some capacity or means to absorb changes, within an acceptable time frame, or take advantage of opportunities
Medium	A vulnerable receptor with limited capacity and means to absorb changes, or take advantage of opportunities and exceeding an acceptable time frame
High	A highly vulnerable receptor with little or no capacity or means to absorb changes, or take advantages of opportunities and exceeding an acceptable time frame

7.3.4 Determination of Impact Significance

The significance of the impact is thus determined by the interaction between the magnitude of impacts and the sensitivity of receptors for the impact, as shown in the significance matrix below.

Table 7-4 Significance Matrix

MAGNITUDE	SENSITIVITY			
	Negligible	**Low**	**Medium**	**High**
Negligible	Insignificant	Insignificant	Insignificant	Minor
Low	Insignificant	Minor	Minor	Moderate
Medium	Insignificant	Minor	Moderate	Major
High	Minor	Moderate	Major	Critical

The definition of the significance rating is presented in the Table 7-5 below.

Table 7-5 Significance definitions

Significance Definitions	
Insignificant	Impacts are considered to have imperceptible or indistinguishable effects from natural background variations on the receptors or resources. No mitigation measures required
Minor	An effect might be experienced, in particular by vulnerable receptors, or on a wider scale, but the effect is well within acceptable standards and receptors can cope with it. May require some response from the Project
Moderate	An effect within acceptable standards but with concern for medium to highly sensitive receptors or exceeding acceptable standards even for low sensitive receptors. Impact should be actively responded to and managed as might require mitigation
Major	An effect exceeding acceptable standards for a medium to large range of (vulnerable) receptors. Requires mitigation

Significance Definitions	
Critical	Impact severely affects highly sensitive receptors and could influence the decision about whether or not to proceed with the project. Mitigation not possible or may not sufficiently addressing the severity of the impact

7.4 Hazard Risk Assessment

A hazard risk assessment is a structured evaluation process used to identify, analyze and prioritize **potential health and safety risks** associated with construction, operation, and maintenance (O&M) activities. The primary objective is to proactively mitigate occupational hazards, thereby protecting the workforce and ensuring regulatory compliance with national occupational health and safety (OHS) standards.

This process allows project teams, contractors, and supervising authorities to implement preventive and corrective actions to reduce the likelihood of injuries, equipment damage and environmental harm throughout the project lifecycle.

Likelihood and Consequence of Hazards

The **Hazard Risk Assessment Criteria** provides a systematic framework for evaluating occupational and environmental health and safety hazards associated with project activities. This assessment involves two critical components:

Likelihood: The probability that a particular hazard or undesired event will occur.
Consequence: The severity of the potential impact on human health, safety, property, or the environment should the hazard materialize.

Each identified hazard is assessed using these two parameters, and the results are plotted on a **Hazard Risk Assessment Matrix** to determine its overall risk level and prioritize mitigation actions.

Table 7-6 Likelihood Classification

Likelihood	Definition
Frequent	The hazard is continuously or repeatedly present, posing an immediate danger to human health, property, or the environment.
Likely	The hazard is expected to occur during the lifecycle of the project if unaddressed. It may occur one or more times under normal operations.
Occasional	The hazard may occur intermittently if corrective measures are not in place.
Rare	The hazard is unlikely to occur under normal conditions but cannot be entirely ruled out.

Table 7-7 Consequence Classification

Severity	Definition
Catastrophic/Fatal	Results in fatality or permanent disability; imminent threat to life, property, or the environment.
Critical/Major	Serious injury or illness requiring medical diagnosis and resulting in days away from work or hospitalization.
Minor	Injury or health effect requiring medical attention beyond first aid but not resulting in lost workdays.
First Aid	Minimal impact requiring only first aid, with no lost time or serious threat to safety, health or property.

Hazard Risk Assessment Matrix

The **Hazard Risk Assessment Matrix** presented in the Table below is used to determine the **risk level** by intersecting the assigned likelihood and consequence of each hazard. This risk rating guides the prioritization of mitigation measures, ensuring that **high and serious risks receive immediate and effective controls**, while lower risks are monitored and managed appropriately.

Table 7-8 Hazard Risk Assessment Matrix

Likelihood \ Severity	Catastrophic	Critical/Major	Minor	First Aid
Frequent	High	High	Serious	Medium
Likely	High	Serious	Medium	Low
Occasional	Serious	Medium	Low	Low
Rare	Medium	Low	Low	Low

Application and Risk Management

Each identified hazard at the project site is assessed using this matrix. Where hazards are rated as **High or Serious**, immediate attention and the most stringent feasible control measures are applied. Lower-risk hazards (Medium or Low) are managed through routine procedures, training, and periodic monitoring to ensure they remain under control. A revised assessment shall be conducted if site conditions or activities change significantly.

7.5 Ambient Air Quality and Climate

7.5.1 Overview

This section assesses the potential impacts on local air quality as a result of the Project activities, while it also discusses the climatic impacts of the Project, including Greenhouse Gas emissions.

Key potential impacts on ambient air quality during the Project are the following:

Table 7-9 Key potential impacts to Ambient Air Quality

Construction Phase	Operations Phase	Decommissioning Phase
• Temporary impacts on local air quality due to atmospheric emissions during Project construction from earthworks, construction machinery and vehicle movements. Main pollutants emitted will be particulate matter, dust and exhaust gases from machinery.	• Vehicle movements associated with maintenance will be minimal, therefore no key potential impacts foreseen.	• Temporary impacts on local air quality due to earthworks and vehicle movements. Main pollutant emitted will be particulate matter and dust.

7.5.2 Construction phase

7.5.2.1 Dust and PM emissions

During the construction of the proposed project, there will be site preparation and construction activities, all of which have the potential to generate dust. Such emissions can be divided into dust and particulate matter (PM_{10}).

Dust comprises of relatively large airborne particles of material, which are resident in the atmosphere for short periods of time after release, as they are heavy enough to fall out of suspension in the air relatively quickly. Therefore, effects of these emissions will be localized and they do not cause long-term or widespread changes to local air quality but their deposition on nearby properties causes soiling and may therefore result in complaints of nuisance, which is usually temporary.

Depending on wind speed and turbulence during construction it is likely that the majority of dust will be deposited in the area immediately surrounding the source (up to 200 m away). Therefore properties within 200 meters of the construction site are most likely to experience nuisance, without appropriate mitigation measures. A radius of 200 m from the locations of generation of dust and PM emissions is considered the AoI of the project in relation to ambient air quality.

The main sources of dust during the construction and dismantling activities include:

- transport routes, construction vehicle movements and other project related traffic
- soil excavation, handling, storage, stockpiling, spillage and disposal
- site preparation and restoration after completion
- construction of towers and access roads

The majority of the dust emissions are likely to occur during the working hours of construction activity. However, in the instance of exposed soil produced from certain earthwork activities, there is potential for dust generation to occur all day long.

Particulate matter (suspended particles), is released during disturbance of aggregate material in the same manner as dust. However, it is much smaller in size (typically less than 10 micrometers) and it remains suspended in the atmosphere for a longer period and can be transported over a wider area than dust, by wind. It is small enough to be drawn into the lung during breathing, which in sensitive members of the public could cause an adverse reaction. As a result of this potential impact on health, limit value for PM_{10} is defined in national legislation on air quality.

Typical sources of PM_{10} during the construction phase are similar in nature to those for dust. Particulate matter is also released from the running engines of construction machinery, such as compressors, generators, etc. As the magnitude of the PM_{10} emissions is relatively minor, any adverse effects resulting from them are likely to be relatively short-term with minor effects outside the boundaries of the construction sites, meaning that the workers may be most exposed.

Baseline ambient air quality monitoring was conducted from **April 3–11, 2025** at **eleven locations (AQ1–AQ11)** along the project corridor. The data indicated that all measured pollutants, including PM, were within **ZEMA, World Health Organization (WHO), and IFC** air quality standards. However, **slightly elevated levels of PM and TVOC** were recorded at **AQ4, AQ5, AQ10, and AQ11**, which are located near **settlements, farmlands, or areas of cleared vegetation**. These sites are considered more sensitive due to their proximity to human receptors and active land use.

The significance of the impact at receptors closer than 200 m from the construction sites is considered moderate for not favourable climatic conditions, i.e. low precipitation and wind speed > 3m/sec (10.8 km/h) blowing towards the receptor. Although the area is generally windy, with wind speed of 14-17.7 km/h on average during the dry winter season, the wind direction is from east / southeast, and thus no villages or large communities are expected to be affected, with the exception of Chiryauku (see Figure 7-1).

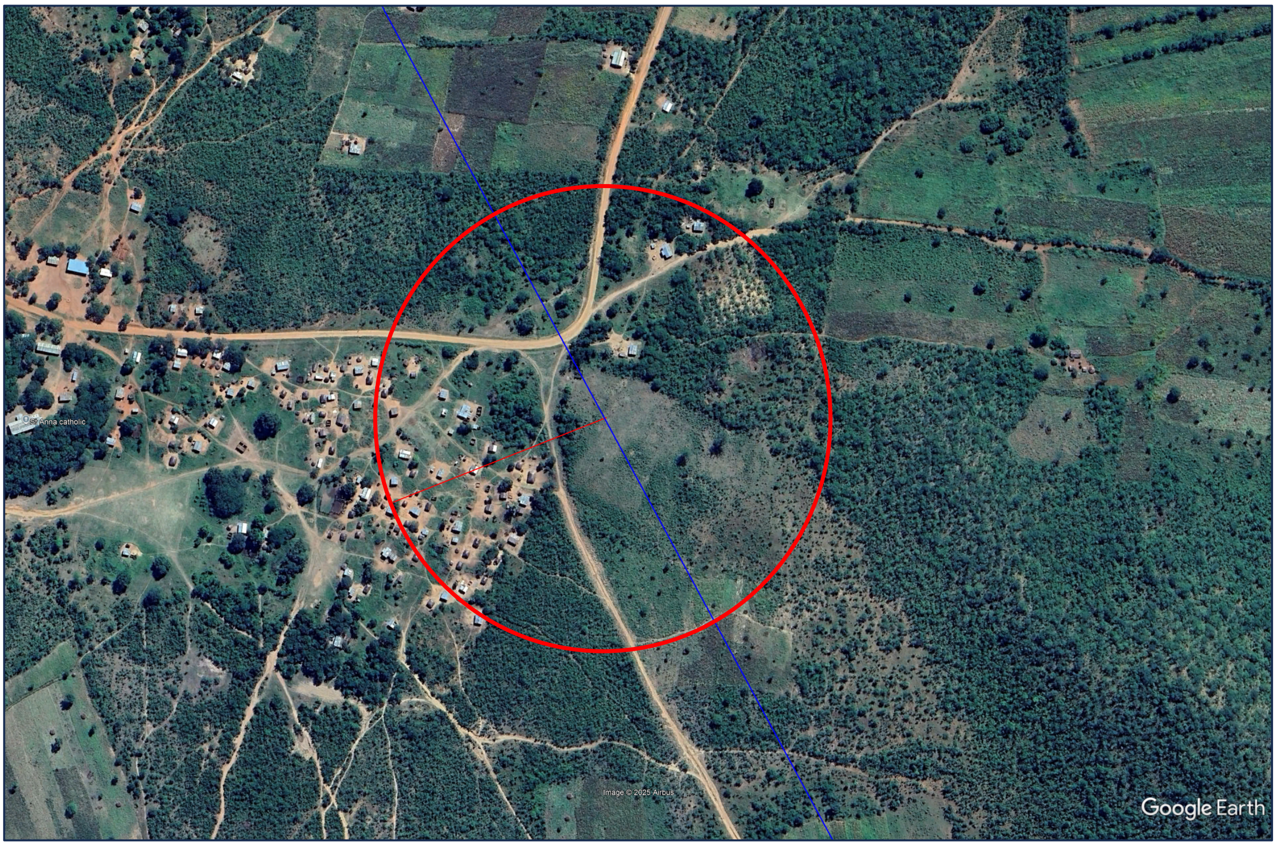


Figure 7-1 Impacts of dust and PM emissions at Pashane Village in Chinyaku area (receptors within 200m from the OHL)

7.5.2.2 Emissions from Vehicles

Construction traffic associated with the proposed project will contribute to existing traffic levels on the surrounding road network. The main pollutants of concern associated with road traffic are NO_2, PM_{10}, CO and TVOC. Of these pollutants, NO_2 and PM_{10} are the emissions most likely to result in exceeding of the relevant air quality standards or objectives.

The greatest potential for impacts on air quality from traffic associated with this phase of the project would be in the areas immediately adjacent to the principal means of access for construction traffic. In construction zones, the dust generated by vehicle movements and local air pollutant emissions from vehicles may be temporarily elevated during the busiest periods of construction activity, however emissions are dispersed, and the magnitude of the impact is minor. Given the low sensitivity of the receptor in the case of the construction sites, impact significance is minor.

7.5.2.3 Mitigations measures

The most effective way to manage and prevent dust and particulate emissions is through effective control of potential sources. Specific mitigation measures designed to ensure that emissions from these sources are minimized are listed below. These measures are specifically related at land clearance, access roads and machinery operations:

- Open excavation areas will be minimized.
- Stockpiling will be minimized by proper coordination of earthworks and excavation activities (excavation, grading, compacting, etc.).
- Reducing fugitive dust emission by applying water sprinkling measures.
- Revegetation of temporarily disturbed areas (e.g., excavation sites) as soon as practical.
- Temporary termination or restriction of construction works if intensive fugitive dust emission occurs, while mitigation measures are put in place. This is particularly the case for works close to Chinyaku village.

- Inspect local roads regularly and clean if necessary
- All construction machinery and equipment will be maintained in good working order and not left running when not in use.
- There will be no burning of any material anywhere on construction sites.
- Drivers will be trained in economical driving, resulting in low vehicle emissions.
- Vehicle speeds will be restricted to 30km/h or less on construction sites and access roads.
- Vehicles carrying aggregate material and workings will be covered at all times.

The measures listed above are good construction practice measures and are designed to ensure that the construction activities do not generate excessive dust or particulate material release.

Implementation of such measures will ensure that no significant dust effects occur during project construction of the proposed project. Further mitigation measures will be developed by the Contractor on a site-specific basis based on a review of the planned construction activities and their proximity to the receptors.

7.5.2.4 Residual impacts

The following table summarises the residual impacts on air quality from project construction.

Table 7-10 Impacts of **dust and PM emissions** during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Moderate	Low
Geographic Extent	Less than 200m from the OHL	Localized
Scale	Low	Low
Duration/Frequency	Short-term	Short-term
Likelihood	Likely	Unlikely
Magnitude	Medium	Low
Sensitivity	Medium	Medium
Significance	Moderate	Minor

7.5.3 Operation and Maintenance Phase

During the operation and maintenance phase of the Malawi–Zambia 400kV Interconnector, air quality impacts are expected to be minimal, as the infrastructure is passive in nature and does not generate emissions during normal operation. Routine maintenance activities are generally infrequent, short-term, and localized, and therefore pose low air quality risks. **Impacts significance is negligible**.

7.5.4 Decommissioning Phase

It cannot currently be foreseen how exactly the project infrastructure will be decommissioned in a few decades from now. In case all parts of equipment, foundations and towers are removed, similar ambient air impacts from ground works along the OHL line as for construction, although it is likely that the environmental and socioeconomic baseline will also be different.

Residual impacts will be similar in nature to those that arise during construction. Similar mitigation measures anticipated for the construction phase with regards to dust generation will apply.

7.5.5 Climate-related impacts

7.5.5.1 Impacts of the project on climate change

The contribution of electricity transmission to climate change has been the subject of a number of studies. The following classification of climate-related impacts are generally identified:

- Embodied emissions from construction materials
- Energy use in construction
- Land-clearing emissions
- Sulphur hexafluoride (SF6) fugitive emissions from electrical equipment where SF6 is used for insulation
- Technical loss reduction (positive)
- Increased reliability (positive)

The impacts are generally negative but are far outweighed by the potential of electricity grids to transfer the ever increasing generation of renewable energy sources to energy deficit areas, as well as the major social benefits related to electrification or the increase of reliable electric power to rural areas. In developing countries, development in electricity transmission is considered key to tackling climate change[8].

7.5.5.2 Impacts of climate change on the project

Climate change and its manifestations may have a number of impacts on transmission infrastructure:

- **Rising temperatures**: High temperatures decrease the operational efficiency of transmission lines and transformers. Heatwaves and sustained high temperatures modify electricity demand patterns and may lead to overloading of the transmission network
- **Increase in the frequency and duration of droughts** increases the probability of wildfires and facilitates the accumulation of particulate matter on insulators, thereby increasing the risk of short-circuits.
- **Increase in the frequency and intensity of high winds** can lead to structural damage or cause the collapse of transmission line towers.
- **Increase in the magnitude and duration of extreme precipitation** may lead to flood events. Landslides and flooding can cause damage to transmission infrastructure

According to the Climate Risk Profile of Zambia, issued by the Federal Ministry for Economic Cooperation and Development of Germany[9], Zambia is expected to experience the following climate changes, based on the climate change scenarios examined (called Representative Concentration Pathways, RCPs. RCP2.6 represents a low emissions scenario that aims to keep global warming likely below 2°C above pre-industrial temperatures; RCP6.0 represents a medium to high emissions scenario that is likely to exceed 2°C):

- Temperature in Zambia is projected to rise by between 1.8 and 2.0°C by 2030 and up to 4.3°C by 2080, compared to pre-industrial levels. Higher temperatures and more temperature extremes are projected for the western part of the country
- Precipitation trends are uncertain and characterised by high inter-annual variability: Under RCP2.6, precipitation is projected to rise earlier in the century, reaching a peak around the year 2030 and slowly declining afterwards. Projections under RCP6.0, however, point to an overall decreasing trend towards the end of the century, indicating no clear trend in precipitation. Nevertheless, future dry and wet periods are likely to become more extreme.
- heavy precipitation events are expected to become more intense due to the increased water vapour holding capacity of a warmer atmosphere. At the same time, the number of days with heavy precipitation events is expected to increase. The data shows an increase in the number of heavy precipitation days for both RCPs, with a difference of 8.3 days under RCP2.6 and 9.3 days under RCP6.0 by 2080.

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[8] Embracing power transmission key to tackling climate change | World Economic Forum
[9] GIZ_Climate-Risk-Profile-Zambia_EN_final-1.pdf

Climate change trends are taken into account during the engineering design of the OHL. Emergency Response Plans (ERP) will need to be developed by the Contractor (for the construction phase) as well as ZESCO (during operation) to ensure that climate-related phenomena (i.e. extreme rainfall, extreme winds, heat waves, flooding events, wildfires, etc.) are taken into account.

7.6 Noise

7.6.1 Overview

This section assesses the impacts on the acoustic environment of the study area that may arise from the construction, operation and decommissioning phases of the Project.

During construction, sources of impact are related to machinery noise emissions that have an effect on the area adjacent to the working sites. Noise sources in this phase will be temporary in nature and depend on the number and type of machinery used for each activity. The noisiest activities during construction will predominantly be concentrated at areas that require hammering for the earthworks related to civil works for tower installation, cable tranches, substation works. Heavy civil works (i.e. hammering and blasting and piling foundations for the towers and HV equipment) also have the potential to generate vibrations.

Key potential impacts on the acoustic environment during the Project are the following:

Table 7-11 Key potential impacts to Acoustic Environment

Construction Phase	Operations Phase	Decommissioning Phase
• Disturbance of nearby settlements from working sites (earthworks, towers and equipment installation, piling activities) or from transportation of equipment and machinery • Potential for sleep disturbance; day and night-time nuisance and potential stress from construction activity noise	• No significant impacts foreseen	• Disturbance of nearby settlements from working sites or from transportation of equipment and machinery • Potential for sleep disturbance; potential stress from decommissioning activity noise

7.6.2 Construction Phase

7.6.2.1 Potential impacts

Construction of the OHL will involve a range of activities with the potential to **temporarily elevate ambient noise levels**, including:

- **Vegetation clearance** using chainsaws, slashers, or bulldozers;
- **Excavation and foundation works** using backhoes, concrete mixers, and compactors;
- **Material transport and delivery** via heavy-duty trucks and low-loaders on unpaved access roads;
- **Operation of cranes**, generators, and other mechanical equipment during tower assembly.

These activities can generate **sustained noise levels ranging from 75 to 90 dB(A)** at source. The table below gives an overview of the noise levels at reference distance of 16 m from the source from various machines that are most frequently used in construction. The values in the table are based on data from literature.

Table 7-12 Noise levels from construction equipment

Noise during construction	Level of noise (dBA) at 16 m from the source
Compressor	81

Noise during construction	Level of noise (dBA) at 16 m from the source
Excavator	80
Compactor	82
Concrete mixing	85
Pump for concrete	82
Vibrator for concrete	76
Crane	88
Mobile crane	83
Bulldozer	85
Generator	81
Machine for flattening	85
Circular saw (metal cutting)	76
Woodcutter	84
Truck loader	85
Truck	88

Source: **FHWA (Federal Highway Administration):** *Construction Noise Handbook*

In general, noise levels drop fast with the distance from the source, while they are also affected by potential noise barriers between the source and the receptors. The table below presents noise predictions for different individual construction processes based on information available in relevant literature as well as in studies undertaken for substation and transmission line developments of similar size. These predictions represent a worst-case scenario as they do not consider eventual noise barriers or air absorption. It is likely that natural or man-made barriers would exist between the source and the noise-sensitive receptor particularly as distance from the source increases. Such barriers may consist of natural features in the landscape or other buildings or structures between the source and the receptor.

Table 7-13 Noise propagation for construction processes

Distance from the source [m]	Construction of vehicular access to tower sites and substation	Civil works at construction of tower foundations	Metal structures at tower assembly and erection	Electrical installations
0-50	≤76	≤77	≤68	≤70
50-100	≤69	≤70	≤62	≤63
100-200	≤62	≤63	≤56	≤56
200-400	≤55	≤56	≤50	≤48
400-600	≤51	≤52	≤46	≤44
600-800	≤48	≤49	≤43	≤41
800-1,000	≤46	≤46	≤41	≤39

For the past few years, ZEMA is working on developing noise standards for different kinds of receptors and time of day. The currently applicable daytime noise limit is 85 dB(A). In the absence of specific noise limits, the project is using the IFC EHS Guidelines (IFC EHS Table 1.7.1).

Table 7-14 Noise limit values as per WB EHS Guidelines

Receptor	One Hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

Table 7-13 demonstrates that the noise generated by construction activities tends to diminish as we move further away from the source, and **reaches acceptable levels (daytime) at a distance of approx. 300 m**. This distance is considered the area of influence for noise impacts.

It needs to be noted, however, that the noise effects predicted at any location are unlikely to be present at a consistent level throughout the entire construction period due to the discontinued nature of construction activities in terms of locations (such as foundation at tower locations). This is particularly true of 'linear' activities such as access road upgrading, and the conductor stringing where relatively high noise levels could potentially occur in the immediate vicinity of any works, but with noise levels soon returning to normal as the work moves on.

With regard to vibrations, it needs to be noted that people's reaction to vibrations is subjective and differs for different people. It is generally accepted that for the majority of people, vibration levels in excess of between 0.15 and 0.3 mm/s peak particle velocity are just perceptible. The table below presents distances at which vibration may be perceptible for certain type of construction activity. These figures are based on historical field measurements and construction practice.

Table 7-15 Distances at which vibration may be perceptible

Construction activity	distances at which vibration may be perceptible, [m]
Excavation	10-15
Vibratory compaction	10-15
Heavy vehicles	5-10

It may be concluded that it is highly unlikely that vibration from the construction of the proposed overhead transmission line would be perceptible.

Identification of sensitive receptors

A number of residential properties have been identified closer than 300 m from the OHL centerline, and are thus considered sensitive to noise emissions:

1. A few houses close to Chipata West SS

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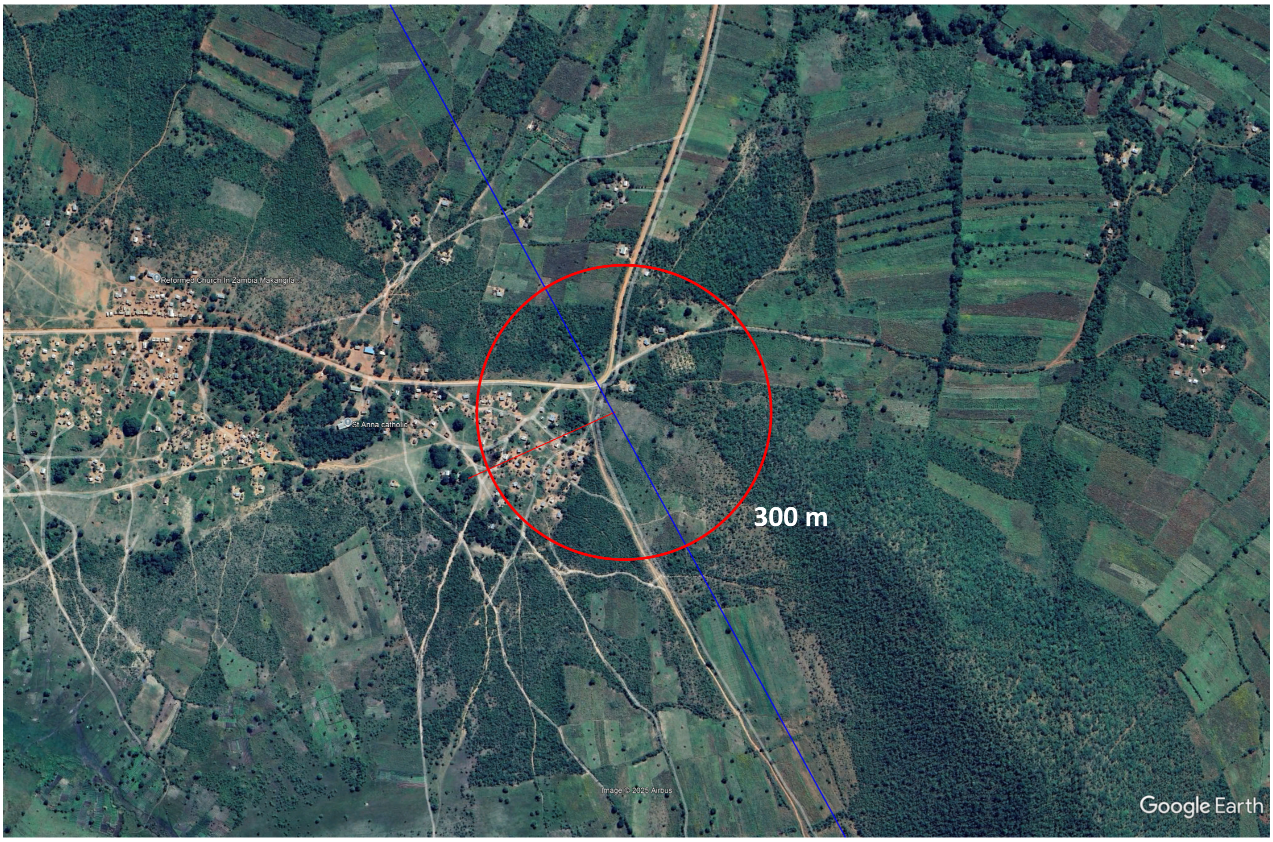
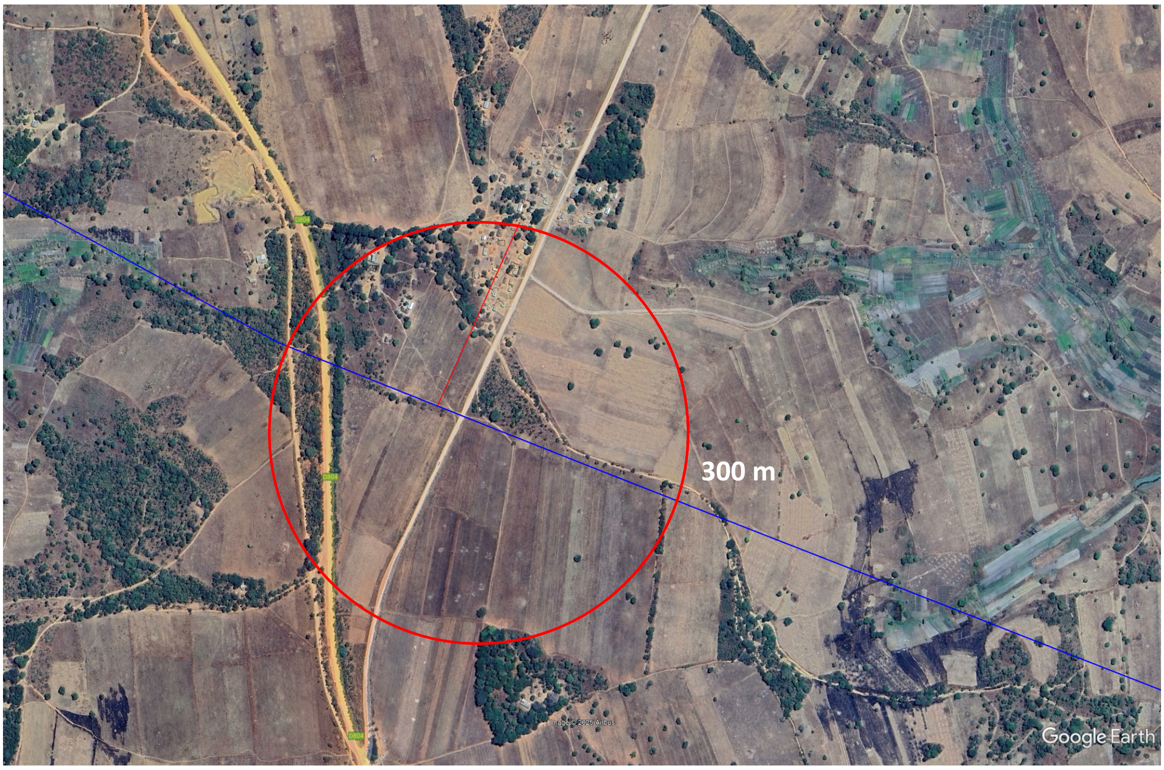
2. Houses approx. 1 km south of crossing of T4

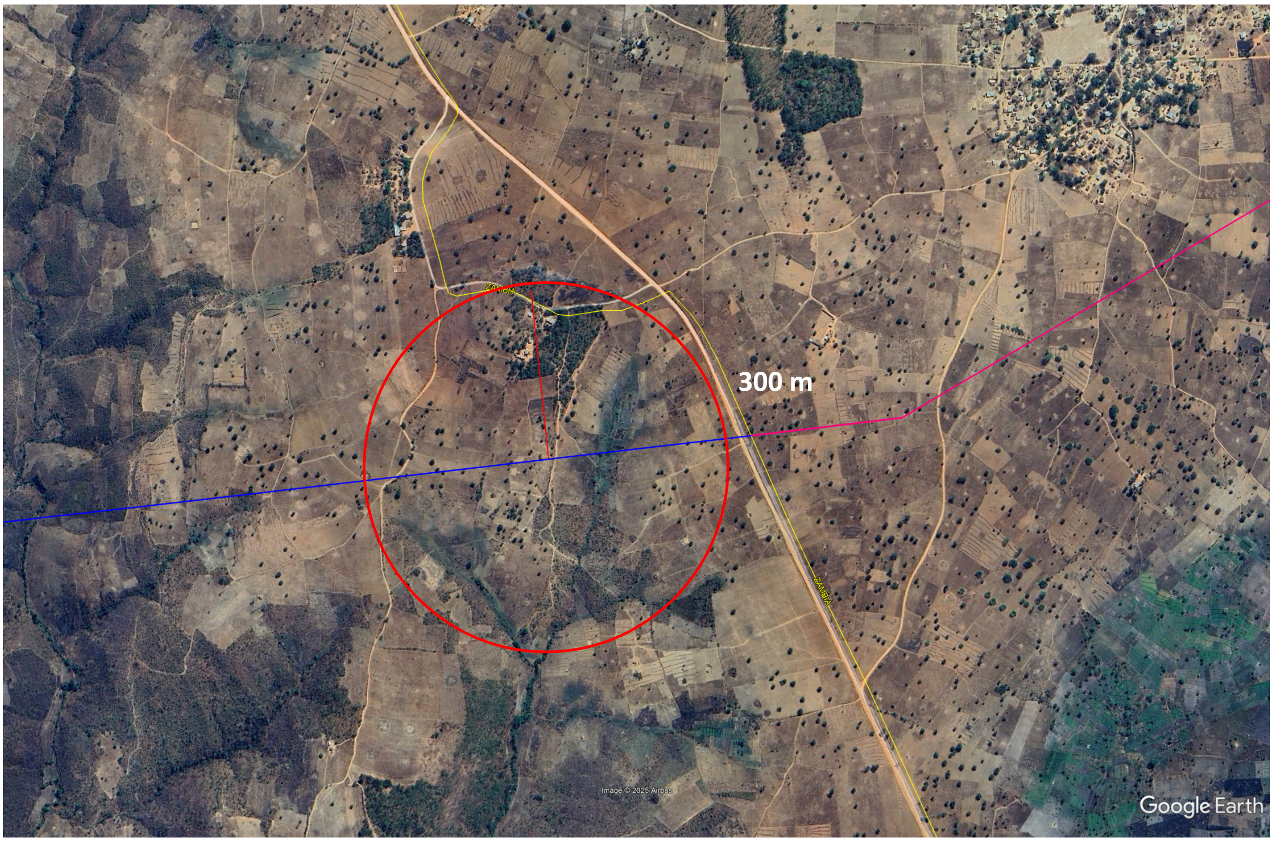
3. Houses of Pashane Village in Chinyaku settlement



4. Houses of settlement after crossing with D804 in Feni Area



5. Houses before border crossing



These sensitive receptors, located less than 300m from the OHL, are considered of medium sensitivity. The impacts are generally temporary and short-term for each specific location, therefore impact magnitude is medium and impact significance is moderate.

7.6.2.2 Mitigation measures

To manage and minimize noise impacts during construction, the following mitigation measures shall be implemented:

- **Use well-maintained machinery and vehicles**, fitted with appropriate mufflers or silencers;
- **Limit simultaneous operation** of multiple high-noise equipment within close proximity;
- **Restrict construction to daytime hours (07:00–18:00)** and **avoid night-time operations**, unless explicitly approved and justified;
- Notify local communities in advance of **high-noise operations**, particularly those near sensitive areas.
- Use **temporary noise barriers** (e.g., earth berms, plywood panels, or acoustic screens) around high-sensitivity receptors where construction is unavoidable.
- Carry out **periodic noise monitoring** at sensitive locations, especially NSP2, NSP3 and NSP7, to verify compliance with ZEMA and WHO guidelines;
- Establish a **grievance mechanism** to receive and respond to community complaints related to noise and vibration.

With these mitigation measures in place, the **residual noise impacts are expected to be of low intensity, temporary, localized, and reduced to *minor* significance**.

7.6.2.3 Residual impacts

The following table summarises the residual impacts on noise from project construction.

Table 7-16 Impacts of **noise** during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Moderate	Low
Geographic Extent	Less than 300m from the OHL	Localized
Scale	Low	Low
Duration/Frequency	Short-term	Short-term
Likelihood	Likely	Unlikely
Magnitude	Medium	Low
Sensitivity	Medium	Medium
Significance	Moderate	Minor

7.6.3 Operation and Maintenance Phase

During operation phase, minor noise emission can be expected from the transmission line due to the corona effect.

Corona is a phenomenon associated with all energized transmission lines. Under certain conditions, the localized electric field near an energized conductor can be sufficiently concentrated to produce a tiny electric discharge that can ionize air close to the conductors. This partial discharge of electrical energy is called corona discharge, or corona.

Several factors, including conductor voltage, shape, and diameter, and surface irregularities such as scratches, nicks, dust, or water drops, can affect a conductor's electrical surface gradient and its corona performance. Corona is the physical manifestation of energy loss and can transform discharged energy into very small amounts of sound, radio noise, heat, and chemical reactions of the air components. Corona is well understood by engineers, and steps to minimize it are a major element in the design of high-voltage transmission lines (220-400 kV). In general, the corona effect will not generate noise above the WB EHS Guidelines outside the OHL wayleave.

7.6.4 Decommissioning Phase

It cannot be foreseen today which decommissioning approaches will be taken at the time of decommissioning, but ZESCO is committed that this will be state-of-the-art at the time when it occurs.

It is expected that similar equipment, machinery and vehicles will be used during Project decommissioning as used for Project construction and similar noise impacts will occur from the associated activities.

7.6.4 **Resource Efficiency and Greenhouse Gas (GHG) Emissions Assessment (ESS3 Compliance)**

(Including Chipata West Substation Extension)

Introduction

In line with **World Bank ESS3: Resource Efficiency and Pollution Prevention and Management**, World Bank (2017). *Environmental and Social Framework (ESF)*, European Investment Bank (2022), *Environmental and Social Standards (ESS)*, Intergovernmental Panel on Climate Change (IPCC) *2006 IPCC Guidelines for National Greenhouse Gas Inventories,* this section presents a **quantified assessment of resource requirements and associated greenhouse gas (GHG) emissions** for both:

- The **46.6 km, 400 kV transmission line**, and

- The **Chipata West Substation extension**, located at the starting point of the interconnector.

The objective is to:

- Quantify key construction inputs (aggregates, water, fuel, materials);
- Assess associated environmental pressures;
- Estimate construction-related GHG emissions; and
- Provide a basis for mitigation, monitoring, and reporting under the ESMP.

Project Components Considered

The assessment covers the following components:

Transmission Line

- 46.6 km, 400 kV overhead line
- 117 towers (400 m spacing)
- Wayleave width: 50 m

Chipata West Substation Extension

- Line and transformer bays
- Busbars, transformers, and switchgear
- Control, protection, and metering systems
- Auxiliary AC/DC systems
- Civil infrastructure including foundations, drainage, oil containment systems, control building, and fencing

Basis of Estimation

Parameter	Value
Line length	46.6 km
Tower spacing	400 m
Number of towers	117
Construction duration	22 months
Substation extension	One facility (Chipata West)

Engineering assumptions:

- Tower concrete volumes:
    - 60 m^3 (suspension towers)
    - 90 m^3 (tension towers)
- Substation concrete (foundations, bunds, buildings): approximately **2,500 m^3 (planning estimate)**
- Cement content: 350 kg/m^3
- Water demand: 480 L/m^3 concrete
- Diesel emission factor: 2.68 kg CO_2e/L
- Cement emission factor: 0.85 t CO_2e/t

Resource Efficiency Assessment

Concrete and Aggregates

Transmission Line + Substation Combined

Resource	Unit	Quantity
Concrete (transmission line)	m^3	7,890

Concrete (substation extension)	m^3	2,500
Total concrete	**m^3**	**10,390**
Cement	tonnes	3,636.5
Sand	tonnes	7,792.5
Coarse aggregate	tonnes	11,429.0
Total aggregates	**tonnes**	**19,221.5**

Interpretation

Approximately **19,200 tonnes of aggregates** will be required, reinforcing the need for:

- Strict **supplier screening and licensing compliance**;
- Controlled use of **borrow pits and quarries**;
- Mandatory **rehabilitation of extraction sites**.

Water Demand

Water Use Category	Quantity (m^3)
Concrete works (line + substation)	4,987.2
Dust suppression	5,720.0
Camp/domestic use	1,430.0
Substation-specific works (curing, cleaning, testing)	500.0
Total water demand	**12,637.2**

Total water demand is estimated at approximately **12,637 m^3** over the construction period. Substation works contribute additional demand through:

- Concrete curing;
- Equipment installation and cleaning;
- Civil works activities.

Water abstraction will be limited to **approved sources**, through the Water Resources Management Authority (WARMA) with strict avoidance of sensitive water bodies.

Fuel Consumption

Diesel Consumption Estimation (Construction Phase)

Diesel consumption for the construction phase has been estimated at a planning level, consistent with standard ESIA practice, using a combination of activity-based engineering assumptions and scaled analogues from comparable transmission line and substation projects.

For the transmission line component, fuel demand associated with tower construction activities—including foundation works, concrete placement, tower erection, and conductor stringing—was derived by scaling activity-based estimates in proportion to the revised tower configuration, based on a 400 m spacing along the 46.6 km corridor. In addition, diesel use associated with site vehicles, supervision, and temporary power generation was estimated based on the total 22-month construction duration. This results in an estimated diesel consumption of approximately 80,329 litres for the transmission line works.

For the Chipata West Substation extension, a provisional allowance of 15,000 litres has been included to account for diesel use associated with site preparation, earthworks, concrete works, structural steel erection, equipment installation, and construction-related transport and auxiliary power requirements.

The total estimated diesel consumption for the construction phase is therefore approximately 95,329 litres.

These estimates are indicative and appropriate for ESIA-level assessment, and will be further refined during the detailed design phase and contractor mobilization, based on finalized construction methodologies, equipment deployment schedules, and site-specific operational parameters.

Activity	Diesel Use (Litres)
Transmission line construction	80,329
Substation construction works	15,000
Total diesel consumption	**95,329**

The substation extension contributes additional fuel demand due to:

- Heavy civil works;
- Equipment installation;
- Transport of transformers and steel structures.

Greenhouse Gas (GHG) Emissions Assessment

Methodology

Formula: Emissions = Activity data x Emission factor

Construction Emissions

(a) Diesel Combustion

95,329 x 2.68 = 255.5t CO_2e

(b) Cement Embodied Emissions

Cement production is a significant source of greenhouse gas emissions due to both process-related emissions from limestone calcination and energy-related emissions from kiln operations. For the purpose of this assessment, an emission factor of 0.85 t CO_2e per tonne of cement has been applied, consistent with international benchmarks (IPCC, IFC). Based on estimated cement consumption of approximately 3,636.5 tonnes, total embodied emissions are estimated at approximately 3,091t CO_2e. This represents the dominant source of construction-phase emissions. Opportunities to reduce embodied emissions will be explored during detailed design and procurement, including the use of blended cement, optimization of concrete volumes, and sourcing from environmentally compliant suppliers.

3,636.5 x 0.85 = 3,091.0t CO_2e

Source	Emissions (t CO_2e)
Diesel combustion	255.5
Cement production	3,091.0
Subtotal	**3,346.5**

Land Clearing Emissions (Transmission Corridor Only)

Source	Emissions (t CO_2e)
Vegetation clearing	2,169.3

Total Indicative GHG Emissions

Component	Emissions (t CO_2e)
Construction (fuel + materials)	3,346.5
Vegetation clearing	2,169.3
Total	**5,515.8**

Substation-Specific Resource and Pollution Considerations

The Chipata West Substation introduces additional ESS3-relevant considerations:

- **Transformer oil management**, including bunded containment and spill prevention;
- Use of **SF_6 gas in switchgear**, requiring leak detection and recovery systems;
- Generation of **hazardous waste** (oils, chemicals, maintenance waste);
- Increased **impermeable surfaces**, requiring drainage and stormwater management.

These aspects are addressed through:

- Hazardous Materials and Waste Management Plan (HMWMP);
- Oil containment systems (bund walls, oil pits);
- Pollution prevention and emergency response measures.

Climate Change Context and Project Benefits

Despite the construction-phase emissions, the project will deliver **long-term climate benefits**, including:

- Enabling **cross-border power trade** within SAPP;
- Supporting integration of **renewable energy sources**;
- Reducing reliance on **biomass fuels (charcoal/firewood)**;
- Improving **grid stability and efficiency**, reducing transmission losses.

Mitigation and Resource Efficiency Measures

Materials

- Source aggregates from **licensed suppliers only**;
- Optimize design to minimize material use;
- Reuse and recycle materials where feasible.

Water

- Use **approved abstraction sources**;
- Implement water conservation practices;
- Avoid contamination of surface and groundwater.

Fuel and Energy

- Use efficient, well-maintained equipment;
- Optimize transport logistics;
- Minimize idle time.

Substation Controls

- Install **oil containment systems**;
- Implement **SF_6 leak detection and recovery**;

- Manage hazardous waste through licensed disposal.

Monitoring and Reporting

Parameter	Indicator
Fuel use	Litres/month
Water use	m^3/month
Material consumption	Tonnes
GHG emissions	t CO_2e (estimated)
Supplier compliance	% licensed suppliers
Substation pollution control	Spill incidents, SF_6 leakage rates

Monitoring will be undertaken by the **Contractor**, supervised by the **CSC**, and overseen by **ZESCO**.

7.7 Hydrology and water resources

7.7.1 Overview

This section assesses the impacts on water resources at the study area that may arise from the construction, operation and decommissioning phases of the Project. An early dry season baseline assessments conducted at six water bodies, namely the Chibila Stream, Mwami Stream, Choli Stream, and Lutembwe River, revealed generally **favourable water quality conditions** in terms of pH, Electrical Conductivity (EC), Dissolved Oxygen (DO), and Total Dissolved Solids (TDS). These parameters indicate **healthy aquatic systems** capable of supporting aquatic life.

However, turbidity levels at **Nyongo Stream** and **Lubwe River** exceeded the ZABS threshold, suggesting **pre-existing sedimentation stress** and a heightened sensitivity to further disturbance. These streams, along with others in the corridor, provide critical ecosystem services, including fish habitat, invertebrate support, and water supply for nearby communities.

During project construction, any activities in rivers, river banks or streams of permanent flow will be avoided. However, a number of key potential impacts remain, as shown in the table below.

Table 7-17 Key potential impacts to Hydrology

Construction Phase	Operation Phase	Decommissioning Phase
• Effects on surface water from sediment plumes caused by earthworks • Accidental pollution of freshwater resources by solid, liquid wastes, mineral oils and hydrocarbon/ fuels • Effects on the existing water regime of watercourses	• Accidental pollution of freshwater resources by solid, liquid wastes, mineral oils and hydrocarbons/fuels.	• Effects on surface water from sediment plumes caused by earthworks • Accidental pollution of freshwater resources by solid, liquid wastes, mineral oils and hydrocarbon/fuels

7.7.2 Construction phase

7.7.2.1 Potential impacts

During the construction phase, a variety of activities pose **short- to medium-term risks** to hydrology and water resources, particularly during the rainy season when surface runoff is intensified. Key impact pathways include:

- **Vegetation clearance** within the 50-meter wayleave, reducing soil stability and increasing sediment runoff into nearby streams and rivers;
- **Excavation works** for tower foundations and access road development, leading to direct soil disturbance and potential sediment mobilization;
- **Stormwater runoff** from exposed construction sites, which may carry fine sediments, hydrocarbons, cement residues, and other pollutants into adjacent water bodies;
- **Accidental spills or leaks** of oils, fuels, lubricants, and concrete wash water, which can introduce harmful substances into aquatic environments;
- **Uncontrolled access across streams**, which may result in bank destabilization, sedimentation, and aquatic habitat degradation.
- **Poor sanitary facilities** at workers camps, potentially resulting in wastewater and sewage discharges that may contaminate surface water and/or groundwater and degrade local water quality.

7.7.2.2 Dewatering and sediment plumes due to earthworks

Potential impacts to surface and ground waters may result from earthworks outside but near the watercourses, due to the following:

- Topsoil and other earth materials will be stripped from construction sites and tower locations and stored to the side. These may become entrained by rainwater during heavy rainfall and subsequently increase the turbidity of neighboring streams and eventually the major watercourses which exists in the project area. Without the implementation of good practice mitigation measures, during times of heavy rainfall, depending on the vicinity to a watercourse (with flow) **potential impacts of moderate significance** could occur to surface water quality. This is judged based on the relatively localized nature of the impact but considering the significant degree of change that sediment will make to a surface water body and the potential secondary impacts that this will have to aquatic life.
- In some wet areas or areas of high water table, it will be necessary to dewater the foundations during tower installation for the OHL. De-watering allows safe construction by preventing ground collapse and allowing bottom (bedding) inspection prior to installing tower foundations. The process of dewatering is continued until construction is completed. The groundwater removed will be discharged into available ditches, irrigation channels, watercourses or to pre-agreed areas of land with permission of the relevant Authority.
- During the construction it is necessary to take into account the existing and planned water facilities and the natural and artificial river bed in a way that will ensure the protection of their stability, the protection of the water regime and implement measures protection of water from pollution, as well as arrangement and use of water

The drawdown of groundwater is expected to be localised and limited in scope, as the groundwater table was found to be at 10 mbgl and deeper. In any case, the groundwater levels will normalise rapidly on cessation of pumping. The consequences of the dewatering to groundwater availability, due to the limited time of dewatering, are considered minor. Dewatering will also have minor consequences to groundwater quality. Therefore, **the significance of the potential impact to groundwater is considered minor**.

Secondary impacts to surface water quality associated with the discharge of waters (from dewatering or run-off or erosion from dewatering) could occur due to sediment content or historic contamination. However, given the nature of the land within the project area it is unlikely that any existing contamination is encountered. As a consequence, due to the low likelihood of existing contamination, the minor magnitude of the impact and the low sensitivity of the receptor, **minor significant impacts are predicted**.

7.7.2.3 Accidental pollution

Accidental pollution of water resources by solid, liquid wastes, mineral oils and accidental spill of hydrocarbon/ fuels, can occur through the following construction activities:

- Production and disposal of solid and liquid wastes. Wastes generated during construction are classified into the following four categories: inert (without risk of pollution), domestic (to be transported to a controlled municipal waste disposal site), oily and hazardous (to be segregated for collection and disposal by specialist contractors), and liquids (“black” and “grey” water from construction sites)
- Storage and handling of fuels and chemicals, to be used for construction machinery. Accidental spills from vehicles, storage tanks and chemical stores, metal working and welding can pollute water resources.

7.7.2.4 Effects on the existing water regime of watercourses

The OHL is expected to cross a number of small watercourses, as detailed in Section 5.7.1. However, the OHL towers will not be installed in water, nor on river banks or riparian zones. Construction traffic will use existing roads and bridges and will not drive through watercourses. As a result, the magnitude of the associated impacts is low and the resulting impact significance is also low.

7.7.2.5 Sanitary conditions

During the construction phase, workers’ camps will generate domestic wastewater and sewage. Where sanitary facilities are inadequate or poorly managed, there is a risk that wastewater may be discharged into the surrounding environment, potentially affecting surface water or groundwater quality. Such discharges may contribute to localized deterioration of water quality, particularly during the rainy season when runoff is intensified and pollutants can be transported to nearby watercourses.

7.7.2.6 Mitigation Measures

To reduce impacts to water resources, the following mitigation measures shall be implemented:

- Install **silt fences, sediment traps, and check dams** downslope of construction sites to capture runoff;
- Avoid stockpiling soils or construction materials near stream banks or flood-prone zones.
- Minimise excavations and topsoil disturbance, and undertake prompt revegetation of disturbed areas.
- Develop and implement a **Stormwater Management Plan**, including temporary diversion channels and settlement ponds in areas with high runoff potential;

Engineering Design Controls

To prevent long-term stagnation in the settlement ponds:

- Settlement ponds will be designed as **temporary sediment control structures**, not permanent water retention bodies.
- Ponds will incorporate **controlled outlet structures** to ensure gradual and complete drainage within 48–72 hours following rainfall events.
- Pond bases will be slightly sloped toward outlet points to prevent standing residual pools.
- **Soakaway systems** will be constructed downstream or adjacent to settlement ponds to facilitate rapid infiltration of treated stormwater into the subsurface.
- Where soil permeability is low, engineered infiltration trenches or gravel-filled soak pits will be installed to enhance percolation capacity.

The integration of soakaways ensures that water does not remain ponded beyond the sedimentation phase.

- Prohibit **washing of concrete, vehicles, or machinery** near any watercourse;
- Ensure **fuel and hazardous materials** are stored in bunded areas at least 100 meters from water bodies, with

spill kits available onsite;
- Develop a **Spill Prevention and Response Plan**, including emergency protocols for containment and cleanup.
- Where river crossings are unavoidable, use existing crossing points or install **temporary crossing structures (e.g., culverts or steel plates)** to reduce bank and bed disturbance;
- Prohibit dumping of any construction waste, fill or excavated material into streambeds or floodplains.
- Develop a **Waste Management Plan**
- Prohibit driving in watercourses
- Ensure appropriate and adequate sanitary facilities at workers camps.

7.7.2.7 Residual impacts

The table below summarises the residuals impacts to water resources during Project construction.

Table 7-18 Impacts to water resources during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Moderate	Low
Geographic Extent	At streams/river crossings	Localized
Scale	Low	Low
Duration/Frequency	Short-term	Short-term
Likelihood	Likely	Unlikely
Magnitude	Medium	Low
Sensitivity	Medium	Medium
Significance	Moderate	Minor

7.7.3 Operation and Maintenance Phase

During the operation and maintenance phase of the Malawi–Zambia 400kV Interconnector, direct impacts to surface water quality and aquatic habitats are expected to be insignificant, provided that the Right of Way (RoW) has been successfully stabilized and that access routes and towers remain structurally sound.

7.7.4 Decommissioning phase

The impacts of decommissioning will depend on the approach and technologies available at the time. Regarding impacts to water resources, in case of removing the towers and wires, impacts will be similar to construction stage. In case tower foundations are not removed, impacts will be much less and will mainly comprise the management of waste arising from metallic structures and wires.

7.8 Geology and soils

7.8.1 Overview

This section assesses the impacts on the geology and soils at the study area that may arise from the construction, operation and decommissioning phases of the Project.

Soil disturbance is expected at the areas of the permanent installations (i.e. substation, tower footprint) and the temporary construction sites (including the OHL corridor, access roads) that will be used during construction.

Key potential impacts of the Project on geology and soils are presented below.

Table 7-19 Key potential impacts to Geology and Soils

Construction Phase	Operation Phase	Decommissioning Phase
• Disturbance and degradation of soil due to erosion and compaction • Accidental pollution of soil by solid and liquid wastes or spills of hydrocarbons / fuels and mineral oils • Soil occupation / Surface sealing • Potential disturbance in case subsurface contamination is uncovered during excavation (legacy waste).	• Accidental pollution of soil by accidental spills • Soil occupation / Surface Sealing • Erosion of sloping terrain until vegetation cover has recovered and re-stabilised	• Accidental pollution of soil by accidental spills, solid and liquid wastes • Soil occupation • Erosion and degradation of soil

7.8.2 Construction phase

7.8.2.1 Potential impacts

During construction, impacts on geology and soils in the project area may be due to the following:

- Preparation, construction and operation of temporary facilities (i.e. construction sites)
- Soil contamination due to accidental pollution by solid and liquid wastes or spills of hydrocarbons / fuels and mineral oils
- Movement of vehicles, equipment and personnel
- Upgrade of existing access roads or building new ones
- Construction waste management and storage and handling of fuels and chemicals.
- Disturbance to pre-project, underground legacy waste during earthworks.

7.8.2.2 Soil erosion

The proposed Malawi–Zambia 400kV Interconnector crosses a variety of soil types in the Eastern Province of Zambia, including **sandy loams, lateritic soils, clayey substrates**, and more erosion-prone units such as **Fersiallitic soils, Leptosols,** and **Gleysols**. These soils, particularly where vegetation cover is sparse or disturbed, exhibit **moderate to high susceptibility to erosion**, especially on slopes and in areas subjected to intense rainfall during the wet season.

Land disturbance from tower pad installation, access track development, and equipment laydown areas within the RoW will temporarily compromise soil stability, increasing the risk of surface runoff, **sheet and rill erosion**, and sediment displacement. The removal of vegetation cover and topsoil exposure are key triggers for erosion and degradation, with potential off-site effects on adjacent agricultural land, local drainage lines, and community water sources.

In areas with small-scale farming near the project alignment, **soil degradation could affect crop yields**, contribute to siltation of surface water bodies, and compromise local livelihoods.

7.8.2.3 Soil compaction

Soil compaction occurs when soil particles are pressed together, reducing the soil porosity. This increases the weight of solids per unit volume of soil (bulk density). Soil compaction can in general occur during most of the construction operations that require heavy machinery, especially if performed when soils are wet. In particular clay dominated soils are more susceptible to compaction. In the project area, Fersiallitic soils (from Chipata West SS to AP6) demonstrate moderate compaction potential while Gleysols (AP6 – AP8 and AP9 to the border crossing) demonstrate high compaction potential.

7.8.2.4 Soil pollution

Accidental pollution of soil during construction could occur through direct spillage of materials such as oils or hydraulic fluids from vehicles and machinery, surface run-off and sanitary waste from construction sites. However, any potential spillages will generally be of small quantities and localized in nature, therefore the magnitude of such potential impacts is considered low. It is clarified that no permanent fuel tanks will be sited along the project area.

As per current knowledge, the construction area is not placed on previously contaminated sites or any dump sites or uncontrolled waste landfills. Overall, impacts of minor significance are anticipated to soil from potential contamination during construction from accidental spillages.

7.8.2.5 Mitigation measures

A number of mitigation measures will apply during construction to avoid or minimise impacts to soil and subsoil:

- **Limit clearing and excavation** strictly to necessary areas within the designated RoW; avoid unnecessary disturbance to surrounding vegetation and root zones;
- Restrict vehicle movement only to designated roads;
- **Preserve topsoil** by stripping and storing it separately during excavation works for use in site rehabilitation;
- Implement **erosion control structures** such as sediment traps, check dams, gabions, and water diversion channels, especially in slope-prone and high-runoff areas;
- Stabilize slopes using **mulching, erosion-control blankets**, or grass wattles as temporary cover until vegetation is reestablished;
- Apply deep ploughing (subsoil de-compaction) to temporary construction facilities (such as construction sites) following project construction and during restoration. Deep ploughing will be performed on the construction corridor of the OHL where topography allows to a depth of approximately 60 cm below surface;
- Implement progressive rehabilitation of disturbed areas immediately after construction, including re-grading of slopes to natural contours, re-application of stockpiled topsoil, seeding or planting with indigenous grass and cover crop species;
- Ensure that fuel handling, especially bulk storage, takes place in secure bunded areas. Similar conditions will apply to lubricant oils, chemicals and liquid wastes. Should a spill occur, polluted soils will be cleaned up or removed for appropriate disposal. All waste will be handled, stored and disposed of as per local regulations.
- Schedule major earthworks and vegetation clearance outside the peak rainy season, as far as possible, to minimize the risk of runoff-related erosion;
- Develop and implement a Spill Prevention and Response Plan to avoid accidental spills
- Develop and implement an Emergency Preparedness and Response Plan in case accidental spills occur

Mitigation Measures for soil compaction

- Clearly demarcate construction corridors and prohibit off-road driving outside approved work zones.
- Schedule construction activities during dry weather conditions to reduce deep compaction of saturated soils.
- Utilize low-ground-pressure machinery where feasible, particularly in agricultural and riparian areas.
- Limit the number of vehicle passes over exposed soils to the minimum necessary.

7.8.2.6 Residual impacts

The table below summarizes the residuals impacts to subsurface and soils during Project construction.

Table 7-20 Impacts to soils during construction

Type of Impact	Direct

Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Moderate	Low
Geographic Extent	All OHL route for erosion, selected sections for compaction	Localized
Scale	Medium	Low
Duration/Frequency	Short-term	Short-term
Likelihood	Likely	Unlikely
Magnitude	Medium	Low
Sensitivity	Medium	Medium
Significance	Moderate	Minor

7.8.3 Operation and Maintenance Phase

During the operation and maintenance phase of the transmission line, soil erosion and land degradation risks are expected to be **negligible**, provided that the RoW is stabilized and vegetation has been successfully reestablished post-construction. During maintenance, apart from control of vegetation, the maintenance crew will periodically check for evidence of soil erosion and advise on the need of stabilization measures where necessary.

7.8.4 Decommissioning Phase

The impacts of decommissioning will depend on the approach and technologies available at the time. Regarding soil impacts, in case of removing the components of substation, towers and wires, impacts will be similar to construction stage. Soil profiles will be disturbed, but as long as ZESCO follows the international best practice (diligent care in excavation, separation and appropriate storage of topsoil and subsoil, de-compacting of construction corridor, appropriate disposal of waste materials) it is ensured that soils will be reinstated to their previous conditions, as close as technically feasible. This way, soils will be available again for agricultural use and re-vegetation.

7.9 Landscape

7.9.1 Overview

This section assesses the potential impacts on the landscape associated with the Project. Impacts may occur on a landscape resource, such as a high landscape value or a sensitive receptor. The assessment is divided into the three main phases of the Project: construction, operation and decommissioning.

Transmission line construction will result in earthworks for the installation of the towers, clearance of a construction corridor along the transmission line route as well as preparation of construction sites and installation of permanent structures such as the Chipata West substation extension.

During operation, the construction corridor will be kept clear from high vegetation (above 3 m height), but otherwise reinstated to the previous conditions, as much as possible. Construction sites will be also reinstated and returned to their previous use. Permanent facilities include the substation as well as the Line towers and the wires connecting them.

The key potential impacts to the landscape from the Project include the following.

Table 7-21 Key potential impacts to the landscape

Construction Phase	*Operation Phase*	*Decommissioning Phase*
• Physical changes to the landscape general unity (fragmentation) due to construction works. • Disturbance of the landscape habitats' features continuity such as the mature trees (felling of trees) • Changes in the viewshed and aesthetic value to residents	• Presence of the access corridor in the receiving landscape especially landscapes cleared of woody vegetation for this purpose. • Presence of tower structures, conductors and substation in the receiving landscape	• Disturbance of the landscape unity by demobilization and abandonment of facilities and infrastructure

7.9.2 Construction phase

7.9.2.1 Potential impacts

Project construction works will cause visual impacts on the surrounding landscape and visual amenity of sensitive receptors. These will be temporary and restricted to the construction period. Project features or processes that will be visible and/or intrude upon existing visual amenity will include:

- Development of the construction corridor and excavation of the foundations for the towers.
- Construction of the permanent Project features, such as the substation extension.
- Construction of the temporary Project features such as the construction sites.

7.9.2.2 Landscape fragmentation

Construction activities will result in physical changes to the overall landscape's unity. According to the results of the baseline survey, the landscape along the HV transmission line mainly consists of hilly rural landscape and lowland agricultural landscape.

Impact significance due to physical changes caused by line construction is related to the landscape character and value of the areas concerned. Plain agricultural areas have low sensitivity to the proposed changes, similar to hilly shrublands and grasslands or hilly mixed grasslands and agricultural areas. This type of landscape is characterised by dispersed settlements with small groups of houses and preserved small patches of natural vegetation. From the functional point of view, this landscape type does not possess significant value since it is already highly fragmented. As a result, impacts are considered of **Minor** significance.

7.9.2.3 Changes in the aesthetic value to residents and visitors

The construction works will generally be observed by a range of viewers, including:

- Residents with prolonged viewing opportunities of their landscape setting.
- Outdoor workers (farmers etc.) with a moderate interest in the environment.
- Nature recreation users and tourists that appreciate the local visual amenity.

Changes are generally likely to be visible from a short distance, through scattered vegetation across gently or undulating topography of plain areas along the transmission line. The main visual impacts likely to be experienced during construction phase will be temporary and restricted to the construction period and will include:

- The presence of construction vehicles and workers

- Movement of construction machinery, workers and construction equipment
- Stockpiles (vegetation, topsoil, subsoil)
- Vegetation clearance
- Earthworks, construction and installation of Project elements
- Lighting during night-time
- Additional vehicular traffic generated by construction workers, materials delivery and disposal.

During project design, effort has been made to avoid crossing areas designated for their landscape value as well as keep a distance from settlements. The habitats crossed, especially those close to settlements are predominantly agricultural and in fewer cases fragmented natural vegetation patches. As a result, impacts of **Minor** significance are associated with viewshed changes.

7.9.2.4 Mitigation measures

The following measures will be implemented during Project construction to mitigate the impacts presented above:

- Construction activities, outside the construction corridor, will be limited to the shortest practicable duration.
- All areas used for construction will be fully restored to their pre-construction state, to the extent possible.
- The use of existing landscape features (roads, fence rows, property lines, forest edges) will be sought in order to minimize visual impacts.
- Materials and machinery will be stored tidily during the works.
- Where possible, protect trees prior to construction and/or trim trees to avoid total removal. This includes vegetation that makes a significant and positive contribution to landscape character.
- Lighting of compounds and construction sites will be restricted to working hours with the exception of security lighting only.
- Where the removal of vegetation landscape features is necessary, the species selected for replanting works will be appropriate and characteristic of that particular landscape area.
- On completion of works all temporary structures, surplus materials and wastes will be completely removed.

7.9.2.5 Residual impacts

The following table presents a summary of the residual impacts to landscape following mitigation.

Table 7-22 Impacts to landscape during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Low	Low
Geographic Extent	Along the OHL	Along the OHL
Scale	Low	Low
Duration/Frequency	Short-term	Short-term
Likelihood	Likely	Unlikely
Magnitude	Low	Negligible
Sensitivity	Low	Low
Significance	Minor	Insignificant

7.9.3 Operation and Maintenance phase

7.9.3.1 Potential impacts

Potential impacts to the landscape during operation are due to the physical presence of the Project structures – towers, conductors and the substation extension – as well as to the restrictions in reinstatement of trees in vegetated areas in the RoW.

7.9.3.2 Permanent presence of project structures

During project design, effort has been put in crossing areas without forests or many trees, predominantly agricultural areas, in order to minimase the environmental impacts associated with cutting forest trees and natural vegetation. Nevertheless, a number of permanent structures will be added to the landscape, including the towers and the connecting wires between them as well as the substation buildings although the new substation will be an extension of an existing one so the new structure becomes less intrusive.

The construction corridor will be reinstated and, in case of farmland, agricultural activities will continue. The construction corridor will be a source of landscape and visual impact, until farming activities become fully established and the land recovers to become indistinguishable from the adjacent undisturbed farmed land cover. This will be the case for most of the construction corridor except in some areas where for safety reasons vegetation will not be allowed to grow over 3 m high, in which case fragmentation of landscape will occur. However, associated impacts are considered to be less significant than those examined during construction as the safety corridor will look like a forest track or a fire-fighting strip.

7.9.3.3 Mitigation measures

The following mitigation measures will apply:

- Reinstate vegetation along the OHL, especially in areas of natural vegetation, with suitable species. Although no high growing species are allowed, lower vegetation may be planted.
- Substation will have a building design (including the use of proper materials and colours) that will allow it to blend with the landscape as much as possible.
- A vegetation screen alongside the substation parcels will be provided to reduce visual impacts in the long term.

7.9.3.4 Residual impacts

The following table presents a summary of the residual impact associated to the impacts identified.

Table 7-23 Impacts to landscape during operation

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Low	Low
Geographic Extent	Along the OHL	Along the OHL
Scale	Moderate	Low
Duration/Frequency	Permanent	Permanent
Likelihood	Likely	Likely
Magnitude	Medium	Low
Sensitivity	Low	Low
Significance	Minor	Minor

7.9.4 Decommissioning phase

The decommissioning phase will create impacts to the visual amenity of the landscape similar to the ones during construction. Although all the necessary reinstatement activities will take place, permanent loss of some floristic landscape features (such as vegetation, mature trees) is inevitable.

7.10 Biodiversity

7.10.1 Overview

This section assesses the impacts on the biodiversity (habitats, flora, fauna and protected areas) of the project area that may arise from the construction, operation and decommissioning phases of the Project.

During project construction, vegetation will be removed, which may cause habitat loss, degradation and fragmentation, leading to a reduction in plant and animal species richness. During operation, impacts are much more limited.

Key potential impacts of the Project on biodiversity during each phase are presented below.

Table 7-24 Key potential impacts to Biodiversity

Construction Phase	Operation Phase	Decommissioning Phase
• Loss, fragmentation and degradation of habitats • Disturbance of fauna species • Killing and injury of animal species	• Loss, fragmentation and degradation of habitats where forest vegetation will be regularly removed • Collision and electrocution of birds and bats	• Disturbance of fauna species

7.10.2 Construction phase

7.10.2.1 Potential impacts

Generally, the construction activities of the proposed project will impact on biodiversity in various ways. These impacts could be grouped as listed below:

- Destruction, fragmentation and degradation of vegetation/habitats (by vegetation clearance).
- Wildlife displacement caused by visual and auditory disturbance due to the presence of machinery and construction workers.
- Killing and injuring of animal specimens (incidental or by poaching).

The impacts on biodiversity during the project construction phase are described in the following sections.

7.10.2.2 Impacts on habitats

The impacts on habitats from the transmission line construction are generally related to their depletion, land occupation and transformation, as well as habitat fragmentation.

<u>Forest habitats</u>

The **thicket habitat** occupies approximately 3.5 hectares, representing 1.5% of the total wayleave area of the OHL. It consists of miombo woodland with a well-developed tree layer and high canopy cover (99.3%), indicating substantial foliage density and structural maturity. The tree density in this habitat is estimated at 502.2 trees per hectare, signifying a moderately dense woodland. It is identified at the start of the OHL route (from Chipata West SS to AP3) and towards the end of the OHL route (from AP10 to the border crossing).

The **wooded vegetation habitat** spans approximately 19.2 hectares, accounting for 8.24% of the total project area. This habitat is also characterized by miombo woodland, exhibiting a canopy cover ranging between 15% and 30% and a tree density of 350 to 451 trees per hectare. The habitat reflects varying levels of ecological stability, with some areas representing relatively mature woodland, while others show evidence of past disturbances and successional recovery.

Although both habitats support important ecological functions, none of them is priority habitat or designated for its ecological significance. Both habitats are common in the Southern Africa region, show evidence of past disturbances, potentially from selective tree cutting, livestock grazing, or firewood harvesting. The flora and vegetation species identified in both habitats are classified as Least Concern (LC) as per IUCN. Their sensitivity is therefore considered medium, while the magnitude of the impact is low as they represent less than 10% of the wayleave area. **Impact significance is minor**.

Agricultural and degraded vegetation habitats

Collectively they represent 89.35% of the wayleave area, i.e. the vast majority of the area affected by the project.

The **agricultural fields habitat** has undergone significant anthropogenic modification, primarily through subsistence and commercial farming activities. The dominant crops cultivated in these areas include maize (*Zea mays*), groundnuts (*Arachis hypogaea*), and soybeans (*Glycine max*), with smaller portions allocated to cassava (*Manihot esculenta*) and various horticultural crops. Natural vegetation is sparse and is limited to fragmented tree patches along field boundaries. The habitat still hosts generalist bird species and insect populations.

The **degraded vegetation habitat** represents habitats that have been subjected to varying degrees of disturbance, primarily due to deforestation, shifting cultivation, uncontrolled grazing, and firewood collection. This habitat is characterized by a sparse tree canopy (often below 15% cover) and a dominance of secondary regrowth vegetation. The habitat hosts disturbance-tolerant fauna species.

Both habitats are degraded. The flora and vegetation species identified are classified as Least Concern (LC) as per IUCN. Their sensitivity is low, while the magnitude of the impact is medium as they represent a large percentage of the wayleave area. **Impact significance is minor**.

River crossings habitat

The habitat comprises narrow strips along rivers or streams (including the Lutembwe, Chibila, Mwami, Lubwe Rivers, and Nyongo and Choli streams), important for hydrological connectivity and wildlife corridors, though limited in spatial extent, as it occupies about 0.08% of the wayleave. Although the species identified are Least Concern (LC), the sensitivity of the habitat is considered high, due to the ecological functions attached to it. The magnitude of the impact is low and therefore **impact significance is moderate**.

7.10.2.3 Impacts on flora

Field surveys carried out during ESIA preparation have identified **66 tree species** in the wayleave area, the most dominant of which were the following:

- **Brachystegia** species, often forming dense canopies;
- **Isoberlinia** trees, known for their resilience to fire - a common occurrence in miombo ecosystems;
- **Julbernardia** species, the wood from which is also used locally for construction and firewood.

All identified species are Least Concern (LC) or Not Evaluated (NE) as per IUCN.

The survey has also identified 26 grass species, the most notable from which were:

- *Setaria sphacelata, Setaria hirta, Setaria verticillata* – Dominant in open grasslands and woodland understory;
- *Sporobolus africanus, Eragrostis superba, Andropogon gayanus, Hyparrhenia filipendula* – Frequently found in semi-arid areas;
- *Aristida stitata, Tristachya rehmannii, Digitaria ternata, Chloris mossambicensis* – Species that enhance the structural diversity of grassland habitats;
- *Pennisetum purpureum* (Elephant Grass) – Commonly associated with riparian zones.

All identified grasses are Least Concern (LC) or Not Evaluated (NE) as per IUCN.

Several other species were identified in degraded vegetation habitats as well as riverine habitats. None of these species exhibited any ecological designation or conservation interest.

In line with the above, the sensitivity of the flora species affected by the project is considered low, while the magnitude of the impact is also low. **Impact significance is minor**.

7.10.2.4 Impacts on fauna

During the construction phase it is expected that the habitat will go through modification during site clearance and preparation which will result in displacement of local fauna, or potential loss of habitat diversity due to vegetation removal.

It is also expected that fauna individuals will be influenced by noise, vibration, light, dust and soil disturbances, in different extent, taking into account fauna group and certain species.

Mammals

Mammal surveys directly recorded 5 small to medium sized mammal species in the project area, including the velvet monkey, the African civet cat, the common duiker, the elephant shrew and the African savanna hare. Community interviews further confirmed the occasional presence of larger mammals such as bushbucks and hyenas, which were not directly recorded during the field survey.

No threatened (i.e. endangered, critically endangered or vulnerable) mammal species were identified during the assessment. As a result the sensitivity of the species is considered low.

Vegetation clearance for the needs of RoW preparation and installation of towers is expected to disturb mammal species during the construction period, as well as to lead to limited loss of species individuals – accidentally or on purpose. However, the magnitude of the impact is considered low and the species are expected to recover successfully after the completion of the construction. **Impact significance is minor**.

Reptiles and amphibians

The baseline survey has identified a few species of reptiles, among which the monitor lizard, the side-stripped chameleon, the Mozambique rough-scaled lizard and potentially the pancake tortoise. All species are Least Concern, as per IUCN classification, with the exception of the **pancake tortoise**, which is protected under national wildlife regulations In Zambia and is classified as **critically endangered (CR)** by IUCN, and which has not been reported from this part of Zambia in the past. Further study is needed to confirm the presence of the species.

With regard to amphibians, the only species recorded was the bocage's burrowing tree frog, a LC species identified in a wetland patch in Plot 4 (towards the Malawian border). Amphibians are highly sensitive to environmental changes, particularly to habitat degradation and water quality. The low amphibian diversity is believed to reflect the limited availability of suitable breeding habitats such as ponds and seasonally flooded areas.

In terms of species sensitivity, amphibians and reptiles are considered of medium sensitivity. The magnitude of the impact is considered low, taking into account the relatively limited area cleared for the preparation of the RoW and the installation of the towers. **Impact significance is Minor.**

Assuming that the presence of the **pancake tortoise** is confirmed, its sensitivity is low despite its IUCN classification because the area that is likely to be impacted is small only about 50m wide RoW and mostly on tower pads. Further the OHL avoids the rocky hills which are likely critical habitats while the magnitude of the potential impact is also low, given the small number of species in the area. **Impact significance is minor**.

Invertebrates (insects)

Baseline surveys have identified a total of 227 insect species, with key groups comprising ants, beetles, butterflies, termites, grasshoppers and crickets. Insect diversity was highest in areas with intact vegetation cover, where micro-habitats such as leaf litter, tree bark, and flowering plants provide essential resources.

No threatened (i.e. endangered, critically endangered or vulnerable) species were identified during the assessment. As a result the sensitivity of the species is considered low. It must be noted that insect species generally have not been assessed as per the IUCN criteria, including the criteria for threatened species. There are, however, no reported indications that unique insect species are likely to be adversely affected.

Vegetation clearance for the needs of RoW preparation and installation of towers is expected to have impacts of low magnitude to the population and diversity of invertebrates, as areas of intact vegetation are generally avoided while the RoW comprises a relatively small area. Insect populations are likely to recover fast after the completion of project construction. **Therefore, impact significance is minor**.

Avifauna (birds)

The ecological survey conducted along the OHL identified a total of **63 bird species**, distributed across various functional groups, including seed eaters, insectivores, frugivores, and raptors. Dominant bird species include:

- **Abdim's Stork (*Ciconia abdimii*)** – A migratory species commonly observed in grassland and open areas.
- **Southern Masked Weaver (*Ploceus velatus*)** – Commonly found in woodland edges and near human settlements.
- **Lilac-Breasted Roller (*Coracias caudatus*)** – A colorful insectivorous species frequently seen in open woodland habitats.
- **Red-Eyed Dove (*Streptopelia semitorquata*)** – Widespread across the project area, particularly in forested and bushy regions.
- **Blue Waxbill (*Uraeginthus angolensis*)** – A small seed-eating bird recorded in grasslands and thicket edges.

No threatened (i.e. endangered, critically endangered or vulnerable) avifauna species were identified during the assessment. In addition, no bird nesting colonies were observed within the surveyed areas. The project area is highly disturbed by human activities, including agriculture and settlements, which limit suitable nesting sites for large avian species. However, scattered woodland patches still provide foraging and perching sites for a variety of birds.

Taking into account the IUCN classification of the species identified in the project area, the sensitivity is considered low. The magnitude of the impact is also low, as the project avoids impacts in intact vegetation which seems to be the preferred habitat for foraging and perching sites of the species identified. **Impact significance is considered minor**.

7.10.2.5 Impacts on protected areas

The proposed project does not traverse any designated protected area (national park, game management area, or forest reserve). The closest national park in Zambia is Lukusuzi National Park 62 km north of the Chipata West

Substation, which is also the nearest Key Biodiversity Area (KBA). The closest game management area (GMA) is Lupande GMA 43 km west of the Chipata West Substation, which is part of the buffer zone for South Luangwa National Park.

The proposed transmission line route also avoids all nearby forest reserves. The nearest one is Msipazi Forest Reserve, which is about 250 m south of the proposed transmission line while Mkwawe Forest Reserve is about 2.8 km north of the proposed line. The Mbewule Ranch and Nature Conservation Reserve (private) is approximately 2.4 km away from the transmission line.

Impact significance to protected areas is therefore minor.

7.10.2.6 Mitigation measures

General measures

- Land clearing shall be avoided wherever possible, particularly in riparian areas
- Setting up camps in the river and stream valleys shall be avoided because valuable riparian habitats can be damaged and because of possibilities to pollute surface and underground waters;
- Avoid any illegal actions that would destroy or disturb the flora and fauna, particularly (i) collection of medicinal plants, mushrooms and fruits, (ii) accidental or intentional killing of species individuals (iii) poaching of game, birds, etc., (iv) collection of bird eggs and other.
- Avoid the ignition of fires due to risk of potential fires. Permanent presence of fire-brigade vehicle should be ensured when fire occurrence is likely.
- Avoid oil, fuel and chemical spills, and planning of emergency response.
- Avoid introduction of invasive alien species
- Use of existing access roads wherever possible and minimise the construction of new access roads.
- After construction, disturbed areas shall be restored and re-integrated to the environment.

Habitats

The following shall not be allowed in **forest** (thickets) and **river crossing** habitats:

- No access roads construction and no gravel and sand extraction.
- No storage / deposition of waste materials (concrete, iron, soil, etc.)

Flora and vegetation

- Strip and store topsoil separately during excavation and construction. This soil shall be re-applied during site restoration to facilitate natural regeneration of native grasses.
- Prohibit the illegal collection of medicinal or decorative plants by project staff.

Reptiles

- Conduct a survey by a biologist prior to land clearing of the wayleave.
- Manually remove all identified species of the Pancake Tortoise in the wayleave by an experienced biologist to avoid injury or death of the individuals during construction.
- Prohibit the capture of Pancake Tortoise individuals by the construction staff

7.10.2.7 Residual impacts

The following table presents a summary of the residual impacts to ecology during project construction.

Table 7-25 Impacts to riparian habitats during construction

Type of Impact	Direct	
Status	Negative	
Criteria	Rating	
	Without Mitigation	With Mitigation (Residual Impact)
Intensity/Severity	Low	Low
Geographic Extent	Close to rivers / streams	Close to rivers / streams
Scale	Low	Low
Duration/Frequency	Permanent	Permanent
Likelihood	Likely	Likely
Magnitude	Low	Negligible
Sensitivity	High	High
Significance	Moderate	Minor

Table 7-26 Impacts to forest habitats during construction

Type of Impact	Direct	
Status	Negative	
Criteria	Rating	
	Without Mitigation	With Mitigation (Residual Impact)
Intensity/Severity	Low	Low
Geographic Extent	Forest thickets along the OHL	Forest thickets along the OHL
Scale	Low	Low
Duration/Frequency	Permanent	Permanent
Likelihood	Likely	Likely
Magnitude	Low	Negligible
Sensitivity	Medium	Medium
Significance	Minor	Insignificant

Table 7-27 Impacts to flora and vegetation during construction

Type of Impact	Direct	
Status	Negative	
Criteria	Rating	
	Without Mitigation	With Mitigation (Residual Impact)
Intensity/Severity	Low	Low
Geographic Extent	Along the OHL	Along the OHL
Scale	Low	Low
Duration/Frequency	Permanent	Permanent
Likelihood	Likely	Likely
Magnitude	Low	Negligible
Sensitivity	Low	Low
Significance	Minor	Insignificant

Table 7-28 Impacts to reptiles (Pancake Tortoise) during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	High	Low
Geographic Extent	Along the OHL	Along the OHL
Scale	Low	Low
Duration/Frequency	Permanent	Permanent
Likelihood	Likely	Likely
Magnitude	Low	Low
Sensitivity	Low	Low
Significance	Moderate	Minor

7.10.3 Operation and maintenance phase

7.10.3.1 Potential impacts

In general, the impacts on the biodiversity from the operation of the transmission line are less destructive and damaging compared to its construction except for any bird and bat species prone to collision with the conductors and earth wires. However, these impacts will be expressed in the long term.

7.10.3.2 Impacts on habitats

During operation of the proposed transmission line, regular clearing/pruning of high trees within the wayleave will be performed. Fragmentation of the forest habitat (thickets) will be established during construction. However, the operation of the project will make this impact permanent, at least for the life of the transmission line. Impact of fragmentation was assessed as low in magnitude and medium in sensitivity. **Impact significance is minor.**

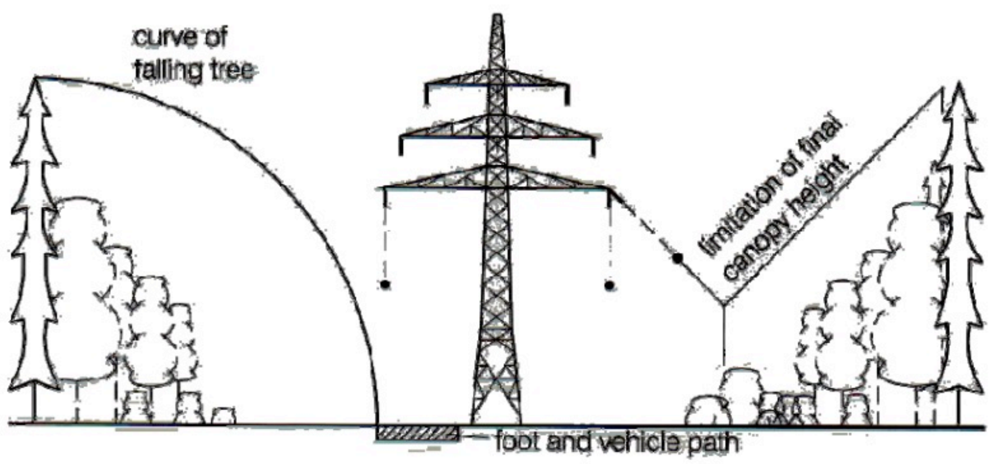


Figure 7-2 Maintenance of the RoW through forest areas

7.10.3.3 Impacts on flora

Most of the impact on flora is related to the project construction phase. Plant species that will be affected during the operation phase are tree species directly below the proposed transmission line. Vegetation control measures will be conducted manually or mechanically, avoiding the use of chemical herbicides. Clearing will be selective and limited to necessary areas beneath the conductors or around tower bases and shall not exceed the already established operational RoW. In addition, during the operation, invasive plants will spread from surrounding areas into habitats located within the project area.

This impact will be low in scale and intensity, while the sensitivity of the species is also low. **Impact significance is minor**.

7.10.3.4 Impacts on fauna

Birds and bats

Birds and bats are potentially the most vulnerable to transmission line operation of all animal groups. Mortality through electrocution occurs when perching or flying bird causes a short circuit, either by touching two different phase conductors, or a conductor and an earth wire (or equivalent energised components of the tower). This is extremely unlikely at any high-voltage transmission lines because of their long-suspended insulators and large clearances.

Potentially the most significant impact of powerline operation on birds and bats is instant or delayed mortality through collision with the OHL wires. Among the most vulnerable avifauna is **Abdim's Stork (*Ciconia abdimii*)**, a Palaearctic–Afrotropical migrant that seasonally traverses the corridor between km 19 and 28. These birds travel in large, coordinated flocks and often fly at low to medium altitudes, especially while foraging over agricultural fields, wetlands, and Miombo woodlands. In open landscapes, especially at dawn, dusk, or during foggy weather, the lack of background contrast can cause individuals to fail to detect shield wires and conductors, thereby increasing collision risk. Other migratory species potentially exposed to this threat include **White Stork (*Ciconia ciconia*), European Bee-eater (*Merops apiaster*), Amur Falcon (*Falco amurensis*).** Resident raptors and soaring birds, such as **Martial Eagle (*Polemaetus bellicosus*), Brown Snake Eagle (*Circaetus cinereus*), Bateleur (*Terathopius ecaudatus*)** and **African Fish Eagle (*Haliaeetus vocifer*)** are also at risk due to their gliding and soaring behaviour, which typically involves flying at conductor height when hunting or thermalling. These species are especially vulnerable near river crossings and ridgelines where transmission towers may intercept flight paths.

None of these bird species are threatened, so the sensitivity is considered low. However, the magnitude of the impact is considered high, especially in the migration corridor. **The significant of the impact is moderate**.

Other fauna

Other fauna can only be affected from powerline operation through disturbance and incidental and/or illegal deliberate killing, injuring and capture, during the maintenance activities. However, this is less likely than during the construction.

7.10.3.5 Mitigation measures

Flora and habitats

- Restrict vegetation clearing / pruning to only the required for safety reasons.
- Prohibit the use of chemical herbicides for vegetation control.
- Prohibit driving outside the RoW or access roads

Birds

The generic term for the devices that serve as tool to minimize collision impact on birds is line markers or bird flight diverters. In most installations, the adequate number of the line markers are placed depending on the configuration of the terrain, the quality and arrangement of the conductor (Jenkins et al., 2010). On transmission lines, typically only the overhead ground wire(s) is marked. To minimise collision risk for migratory birds and raptors as well as for all other birds impacted, as presented in Section 7.10.3.4, bird diverters on the ground wire of the OHL section from km 19 to km 28 shall be installed.

Marker balls, **bird diverters** and **paint** have been demonstrated to reduce collision risk

The installation of yellow marker balls reduced collision by 53% in S. Carolina, and the installation of polyvinyl chloride plastic dampers reduced collision of cranes and waterfowl by 61% in Colorado while the installation of yellow fibre-glass square plates by 63%.

More recently, a before-and-after trial at a wetland site in Essex, England, installed 500 red, spiral-shaped 'flight diverters' (32 cm long, 17.5 cm in diameter) at 5 m intervals along 1.5 km of power lines. In two springs preceding installation (2004 and 2006), 28 mute swans *Cygnus olor* were killed through collisions with the wires. Following installation, one swan was killed in the springs of 2007 and 2008 combined.

Most of these studies were carried out for transmission lines of much lower voltage than the proposed 400 kV line, for which line conductors are thicker and more visible to birds. A recent publication studied the installation of a 500kV line crossing a corridor for raptors migrating south through New Jersey and Pennsylvania, USA. Post-construction the team recorded 4,482 crossings of raptors as well as a change of flying behavior, with the birds flying at higher altitude. No collisions were observed.

A variety of bird diverters are available, such as spiral conductor static wire marker (30cm × 100cm), black crossed band conductor markers (35cm × 5cm), thin black strip conductor markers (70cm × 0.8cm), yellow spiral vibration dampers and yellow fibreglass swinging plates. All these have been found to reduce collision to specific species and in specific seasons and conditions.

Recently project in three EU countries: Czech Republic, Slovakia and Hungary related to prevention and mitigation of bird mortality associated with power lines[10]. They produced Handbook for the application of effective methods and approaches to improve the safety of power lines for birds[11]. According to the findings of ornithologists in these countries, the selected bird flight diverter should meet the following environmental parameters: movement of all or part of the device, contrasting color to the surrounding landscape, reflectivity, and glow after sunset for at least 6 hours. The placement of various designs of diverters on wires has shown to effectively reduce bird collisions, up to nearly 95%.

There are several ways used in practice how to attach devices against collision: Some devices can be attached manually from the ground (e.g. during the construction of the line), others are snap on automatically via a claw, and some need to be manually attached in place from hanging basket. Related to this is the speed of installation. For example, a FireFly diverter can be installed from the ground using a telescopic stick in 1 day in a quantity of 50 pieces, which means about 500-600 m of secure power line. In the case of installation using rollerblading, from a bucket truck, it is necessary that the power line is switched off, when using a drone it is not necessary. Installation of bird diverters by drone results in attaching 200 pcs/day which means, app. 1.5 minutes on 1 diverter.

The recommendation is that installation must be carried out according to the design of the bird diverter, the technical possibilities resulting from the type of power line and the conditions given by the position of the power line in the area. The spacing between the diverters varies and ranges from 5 to 30 m, depending on the type used. (e.g. FireFly-10m; RIBE bird diverter/ Swan-Flight Diverter, spacing 20-40m). The installation of bird diverters is recommended for 220 kV and 400 kV lines only on the ground/shield wire, which is the main cause of bird mortality due to collisions.

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[10] The project „Transnational conservation of birds along Danube river" (LIFE19 NAT/SK/001023 - LIFE Danube Free Sky), co-funded by the European Union from the LIFE Programme.

[11] Marek Gális, Solt Szabolcs, Jitka Uhlíková, 2023: Handbook for the application of effective methods and approaches to improve the safety of power lines for birds. The Handbook was created with the support of the project „Increased awareness on reducing human-caused mortality of wildlife", co-financed by the Governments of Czechia, Hungary, Poland and Slovakia through Visegrad Grants from International Visegrad Fund.

Figure 7-3 Bird flapper

To assess bird mortality (particularly of raptors and other large birds) and the effectiveness of bird diverters, mortality monitoring programme along the proposed transmission line will start once it is operational. Mortality monitoring programme will include marked and unmarked wires in order to assess the effectiveness. The monitoring will be carried out during the first three years of the project operation after which a new assessment of impact would be carried out and, if needed, new measures will be implemented.

Any animal carcasses will be removed from the vicinity of the proposed corridor in order to prevent gathering of large flocks of raptors and vultures in the area around the transmission line, which will increase collision risk.

Avian Collision and Electrocution Risk Management (ESS6 Compliance)

Introduction

In line with the requirements of **World Bank Environmental and Social Standard 6 (ESS6): Biodiversity Conservation and Sustainable Management of Living Natural Resources**, transmission infrastructure can pose risks to avifauna, particularly through **mid-air collisions and, to a lesser extent, electrocution**.

While initial mitigation measures—such as the installation of bird flight diverters—have been included in the ESMP, the ESIA has been further strengthened through the development of a **comprehensive Avifauna Risk Management Framework**, incorporated within the **Biodiversity Management Plan (BMP)**. This framework adopts a **spatially explicit, risk-based, and performance-oriented approach**, aligned with **international good practice**, including the **IFC Environmental, Health and Safety (EHS) Guidelines** and **Avian Power Line Interaction Committee (APLIC) guidance**.

The framework comprises the following key components:

1. Avifauna Sensitivity Mapping

A **spatial avifauna sensitivity assessment** will be undertaken to identify high-risk zones along the transmission corridor. These include:

- **Riparian habitats and river crossings** (e.g., Lutembwe, Mwami, Lubwe, Nyongo, and Choli), which function as key movement corridors and foraging areas;
- **Open agricultural landscapes**, where flocking species such as Abdim's Stork are likely to fly at conductor height;
- **Known or suspected migratory pathways**, particularly within the identified high-risk section between km 19–28;
- Areas supporting **raptors and large-bodied bird species** that are more susceptible to collision and electrocution risks.

These areas will be mapped and classified into **risk categories (high, moderate, low)** to guide targeted mitigation measures.

2. Design Measures and Infrastructure Specifications

Collision Risk Reduction

To minimize collision risk, the following measures will be implemented:

- Installation of **bird flight diverters** on **earth wires/OPGW and upper conductors** within identified high-risk zones;
- Diverters will be:
    - High-visibility (e.g., spiral, flapper, or reflective marker types);
    - Installed at intervals of **10–15 metres** in high-risk sections;
    - Selected to enhance visibility under **low-light conditions** (e.g., dawn, dusk, fog).

Priority installation will be undertaken in:

- Riparian crossings;
- Open terrain with low visual contrast;
- Documented avian flight corridors.

Electrocution Risk Reduction

Although electrocution risk is generally lower for high-voltage transmission lines, the following precautionary measures will be adopted:

- Design of structures to maintain **adequate phase-to-phase and phase-to-ground clearances**;
- Avoidance of configurations that enable large birds (e.g., raptors) to bridge energized components;
- Application of **bird-safe designs** for substation structures and associated infrastructure where relevant.

3. Construction Phase Controls

To reduce disturbance during construction:

- Construction activities in high-sensitivity areas will be **avoided or minimized during peak breeding and migratory periods**, where feasible;
- Disturbance near **riparian habitats and avifauna aggregation areas** will be limited, where feasible.
- Construction personnel will receive **training on avian sensitivity, identification, and incident reporting protocols**.

4. Post-Construction Monitoring Programme

A **structured avifauna monitoring programme** will be implemented during the first **2–3 years of operation**, including:

- **Systematic carcass surveys** along identified high-risk sections;
- Recording of:
    - Species affected;
    - GPS location of incidents;
    - Probable cause of mortality (collision or electrocution);
- Monitoring of **bird flight behaviour and interactions** with the transmission line;
- Engagement of qualified **ornithologists or biodiversity specialists** to support data collection and analysis.

5. Corrective Action Triggers and Adaptive Management

The BMP will define **clear thresholds and triggers** for adaptive management, including:

- Exceedance of **predefined mortality thresholds**, based on baseline data and international benchmarks;

- Impacts on **species of conservation concern**;
- Repeated incidents within specific corridor segments.

Where such triggers are met, corrective actions may include:

- Increasing the **density or type of bird diverters**;
- Installing additional **line markers or visibility enhancements**;
- Modifying infrastructure design where technically feasible;
- Expanding the scope and frequency of monitoring activities.

6. Monitoring Indicators

Aspect	Indicator
Diverter installation	Percentage of high-risk areas fitted with diverters
Avian mortality	Number of recorded collision/electrocution incidents
Species affected	Presence of sensitive or protected species in incidents
Compliance	Adherence to mitigation and design specifications
Effectiveness	Reduction in mortality trends over time

7. Institutional Arrangements

- The **Contractor** will implement avifauna mitigation measures during construction, including installation of diverters;
- The **Construction Supervision Consultant (CSC)** will monitor compliance;
- **ZESCO** will be responsible for operational monitoring and adaptive management;
- **Specialist ornithologists and ecologists** will support monitoring and evaluation;
- **The Department of National Parks and Wildlife (DNPW) and ZEMA and other relevant stakeholders** will provide regulatory oversight.

7.10.3.6 Residual impacts

The following table presents a summary of the residual impacts to ecology during project operation and maintenance.

Table 7-29 Impacts to habitats during operation and maintenance

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Low	Low
Geographic Extent	Along the OHL (forest thickets)	Along the OHL (forest thickets)
Scale	Low	Low
Duration/Frequency	Permanent	Permanent
Likelihood	Likely	Likely
Magnitude	Low	Negligible
Sensitivity	Low	Low

Significance	Minor	Insignificant

Table 7-30 Impacts to flora and vegetation during operation and maintenance

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Low	Low
Geographic Extent	Along the OHL	Along the OHL
Scale	Low	Low
Duration/Frequency	Permanent	Permanent
Likelihood	Likely	Likely
Magnitude	Low	Negligible
Sensitivity	Low	Low
Significance	Minor	Insignificant

Table 7-31 Impacts to birds and bats during operation and maintenance

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	High	Low
Geographic Extent	OHL between km 19 to km 28	OHL between km 19 to km 28
Scale	Low	Low
Duration/Frequency	Permanent	Permanent
Likelihood	Likely	Likely
Magnitude	High	Low
Sensitivity	Low	Low
Significance	Moderate	Minor

7.10.4 Decommissioning phase

Depending on the approach and technologies available at decommissioning stage, the line will be dismantled and removed from the project area. The impacts and mitigation measures will be related to likely disturbance or displacement of species due to line dismantling works, and will be similar to construction stage although to a smaller scale.

7.11 Economy, Employment and Income

7.11.1 Overview

This section assesses the potential impacts on economy and employment that may arise from the construction, operation and decommissioning phases of the Project. Key potential impacts are considered the following:

Table 7-32 Key potential impacts on economy and employment

Construction phase	Operation phase	Decommissioning phase
• Temporary direct and indirect employment opportunities • Temporary economic impact from procurement of goods and services, and worker spending as well as compensation payments	• Economic impact of transmission line operation to national economy	• Temporary direct and indirect employment opportunities • Temporary economic impact from worker spending in the local area

7.11.2 Construction phase

7.11.2.1 Potential impacts

Project construction works will cause a number of impacts to the local and regional economy. These will mainly be positive, temporary and restricted to the construction period.

The impacts will be related to project spending for the purchase of materials and services as well as to creating employment opportunities for skilled and (mostly) unskilled personnel which can be exploited by the local population along the transmission line route. The project can help in maximising these positive impacts for the benefit of the local communities affected by project construction.

7.11.2.2 Employment opportunities

Most of the economic and employment impacts from the project can be expected to accrue during the construction phase. The project will need to hire and accommodate workers and purchase goods and services, potentially resulting in positive impacts on the local communities.

Temporary employment during the construction phase includes people directly employed by the primary contractor for the construction and upgrading of roads and infrastructure (pre-construction) and construction of the transmission line and substation. It also includes jobs supplying the goods and services needed to support the construction process, including food and transport services and support staff in construction sites.

Although the number of workers likely to be needed for construction activities will largely depend on the contractor, it is estimated that 250 – 300 staff will be involved. Many of these workers will be specialised, not from the project area and only stay in the project area as long as their specialised skills are required. However, there will be need for unskilled personnel to support construction activities, i.e. for clearing vegetation, transportation of staff and materials, reinstatement, etc. Preference will be given to local staff for these positions, provided that this does not contradict national and international regulations on competition and procurement.

The purchase of goods and services during construction may also generate some local employment opportunities, mainly in nearby cities and in settlements close to the construction sites for the line and the substation.

It is expected that the employment opportunities generated by the project will provide more employment options to the local population, and therefore the relevant impacts are considered positive.

7.11.2.3 Economic impacts

Economic impacts during OHL construction will stem from procurement of goods and services by the project and induced economic effects of spending by project employees.

Detailed information on the procurement needs for the construction phase is not yet available. In general terms, the types of goods and services required will include:

- Transport, catering, laundry, food supply, security services for construction sites;
- Supply of vehicles, machinery and equipment;
- Provision of construction materials including aggregates/sand, concrete, and building materials

It is assumed that most services (including transport, laundry, catering, etc.) can be sourced from local or regional companies. This will be specifically targeted by the project so that the economic impact from purchase of goods and services will primarily accrue at a local or regional level.

The economic impact of spending in the local economy by project employees is expected to be relatively small, due to the relatively short duration of the construction period in each specific location. However, benefits are expected to accrue for local population centres, local tradesmen, café owners and others with existing formal businesses from project employee spending for subsistence and recreation. Multiplier effects resulting from increased employment will include increased local and national public revenues such as taxes to the Zambia Revenue Authority (ZRA) and contributions to the National Pension Scheme Authority (NAPSA) from formally employed persons and other indirect taxes resulting from the construction project such as VAT on materials and services.

Experience from construction projects shows that such temporary local economic booms occur in most large construction projects, particularly where there is no rapid market response to increase production or supply. As a result, employment and salaries, procurement of goods and services by the project and its workers, as well as compensation payments to PAPs, may lead to local inflation in markets for various consumables. Local people who do not benefit economically but rely on purchasing goods at local markets at inflated prices may experience a reduction in their real income and purchasing power. This represents a negative impact for certain segments of the local population..

Overall, the relevant impacts to local and regional economy are considered positive.

7.11.2.4 Mitigation measures

In order to further enhance the positive impacts to local economy and employment, ZESCO and its contractors are committed to recruit and source locally, work with local businesses and give preference to both. Specific mitigation measures in line with this concept include the following:

- The project will work with local authorities and employment organisations to ensure that all positions are advertised in a manner that is accessible to the settlements and communities crossed by the transmission line route.
- The project will ensure that the recruitment process is fair and transparent, public and open to all regardless of ethnicity, religion or gender.
- The project will stipulate that the Contractors provide clear contracts prior to mobilisation stipulating working hours, pay, and other terms of employment.
- As part of the tendering process, Contractors will be required to develop a purchasing strategy that stipulates how purchase of goods will be optimised at regional and local level.
- Immediately upon opening a tender the project will make information on tendering opportunities available to local businesses through trade and industry chambers and local business organisations along the transmission line route.
- Efforts should be made to inform suppliers of local consumables that an increased demand will likely materialise to encourage adequate supply and minimising local inflation during the construction phase.

7.11.2.5 Residual impacts

The following table presents a summary of the residual impacts associated to the impacts identified.

Table 7-33 Impacts to economy, employment and income during construction

Type of Impact	Direct	
Status	Positive	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Low	Low
Geographic Extent	Local / regional	Local / regional

Scale	Low	Low
Duration/Frequency	During construction	During construction
Likelihood	Likely	Likely
Magnitude	Low	Medium
Sensitivity	Medium	Medium
Significance	Minor	Moderate

7.11.3 Operation and maintenance phase

During operation, the primary economic impact is related with the benefits of the transmission line to ZESCO and the national economy. Such benefits have been presented in more detail in Chapter 4 of this ESIA. They are expected to be positive, permanent and of major significance but mainly outside the project area.

The necessary manpower for maintenance purposes is expected to be provided by ZESCO, in which case potential employment opportunities will be minimal. However, employment opportunities may arise at local level for the maintenance of access roads and the trimming of vegetation at the RoW.

7.11.4 Decommissioning phase

The workforce required for decommissioning the transmission line will depend on the approach taken but is likely to be much smaller than the construction workforce. At this stage, it is thought that decommissioning will require all permanent aboveground elements to be taken down and the sites reinstated (subject to the relevant legislation prevailing at the time of decommissioning).

Economic impacts during the decommissioning phase will be relatively minimal. There will be a small amount of procurement of goods and services associated with the construction sites and some induced economic impact from employee spending.

7.12 Land and Livelihoods

7.12.1 Overview

This section assesses the potential impacts to lands and livelihoods of affected population that will arise from the construction, operation and decommissioning phases of the project. Key potential impacts are considered the following.

Table 7-34 Key potential impacts to land and livelihoods

Construction Phase	Operation Phase	Decommissioning Phase
• Physical displacement • Economic displacement • Loss of livelihoods from temporary land acquisitions	• Loss of livelihoods from permanent land acquisitions • Loss of livelihoods from the establishment of easement	• Temporary use of land due to decommissioning activities • Restoration of land use

Over the entire stretch of the power line from Chipata West Substation to the border with Malawi, a total of 233 hectares of land will be occupied by the wayleave of the power line. The land use of the wayleave is as follows:

- Thicket Habitat 3.5 ha (1.50%)
- Wooded vegetation Habitat 19.2 ha (8.24%)
- Agricultural fields Habitat 150.5 ha (64.59%)

- Built up area Habitat 1.9 ha (0.82%)
- Degraded vegetation Habitat 57.7 ha (24.76%)
- River Crossings Habitat 0.2 ha (0.08%)

Although the proposed power line will traverse some agricultural land, the existing land tenure system will not be affected in the project area. Chiefs, and local authorities will maintain their authority over land during both the construction and operation phases of the project. Most of the land traversed by the transmission line is customary land. However, there are a few parcels of land near the substation and near the border with Malawi which are on lease hold (titled). A total of 57.342 hectares of titled land, belonging to 12 households and one institution (Mwami Mission Hospital) are impacted by the project in Kauzu, Mpande, Lufazi and Pililani villages.

A total of 12.69 hectares of land will be acquired for the substation extension to accommodate the required works.

7.12.2 Construction phase

7.12.2.1 Potential impacts

The project will cause physical displacement as well as temporary and permanent economic displacement of people owning and using land that is affected by the towers, the transmission line and the construction corridor.

In specific, a number of potential impacts to lands and livelihoods are associated with the project construction period. Key impacts are the following:

- Physical displacement, for residential houses and other structures located directly in the construction corridor/wayleave and need to be removed
- Economic displacement of people losing agricultural or otherwise productive land for the construction of the footprint of the towers
- Loss of livelihoods from temporary land acquisition, i.e. in those cases associated with properties that will be used by ZESCO/Contractor during project construction but will be reinstated and returned to their owners when construction ends
- Loss of livelihoods from the restrictions on land use posed on the wayleave (establishment of easement)

7.12.2.2 Physical displacement

The alignment of the transmission line has been selected such that as few as possible residential properties are affected. Despite the effort in minimising physical resettlement impacts, 10 residential properties belonging 7 households will need to be removed from the wayleave. However, after compensation, the affected households are expected to resettle within their communities as there is no scarcity of land.

PAPs affected by physical resettlement are identified, consulted and compensation has been calculated for them, in line with national legislation and international standards, namely EIB ESS6 and WB ESS5. This is described in the RAP for the Zambian section of the OHL, prepared under a separate cover.

It is noted that the area required for the extension of Chipata West substation is already owned by ZESCO and there are no houses or other structures in it.

7.12.2.3 Economic displacement

The project will acquire land for the construction of the substation (12.69 hectares) as well as the installation of the towers along the power line wayleave (233 hectares)

Most of the land in the project area is traditional land belonging to families in the villages along the power line corridor. Family land is punctuated with communal land for grazing, graveyards and other uses. However, around Chipata West Substation, Kauzu and Mpande areas there are some farms on Government lease hold (with title deeds).

PAPs affected by economic resettlement are identified, consulted and compensation has been calculated for them, in line with national legislation and international standards, namely EIB ESS6 and WB ESS5. This is described in the RAP for the Zambian section of the OHL, prepared under a separate cover.

7.12.2.4 Loss of livelihood from temporary land acquisition

During the OHL construction, the wayleave will be cleared from vegetation and used for the installation of the towers, the stringing of the conductors and the traffic of project vehicles transporting staff and materials.

Any income of PAPs from harvesting crops and trees will be lost. These losses are calculated in line with national legislation and international standards, namely EIB ESS6 and WB ESS5, and appropriate compensation is proposed in the RAP for the Zambian section of the OHL.

With the exception of the land used for the installation of the towers, the rest of the wayleave will be reinstated and returned to its previous owners and use except restrictions on planting trees and constructing houses or other structures.

7.12.2.5 Mitigation measures

Taking into consideration that the PAPs are predominantly farmers of low income and limited financial means, the sensitivity of the affected people to the project impacts is considered high, especially with regard to physical displacement. However, appropriate compensation procedures are foreseen to minimise such impacts and support the livelihood of the PAPs. The loss of agricultural land for the installation of the towers is small compared to the total wayleave area, while compensation on replacement value will also be provided. The magnitude of the impact is therefore low. The **impact significance is moderate**.

The project is preparing a Resettlement Action Plan (RAP) in line with the national legislation as well as international standards (EIB ESS6 and WB ESS5), with the following objectives:

- Providing compensation for loss of land and assets at replacement cost;
- As far as possible allow land users to harvest crops and salvage structures prior to land handover and construction activities; If construction commences before harvest time, the affected households will be compensated from the funds allocated in the RAP budget.
- Ensuring that displacement of economic activities is implemented with appropriate disclosure of information, consultation, and the informed participation of those affected;
- Improving or, at a minimum, restoring the livelihoods and standards of living of displaced persons to pre-project levels, so as to facilitate sustainable improvements to socioeconomic status; and
- Paying particular attention to the needs of vulnerable groups

The RAP will be submitted to the Financiers for no objection. Compensations will be paid to PAPs as per the provisions of RAP, prior to any works on site.

7.12.2.6 Residual impacts

The following table presents a summary of the residual impacts associated to the impacts identified.

Table 7-35 Impacts to land and livelihoods during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Moderate	Low

Geographic Extent	Local	Local
Scale	Low	Low
Duration/Frequency	During construction	During construction
Likelihood	Likely	Likely
Magnitude	Moderate	Low
Sensitivity	High	High
Significance	High	Moderate

7.12.3 Operation and maintenance phase

7.12.3.1 Loss of livelihoods from restrictions on the wayleave

Land under the power line wayleave will remain the property of the owner, but access to the land will have some restrictions for safety reasons. Building of houses, shops and other structures under the power line as well as planting of trees (fruit and plantation trees) is prohibited according to The Electricity Act No. 11 of 2019 and The Land Acquisition Act CAP 189 of the Laws of Zambia.

In specific, the use of land in the wayleave will have the following restrictions:

- Construction of houses and other structures is prohibited for safety reasons.
- Planting fruit, plantation trees and other perennial cultivations growing higher than 3m tall (such as bananas and sugarcane), is prohibited for safety reasons.
- Growing of low seasonal crops is permitted except immediately around tower foundations. Towers requires land of 20m x 20m in extent.

Large percentage of the PAPs are involved in the cultivation of seasonal crops, in which case the operation of the line will not have a notable impact. For those losing productive trees or perennial crops, adequate compensation is foreseen in the RAP. The sensitivity of the affected people is considered low while the magnitude of the impact is also low. **Impact significance is minor**.

7.12.3.2 Mitigation measures

Compensation will be provided to the affected households for restricted access and use of the land under the wayleave. The details are presented in the RAP.

7.12.3.3 Residual impacts

The following table presents a summary of the residual impacts associated to the impacts identified.

Table 7-36 Impacts to land and livelihoods during operation and maintenance

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Low	Negligible
Geographic Extent	Local	Local
Scale	Low	Low
Duration/Frequency	During construction	During construction
Likelihood	Likely	Likely

Magnitude	Low	Negligible
Sensitivity	Low	Low
Significance	Minor	Insignificant

7.12.4 Decommissioning phase

The decommissioning phase will require the temporary use of land around the towers and along the transmission line. This will result in temporary impacts on land-based activities and respective livelihoods. However, this will be short-term and compensated under the same principles as construction activities. After decommissioning, the land will be reinstated and returned to former use without any restrictions. This will have a small positive impact on agriculture in the area.

7.13 Labour and Working Conditions

7.13.1 Overview

Labour and working conditions are a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. Labour and working issues are regulated by a number of laws and decrees of the national legislation as well as EIB ESS8 and WB ESS2. Both the national legislation and international standards build on key ILO Conventions that the Government of Zambia has signed and ratified, such as:

- Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98)
- Forced Labour Convention, 1930 (No. 29) (and its 2014 Protocol)
- Abolition of Forced Labour Convention, 1957 (No. 105)
- Minimum Age Convention, 1973 (No. 138)
- Worst Forms of Child Labour Convention, 1999 (No. 182)
- Equal Remuneration Convention, 1951 (No. 100)
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
- Occupational Safety and Health Convention, 1981 (No. 155)
- Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187).

The goals of the above conventions include:

- To establish, maintain and improve the worker-management relationship
- To promote fair treatment, non-discrimination and equal opportunity of workers, and compliance with national labour and employment laws
- To protect the workforce by addressing child labour and forced labour
- To promote safe and healthy working conditions, and to protect and promote the health of workers

7.13.2 Construction phase

7.13.2.1 Potential Impacts

Labour Conditions

Project construction will imply the engagement of significant number of workers, of foreign and national origin, hired by a main Contractor and usually one or several subcontractors. A number of labour-related issues may arise[12]:

[12] Environmental and Social Management System Implementation Handbook - Construction, IFC, 2014

- Overcrowding in residential camps, which compromises the quality of life of the workers and may lead to outbreak and spread of communicable diseases;
- Inadequate water and sanitation services in campsites and on construction sites, affects the wellbeing of the workers and may lead to outbreak and spread of communicable diseases;
- Lack of a comprehensive labour employment (recruitment) procedure may lead to corrupt practices and sexual abuse
- Lack of provision of appropriate personal protective equipment (PPE) may result in injuries and, even death.
- Failure to screen contractors' and subcontractors' possession of licenses leading to assignment of unqualified workers to potentially hazardous work
- Failure to monitor contractors' and subcontractors' compliance with and enforcement of labor laws
- Low awareness of labor laws among contractors and subcontractors as minimum working conditions are typically absent from the subcontracting process
- Use of migrant/temporary labor subject to working conditions below minimum standard established by law
- Restricted freedom of association due to high turnover and hostility of employers to organized labor
- Low wages
- Gender discrimination in terms of employment (such as remuneration)
- Sexual harassment
- Social Conflict arising from competition for women due to the fact that some of the workers may not bring their wives into the project area and will start going out with local women.

The influx of workers may contribute to an increase in teenage pregnancies, considering that Eastern Province has a high prevelency rate.

Experience has shown that most of the above-mentioned problems are related to subcontractors. The main Contractors are usually international companies that often participate in international tenders and are therefore used to the requirements of IFIs. In addition, main Contracts have standard safeguard requirements which cover cases such as the above. In contrast, subcontractors are mostly small, local companies which are selected by the main Contractors on the basis of cost efficiency and are not always made aware of the labour and OHS requirements of the main Contract.

The use of migrant labour is also widespread in the construction industry, particularly for unskilled or low-skilled workers. Many are young inexperienced workers. Temporary work and unfair contracting leave migrant workers vulnerable to violations of freedom of association, forced labor, harassment, unlawful deduction of wages, unpaid overtime and other labor violations. In general, according to the Zambian labour laws, employment may be on a temporary basis, depending on the specific needs and project activities. In any case, both the employers and employees are obligated to follow the stipulations outlined in various legal acts related to labour and social protection legislation. Supervision of implementation of the labour laws is with the Ministry of Labour and Social Protection.

Gender discrimination (usually in the form of lower wages for women) and sexual harassment are often encountered in the construction industry which is a heavily male-dominated environment.

Taking into account that the above-mentioned practices affect relatively vulnerable individuals, the sensitivity is considered medium while the magnitude of the impact is high as such practices are illegal. **Impact significance is major**.

<u>Occupational Health and Safety (OHS)</u>

Most occupational health and safety impacts during the construction, operation, maintenance and decommissioning of the project include exposure to physical hazards from use of heavy equipment and cranes; trip and fall hazards; exposure to dust and noise; falling objects; work in confined spaces; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery.

Occupational Health and Safety Hazards – Electric Power Transmission.

Electric power transmission and distribution projects present a range of specialized occupational hazards due to the presence of high-voltage infrastructure, elevated work platforms, energized equipment, and remote field conditions. The principal hazards include the following:

1. Live Power Conductors

Workers may be exposed to serious injury or fatality from direct or indirect contact with energized conductors during construction, operation, and maintenance activities.

Key risk scenarios include:

- Accidental contact during stringing operations
- Induced voltage exposure on de-energized lines
- Inadequate grounding during maintenance
- Arc flash incidents during switching or substation work

At 400 kV, exposure can result in catastrophic electrical burns, cardiac arrest, or electrocution. Strict adherence to limited approach boundaries, lock-out/tag-out (LOTO) procedures, grounding protocols, and use of qualified electrical personnel is mandatory.

2. Working at Height on Towers and Structures

Construction and maintenance of transmission towers require work at significant elevations, exposing personnel to:

- Falls from height
- Structural instability risks
- Tool or material drop hazards
- Weather-related risks (wind, rain, lightning)

Tower climbing, conductor stringing, insulator replacement, and hardware installation must comply with working-at-height procedures, fall arrest systems, certified climbing equipment, and rescue planning.

3. Electric and Magnetic Fields (EMF)

Electric and magnetic fields are generated by energized transmission lines and electrical equipment. Although EMF exposure levels from transmission infrastructure are generally below international limits when appropriate Right of Way (RoW) widths are maintained, occupational exposure may occur during:

- Substation maintenance
- Prolonged proximity to energized conductors
- Specialized diagnostic or inspection activities

Monitoring should ensure compliance with ICNIRP and national standards. Design considerations such as conductor spacing and RoW width reduce public and occupational exposure risk.

4. Exposure to Hazardous Chemicals

Transmission and substation operations involve hazardous substances including:

- Insulating oils (transformer oil)
- Sulfur Hexafluoride (SF_6) gas used in circuit breakers
- Arc by-products from SF_6 decomposition
- Fuels and lubricants
- Wood preservation chemicals for poles

Exposure risks include inhalation, dermal contact, chemical burns, and environmental contamination. Proper handling, storage, spill response procedures, and PPE usage are required. Faulted SF_6 systems require evacuation and ventilation prior to maintenance due to potentially toxic decomposition products.

5. Lightning Strikes

Transmission infrastructure is typically located in open terrain and elevated environments, significantly increasing exposure to lightning hazards.

Risk factors include:

- Tower climbing during storm activity
- Working at height in exposed landscapes
- Substation work during thunderstorm conditions

Lightning strikes can result in fatal electrocution, secondary falls, and equipment damage. Implementation of a formal lightning safety protocol—including weather monitoring, suspension of elevated work during storms, and proper grounding systems—is essential.

6. Snake Bites and Wildlife Encounters

Transmission corridors traverse grasslands, thickets, wooded vegetation, degraded habitats, and riparian zones—environments that may host venomous snake species.

Workers are particularly vulnerable during:

- Vegetation clearing
- Access road maintenance
- Tower foundation excavation
- Work in tall grass or rocky outcrops

Snake bites can result in serious medical emergencies, particularly in remote locations. Preventive measures include site inspections, vegetation management, PPE (high-ankle boots), worker awareness training, and emergency medical response planning.

Considering that the OHS risks and impacts apply to trained individuals, the sensitivity is considered low. However, the magnitude of the potential impacts is high, as impacts may be life-threatening. **Impact significance is moderate**.

7.13.2.2 Mitigation measures

Labour conditions

A **Labour Management Plan** shall be drafted by the Contractor in order to describe how they intend to comply with the relevant national and EIB ESS8 / WB ESS2 requirements. Among others:

- The Contractor will put in place hiring mechanism to ensure no employee or job applicant is discriminated against on the basis of his or her gender, marital status, nationality, age, religion or sexual orientation;
- Worker accommodation will conform to international standards[13];
- In all contractor contracts, explicit reference shall be made to the need to abide by Zambian law, international standards and ZESCO's policies in relation to labour and welfare standards;
- The Contractor shall provide as part of their induction, training on worker rights and shall require subcontractors

[13] Useful guidance can be found in "Worker's Accommodation: processes and standards" A guidance note by IFC and EBRD

to provide training on workers' rights to their employees;
- The Contractor shall ensure that all its employees have contracts that clearly state the terms and conditions of their employment and their legal rights.
- All workers (including those of contractors and subcontractors) shall be able to join unions of their choice and have the right to collective bargaining;
- To prevent teenage pregnancies arising from the interaction of girls with project workers, the project will work with local service providers and relevant government departments throughout the construction phase to sensitise both the girls and project workers about the dangers of teenage pregnancies and sexually transmitted diseases.
-

In addition, a grievance redress mechanism (GRM) shall be prepared for workers and project staff. Workers shall be informed of the grievance mechanism, and the measures put in place to protect them against any reprisal for its use, at the time of recruitment. Measures shall be put in place to make the grievance mechanism easily accessible to all such project workers. The worker grievance mechanism shall be separate from the community grievance mechanism.

The GRM shall be designed to address concerns promptly, using an understandable and transparent process that provides timely feedback to those concerned in a language they understand, without any retribution, and shall operate in an independent and objective manner. The grievance mechanism shall not impede access to other judicial or administrative remedies that might be available under the law or through existing arbitration procedures.

For sensitive grievances related to Sexual Exploitation, Abuse and Harassment (SEAH), a separate procedure will be developed. The Contractor shall develop and implement a **Code of Conduct (CoC)** for its staff and subcontractors, to establish a zero-tolerance policy against, among others, sexual harassment or any misconduct against female staff, use of alcohol, drugs or any other intoxicating or impairing substances.

The Contractor shall implement measures to prevent risks of human trafficking, forced labour and unfair remuneration, including screening of workers, monitoring of working conditions, and enforcement of contractual obligations in line with national legislation and international standards.

Primary supply workers (e.g. suppliers of construction materials) shall be screened to ensure compliance with applicable labour and working conditions requirements.

ZESCO will supervise project construction and ensure that the Contractor is fulfilling its obligations as per the provisions of the ESMP, the C-ESMP and international best practice.

Occupational Health and Safety

Protection of workers engaged on this project is recognised as a key priority in construction and operation of the proposed OHL and substation.

The Contractor shall prepare an **Occupational Health & Safety Plan** in order to identify, assess and prevent all OHS risks related to project construction. The following provides a preliminary list of OHS risks for power projects (overhead lines, substations) as well as the preventive measures proposed according to international best practice. The Contractor shall verify and update this list on the basis of the particular project characteristics and include OHS provisions and prevention measures in all method statements.

Table 7-37 Summary of OHS risks and prevention measures

Impact of various activities	Severity	Probability	Significance before Preventive Action	Preventive Measures	Significance of Residual Risks
During Construction					
Impact of drilling at tower locations	Critical	Probable	High	Training and education will be provided to all workers involves in drilling and other related works. Effective PPE's will be provided and ensured to use during all works. Machines will be checked and maintained to efficient level to ensure risk free operations.	Low
Operation of heavy equipment and machinery	Critical	Occasional	Medium	Develop safe working procedures, training of the operators and workers and maintain a safe zone, ensuring visibility and stationing flagman.	Low
Excavation and levelling for tower foundation and substation extension	Major	Occasional	Medium	Excavation for tower foundation for a depth of 3-6 m will be required. In addition, cut and fill will also be required at the substation. The Contractor will be responsible for sloping by cutting back the trench wall at an angle inclined away from the excavation. Shoring will require installing aluminum hydraulic or other types of supports to prevent soil movement and cave-ins. Shielding will be required to protect workers by using trench boxes or other types of supports to prevent soil cave-ins. Contractor will design a protective system considering: soil and rock classification, depth of cut, water content of soil, changes due to weather or climate, surcharge loads (e.g., spoil, other materials to be used in the trench) and other operations in the vicinity.	Low
Transportation of construction, tower materials, heavy equipment by road close to tower locations and substation	Major	Occasional	Medium	The Contractor will develop a **traffic management plan** by considering the heavy load, control of traffic in main and other local roads, pavement condition and stability, radius of curvature of the local roads to take turns on sharp curve, etc.	Low

Impact of various activities	Severity	Probability	Significance before Preventive Action	Preventive Measures	Significance of Residual Risks
Working at height for tower erection and substation assembly	Critical	Frequent	High	Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area. Use of fall prevention devices, including safety belt and lanyard, travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines.	Low
Stringing conductors at road, river, and existing transmission line crossings	Critical	Occasional	Medium	Prepare and submit a traffic management plan for approval at least 30 days before commencing work on any project component involved in traffic diversion and management. Ensure the provision of Lifejackets/buoyancy aids with lifeline worn by workers with risk of falling into water. Lifejackets/buoyancy aids should conform to BS EN ISO 12402-1, 2, 3 or 4, or other equivalent international standards according to working conditions. Coordinate with the transmission line staff to plan the work. Take necessary shutdown on the live transmission lines. Provide training and appropriate personal protective equipment to workers.	Low
Transportation of oversized equipment to substation	Major	Occasional	Medium	Ensure that the vehicle route is surveyed and that its geometric design and condition is appropriate for the transportation of the big and heavy load. Ensure that turning curves are appropriate for the special vehicles.	Low
Lifting and Assembly of Heavy Equipment at substation	Major	Occasional	Medium	Lifting equipment selection shall be based on a risk assessment and shall be suitable for the task for which it will be used. Lifting equipment will be inspected and tested regularly by the Inspector of	Low

Impact of various activities	Severity	Probability	Significance before Preventive Action	Preventive Measures	Significance of Residual Risks
				Factories under Ministry of Labour and Social Security as a requirement under CAP 441 Factories Act of the Laws of Zambia.	
Frequent accidents and injuries due to various construction activities without the use of PPE	Critical	Probable	Serious	Contractors will be responsible for supplying effective PPEs to all workforces and staff of consultants and PMU visiting the worksites. Contractors must ensure that all workers and staff are trained how to use them prior to station and visit to construction sites. Any violation of the supply of PPEs by Contractor and use of PPEs by workers will lead to severe penalties.	Low
Community health and safety from construction activities and traffic	Major	Occasional	Medium	Construction areas will be secured using fences	Low
Security of workers and assets	Major	Occasional	Medium	The Contractor shall: • Provide appropriate security personnel (i.e. security guards) to prevent unauthorized entry into the construction area. • Employ night watchman for periods of significant on-site storage or when the area necessitates. • Security personnel and watchmen shall comply with the requirements of WB ESS4. • Ensure there is proper fencing around construction site perimeter. • Ensure construction site has controlled access points (one or two entry points at most), allowing for close monitoring of entry and exit.	Low
During Operation and Maintenance					
Workers' health and safety during maintenance	Critical	Occasional	Medium	Implementation of Standard operating procedures (SOPs) of ZESCO	Low

Impact of various activities	Severity	Probability	Significance before Preventive Action	Preventive Measures	Significance of Residual Risks
Impacts from electric and magnetic fields from transmission lines	Severe	Minimal	Negligible	Exposure to EMF has been considered during the design of the transmission line conductors and right of way to ensure compliance with the internationally recognized standards. The electric and magnetic fields will be regularly monitored during O&M phase to ensure compliance with national limit values and ICNIRP standards and if required additional mitigation measures will be proposed during O&M phase. ZESCO will maintain and clear entire RoW from the establishment of permanent structures. Awareness will be created along the OHL alignment to avoid long exposures under the line.	Negligible
Handling of faulted SF6 in circuit breakers and transformers maintenance	Critical	Probable	Serious	Evacuate the faulted SF6 gas from the circuit breaker and flush with fresh air before working on the circuit breaker. Arc products which do not recombine, or which combine with any oxygen or moisture present, are normally removed by the molecular sieve filter material within the circuit breaker.	Low
Electrical contact during maintenance addressing working near exposed energized overhead lines or substations; working on electrical equipment and systems; and wet locations	Catastrophic	Occasional	Serious	Conduct a job hazard analysis to identify the hazard risks. Follow ZESCO's standard operating procedure for repair and maintenance. Only qualified persons using proper test equipment and personal protective equipment must adhere to limited approach boundary with a distance of 7.25 m for 400 kV voltage. Must comply with the working space requirement for the equipment. Receptacles and cord connectors used in damp or wet locations must be designed for use in wet or damp locations and, unless approved for submersion, must not be allowed to lie in water.	Low

Impact of various activities	Severity	Probability	Significance before Preventive Action	Preventive Measures	Significance of Residual Risks
Thermal risks (e.g. Burns due to short circuit caused by insulation breaks…)	Critical	Probable	Serious	Conduct a job hazard analysis to identify the hazard risks. Follow ZESCO's standard operating procedure for repair and maintenance. Only qualified persons using proper test equipment and personal protective equipment must approach live electrical equipment	Low
Lightning strikes during construction and maintenance activities (working at heights, tower climbing, open-field exposure)	Critical	Probable	Serious	• Suspend all tower climbing, stringing, lifting, or exposed electrical work immediately when thunderstorms are forecast or lightning is detected within a defined radius (e.g., 10 km). • Install lightning detection systems and implement a weather monitoring protocol. • Develop and enforce a Lightning Safety Procedure, including safe shelter identification and evacuation protocols. • Prohibit working at heights during storm conditions. • Ensure all substations and towers are properly earthed and grounded in accordance with IEC and ZESCO standards. • Conduct toolbox talks and worker training on lightning hazard awareness and emergency response. • Maintain first aid and CPR-trained personnel on site at all times.	Moderate
Snake bites and venomous wildlife encounters in wooded, grassland, and	Critical	Probable	Serious	• Conduct pre-work site inspections to identify potential snake habitats (rock crevices, tall grass, debris piles, riparian zones). • Maintain vegetation clearance around camps, substations, and tower working areas. • Require workers to wear appropriate PPE (high-ankle boots, long trousers, gloves). • Prohibit storage of materials in ways that create hiding spaces for snakes. • Provide snake awareness training during induction, including identification of common venomous species in Eastern Province. • Maintain stocked first aid kits including snake bite kits (pressure bandages; no incision/suction). • Establish emergency evacuation procedures and identify nearest medical facilities with antivenom availability. •	Moderate

Impact of various activities	Severity	Probability	Significance before Preventive Action	Preventive Measures	Significance of Residual Risks
				Keep detailed incident reporting and investigation procedures and train personnel in first aid for snake bites.	
Sexual Exploitation, Abuse and Harassment	Critical	Likely	High	Develop and implement a SEAH code of conduct for all workers. Conduct mandatory SEAH awareness training for workers and local communities Conduct Community sensitisation on their rights, reporting channels and available support. Engage local leaders, women's groups and civil society organisations. Establish confidential, survivor-centered Grievance Redress Mechanism. Establish a referral channel to health, psychosocial and legal services. Collaborate with local authorities, local service providers and relevant Government departments.	Moderate

7.13.2.3 Residual impacts

The following table presents a summary of the residual impacts associated to the impacts identified.

Table 7-38 Impacts to labour during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Moderate	Low
Geographic Extent	On-site	On-site
Scale	Low	Low
Duration/Frequency	Short term	Short term
Likelihood	Likely	Possible
Magnitude	High	Low
Sensitivity	Medium	Medium
Significance	Major	Minor

Table 7-39 Impacts to OHS during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Moderate	Low
Geographic Extent	On-site	On-site
Scale	Low	Low
Duration/Frequency	Short term	Short term
Likelihood	Likely	Possible
Magnitude	High	Medium
Sensitivity	Low	Low
Significance	Moderate	Minor

7.13.3 Operation and maintenance phase

7.13.3.1 Potential impacts

During operation and maintenance, the staff involved will be employees of ZESCO who will be employed under temporary or permanent contracts in line with ZESCO's policy and national legislation. Sometimes, ZESCO contracts community based organisations (cooperatives) to carry out vegetation control and are directly supervised by ZESCO. Therefore, no potential impacts related to labour conditions are anticipated.

The OHS risks during operation and maintenance may include:

- Impacts from electric and magnetic fields

- Handling of faulted SF6 in circuit breakers and transformers maintenance
- Electrical contact during maintenance, working near exposed energized overhead lines or substations; working on electrical equipment and systems
- Thermal risks (e.g. Burns due to short circuit caused by insulation breaks…)

Although the above-mentioned risks are high, the maintenance staff is trained, experienced and well-equipped, and the resulting impact significance is minor. More details on the impacts and the mitigation measures are given in Table 7-37.

7.13.4 Decommissioning phase

During decommissioning, provided that the OHL and the substation will be dismantled, risks and prevention / mitigation measures will be similar to construction.

7.14 Community Health, Safety and Security

7.14.1 Overview

A project of this magnitude is expected to have some health, safety and security risks to neighbouring communities, arising from project activities, especially during construction.

7.14.2 Construction Phase

7.14.2.1 Potential Impacts

Community health

Community health impacts during the construction of the transmission line are common to those of most large developments. These impacts include, among others, dust, noise and vibration from construction activities and vehicle transit, and communicable diseases associated with the influx of temporary construction labour.

Additional stress on local resources and supplies

The construction works and camp operation will require supplies such as water, fuel and camp supplies. Obtaining these supplies from the local sources can exert additional pressure on these sources which may already be over-exploited and therefore adversely affect the local communities particularly in remote areas. Any such impact on the local community can increase their hardship and even result in disruption of the construction works.

Social conflicts

The influx of a large number of workers from other parts of the Country and even from other countries can potentially cause conflicts between the project personnel and the local community. This could be because of differences in culture, religion, social norms, acceptable social behaviour and even dress code.

Construction workers are predominantly younger males, away from home, typically separated from their family and act outside their normal sphere of social control. This can lead to inappropriate behaviour, such as sexual harassment of women and girls and exploitative sexual relations with members of the local community, including result in teenage pregnancies.

Mitigation Measures for Gender-Based Violence (GBV) and Sexual Exploitation, Abuse and Harassment (SEAH)

Recognizing the seriousness of these risks, the Project will implement a comprehensive and structured GBV/SEAH Risk Prevention and Response Framework integrated into the Environmental and Social Management Plan (ESMP).

1. Project-Level Prevention Measures

1.1 Mandatory Code of Conduct

- All contractor and subcontractor personnel shall sign and adhere to a **zero-tolerance Code of Conduct** explicitly prohibiting:
    - Sexual exploitation and abuse
    - Sexual harassment
    - Transactional sex
    - Sexual relationships with minors
    - Gender discrimination and intimidation
- Breach of the Code shall result in disciplinary action, including termination and referral to law enforcement.

1.2 Induction and Continuous Training

- Mandatory GBV/SEAH induction for all workers prior to site mobilization.
- Refresher training conducted quarterly.
- Training content to include:
    - Definitions and examples of GBV/SEAH
    - Legal consequences under Zambian law
    - Cultural sensitivity and respectful engagement
    - Reporting mechanisms and survivor-centered approach.

1.3 Workforce Management Controls

- Strict enforcement of:
    - Controlled camp access
    - Curfews and visitor restrictions
    - Prohibition of alcohol abuse in camps
- Deployment of trained security personnel vetted for misconduct history.
- Gender-sensitive camp design (separate sanitation facilities, lighting, privacy).

2. Community-Level Safeguards

2.1 Community Awareness Campaigns

- Structured community engagement sessions to:
    - Raise awareness about GBV/SEAH risks
    - Inform communities about complaint mechanisms
    - Promote rights awareness for women and vulnerable groups
- Information materials to be disseminated in local languages.

2.2 Grievance Redress Mechanism (GRM)

- Establish a **confidential, survivor-centered grievance mechanism** that:
    - Allows anonymous reporting

- Protects complainant identity
- Ensures non-retaliation
- Provides multiple reporting channels (community focal points, hotline, CSC, PMU)

- Immediate referral pathways to health, psychosocial, and legal support services.

3. Collaboration with Specialized Organizations

To strengthen prevention, response, and survivor support systems, the Project will formally collaborate with:

- Local and national **GBV service providers**
- Ministry of Community Development and Social Services
- Zambia Police Victim Support Unit
- Civil society organizations specializing in:
  - Women's rights
  - Child protection
  - Legal aid
  - Psychosocial counselling
- Health facilities capable of providing post-incident medical care

Formal Memoranda of Understanding (MoUs) will be established where feasible to ensure:

- Rapid referral pathways
- Survivor-centered case management
- Confidential data handling
- Monitoring and reporting coordination

This collaboration ensures alignment with national GBV Action Plans and enhances institutional response capacity within host communities.

4. Monitoring, Reporting and Accountability

- Appointment of a **GBV/SEAH Focal Point** within the Contractor's ESHS team.
- Monthly reporting (without breaching confidentiality) on:
  - Training delivered
  - Awareness sessions conducted
  - Complaints received and resolved
- Independent audits by the CSC and ZESCO.
- Immediate notification protocol for serious incidents.

5. Sanitation, Welfare and Worker Facilities

To reduce vulnerability and harassment risk:

- Provision of adequate, gender-segregated sanitation facilities.
- Safe water supply and hygiene infrastructure.

- Adequate lighting in camps and work sites.
- Clear separation between worker accommodation and residential community areas.

6. Residual Risk Assessment

With strengthened prevention, collaboration, monitoring, and survivor-centered response mechanisms in place, the residual GBV/SEAH risk is expected to be reduced to **low to moderate**, subject to continuous monitoring and adaptive management.

Any such impact can be detrimental to the project since it can potentially cause tension between the project and local communities and disruption of construction works.

<u>**Accidents**</u>

Unattended construction sites may also be a safety risk for the local population and especially children of the neighbouring communities, who may wander around from curiosity or using the work sites as playground.

Accidents in the worksites (such as fire, explosions, major spills) may also affect the neighbouring communities, depending on the type of accident, scale and environmental conditions.

Security of Project Assets and Anti-Vandalism Measures

(Community Health, Safety and Security – CHSS)

1. Overview

Construction of the Malawi–Zambia 400 kV Interconnector will involve the deployment of high-value materials and equipment, including transmission towers, conductors, insulators, fuel, vehicles, machinery, and temporary camp infrastructure. These assets may be vulnerable to theft, vandalism, sabotage, and unauthorized access during construction and early operational phases.

In addition to economic losses, vandalism of transmission infrastructure poses serious public safety risks, including electrocution, fire hazards, structural collapse, and interruption of power supply to regional consumers. Unauthorized access to construction sites may also expose community members—particularly children and livestock—to injury from equipment, excavations, or energized systems.

Strengthening asset protection is therefore both a financial safeguard and a public safety obligation under the project's Community Health, Safety and Security framework.

2. Key Risks Identified

Potential security-related risks during construction include:

- Theft of tower components, conductors, and electrical fittings;
- Fuel and equipment theft from construction compounds;
- Intentional damage to installed infrastructure (vandalism or scrap metal theft);
- Unauthorized entry into tower foundation excavations or storage yards;
- Sabotage motivated by land grievances or misinformation;
- Community injury resulting from interference with partially installed infrastructure.

During the operational phase, risks may include:

- Removal of tower bracing, bolts, or conductors for scrap;
- Illegal connections;

- Deliberate damage to tower footings or grounding systems;
- Access to energized structures.

3. Security Management Principles

Security measures shall be implemented in accordance with:

- EIB Performance Standard ESS6 (Community Health, Safety and Security);
- Proportional use of force principles;
- Respect for human rights;
- The Voluntary Principles on Security and Human Rights (where applicable);
- National security and public safety laws.

Security arrangements must not create conflict with local communities or exacerbate social tensions.

4. Anti-Vandalism and Asset Protection Measures

4.1 Physical Security Measures

Construction Phase

- Establish fenced and controlled-access construction compounds;
- Install perimeter fencing, lighting, and lockable storage facilities for equipment and fuel;
- Use tamper-proof storage containers for high-value electrical components;
- Install clear hazard and restricted-access signage in English and local languages;
- Secure partially completed towers and foundations to prevent unauthorized access;
- Deploy night lighting at key storage facilities (security lighting only).

Operational Phase

- Use anti-climb devices on transmission towers in high-risk areas;
- Install anti-theft tower bolts and tamper-resistant fittings;
- Apply serial marking or identification tags to conductors and hardware;
- Avoid easily removable fittings where possible;
- Consider surveillance (where appropriate) at substations or high-risk nodes.

4.2 Security Personnel and Surveillance

- Engage licensed and trained security personnel during construction;
- Ensure security staff receive training on:
    - Community engagement;
    - Human rights compliance;
    - Conflict de-escalation;
    - Non-violent intervention;
- Maintain incident registers documenting theft, attempted vandalism, or security breaches;

- Coordinate with local police and traditional leadership structures for joint response mechanisms;
- Avoid excessive or militarized security presence that may intimidate communities.

4.3 Community-Based Prevention Strategy

Recognizing that vandalism often stems from misunderstanding or economic grievances, the project shall:

- Conduct regular community engagement meetings explaining:
  - The purpose and benefits of the transmission line;
  - The dangers of tampering with electrical infrastructure;
  - Legal consequences of vandalism;
- Promote community reporting mechanisms for suspicious activities;
- Establish a grievance redress mechanism accessible to all stakeholders;
- Engage traditional leaders and Community Resource Boards where applicable;
- Employ local labor where feasible to enhance community ownership;
- Integrate awareness campaigns on electrical safety in schools and villages.

4.4 Transport and Materials Management

- Schedule controlled delivery of conductors and hardware to reduce prolonged on-site storage;
- Escort high-value deliveries where necessary;
- Conduct daily inventory reconciliation of materials;
- Immediately remove scrap materials from site to prevent scavenging.

4.5 Emergency and Incident Response

- Develop a Security Incident Response Plan as part of the Emergency Preparedness and Response Plan;
- Define clear reporting lines for theft, sabotage, or intrusion;
- Immediately investigate all security incidents;
- Record and analyze patterns to strengthen preventive measures;
- Ensure prompt repair of vandalized infrastructure to prevent cascading risks.

5. Monitoring and Compliance

- Monthly security audits during construction;
- Quarterly asset vulnerability assessments during first two years of operation;
- Review of vandalism trends and community feedback;
- Annual reporting to ZESCO and relevant regulatory authorities.

Security personnel

To avoid unauthorised access to construction sites, security personnel may need to be employed by the Contractor. Security personnel can be private (employees of a private security company) or public (such as police or military personnel). Their presence can pose risks to, and have unintended impacts on, local communities. For example, the way in which security personnel interact with communities may appear threatening to them, may lead to conflict and there may be the use of disproportionate force against community members.

The sensitivity of the communities affected by the proposed OHL construction is considered high since people are generally not accustomed to projects of such scale. However, the magnitude of the impacts is low as the project design has generally avoided the proximity to settlements and the anticipated impacts can be easily mitigated with standard engineering measures of good practice. **Impact significance is considered Moderate**.

7.14.2.2 Mitigation measures

The impacts on **communities' health** will be addressed through the following measures:

- Construction camps will be located at least 500 m away from communities. Entry of the site personnel in the local communities will be minimized to the extent possible/appropriate.
- The contractor will prepare and implement a Community Health and Safety Plan that will cover communities' health and safety aspects.
- The communities will be informed about the nature of construction activities and the associated health and safety risks; awareness raising of the communities will be carried out for this purpose with the help of training sessions, posters, signage and other similar means.
- Awareness raising of communities will be carried out in a culturally-sensitive manner, about the communicable diseases including sexually transmitted infections.
- Liaison with the community will be maintained during construction.
- A GRM will be established to address community grievances related to health and safety aspects.

The impacts associated with the **availability of local resources and supplies** will be addressed through the following measures:

- The contractor will prepare and implement a plan to obtain key supplies such as water and fuel, in consultation and coordination with the local communities.
- The plan will ensure that there is no significant impact on the local community and local resources.
- Liaison with the communities will be maintained during construction.
- The GRM described earlier will also address community grievances related to usage of local resources.

The impacts associated with **social conflict** will be addressed through the following measures:

- The contractor will prepare and implement a Code of Conduct (CoC) for all site personnel.
- All site personnel will be provided orientation and training on Code of Conduct. Awareness raising materials such as posters and signage will be used as appropriate.
- Privacy of women will be respected; routes and places used by them will be avoided as far as possible.
- As described earlier, construction camps will be located at least 500 m away from the communities. Entry of the site personnel in the local communities will be minimized to the extent possible/appropriate.
- Liaison with the community will be maintained during construction.
- The GRM described earlier will also address community grievances related to social conflict.

The impacts associated with **accidents** will be addressed through the following measures:

- The construction sites used for considerable time will be fenced as appropriate, and short-term construction sites clearly demarcated, to minimize entry of the local residents, particularly children in the work areas.
- Security personnel will be engaged to guard active construction sites, workers camps, transport vehicles, construction machinery and the equipment storage areas.
- An Emergency Preparedness and Response Plan (EPRP) will be developed and implemented in order to respond to accidental and emergency situations in a manner appropriate to the construction risks.
- The EPRP shall be communicated to the neighbouring communities as well as civil protection authorities.

The EPRP shall be based on prior identification of major accidents, hazards and shall include measures necessary to prevent major accidents and to limit their consequences to local communities. The EPRP shall include, as appropriate:

- engineering controls (such as containment, automatic alarms, and shutoff systems) proportionate to the nature and scale of the hazard;
- identification of and secure access to emergency equipment available on-site and nearby;
- notification procedures for designated emergency responders;
- diverse media channels for notification of the affected community and other stakeholders;
- a training program for emergency responders including drills at regular intervals;
- public evacuation procedures;
- designated coordinator for ERP implementation; and
- measures for restoration and clean-up of the environment following any major accident.

The impacts associated with **security personnel** will be addressed through the following measures:

- Develop and implement a Code of Conduct for security personnel, including behavioural commitments and disciplinary process.
- A policy on "use of force" and clarity on proportionality to risk shall be developed and communicated to security personnel.
- A GRM shall be prepared to manage allegations of abuse by the communities.
- Induction training and refresh training will be provided to security personnel on all the above.

7.14.2.3 Residual impacts

The following table presents a summary of the residual impacts associated to the impacts identified.

Table 7-40 Impacts to Community Health, Safety and Security during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Low	Low
Geographic Extent	Local	Local
Scale	Low	Low
Duration/Frequency	During construction	During construction
Likelihood	Likely	Possible
Magnitude	Low	Negligible
Sensitivity	High	High
Significance	Moderate	Minor

7.14.3 Operation and Maintenance Phase

7.14.3.1 Potential impacts

During the operation phase, the proposed transmission line and associated substation will release electrical and magnetic fields and operational noise (discussed in Section 7.6), which may be considered as community health risk.

7.14.3.2 Electric and magnetic fields

Overview

Electric and magnetic fields (often referred to as EMF) and the electromagnetic forces they represent are an essential part of the physical world. Their sources are the charged fundamental particles of matter (principally electrons and protons). Electromagnetic forces are partly responsible for the cohesion of material substances and they mediate all the processes of chemistry, including those of life itself. People experience the natural magnetic field of the Earth (to which a magnetic compass responds) and natural electric fields in the atmosphere. Electric fields are measured in volts per meter (V/m) or kilovolts per meterkV/m). Magnetic fields are measured in microteslas (µT) or nanoteslanT).

High-voltage power transmission line equipment is a source of extremely-low-frequency (ELF) that modulates the Earth's steady natural electric and magnetic fields.

The amplitude of the electric field modulation depends on the voltage of the OHL equipment, which remains more or less constant as long as the OHL equipment is under operation. The strength of the magnetic field modulation depends on the electrical current (the load) carried by the OHL equipment, which varies according to the demand for power at any given time.

Legal framework

In 1998, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) issued recommendations for low-frequency fields exposure limits, listed in the "Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)". ICNIRP recommendations are applicable both to the long-term exposure of the general public and the short-term exposure at the industrial sites. The exposure limits established in the recommendations are widely accepted all over the world.

Table 7-41 Limit values for exposure to EMF (ICNIRP, 1998)

Exposure of public		Industrial exposure	
Electric field	Magnetic field	Electric field	Magnetic field
5 kV/m	100 µT	10 kV/m	500 µT

In 2020, ICNIRP published a revision of its recommendation[14]. According to this, “there is no evidence of adverse health effects at exposure levels below the restriction levels in the ICNIRP (1998) guidelines and no evidence of an interaction mechanism that would predict that adverse health effects could occur due to radiofrequency EMF exposure below those restriction levels”.

EMF calculations

EMF calculations as well as measurements of actual EMF of transmission lines from various utilities around the world have shown that the intensity of EMF decreases rapidly with distance from the OHL and depends on technical parameters such as conductor height, spacing, current load and grounding design. The measured values at the limits of the wayleave are typically an order of magnitude below the restriction levels of ICNIRP.

As a consequence, **the significance of the associated impacts is minor**.

7.14.3.3 Mitigation measures

Exposure to EMF has already been considered during the design of the transmission line conductors and right of way to ensure compliance with the internationally recognized standards. Hence no additional mitigation measures are proposed.

[14] ICNIRPrfgdl2020.pdf

The electric and magnetic fields will be regularly monitored during O&M phase to ensure compliance with the ICNIRP standards and if required additional mitigation measures will be proposed during O&M phase.

7.14.4 Decommissioning Phase

Community health and safety impacts during decommissioning are similar to those of the construction phase, but are of lower magnitude. They include, among others, dust, noise and vibration from the decommissioning works in the worksites as well as vehicle traffic, risks to people due to the movements of heavy trucks and other project vehicles in the wider project area, accident risks to people and especially children from the neighbouring settlements in case access to worksites is not restricted, and risks to the local population from interaction with construction labour.

7.15 Construction Traffic and Transport

7.15.1 Overview

Construction works, heavy machinery and large transport vehicles and increased intensity and volume of the traffic will affect the normal traffic regime in the project area. The key traffic aspects can generally be grouped in:

- off-site aspects, and
- in-site aspects.

The off-site aspects concern conditions outside the construction sites of the proposed transmission line:

- Selection of routes of access roads and travelling time
- The ability of local roads to accept the planned volume and intensity of the traffic during the construction phase, taking into account technical and operational requirements of large and heavy vehicles
- Safety of the roads
- Plan for the transport and traffic

The in-site aspects concern the conditions within the construction sites:

- Standards for access roads, including possible need for upgrading of the existing ones

7.15.2 Means of Transport

The principal means of transport proposed to service project construction is by road. This is primarily due to the already existing road network in the project area and the flexibility required in delivering machinery and materials to locations in remote areas over difficult terrain and across the project corridor. The railroad alternative, which could be interesting to explore as there is the line Chipata-Mchinji-Nacala that could provide connection to the Indian Ocean for Zambia's imports and exports, is currently not operational.

Transportation and delivery of the transformers and associated equipment and materials to the substation area will be made using specialised vehicles, which will have non-standard dimensions. Some advance works along public roads used for access to the substation may be required, including eventual strengthening of bridges and minor improvements to alignments and road geometry. This will be addressed by the Contractor depending on the actual needs.

7.15.3 Types of Vehicles

The Table below presents information on the assumed types of light and heavy vehicles, which will be used to satisfy construction requirements.

Table 7-42 Vehicles typically used in construction

Light vehicles	Heavy vehicles
Cars	Ready mix concrete
Vans	Trucks
Light tractors	Cranes
4-wheel drive vehicles	Heavy tractors

7.15.4 Key transport routes

The main roads expected to be used for the transportation of materials for the needs of the project include:

- The Great East Road (T4), i.e. the primary route from Lusaka and going northeast into Chipata while passing through towns like Chongwe, Rufunsa, Nyimba, Petauke, Sinda and Katete.
- The Chipata-Mchinji Road going southeast, connects Chipata to Malawi and further links to the Nacala corridor for access to the Indian Ocean port of Nacala in Mozambique.
- The Chipata-Vubwi Road (D804), which serves as the primary link between the district and the provincial capital, Chipata.

D804 is in generally bad condition, with only small sections covered by asphalt and most of the rest covered by gravel. Although the road is earmarked for rehabilitation, this has not taken place yet.

7.15.5 Construction Phase

7.15.5.1 Traffic Impacts

It is clear that the project construction traffic will increase traffic flows on some roads, particularly the local road network and unclassified roads, where the levels of traffic are typically low. The effects of construction traffic on such roads will cause significant increases over baseline traffic flows, however these effects will be short-term, limited to the duration of the works in each location, and be controlled through traffic management measures where necessary.

The following type of impacts is anticipated to arise from the above-described construction traffic:

- Road use delays: the amount of traffic close to a construction site would increase overall traffic in the surrounding area and may affect daily road users, including public transport.
- Road quality: heavy trucks used during the rainy season may result in deterioration of the local roads unless sufficient restrictions are introduced.
- Increase of noise, vibration and air pollution: the traffic of heavy machinery on unpaved roads would increase noise and vibration levels as well as the emissions of dust.

Overall, the construction traffic will have high impacts to the pre-project traffic patterns of the project area as well as the quality of roads, although such impacts will be short in duration and fully reversible once the construction ends. The sensitivity of the area is rather low, as the OHL crosses by design less inhabited areas. As a consequence, the **impact significance is considered moderate**.

7.15.5.2 Reduced Road Safety

During the construction phase, the project will contribute to an increase in traffic on the roads leading to construction sites. Increased traffic will emanate from the transportation of construction materials and workers to site. This heavy traffic will, however, be experienced during working hours from 07.00 hours to 17.00 hours. The construction traffic might cause reduced safety for (unsuspecting) people and animals, especially where it passes through or near the village areas and where homesteads, schools or other facilities used by many people are located close to the road.

On gravel roads, increased traffic will cause dust emission which compromises visibility for road users, and this may result in accidents.

The magnitude of the impact on local communities close to project transport routes is generally low as the project is generally crossing low populated areas, but the sensitivity of the population potentially affected is high. **Impact significance is moderate**.

7.15.5.3 Mitigation measures

Standard mitigation measures apply to project construction in order to minimise traffic impacts. The Contractor shall prepare a **Traffic Management Plan** in consultation with the local authorities and the traffic police, detailing such measures. A non-exhaustive list of measures includes the following:

- Restrict speed limit of construction traffic to 20 km/hr in inhabited areas;
- Advance warning shall be given of any proposed road diversions and blockages;
- Drivers of project vehicles shall be trained/briefed about safe driving with respect to other drivers, non-motorised traffic such as pedestrians, cyclists, and livestock;
- Clear signs and signals shall be set up where necessary and speed humps shall be considered at high risk locations such as schools and markets and implemented where agreed with stakeholders;
- Systematic presence of flagmen in the work areas close to traffic lanes;
- Assignment of heavy vehicle construction traffic to suitable routes to and from the working area and avoiding their use in locations and at times that may damage the roads;
- Information on traffic safety shall be provided to communities not normally subjected to high traffic loads;
- Raising awareness and training of drivers of light vehicles and trucks in elementary safety rules and risks: driving under the influence of alcohol, drugs, speed, tire control, loading (stability);
- Regular vehicle inspections to ensure the vehicles are fit for safe use.
- Access and site roads will be maintained in good condition.

7.15.5.4 Residual impacts

The following table presents a summary of the residual impacts associated to the impacts identified.

Traffic and road quality

Table 7-43 Impacts on Traffic during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Low	Low
Geographic Extent	Local	Local
Scale	Transport routes	Transport routes
Duration/Frequency	During construction	During construction
Likelihood	Likely	Possible
Magnitude	High	Medium
Sensitivity	Low	Low
Significance	Moderate	Minor

Road safety

Table 7-44 Impacts on Road safety during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Low	Low
Geographic Extent	Local	Local
Scale	Transport routes	Transport routes
Duration/Frequency	During construction	During construction
Likelihood	Likely	Possible
Magnitude	Low	Negligible
Sensitivity	High	High
Significance	Moderate	Minor

7.15.6 Operation and Maintenance Phase

Traffic associated with the operation and maintenance phase of the power line will be minimal. Maintenance crews will occasionally drive along the power line for routine inspection and maintenance. Hence, the risks related to road safety will be minimal.

7.15.7 Decommission Phase

During decommissioning, there will be an increase in traffic to transport the recovered conductors, steel and other materials away from site. Impacts to traffic and road safety will be similar to those for project construction.

7.16 Cultural Heritage

7.16.1 Overview

People in the project area value and respect their cultural heritage. Hence, the identification of the project's impacts on cultural resources and the preservation of the cultural sites is of paramount importance.

7.16.2 Construction Phase

7.16.2.1 Potential impacts

Most of the archaeological sites identified during survey in Chipata and Vubwi districts are outside the immediate transmission line corridor. The following two cultural sites were found to be potentially affected by the proposed transmission line project, and have received particular attention.

- **Kauzu Graveyard**: Kauzu Zone graveyard is active and located about 2.8 km from Chipata West Substation. The graveyard was located within the transmission line wayleave. Graveyards are considered to be sacred places and of cultural importance. Any disturbance or destruction of the grave will not be acceptable to the local people. The OHL route was realigned in this area to avoid crossing the graveyard
- **Kauzu Nyau Ritual Site**: The site is used for the training and initiation of teenage boys into culture and cultural practices of the Chewa people that prepare them for adult life. The site was outside the power line wayleave.

However, the cutting of trees in the wayleave might affect the ritual site and erode the sacredness of the site. The OHL route was realigned in this area to avoid crossing the site

With the current knowledge of cultural heritage baseline, the magnitude of the impacts is considered low, however, the sensitivity of likely impacts is high. The **significance of cultural impacts is moderate**.

7.16.2.2 Mitigation measures

During construction, a "chance-find" procedure shall be developed and implemented for accidental findings for the protection of cultural heritage, in accordance with Section 35 and 36 of the National Heritage Conservation Act, as well as EIB ESS10 and WB ESS8. Workers will be trained in the use of these procedures.

If an archaeological site or items of archaeological significance are found during execution of construction works, the Contractor is obliged to:

- cease operations and to secure the site against any damaging and against unauthorized access;
- inform immediately the Project Site Manager and the regional office of the National Heritage Conservation Commission about the discovery; and
- maintain the discovered items in the location and in condition they were found.

7.16.2.3 Residual impacts

The following table presents a summary of the residual impacts associated to the impacts identified.

Table 7-45 Impacts on Cultural heritage during construction

Type of Impact	Direct	
Status	Negative	
Criteria	**Rating**	
	Without Mitigation	**With Mitigation (Residual Impact)**
Intensity/Severity	Low	Low
Geographic Extent	Local	Local
Scale	OHL corridor	OHL corridor
Duration/Frequency	During construction	During construction
Likelihood	Possible	Not likely
Magnitude	Low	Negligible
Sensitivity	High	High
Significance	Moderate	Minor

7.16.3 Operation and Maintenance Phase

There will be no anticipated impacts during the operations and maintenance phase.

7.16.4 Decommissioning Phase

Decommissioning will take place along an already investigated OHL corridor. Therefore, there will be no anticipated impacts during decommissioning.

7.17 Summary of impacts

Table 7-46 Summary of impact significance before and after mitigation

Impact	Sensitivity of the receptor	Magnitude of the impact	Significance of the impact	Magnitude of the impact	Significance of the impact
		Before mitigation		After mitigation (residual)	
Construction phase					
Air quality	Medium	Medium	Moderate	Low	Minor
Noise	Medium	Medium	Moderate	Low	Minor
Hydrology and water resources	Medium	Medium	Moderate	Low	Minor
Geology and soils	Medium	High	Moderate	Low	Minor
Landscape	Low	Low	Minor	Negligible	Insignificant
Riparian habitats	High	Low	Moderate	Negligible	Minor
Forest habitats	Medium	Low	Minor	Negligible	Insignificant
Flora and vegetation	Low	Low	Minor	Negligible	Insignificant
Reptiles	High	High	Moderate	Low	Minor
Economy, employment and income *	Medium	Low	Minor	Medium	Moderate
Land and livelihoods	High	Low	Moderate	Negligible	Minor
Labour and working conditions	Medium	High	Major	Low	Minor
OHS	Low	High	Moderate	Medium	Minor
Community Health, Safety and Security	High	Low	Moderate	Negligible	Minor
Traffic	Low	High	Moderate	Medium	Minor
Road safety	High	Low	Moderate	Negligible	Minor
Cultural heritage	High	Low	Moderate	Negligible	Minor
Operation and maintenance phase					
Landscape	Low	Medium	Minor	Low	Minor
Habitats	Low	Low	Minor	Negligible	Insignificant
Flora and vegetation	Low	Low	Minor	Negligible	Insignificant
Birds	Low	High	Moderate	Low	Minor
Lands and livelihoods	Low	Low	Minor	Negligible	Insignificant

* These impacts are positive

7.18 Cumulative Impact Assessment

7.18.1 Overview

Cumulative impacts refer to the combined, incremental, and interactive effects on the environment and society that result from the project when considered alongside other existing, planned, or reasonably foreseeable developments within the area of influence. These impacts may arise over time and across different spatial scales, often exceeding the sum of individual project impacts. However, there has not been any readily information available on likely projects such as agricultural development projects, proposed conservation areas, electrification projects and the like.

This assessment follows international best practice, including EIB and World Bank standards, to evaluate the potential for cumulative impacts associated with the Malawi–Zambia 400 kV Interconnector Project.

7.18.2 Potential projects

The project area in Eastern Province, Zambia, particularly near Chipata and the border with Malawi, will be experiencing ongoing infrastructure and socio-economic development, which may interact with the project's impacts. Key existing and planned developments include the following.

Table 7-47 Existing and planned developments in the project area

Development	Status
Chipata-Mchinji-Nacala railway line	The rail line is in place but its condition is unknown and the level of investment required to operationalise it has not been disclosed.
Chipata–Lundazi-Chasefu road improvement	The works are currently in progress
Rent-to-Own Housing Project	Unknown
Energy Infrastructure (mini-grids, off-grid solar)	On-going or planned, several small-scale developments

7.18.2.1 The Chipata-Mchinji-Nacala railway line[15]

The Chipata-Mchinji-Nacala railway line stretches 1,150 km from Chipata to the Port of Nacala through Mchinji the border town in Malawi. The Zambian portion is 24km from Chipata to Mchinji and is located 10-15 km north of the OHL project. ZRL, the Zambia Railways Ltd., commenced Chipata -Mchinji train operations in 2014 but had to stop in 2016, due to wash aways between Mchinji and Blantyre caused by heavy rains.

In April 2025, ZRL has commenced meetings with Nacala Logistics, aimed at operationalizing the Chipata-Mchinji railway line, targeting the Nacala port in Mozambique. The meetings aimed at exploring strategic partnerships for the operationalization of the Chipata-Mchinji railway line, the development of Chipata railway station infrastructure as well as corridor diversification.

The discussions are reportedly continuing, and Nacala Logistics and Zambia Railways Limited aim to operationalize the Chipata-Mchinji-Nacala railway line within three months.

7.18.2.2 The Chipata–Lundazi-Chasefu road improvement

The Road Development Agency has commenced improvement works on the Chipata-Lundazi road (heading north from Chipata and not crossing the OHL project area) including heavy grading and installation of drainage structure over a 90-km stretch. As per published information from August 2025, about 70% of the project has been completed.

[15] ZRL UNDERTAKES STRATEGIC PARTNERSHIP MEETINGS FOR OPERATIONALIZATION OF CHIPATA-MCHINJI RAILWAY LINE – Zambia Railways Limited

It is very likely that the road improvement project will have been completed before the commencement of the OHL project.

7.18.2.3 Rent-to-Own Housing project in Chipata[16]

Collins Mutual Limited, a local investment company, has partnered with China State Construction and Engineering Corporation Limited to undertake the project, starting with 2,500 units on 400 hectares of land secured in Senior Chief Nzamane's area. The project is part of a larger development involving the construction of 40,000 housing units at a cost of US$1.9 billion across the country in 10 years.

The area of the housing development has not been made public, while the project was supposed to start 3 years ago.

7.18.3 Potential Cumulative Impacts

There is currently considerable uncertainty over the actual implementation of the projects mentioned in the previous section, or their implementation concurrently with the proposed OHL. In specific:

The Chipata-Mchinji-Nacala railway line depends on the cooperation of ZRL with Nacala Logistics and possibly other international partners. The current condition of the section Chipata-Mchinji, which is likely to generate cumulative impacts with the proposed OHL, is currently unknown. However, the reported estimates of ZRL that the line can be operational within 3 months shows that the required works are of small scale and are thus unlikely to have any considerable cumulative impacts with the proposed OHL even if their construction works coincide.

The Chipata-Lundazi road is currently in progress and towards its completion. Under normal circumstances, the project will have been completed prior to the commencement of construction of the proposed OHL. As a consequence, no cumulative impacts are anticipated.

The Housing project carries a lot of uncertainty as its project area has not been disclosed, while its start has been postponed a number of times since 2020 when it was announced. If it is finally implemented in the wider area of Chipata, as announced, it is likely to require several years of construction and will thus coincide with the construction of the proposed OHL. More details on its size and location will be required to calculate the anticipated cumulative impacts, however, the following impacts can be mentioned:

- **Habitat Loss and Fragmentation**
  Unlike the proposed OHL, which by design avoids crossing Miombo woodlands and impact riparian zones, the Housing Project is expected to occupy a large area of land and thus impact on habitats, biodiversity and ecological connectivity.

- **Increased Human Access and Resource Pressure**
  The construction of access roads and the development of the housing infrastructure may facilitate human intrusion into previously inaccessible areas, compounding pressures on forests, wildlife, and other natural resources when combined with urban development.

- **Socio-Economic Dynamics**
  The Housing Project construction will require considerable numbers of workers who will not be possible to be sourced from the local area. This will drive population influx, increase demand for services, social tensions and community health and safety risks – similar to the ones described for the Proposed OHL but to a larger scale.

[16] Zambia : Rent-to- own housing project launched in Chipata

7.18.4 Mitigation measures

The following general mitigation measures are proposed to reduce the significance of cumulative impacts.

- Maintain intact miombo vegetation to the extent possible, by integrating interconnected green zones in the housing development area;
- Avoid impacting riparian vegetation;
- Ensure water quality in rivers and streams is maintained by avoiding wastewater and waste discharge into rivers and streams in the development area;
- Ensure that the housing development includes the development of essential services (education, health, sanitation, waste management, recreation, etc.) in order to minimise pressure on existing social amenities;
- Introduce Code of Conduct and train foreign staff on their interaction with the local population;

7.19 Transboundary Impacts

Malawi–Zambia 400 kV Interconnector Project

Transboundary impacts refer to environmental, social, or economic effects that extend beyond the national boundaries of the country implementing the project. Such impacts may occur in neighbouring countries, across regional ecosystems, or, in some cases, contribute to broader global environmental processes.

The Malawi–Zambia 400 kV Interconnector is a critical regional energy infrastructure project designed to facilitate electricity trade, improve grid stability, and enhance energy access between Zambia and Malawi. The project involves constructing a high-voltage transmission line, associated substations, and supporting infrastructure, with the physical interconnection crossing the Zambia–Malawi border.

The project will be designed and implemented within the framework of existing bilateral and regional agreements. Key coordination mechanisms include:

- Bilateral cooperation between Zambia and Malawi energy authorities.
- Engagement with the SADC Regional Energy Programmes.
- Compliance with transboundary environmental obligations under the Convention on Biological Diversity and other relevant treaties.

The impact assessment presented in previous sections has shown that no significant negative environmental or social impacts were identified that had a larger than local geographical scope. The identified impacts will be managed as described in the previous sections by ZESCO, keeping ESCOM informed, in the framework of the bilateral cooperation of the two countries. Similarly, an ESIA has been prepared by ESCOM in order to manage the corresponding impacts of the OHL in Malawi.

8 Environment and Social Management Plan (ESMP)

8.1 Introduction

The Environmental and Social Management Plan (ESMP) for the Malawi–Zambia 400kV Interconnector Project has been designed to guide the identification, prevention, mitigation, and management of adverse environmental and social impacts, including health and safety, throughout the project lifecycle.

The ESMP ensures alignment with national regulatory frameworks, including ZEMA requirements, and adheres to international best practices such as EIB and World Bank Environmental and Social Standards. This includes implementing the mitigation hierarchy as described in Section 7.1 above, including assessing different alternatives and layouts (line routes) to avoid and minimise risks and impacts in collaboration with the separate engineering consultant undertaking the Feasibility Study in parallel with this ESIA. A separate RAP is being prepared and includes details related to physical and economic displacement that are not elaborated below.

8.2 Objectives of the ESMP

The basic objective of the ESMP is to manage adverse impacts and hazards of proposed project interventions in a way that minimises the adverse impact and risk on the environment, workers, and community during construction and operation stages of the Project. The specific objectives of the ESMP are to:

- Facilitate the implementation of the mitigation measures discussed earlier in the document;
- Maximise potential project benefits and control negative impacts;
- Address occupational health and safety (OHS) hazards and corresponding preventive measures during construction and operation stages;
- Draw responsibilities for ZESCO, contractors, consultants, and other members of the project team for the environmental, health, safety, and social management of the Project;
- Define a monitoring and supervision mechanism and identify monitoring and inspection parameters in order to:
    - Ensure the complete implementation of all mitigation measures and preventive actions,
    - Ensure the effectiveness of the mitigation measures and preventive actions;
- Assess environmental, health, safety training requirements for different stakeholders at various levels.

8.3 ESMP implementation

Organisational Roles, Responsibilities and Reporting Structure
1. Institutional Framework for ESMP Implementation
Effective implementation of the Environmental and Social Management Plan (ESMP) requires a clearly defined institutional framework outlining roles, responsibilities, authority, and reporting lines among all project stakeholders. For the Malawi–Zambia 400 kV Interconnector Project, ESMP implementation will be undertaken through coordinated action between:

- **ZESCO Limited (Project Proponent / Employer)**
- **Engineering Consultant / Construction Supervision Consultant (CSC)**
- **EPC Contractor**
- **Regulatory Authorities and Oversight Institutions**
- **Local Government and Community Structures**

This framework ensures accountability, transparency, regulatory compliance, and effective monitoring of environmental and social performance throughout construction and commissioning.
2. Roles and Responsibilities

8.3.1 Role of the Project Owner

ZESCO Limited (Project Proponent)
ZESCO retains overall responsibility for environmental and social compliance.
Key Responsibilities:

- Overall accountability for ESMP implementation.
- Ensure ESMP requirements are incorporated into bidding and contract documents.
- Provide oversight and approval of Contractor's site-specific management plans.
- Ensure compliance with national legislation and EIB Environmental and Social Standards.
- Commission independent environmental audits.
- Report ESMP compliance to regulators and financiers.
- Ensure adequate budget allocation for ESMP implementation.

Key Positions:

- **Project Manager (PMU)**
- **Environmental & Social (E&S) Manager**
- **Resettlement & Social Safeguards Specialist**
- **Health, Safety & Security Coordinator**
- **Stakeholder Engagement Officer**

Reporting Line:
Contractor → CSC → ZESCO PMU → Financiers & Regulators

8.3.2 Obligations of the Contractor

Construction Supervision Consultant (CSC)
The Consultant acts as the supervisory and verification body on behalf of ZESCO.
Key Responsibilities:

- Day-to-day supervision of Contractor ESMP implementation.
- Review and approve site-specific management plans.
- Verify implementation of mitigation measures.
- Conduct site inspections and compliance audits.
- Issue corrective action notices where necessary.
- Prepare monthly environmental and social compliance reports.
- Validate completion of rehabilitation works.

Key Positions:

- **Resident Engineer**
- **Environmental Specialist**
- **Social Safeguards Specialist**

- **Biodiversity Specialist**
- **Health & Safety Officer**

Reporting Line:
CSC reports directly to ZESCO PMU.
EPC Contractor
The Contractor is directly responsible for implementing ESMP mitigation measures.
Key Responsibilities:

- Prepare and implement site-specific management plans prior to mobilization.
- Ensure full compliance with ESMP requirements.
- Provide qualified E&S personnel on site.
- Conduct routine monitoring and internal reporting.
- Implement corrective measures immediately upon identification of non-compliance.
- Maintain grievance mechanism at site level.
- Submit monthly ESMP performance reports to CSC.

Key Positions:

- **Site Manager**
- **Environmental Officer**
- **Social Officer / Community Liaison Officer**
- **Occupational Health & Safety Officer**
- **Biodiversity Officer (where required, e.g., Pancake Tortoise SSAP implementation)**
- **Security Coordinator**

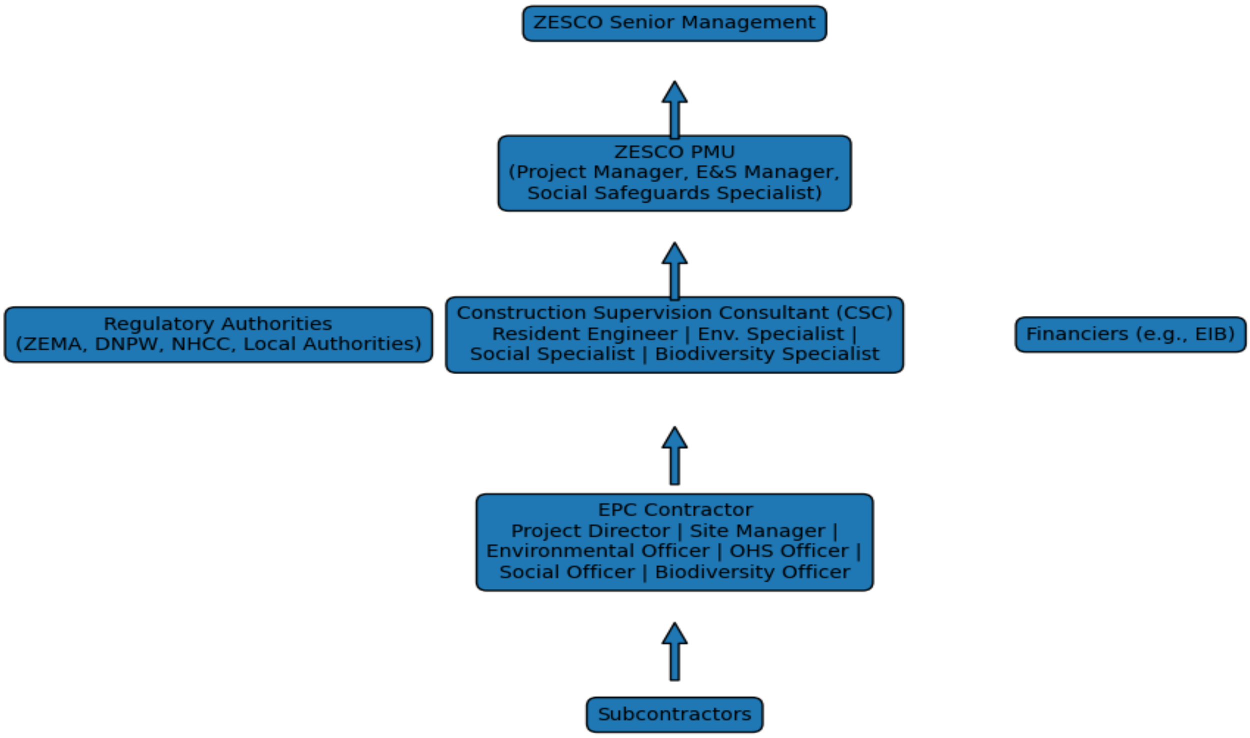
Internal Reporting Line:
Environmental & Social Officers → Site Manager → Project Director → CSC
Regulatory Authorities and Key Institutions
The following institutions will provide regulatory oversight and statutory approvals:

Institution	Role
ZEMA (Zambia Environmental Management Agency)	ESIA approval, environmental compliance monitoring, environmental audits
Department of National Parks & Wildlife (DNPW)	Wildlife protection, species-specific permits (e.g., Pancake Tortoise), biodiversity oversight
National Heritage Conservation Commission (NHCC)	Cultural heritage protection
Ministry of Lands & Natural Resources	Land use compliance
Local Authorities / District Councils	Local land use and community coordination
Ministry of Community Development & Social Services	Resettlement oversight
Ministry of Labour	Labour compliance and worker protection
Zambia Police Service	Security coordination and anti-vandalism support

Working and Reporting Lines
To streamline communication and ensure clarity:
Primary Reporting Hierarchy:

1. **Contractor Environmental & Social Team**
   ↓

2. **CSC Environmental & Social Specialists**
   ↓
3. **ZESCO PMU Environmental & Social Manager**
   ↓
4. **ZESCO Senior Management**
   ↓
5. **Regulators and Financiers (e.g., EIB)**



Organogram for Project Implementation

ZESCO, as the project owner, is overall responsible for the ESMP implementation. A key element is effective contractor management because many activities will be undertaken by contractors and subcontractors rather than ZESCO during construction. ZESCO will therefore incorporate relevant ESMP requirements into tender documents and ensure that tender evaluation criteria cover ESHS risk management (e.g., contractor knowledge and experience) and is reflected in the costs. Client monitoring and supervision of contractors as well as reporting requirements will also include ESHS. Contractors will be required to reflect relevant ESHS requirements in the conditions for any subcontractors and main suppliers.

8.3.1.1 Construction Environmental and Social Management Plan (C-ESMP)

The ESMP of the Project will be included in the contractual documentation for the engagement of the Contractor. The technical specifications within the contractual documentation will clearly state that the Contractor will need to comply with the mitigation measures and preventive actions provided in the ESMP; EIB ESS, WB ESS and EHS General Guidelines; ILO Conventions, WHO Guidelines on Environmental Noise, and Zambia’s environmental, social, H&S legislation and standards.

The Contractor will be required to prepare a Construction Environmental and Social Management Plan (C-ESMP), demonstrating the manner in which they will comply with the requirements of the ESMP. They will also prepare the specific management plans requested in the ESMP.

The C-ESMP will be submitted within 30 days of Contractor’s mobilization and will be approved by ZESCO prior to starting any construction activities. The C-ESMP will be used as a monitoring tool for compliance. Violation of the compliance requirements will be treated as non-compliance leading to the corrective measures or otherwise imposing penalty on the contractor.

8.3.1.2 Occupational Health and Safety Plan (OHS Plan)

The Contractor will also prepare an occupational health and safety (OHS) plan in line with the general guidelines for the identified hazards and preventive measures presented in the site specific actions in the ESIA. The EIB ESS, WB ESS and EHS General Guidelines, as well as national legislation will be the applicable regulatory framework. If these guidelines cannot address a specific OHS management in the project, international good practice will be applied, as for example, OSHA, ILO, etc. Review and update of the OHS plan will be done (a) when there is a change in the scope of the project, (b) there is a change in construction methodology/technique based on site conditions, (c) following the identification of a significant OHS hazard or a major accident, and (d) at the end of the Project (to allow for improvements in subsequent projects).

The OHS Plan should contain general guidance for all identified hazards under each work activities and they should be presented in three discrete headings, (a) Contractor’s Standards on the identified hazard management, (b) Expected Site specific OHS hazard and risks during construction, and (c) Control and Preventive Measures proposed by the Contractor.

Among other provisions, the OHS Plan shall:

- Specify that OHS training is mandatory for all workers
- Require the Contractor to maintain records of all occupational accidents, diseases, and other dangerous incidents or occurrences
- Require the Contractor to inform the relevant local healthcare institution(s) about the expected number of workers for OHL and SS construction and include information on their service capacities and potential alternatives.
- Require the Contractor to notify the local firefighting unit about the construction site locations and the expected duration of works, and to ensure that an adequate type and quantity of firefighting equipment is available and accessible at the construction site.
- Require regular monitoring of weather conditions and implementation of appropriate responses to extreme conditions (e.g. suspension of work during heatwaves to protect workers from heat exposure).
- Include specific provisions for managing the risk of potential snake bites, including prevention and emergency procedures

8.3.1.3 Job Hazard Analysis

Job hazard analysis (JHA) will be conducted for each construction component focusing on job tasks as a way to identify hazards before they occur. It will focus on the relationship between the worker, the task, the tools and the work environment. In principle, after identifying uncontrolled hazards, steps should be taken to eliminate or reduce them to an acceptable risk level.

The JHA should be one of the major components of the larger commitment of the Contractor's Health and Safety Management System. The JHA should be conducted on many jobs in the worksite. Priority should be given to the following types of jobs:

- Jobs with the highest injury or illness rates;
- Jobs with the potential to cause severe or disabling injuries or illness, even if there is no history of previous accidents;
- Jobs in which one simple human error could lead to a severe accident or injury;
- Jobs that are new or complex to the construction or have undergone changes in construction processes and procedures; and
- Jobs complex enough to require written instructions.

8.3.1.4 ESHS in Method Statements

The Contractor shall include an ESHS section in each Method Statement. This ESHS section will be based on the JHA, environmental and social issues of the site and specific to construction methods to be followed by the Contractor. This section will be reviewed by the ESHS Specialists of the Construction Supervision Consultant (CSC) and confer approval along with other technical parameters to be reviewed by the engineering team of the CSC. Each revision of the method statement should also be reviewed by the ESHS specialists, and their concurrence will be required to get them approved.

8.3.1.5 Incident and Accident Reporting

The Contractor shall implement an incident reporting protocol, including notification of serious incidents (e.g. fatalities, OHS incidents, spills, security incidents, SEA/SH allegations) to the PIU within 48 hours or sooner for severe cases. Incidents shall be recorded, investigated, and corrective actions implemented. SEA/SH cases shall follow a survivor-centred approach. The PIU shall report relevant incidents to the World Bank.

8.3.4.6 **ESS3: Hazardous Materials and Waste Management**

Introduction

In line with the requirements of **World Bank Environmental and Social Standard 3 (ESS3): Resource Efficiency and Pollution Prevention and Management**. While existing ESMP provisions address aspects of hazardous materials handling, the Project acknowledges the World Bank's recommendation to establish a more **integrated, systematic, and auditable framework**. Accordingly, the ESIA and ESMP will be updated to incorporate a **comprehensive Hazardous Materials and Waste Management Plan (HMWMP)**. This plan will provide a structured approach to the identification, handling, storage, transport, and disposal of hazardous substances, ensuring full compliance with **ESS3**, national regulatory requirements, and international good practice.

The HMWMP will cover both the **construction phase** and the **operation and maintenance (O&M) phase**, and will include the following key components:

1. Hazardous Materials Inventory and Control

- Establish and maintain a **centralized hazardous materials register** covering all substances used during construction and O&M, including:
    - Sulphur hexafluoride (SF_6) in GIS equipment;

  - Transformer and insulating oils;
  - Fuels, lubricants, and other chemicals.
- Implement **inventory tracking systems** (receipt, storage, use, and disposal) to ensure full traceability and accountability.
- Maintain up-to-date **Material Safety Data Sheets (MSDS)** at all operational sites.

2. SF_6 Gas Management (GIS Equipment)

Recognizing SF_6 as both a **hazardous substance and a high global warming potential (GWP) gas**, the following measures will be implemented:

- Inventory control and continuous monitoring of SF_6 quantities;
- Installation of **leak detection systems** and routine inspection protocols;
- Implementation of **preventive maintenance programmes** to minimize leakage;
- Recovery, recycling, and reuse of SF_6 during maintenance and decommissioning using certified systems;
- Maintenance of detailed **handling records and emission logs** to support environmental reporting and auditing.

3. Transformer Oil Management

- Storage of transformer oil in **bunded areas with secondary containment** (minimum 110% of the largest tank capacity);
- Installation of **oil-water separators** where required;
- Use of **impermeable surfaces** in storage and handling areas;
- Implementation of **safe handling procedures** for filling, draining, and maintenance activities;
- Routine inspection for leaks and structural integrity of storage systems.

4. PCB Screening and Management

- Conduct **screening for Polychlorinated Biphenyls (PCBs)** in any legacy or refurbished equipment, where applicable;
- Ensure that any PCB-containing equipment is:
  - Clearly identified and labelled;
  - Managed in accordance with the **Stockholm Convention** and national regulations;
  - Disposed of through **licensed hazardous waste facilities**.

5. Waste Management Framework (Waste Hierarchy Approach)

The Project will adopt the internationally recognized **waste hierarchy**, prioritizing:

1. Avoidance
2. Reduction
3. Reuse
4. Recycling
5. Safe treatment and disposal

Key measures will include:

- Segregation of **hazardous and non-hazardous waste at source**;
- Identification and recovery of **recyclable waste streams** (e.g., scrap metals, packaging materials);
- Minimization of hazardous waste generation through improved material handling and procurement practices.

6. Storage, Transport, and Disposal

- Establishment of **designated hazardous waste storage areas** with appropriate containment, labelling, and signage;
- Use of **licensed and approved waste transporters**;
- Disposal at **authorized facilities** in compliance with ZEMA and local government regulations;
- Implementation of a **waste manifest system** to ensure cradle-to-grave tracking of hazardous waste.

7. Spill Prevention and Emergency Response

- Provision of **spill kits** at all high-risk locations (e.g., substations, fuel storage areas, maintenance yards);
- Development of **site-specific spill response procedures**;
- Conduct of regular **emergency response drills**, including oil and chemical spill scenarios;
- Training of personnel in **spill containment, clean-up, and incident reporting**.

8. Monitoring, Auditing, and Reporting

- Routine inspection and monitoring of hazardous materials handling, storage, and disposal practices;
- Maintenance of comprehensive records, including:
  - Hazardous materials inventory;
  - SF_6 usage and emissions;
  - Waste generation and disposal logs;
- Periodic **internal and external audits** to verify compliance with ESMP, national legislation, and lender requirements;
- Integration of hazardous materials management into the **overall ESMP monitoring and reporting system**.

9. Institutional Responsibilities

- The **Contractor** will be responsible for implementing the HMWMP during the construction phase;
- **ZESCO** will oversee compliance and implement HMWMP requirements during operation;
- The **Construction Supervision Consultant (CSC)** will monitor implementation and compliance;
- **ZEMA and other relevant regulatory authorities** will provide oversight and enforcement.

8.3.4.7 **Borrow Pits, Aggregates, and Material Sourcing (ESS1 & ESS3 Compliance)**

Introduction

In accordance with the requirements of **World Bank Environmental and Social Standards ESS1 (Assessment and Management of Environmental and Social Risks and Impacts)** and **ESS3 (Resource Efficiency and Pollution Prevention and Management)**, the Project Proponent recognizes the importance of ensuring that the sourcing of construction materials—particularly aggregates and lateritic materials—is undertaken in a **quantified, controlled, and environmentally and socially responsible manner**.

While the initial ESIA identified potential sources of construction materials, the assessment has been strengthened to explicitly link **material sourcing strategies to quantified resource demand**, as well as to define clear **environmental and social mitigation measures**, supplier compliance requirements, and rehabilitation obligations. This approach ensures that material extraction and supply chains are aligned with **national regulations, international lender standards, and good international industry practice (GIIP)**.

1. Quantification of Construction Resource Requirements

The ESIA includes **indicative quantified estimates** of key construction inputs required for the transmission line and associated infrastructure. These include:

- **Aggregates (sand and coarse materials):** approximately 11,600 tonnes

- **Concrete volumes:** approximately 6,270 m³
- **Water demand (construction phase):** approximately 6,760 m³
- **Fuel consumption (diesel):** approximately 54,575 litres

These estimates are presented in tabular form above and will be refined during the **detailed design phase and contractor mobilization**.

The quantification of resource requirements provides a critical basis for:

- Planning and optimizing **material sourcing locations**;
- Assessing potential **pressure on local natural resources**;
- Designing **targeted mitigation measures** for extraction, transport, and utilization; and
- Supporting compliance with **ESS3 resource efficiency objectives**.

2. Material Sourcing Strategy

To minimize environmental and social impacts associated with borrow pits and material extraction, the Project will adopt a **hierarchical sourcing strategy**:

1. **Primary Option:** Procurement from **licensed and regulated commercial suppliers**, compliant with ZEMA requirements and national legislation;
2. **Secondary Option:** Development of **project-specific borrow pits and quarries**, subject to:
    a. Environmental approval and permitting;
    b. Preparation and implementation of **site-specific ESMPs**;
    c. Development and execution of **rehabilitation and closure plans**.

The use of **informal, unlicensed, or unregulated material sources will be strictly prohibited**.

3. Supplier Screening and Environmental and Social Compliance

A formal **Supplier Screening and Approval Framework** will be implemented to ensure that all material suppliers meet the requirements of **ESS1 and ESS3**. Suppliers will be required to demonstrate:

- **Legal compliance**, including valid extraction permits, licenses, and land tenure documentation;
- Compliance with **national environmental regulations**, including ZEMA approvals;
- Adherence to **environmental and social standards**, including:
    - Pollution prevention and control measures;
    - Occupational health and safety practices;
    - Waste management systems;
- Evidence of **stakeholder engagement and grievance mechanisms**;
- Absence of significant adverse impacts on **sensitive habitats or local communities**.

All suppliers will be subject to **due diligence assessments prior to engagement**, as well as **periodic compliance monitoring** during project implementation.

4. Environmental and Social Mitigation Measures for Borrow Pits and Quarries

Where project-specific borrow areas are required, the following mitigation measures will be implemented:

Site Selection

- Avoidance of:
    - Ecologically sensitive areas (e.g., riparian zones, wetlands);
    - Community resource areas (e.g., grazing land, water sources);
- Preference for **previously disturbed or degraded areas**.

Operational Controls

- Implementation of **dust suppression measures** (e.g., water spraying);

- Controlled excavation practices and **slope stabilization**;
- Installation of **drainage systems** to prevent erosion and sedimentation;
- Restriction of extraction depth and spatial footprint.

Community Protection Measures

- Development of **traffic management plans** for haul routes;
- Ongoing **engagement with affected communities**;
- Provision of **compensation where land use is impacted**, in accordance with project resettlement and compensation frameworks.

5. Rehabilitation and Closure Requirements

All borrow pits and extraction sites will be subject to **mandatory rehabilitation and closure plans**, including:

- Backfilling or re-contouring to achieve **safe and stable landforms**;
- Replacement of topsoil and **re-vegetation using native species**;
- Restoration of natural **drainage patterns**;
- Implementation of **post-closure monitoring** to ensure ecological recovery and safety.

Contractual provisions will require contractors to allocate adequate **financial and technical resources** to ensure effective site rehabilitation prior to closure.

6. Integration into ESMP and Contractual Framework

The above commitments will be formalized through:

- Development of a **Borrow Pit and Materials Sourcing Management Plan**, as a sub-plan under the ESMP;
- Inclusion of **specific contractual clauses**, requiring:
  - Compliance with **ESS1 and ESS3 standards**;
  - Use of **approved and screened suppliers only**;
  - Implementation of all **mitigation and rehabilitation measures**;
- Ongoing monitoring by the **Construction Supervision Consultant (CSC)**, with oversight by **ZESCO**.

7. Monitoring and Reporting

A structured monitoring framework will be implemented to track:

- Volumes and sources of materials extracted and supplied;
- Compliance status of suppliers and contractors;
- Environmental condition and rehabilitation status of borrow pits;
- Community grievances related to material sourcing;
- Key environmental indicators, including **dust levels, erosion, and water quality** near extraction sites.

Monitoring results will be integrated into the **ESMP reporting system** and used to support adaptive management.

8.3.4.8 **Biodiversity Management Plan (BMP) (ESS6 Compliance)**

Introduction

In accordance with the requirements of **World Bank Environmental and Social Standard 6 (ESS6): Biodiversity Conservation and Sustainable Management of Living Natural Resources**, the Project Proponent recognizes the need to strengthen the management of biodiversity risks associated with the Malawi–Zambia 400 kV Interconnector Project.

While biodiversity mitigation measures are currently incorporated within the ESMP, the ESIA has been enhanced through the development of a **consolidated Biodiversity Management Plan (BMP)**. This BMP provides a **structured, operational, and auditable framework** for managing biodiversity impacts across all phases of the project, including construction, operation, and maintenance. It aligns with **international good practice** and ensures that biodiversity considerations are systematically integrated into project planning and implementation.

The BMP incorporates the following key components:

1. No-Go Areas and Sensitive Habitat Protection

The BMP defines and maps **environmentally sensitive areas and exclusion zones** along the transmission corridor, including:

- **Riparian habitats** along key watercourses such as the Lutembwe, Mwami, Lubwe, Nyongo, and Choli rivers;
- Areas of **intact wooded vegetation and thicket habitats** with higher ecological value;
- Locations of **suspected presence of sensitive species**, including the *Pancake Tortoise (Malacochersus tornieri)*;
- **Wetlands, drainage lines**, and areas providing critical ecosystem services to local communities.

These areas will be designated as **no-go zones** or subject to **strict activity controls**, and will be clearly demarcated prior to the commencement of construction activities.

2. Micro-Siting and Infrastructure Design Controls

To minimize habitat disturbance and fragmentation, the BMP establishes **micro-siting and design controls** for project infrastructure:

- Avoidance of sensitive habitats identified during ecological surveys;
- Optimization of tower placement to **reduce vegetation clearance and habitat fragmentation**;
- Use of **existing access roads and tracks** wherever feasible;
- Adjustment of infrastructure alignment within the approved corridor to avoid **high-value ecological features**.

All micro-siting decisions will be verified by an **Ecological Clerk of Works (ECoW)** or qualified biodiversity specialist prior to implementation.

3. Seasonal Constraints and Timing of Activities

The BMP incorporates **seasonal restrictions** to minimize disturbance to wildlife:

- Avoidance of vegetation clearing during **peak breeding and nesting periods for avifauna**;
- Restriction of construction activities in sensitive areas during **critical ecological periods**;
- Consideration of **migration periods**, including those of species such as Abdim's Stork, when scheduling high-disturbance activities.

Where seasonal constraints cannot be fully avoided, **additional mitigation measures** will be implemented.

4. Vegetation Clearing and Habitat Management

Environmentally responsible clearing practices will be applied, including:

- **Selective clearing** within the Right of Way (RoW), avoiding unnecessary removal of vegetation;
- Retention of **low-growing vegetation** to maintain ground cover and reduce erosion;
- Conduct of **pre-clearing biodiversity walk-downs** to identify and protect sensitive species and habitats;

- Controlled vegetation removal including stumping as opposed to uprooting to ensure impacts remain within the **approved project footprint**;
- Prohibition of indiscriminate clearing and burning outside designated areas.

5. Species-Specific Management Measures

Targeted measures will be implemented for sensitive and priority species:

- Implementation of a **Species-Specific Action Plan (SSAP)** for the Pancake Tortoise;
- Installation of **bird flight diverters** in identified high-risk avian collision zones (e.g., km 19–28);
- Monitoring of **raptors, migratory birds, and bats** in relation to collision and electrocution risks;
- Protection and maintenance of **riparian vegetation** to support both aquatic and terrestrial biodiversity.

6. Monitoring Framework and Indicators

A comprehensive biodiversity monitoring programme will be established, including:

Monitoring Aspect	**Indicator**
Habitat disturbance	Area cleared versus approved footprint
Vegetation recovery	Survival rate of replanted vegetation
Avian interactions	Number of collision incidents and observations
Sensitive species	Presence/absence trends (e.g., pancake tortoise)
Compliance	Adherence to no-go zones and micro-siting requirements

Monitoring will be undertaken by the **Contractor**, verified by the **Construction Supervision Consultant (CSC)** and **ZESCO**, and reported periodically.

7. Adaptive Management

The BMP adopts an **adaptive management approach**, whereby:

- Monitoring results are regularly reviewed;
- Mitigation measures are **adjusted based on observed impacts and effectiveness**;
- Additional interventions (e.g., increased bird diverter density, habitat restoration) are implemented where necessary;
- Lessons learned are integrated into **ongoing construction and operational practices**.

8. Institutional Arrangements

Implementation of the BMP will be supported through clearly defined roles and responsibilities:

- The **Contractor** will implement BMP measures during construction;
- An **Ecological Clerk of Works (ECoW)** or biodiversity specialist will oversee on-site implementation;
- The **Construction Supervision Consultant (CSC)** will monitor compliance;
- **ZESCO** will assume responsibility for BMP implementation during the operational phase;
- **ZEMA and other relevant regulatory authorities** will provide oversight and enforcement.

8.4 Institutional Arrangements

8.4.1 Project Management Unit (PMU)

The Project implementation will be led by the Project Management Unit (PMU) established by ZESCO. The PMU will be responsible for the procurement of contractors for construction as well as procurement of consulting services - for construction supervision and for monitoring and evaluation (M&E) and/or in-house PMU. The PMU will be headed by the Project Director (PD) and will include an Environment and Social Specialist and an H&S Specialist (collectively ESHS Specialists). The PMU will be responsible for the following:

- Ensure that all project activities are well-managed and coordinated.
- Procurement of works and goods.
- Payment of compensation to the PAPs prior to the mobilization of the Contractors
- Recruitment and supervision of Construction Supervision Consultant (CSC)
- Recruitment of third-party M&E Consultant.

The PMU will also be responsible for the management of the Grievance Redress Mechanism (GRM) and will collaborate with the Community Focal Point Persons, Workers GRM Committee, the District GRM Committee as well as the Project Steering Committee as stipulated in the project GRM document.

8.4.2 ESHS Specialists

The ESHS Specialists will be part of the PMU and will be mandated to ensure compliance with the national regulatory as well as EIB/WB safeguard policy requirements pertaining to environment, social, H&S and resettlement aspects. The ESHS Specialists will be responsible for the following tasks:

- Obtaining environmental, labour and any other ESHS-related clearances for the project from regional / local authorities and oversee that contractors obtain the same where needed for their facilities and works
- Responsible for assisting PD in reviewing bid documents for inclusion of ESMP measures, overseeing and monitoring construction activities, producing periodic monitoring reports,
- Ensuring inclusion of ESMP including OHS aspects, and ESMP budget with detailed BoQ in bidding documents
- Advising on ESMP principles and requirements to CSC, contractors, and providing training to ZESCO field staff, and others as needed to ensure effective implementation of the ESMP
- Supervising CSC for the implementation of ESMP
- Closely coordinate with other concerned agencies, local governments, traditional authorities and communities to support implementation of ESMP
- Preparation of progress reports on implementation of ESMP.
- Coordination of development and implementation of Site emergency response plan including investigation and reporting in case of environmental accidents, H&S incidents, etc.

8.4.3 Field-level Construction Camp Offices

The PMU will set up one or more field-level Construction Camp Offices (CCO) for facilitating the monitoring of implementation of C-ESMP and OHS Plan. They will be responsible for the following:

- Maintain liaison and interaction with the PAPs and local communities to address their concerns;
- Provide proper guidance to PAPs for the submission of their requests for compensation as per eligibility and entitlement;
- Help the local population to forward their complaints, if any, through the GRM;
- Maintain close liaison with PMU, ESHS Specialists, contractor, and relevant government departments for traffic management.

8.4.4 Construction Supervision Consultant (CSC)

The CSC will be responsible for the following tasks:

- Responsible for the supervision of ESMP implementation
- Supervise civil works, ensuring compliance with all design parameters including quality requirements
- Ensure that Contractors include ESHS parameters based on Job Hazard Analysis in their Method Statements
- Supervising contractors for ESMP implementation and issuance of noncompliance reports
- Conduct ESHS trainings and capacity building to Contractor's personnel or the PMU staff, as requested by the PMU
- Provide input, advice and approval on activity specific method statements relating to ESMP
- Prepare monthly reports and submit to PMU

8.4.5 Contractor

Contractors will be responsible for the following:

- Preparation of C-ESMP with site specific management plans for approval of CSC before mobilization.
- Preparation of Occupational Health and Safety Plan based on construction methods, site specific hazards. Revise OHS Plan (a) when there is a change in the scope of the project, (b) there is a change in construction methodology/technique based on site condition, and (c) following significant OHS hazard or a major accident.
- Responsible for implementation of mitigation and monitoring measures and preventive actions proposed in the ESMP
- Prepare separate monthly reports for addressing environmental and social impacts and OHS issues

8.5 Site-specific Management Plans

The Contractor will be required to prepare site specific management plans, before contractor mobilization and commencement of construction works, for approval by the PMU and CSC.

Table 8-1 Site-specific management plans

Plan	Description
Waste Management Plan	This plan will be developed to avoid solid and liquid discharges onto the soil or water. It identifies waste quantities and types generated during project construction, establishes procedures for the collection and storage of waste, and defines methods for the disposal of waste, including liquid and solid waste and hazardous and non-hazardous waste. Waste reuse and recycling shall be examined taking into account the available infrastructure in the project area
Erosion Prevention and Stormwater Management Plan	Erosion Prevention Stormwater Management Plan, including erosion prevention measures for earthmoving activities and temporary diversion channels and settlement ponds in areas with high runoff potential
Emergency Preparedness and Response Plan	The Emergency Preparedness and Response Plan assembles and describes site-specific actions and procedures to be taken in emergency situations during construction, operation and decommissioning. It shall address both worker and community-level risks, including electrical accidents, fires and traffic incidents. The Plan shall include coordination with local authorities and emergency services, communication procedures, and periodic emergency drills.
Traffic Management Plan	The Traffic Management Plan will be developed to manage construction traffic generated by the project, minimise traffic disruption and road user delay and provide for the on-going safety of road users, including pedestrians and cyclists.
Spill Prevention and Response Plan	The Spill Prevention and Response Plan will aim at identifying and preventing pollution to soil, surface and ground waters by project-related materials and activities. It will include general measures and best practices at construction stage, measures for the prevention of accidental spills, product specific practices (i.e. for handling of petroleum products, lubricants, chemicals; vegetation management and pest control, etc.), measures for safe storage of materials, material

Plan	Description
	substitution recommendations and list of prohibited materials. Air pollution in the sense of suppression of dust particles during machine work and transport are part of this plan.
Hazardous Materials Management Plan	The purpose of the Hazardous Materials Management Plan is to define how the Contractor and its subcontractors will select, handle, store and dispose of the chemicals in order to prevent damage to people and the environment. The plan shall identify the type and quantities of hazardous waste expected to be generated during project construction, define the conditions and specifications of hazardous waste storage and identify sustainable ways to dispose of hazardous waste through specialised contractors.
Workers Accommodation Management Plan	The Workers Accommodation Management Plan provides standards and guidance on accommodation and living conditions for the project workforce.
Community Health and Safety Plan	The aim of the Community Health and Safety Plan is to identify and assess all risks and impacts to the communities associated with the construction of the project. Such risks and impacts may be associated with the interaction with project staff, access to the project site, traffic of project machinery and equipment, potential emissions from construction sites, large scale accidents, Measures will be proposed to prevent or mitigate such impacts. The Plan will link to other Plans, such as the Emergency preparedness and Response Plan, the Traffic Management Plan, etc.
Chance Finds Procedure	The Chance Finds Procedure provides guidance on the necessary actions in case of cultural heritage / archaeological findings during project construction.
Occupational Health and Safety (OHS) Plan	Ensures safe working conditions by identifying hazards, enforcing PPE use, monitoring occupational exposures, and preparing for emergencies.
Temporary Land Uptake Procedure	Manages temporary land access fairly through formal agreements, compensation, livelihood monitoring, and reinstatement verification.
Explosives Storage and Use Procedure	Provides safe storage and controlled use of blasting materials, including licensed handlers, secure magazines, community notifications, and vibration/noise monitoring.
GBV / HIV / SEAH Management Plan	Prevents gender-based violence, sexual exploitation, and communicable diseases through codes of conduct, awareness campaigns, HIV prevention programs, grievance mechanisms, and survivor support.
Labour Management Plan (LMP)	Promotes fair labour practices with transparent recruitment, written contracts, prohibition of child/forced labour, grievance mechanisms, and welfare facilities.
Biodiversity Management Plan (BMP)	Protects biodiversity and sensitive species through ecological surveys, habitat avoidance, bird diverters, invasive species control, and a Pancake Tortoise Species-Specific Action Plan.
Biosecurity Management Plan	Prevents introduction and spread of invasive species via vehicle wash-downs, controlled sourcing of materials, monitoring, rapid removal, and use of native species in rehabilitation.
Stakeholder Engagement Plan (SEP)	Ensures transparent consultation and grievance management through stakeholder mapping, structured consultations, vulnerable group engagement, and a functional GRM.
Working at Heights Procedure	Prevents fall-related injuries during tower construction and maintenance with certified climbers, fall arrest systems, rescue procedures, equipment inspections, and weather restrictions.

8.6 Mitigation Plan

The Mitigation Plan below contains information on the identified risks and impacts, the foreseen management and monitoring arrangements (mitigation measures), the provisions for monitoring to assess the effectiveness of these measures and the related roles in implementing these arrangements. This information is presented in the following tables for project construction, operation and maintenance phases of the project.

During construction, the Contractor (incl. subcontractors) will be responsible for the actual implementation of most construction-related measures. However, ZESCO remains overall responsible for the project and the construction activities, including mitigation measures. ZESCO will therefore supervise and monitor and where needed actively take part in defining and implementing measures and liaising with authorities and other stakeholders (see also Section 8.4 above on institutional arrangements). The measures listed in the table for the construction phase will be further detailed in the specific management plans listed above. In terms of the monitoring, the Contractor (incl. subcontractors) will be required to monitor and report while at the same time ZESCO and its service providers such as the CSC will also oversee and monitor the performance of the Contractor and the effectiveness of mitigation measures.

8.6.1 Mitigation plan for the construction phase

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
ESHS Management				
Implementation of ESMP measures	• Setting-up of Environmental, Social and Health & Safety Management organisation, in compliance with ISO14001 and ISO45001 standards and Zambia's national Health & Safety and environmental legislation and standards	Contractor	• Management organisation set-up including relevant staff. • Management reporting systems in place • Regular inspection and monitoring of ESHS performance	• Management organisation and relevant staff in place before start of construction
Ambient Air Quality and Climate - Section 7.5				
Vehicle emissions	• Maintenance of equipment and vehicles. • Training of operators and drivers • Restrict vehicle speeds to 30km/h or less on construction sites, access roads	Contractor	• Maintenance records of vehicles • Training records • CSC and ZESCO audit reports	• Implementation throughout construction
Dust and PM emissions	• Minimize open excavation areas • Minimize stockpiling by proper coordination of earthworks and excavation activities • Reduce fugitive dust emissions by water sprinkling measures • Temporary terminate or restrict construction works if intensive fugitive dust emission occurs, while mitigation measures are in place. This is particularly the case for works close to Chiryauku village. • Inspect local roads regularly and clean if necessary • Maintain all construction machinery and equipment in good working order and do not left running when not in use. • No burning of any material anywhere on construction sites	Contractor	• Site surveys by CSC and ZESCO • CSC and ZESCO audit reports • Grievances by local population	• Implementation throughout construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
Noise – Section 7.6				
Earthworks, steelworks, towers assembly, HV equipment, and installation	• Use well-maintained machinery and vehicles, fitted with appropriate mufflers or silencers; • Limit simultaneous operation of multiple high-noise equipment within close proximity; • Restrict construction to daytime hours (07:00–18:00) and avoid night-time operations, unless explicitly approved and justified; • Notify local communities in advance of high-noise operations, particularly those near sensitive areas. • Use temporary noise barriers (e.g., earth berms, plywood panels, or acoustic screens) around high-sensitivity receptors where construction is unavoidable. • Carry out periodic noise monitoring at sensitive locations, especially NSP2, NSP3 and NSP7, to verify compliance with ZEMA and WHO guidelines; • Establish a grievance mechanism to receive and respond to community complaints related to noise and vibration.	Contractor	• Results of inspections (application of mitigation measures). • Project activity restrictions schedule • Grievances from local population • Monitoring results	Before and throughout construction phase.
Hydrology – Section 7.7				
Construction sites / Earthworks for tower installations and construction of substation	• Install silt fences, sediment traps, and check dams downslope of construction sites to capture runoff; • Avoid stockpiling soils or construction materials near stream banks or flood-prone zones. • Prohibit washing of concrete, vehicles, or machinery near any watercourse; • Ensure fuel and hazardous materials are stored in bunded areas at least 100 meters from water bodies, with spill kits available onsite; • Where river crossings are unavoidable, use existing crossing points or install temporary crossing	Contractor	• Periodic monitoring of application of mitigation measures and results reporting – by CSC • Take action when sediment runoff is detected and report actions taken	• During construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
	structures (e.g., culverts or steel plates) to reduce bank and bed disturbance; • Prohibit dumping of any construction waste, fill or excavated material into streambeds or floodplains. • Prohibit driving in watercourses			
Accidental pollution of water resources by solid and liquid wastes	Development and implementation of: • Waste Management Plan • Spill Prevention and Response Plan • Stormwater Management Plan	Contractor	• Review and approval of C-ESMP (including specific management plans) by CSC and ZESCO • Monitoring and reporting by the Contractor to ZESCO on implementation of Waste Management Plan, Spill Prevention and Response Plan, Stormwater Management Plan • Site surveys by CSC and ZESCO • CSC and ZESCO audit reports	• Preparation of Plans before construction • During construction
Geology and Soils – Section 7.8				
Soil erosion	• **Limit clearing and excavation** strictly to necessary areas within the designated RoW; avoid unnecessary disturbance to surrounding vegetation and root zones • **Preserve topsoil** by stripping and storing it separately during excavation works for use in site rehabilitation • Implement **erosion control structures** such as sediment traps, check dams, gabions, and water diversion channels, especially in slope-prone and high-runoff areas • Stabilize slopes using **mulching, erosion-control blankets**, or grass wattles as temporary cover until vegetation is reestablished • Implement progressive rehabilitation of disturbed areas immediately after construction, including re-grading of slopes to natural contours, re-application of	Contractor	• Monitoring and reporting of soil handling and storage measures (height of topsoil mounds, volumes of topsoil handled) by CSC • Monitoring and reporting of restoration and erosion control measures by CSC	• Before and during construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
	stockpiled topsoil, seeding or planting with indigenous grass and cover crop species. • Schedule major earthworks and vegetation clearance outside the peak rainy season, as far as possible, to minimize the risk of runoff-related erosion			
Soil compaction	• Topsoil stockpiles will be approximately 2-3 m in height • Soil stockpiles will be protected from heavy rainfall (covering). • Restrict vehicle movement only to designated roads. • Apply deep ploughing to temporary construction facilities and construction sites following project construction and during restoration. Deep ploughing will be performed on the construction corridor of the OHL where topography allows to a depth of approximately 60 cm below surface.	Contractor	• Number of events when machinery has been identified outside the designated working areas. • Monitoring and reporting by CSC	• Before and during construction
Soil Pollution and accidental spills	• Fuel and other hydrocarbons handling, especially bulk storage, will take place in secure bunded areas • Development and implementation of the Spill Prevention and Response Plan to avoid accidental spills • Development and implementation of the Emergency Preparedness and Response Plan in case accidental spills occur • Segregation of the excavated contaminated soil and management as hazardous waste	Contractor	• Periodic monitoring of Spill Prevention and Response Plan and Emergency Preparedness and Response Plan by CSC • Reporting and addressing non conformities to the mentioned plan by CSC	• Before and during construction • Reinstatement phase
Landscape – Section 7.9				
Landscape homogenization and changes in aesthetic value	• Construction activities, outside the construction corridor, will be limited to the shortest practicable duration. • All areas used for construction will be fully restored to their pre-construction state, to the extent possible.	Contractor	• Supervision during construction by appropriate landscape/ecological site supervisor (CSC) • Construction monitoring reports (CSC)	• Before and during construction • Reinstatement phase

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
	• The use of existing landscape features (roads, fence rows, property lines, forest edges) will be sought in order to minimize visual impacts. • Materials and machinery will be stored tidily during the works. • Where possible, protect trees prior to construction and/or trim trees to avoid total removal. • Lighting of compounds and construction sites will be restricted to working hours with the exception of security lighting only. • Where the removal of vegetation landscape features is necessary, the species selected for replanting works will be appropriate and characteristic of that particular landscape area. • On completion of works all temporary structures, surplus materials and wastes will be completely removed.		• Reinstatement monitoring report (CSC)	
Biodiversity – Section 7.10				
General biodiversity loss or degradation	• Land clearing shall be avoided wherever possible, particularly in riparian areas • Setting up camps in the river/stream valleys shall be avoided because valuable riparian habitats can be damaged and because of possibilities to pollute surface and underground waters; • Avoid any illegal actions that would destroy or disturb the flora and fauna, particularly (i) collection of medicinal plants, mushrooms and fruits, (ii) accidental or intentional killing of species individuals (iii) poaching of game, birds, etc., (iv) collection of bird eggs and other. • Avoid the ignition of fires due to risk of potential fires. Permanent presence of appropriate fire- fighting	Contractor	• CSC and ZESCO audits	• During construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
	equipment should be ensured in works sites where the risk of fire is high. • Avoid oil, fuel and chemical spills, and planning of emergency response. • Avoid introduction of invasive alien species through implementation of practical control measures, including vehicle and equipment wash-down, inspection of materials, controlled sourcing of construction materials, rehabilitation of disturbed areas (including borrow pits), and use of native species for revegetation. • Use of existing access roads wherever possible and minimise the construction of new access roads. • After construction, disturbed areas shall be restored and re-integrated to the environment.			
Habitat loss and fragmentation: **forest** (thickets) and **river crossing** habitats	• No access roads construction and no gravel and sand extraction from forests or in rivers. • No storage / deposition of waste materials (concrete, iron, soil, etc.) in forests or in or near rivers. • Avoid introduction of invasive alien species through control of equipment and materials, including inspection and cleaning prior to site entry.	Contractor	• Records of verifying implementation of mitigation and compensation measures (CSC) • CSC and ZESCO audits	• During construction
Loss of flora and vegetation species	• Strip and store topsoil separately during excavation and construction. This soil shall be re-applied during site restoration to facilitate natural regeneration of native grasses. • Prohibit the illegal collection of medicinal or decorative plants by project staff.	Contractor	• CSC and ZESCO audits	• Before and during construction
Loss of fauna species - reptiles	• Conduct a survey by a biologist prior to land clearing of the wayleave. • Manually remove all identified species of the Pancake Tortoise in the wayleave during construction to avoid	Contractor, biodiversity experts	• CSC and ZESCO audits	• During construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
	injury or death to the individual tortoises. • Prohibit the capture of Pancake Tortoise individuals by the construction staff • Minimise availability and sharing of detailed information about where the species if found beyond what is required to implement the measures in this plan			
Economy and Employment – Section 7.11				
Employment opportunities	• Work with local authorities and employment organisations to ensure that all positions are advertised in a manner that is accessible to the settlements and communities crossed by the PV plant and HV transmission line route. • Ensure that the recruitment process is fair and transparent, public and open to all regardless of ethnicity, religion or gender. • Ensure that the Contractors provide clear contracts prior to mobilisation stipulating working hours, pay, and other terms of employment.	ZESCO, Contractor	• Evidence of employment advertisements • Evidence of recruitment process • Evidence of meetings with Authorities	• Before and after start of construction
Economic impacts	• Immediately upon opening a tender, make information on tendering opportunities available to local businesses through trade and industry chambers and local business organisations along the HV transmission line route • As part of the tendering process, develop a purchasing strategy that stipulates how purchase of goods will be optimised at regional and local level.	Contractor	• Purchasing strategy for local goods and services	• During contractor tendering process
Land and Livelihoods – Section 7.12				
Impacts on livelihoods from physical and economic displacement	• Provide compensation for loss of land and assets at replacement cost; • Ensure that displacement of economic activities is implemented with appropriate disclosure of	ZESCO	• RAP prepared and granted NO from Financiers • Evidence of compensation payments (CSC)	• Prior to start of construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
	information, consultation, and the informed participation of those affected, including through specific measures targeting vulnerable groups; • Improve or, at a minimum, restore the livelihoods and standards of living of displaced persons to pre-project levels, so as to facilitate sustainable improvements to socioeconomic status; • Prepare and implement a Resettlement Action Plan (RAP) in line with the national legislation as well as international standards (EIB ESS6 and WB ESS5), including pay particular attention to the needs of vulnerable groups • Ensure the proper operation of a grievance management mechanism.		• Evidence of public consultation events • Land acquisition progress reports outlining the stage of land acquisition, any delays in payments, any grievances raised by PAPs as well as any vulnerable PAPs identified and how vulnerability was addressed.	
Labour and Working Conditions – Section 7.12				
Worker rights	• Put in place a hiring mechanism to ensure no employee or job applicant is discriminated against on the basis of his or her gender, marital status, nationality, age, religion or sexual orientation • Ensure that worker accommodation conforms to international best practice. The Contractor shall develop and implement the **Worker's Accommodation Management Plan** in compliance with IFC/EBRD guidance note • In all contracts explicit reference will be made to the need to abide by Zambian law, international standards and ZESCO policies in relation to labour and welfare standards. • Provide training on worker rights and GBVH prevention and management, and require subcontractors to provide similar training to their employees.	Contractor	• Socioeconomic compliance monitoring results (CSC) • Inspections and audit results (CSC) • Contracts • GRM for workers in place • Training records • Number of grievances received / resolved	• Before start of construction • Throughout construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
	• Ensure that all employees have contracts which clearly state the terms and conditions of their employment and their legal rights. • Ensure that all workers (including those of subcontractors) are able to join unions of their choice and have the right to collective bargaining. • Put in place a worker grievance redress mechanism (GRM) that will be accessible to all workers.			
Occupational Health and Safety				
Impact of drilling at sub stations site and tower locations	• Training and education will be provided to all workers involved in drilling and other related works. • Effective PPE's will be provided and ensured to use during all works. • Machines will be checked and maintained to efficient level to ensure risk free operations.	Contractor	• Evidence of training / training records • Inspections to ensure use of PPE (CSC) • Compliance checks for machinery (OE)	• Before and during construction
Operation of heavy equipment and machinery	• Develop safe working procedures, training of the operators and workers and maintain a safe zone, ensuring visibility and stationing flagman.	Contractor	• Evidence of training / training records • CSC and ZESCO audits	• During construction
Excavation and levelling for tower foundation and substation construction	• Excavation for tower foundation for a depth of 3-6 m will be required. In addition, cut and fill will also be required at the substation. • The Contractor will be responsible for sloping by cutting back the trench wall at an angle inclined away from the excavation. • Shoring will require installing aluminum hydraulic or other types of supports to prevent soil movement and cave-ins. • Shielding will be required to protect workers by using trench boxes or other types of supports to prevent soil cave-ins.	Contractor	• CSC and ZESCO audits	• During construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
	• Contractor will design a protective system considering: soil and rock classification, depth of cut, water content of soil, changes due to weather or climate, surcharge loads (e.g., spoil, other materials to be used in the trench) and other operations in the vicinity.			
Transportation of tower materials, heavy equipment by road close to construction sites	• The Contractor will develop a **Traffic Management Plan** by considering the heavy load, control of traffic in main and other local roads, pavement condition and stability, radius of curvature of the local roads to take turns on sharp curve, etc.	Contractor	• Traffic Management Plan available	• Before Construction
Working at height for tower erection and substation assembly	• Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area. • Use of fall prevention devices, including safety belt and lanyard, travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal lifelines.	Contractor	• Work Instructions • CSC and ZESCO audits	• During construction
Stringing conductors at road, river, and existing transmission line crossings	• Prepare and submit a traffic management plan for an approval at least 30 days before commencing work on any project component involved in traffic diversion and management. • Ensure the provision of Lifejackets/buoyancy aids with lifeline worn by workers with risk of falling into water. Lifejackets/buoyancy aids should conform to BS EN ISO 12402-1, 2, 3 or 4, or other equivalent international standards according to working conditions. • Coordinate with the PMU staff to plan the work. Take necessary shutdown on the live transmission lines/switchyard field. Provide training and appropriate personal protective equipment to workers.	Contractor	• Traffic Management Plan • Inspections to ensure use of PPE • CSC and ZESCO audits	• During construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
Transportation of oversized equipment to substation	• Ensure that the vehicle route is surveyed and that its geometric design and condition is appropriate for the transportation of the big and heavy load. Ensure that turning curves are appropriate for the special vehicles.	Contractor	• Traffic Management Plan • Route survey reports	• Before construction
Lifting and Assembly of Heavy Equipment at Substation	• Lifting equipment selection shall be based on a risk assessment and shall be suitable for the task for which it will be used.	Contractor	• Work Instruction	• Before construction
Lightning strikes (outdoor construction and maintenance exposure)	· Monitor weather conditions and suspend outdoor work during thunderstorms. · Establish lightning safety protocols, including safe shelters and evacuation procedures. · Train workers on lightning risk awareness and emergency response. · Install lightning protection systems at substations and temporary facilities where applicable. · Prohibit work on elevated structures (towers) during lightning risk periods.	Contractor	· Weather monitoring logs · Training records · Incident/near-miss reports · CSC inspections	· During construction and maintenance
Snake bites and wildlife encounters	· Conduct site risk assessments to identify high-risk areas (tall grass, rocky areas, wetlands). · Clear vegetation around work areas and camps to reduce habitat for snakes. · Provide training on snake awareness, avoidance, and first aid response. · Equip sites with snake bite kits and ensure rapid access to medical facilities. · Require use of protective PPE (e.g., boots, gloves) in high-risk areas. · Engage local expertise where necessary for safe removal of snakes.	Contractor	· Training records · PPE compliance inspections · Incident reports · CSC monitoring reports	· Before and during construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
Security of workers and assets	• Provide appropriate security personnel (i.e. security guards) to prevent unauthorized entry into the construction area. • Employ night watchman for periods of significant on-site storage or when the area necessitates. • Security personnel and watchmen shall comply with the requirements of WB ESS4 • Ensure there is proper fencing around construction site perimeter • Ensure construction site has controlled access points (one or two entry points at most), allowing for close monitoring of entry and exit.	Contractor	• Construction site layout • CSC and ZESCO audits	• During construction
Community Health, Safety and Security – Section 7.14				
Communities' health	• Construction camps will be located at least 500 m away from communities. Entry of the site personnel in the local communities will be minimized to the extent possible/appropriate. • The contractor will prepare and implement a **Community Health and Safety Plan** that will cover communities' health and safety aspects. • The communities will be informed about the nature of construction activities and the associated health and safety risks. • Awareness raising of communities will be carried out in a culturally-sensitive manner, about the communicable diseases including sexually transmitted infections. • Liaison with the community will be maintained during construction. • A GRM will be established to address community grievances related to health and safety aspects.	Contractor	• Community Health and Safety Plan available • Evidence of community information sessions • Information on GRM displayed in construction sites	• Before start of construction • Throughout construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
Stress on local resources and supplies	• The contractor will prepare and implement a plan to obtain key supplies such as water and fuel, in consultation and coordination with the local communities. • The plan will ensure that there is no significant impact on the local community and local resources. • Liaison with the communities will be maintained during construction. • The GRM described earlier will also address community grievances related to usage of local resources.	Contractor	• Resources plan • Evidence of stakeholder engagement	• Throughout construction
Social conflicts	• The contractor will prepare and implement a Code of Conduct (CoC) for all site personnel. • All site personnel will be provided orientation and training on Code of Conduct. Awareness raising materials such as posters and signage will be used as appropriate. • Privacy of women will be respected; routes and places used by them will be avoided as far as possible. • As described earlier, construction camps will be located at least 500 m away from the communities. Entry of the site personnel in the local communities will be minimized to the extent possible/appropriate. • Liaison with the community will be maintained during construction. • The GRM described earlier will also address community grievances related to social conflict. • Work with local Government agencies and NGOs in the prevention and management of GBV, sexual harrashment, abuse and exploitation.	Contractor	• CoC in place • Records of training • CSC audits	• Throughout construction
Accidents	• The construction sites will be fenced as appropriate to minimize entry of the local residents, particularly children in the work areas.	Contractor	• Fencing in place • Security personnel employed	• Throughout construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
	• Security personnel will be engaged to guard active construction sites, workers camps, transport vehicles, construction machinery and the equipment storage areas. • An Emergency Preparedness and Response Plan (EPRP) will be developed and implemented in order to respond to accidental and emergency situations in a manner appropriate to the construction risks. • The EPRP shall be communicated to the neighbouring communities as well as civil protection authorities.		• EPRP developed and communicated to the communities	
Traffic and Transport – Section 7.15				
• Traffic impacts • Reduced road safety	• Develop a Traffic Management Plan • Restrict speed limit of construction traffic to 20 km/hr in inhabited areas; • Advance warning shall be given of any proposed road diversions and blockages; • Drivers of project vehicles shall be trained/briefed about safe driving with respect to other drivers, non-motorised traffic such as pedestrians, cyclists, and livestock; • Clear signs and signals shall be set up where necessary; • Systematic presence of flagmen in the work areas close to traffic lanes; • Assignment of heavy vehicle construction traffic to suitable routes to and from the working area and avoiding their use in locations and at times that may damage the roads; • Information on traffic safety shall be provided to communities not normally subjected to high traffic loads; • Raising awareness and training of drivers of light vehicles and trucks in elementary safety rules and risks: driving under the influence of alcohol, drugs, speed,	Contractor	• Traffic Management Plan in place • Records of training to drivers • Minutes of meeting from consultations and agreements with stakeholders (communities) and authorities incl. traffic police • CSC audits	• Before start of construction • Throughout construction

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
	tire control, loading (stability); • Regular vehicle inspections to ensure the vehicles are fit for safe use. • Access and site roads will be maintained in good condition.			
• Temporary land use and access roads	• Temporary access roads and land use shall comply with ESS5 requirements, including avoidance and minimisation of impacts and compensation where applicable.	Contractor	• Temporary access roads comply with ESS5 requirements and any affected land is compensated where applicable	• Construction phase
Cultural Heritage – Section 7.16				
Chance Finds	• Develop and implement a Chance Finds Procedure • Inform immediately the competent public institution for protection of cultural heritage about the discovery • Cease the operations and secure the site against eventual damaging or destroying, as well as against unauthorized access, and • Maintain the discovered items in the location and in the condition, they were found	Contractor	• Chance Finds Procedure in place • Chance Finds Record Forms	• Before start of construction • Throughout construction
Climate-related risks				
extreme rainfall, flooding, drought	• Schedule works considering seasonal weather patterns • Ensure adequate drainage and erosion control at all sites • Avoid construction in flood-prone areas where possible • Monitor weather conditions and adjust activities accordingly	Contractor	• No significant erosion or flooding observed at construction sites • Drainage systems in place and functioning • Construction activities adjusted during extreme weather events	• During construction

8.6.2 Mitigation plan for the operation and maintenance phase

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
Landscape – Section 7.9				
Permanent presence of project structures	• Reinstate vegetation along the OHL, especially in areas of natural vegetation, with suitable, indigenous species. Although no high growing species are allowed, lower vegetation may be planted. • Substation will have a building design (including the use of proper materials and colours) that will allow it to blend with the landscape as much as possible. • A vegetation screen alongside the substation parcels will be provided to reduce visual impacts in the long term.	ZESCO	• Records of establishment and growth of vegetation planting as part of the mitigation landscape design	• During the first years of operation
Biodiversity – Section 7.10				
Flora and habitats	• Restrict vegetation clearing / pruning to only the required for safety reasons. • Prohibit the use of chemical herbicides for vegetation control. • Prohibit driving outside the RoW or access roads	ZESCO	• Records of vegetation maintenance	• Throughout operation
Birds	• Install bird diverters on the ground wire of the OHL section from km 19 to km 28, every 10m • Commission a post-construction ornithological study to monitor flight behaviour of bird species in the presence of the entire transmission line, record bird collision incidents and identify line segments that present most impacts	ZESCO	• Photographic records / installation reports • Ornithological study reports	• During the first 3 years of operation

Issue / Risk	Preventive / Mitigation measures	Responsibility	Performance Indicators	Timing of Implementation
Land and livelihoods – Section 7.12				
Loss of livelihoods from restrictions on the way-leave Stakeholder Engagement	• Provide compensation to the affected households for restricted access and use of the land under the way-leave, as per the RAP. • Ensure the proper operation of a grievance management mechanism. Stakeholder engagement will be undertaken in operation and decommissioning phases as well.	ZESCO	• Records of payments	• Before start of operation

8.7 Monitoring programme

The monitoring plan for the Malawi-Zambia 400kV Interconnector Project provides a structured framework for systematically tracking the impacts and the effectiveness of mitigation measures outlined in the Environmental and Social Management Plan (ESMP). This plan ensures that all environmental and social aspects are monitored, assessed and managed in compliance with national regulatory requirements and international best practices.

8.7.1 ESHS Monitoring plan

Table 8-2 Monitoring plan

Parameter/ Activity	Location	Means of Monitoring	Compliance indicator/ threshold limits	Frequency	Implementation	Supervision
During Construction						
Hydrocarbon and chemical storage and handling	Construction camps and yards	Visual Inspection of storage facilities Water quality testing of water released from oil/water separators, if any.	No leakages from the containers in the storage. Handling follows procedures to avoid spillages. Water releases within regulatory limits.	Monthly	Contractor	ZESCO/CSC
Spoils	At all construction sites	Visual inspections	Disposal in approved locations	Monthly	Contractor	ZESCO/CSC
Dust	Construction sites	Visual inspection to ensure good standard equipment is in use and dust suppression measures (e.g., spraying of waters) are in place.	No dust generation from the construction activities	Weekly	Contractor	CSC
	Construction Sites and reference areas	Spot measurements with portable meters	Compliance with national Emission Limit Values (ELVs).	Monthly	Contractor	ZESCO/CSC
Occupational noise	Construction sites	Noise measurement using portable noise meter;	Compliance with national ELVs	Monthly	Contractor	ZESCO/CSC
Environmental noise	Villages along OHL and in reference areas	15 minutes continuous monitoring during day and night	Compliance with national ELVs	Once at villages close to towers; Quarterly at locations in substation	Contractor	ZESCO/CSC

Parameter/ Activity	Location	Means of Monitoring	Compliance indicator/ threshold limits	Frequency	Implementation	Supervision
				during civil works		
Waste Management	Construction camps and construction sites	Visual inspection that solid waste collection facilities are in place. Waste registers. Certificates of destruction for hazardous waste and documentation of acceptable disposal for non-hazardous	Facilities are clean and waste collection and disposal facilities are in place Availability of waster registers for different types of waste. Documented disposal.	Monthly	Contractor	ZESCO/CSC
Cultural and archaeological Sites	At all work sites	Visual observation for chance finds. Documented findings, salvage and authorised restart of works.	Indication of chance finds. Relevant responsible or authority approved restart of works.	Daily Continuous	Contractor Contractor	ZESCO/CSC ZESCO/CSC
Restoration of Work Sites	All Work Sites	Visual Inspection	The facilities are clean with no waste at the works sites, no ponding of rainfall or run-off, no new invasive alien species, and similar to pre-project conditions.	After completion of relevant works	Contractor	ZESCO/CSC
Birds / nesting birds monitoring	All work sites	Visual inspection of nesting birds	Report and photo evidence Implementation of the measures of vegetation clearance outside the bird nesting season in areas with natural vegetation (e.g., riverine vegetation, forest, thicket). Only avoid areas where nesting colonies have	Monthly	Contractor/ expert biologist-ornithologist	ZESCO/CSC

Parameter/ Activity	Location	Means of Monitoring	Compliance indicator/ threshold limits	Frequency	Implementation	Supervision
			been identified by a biologist			
Safety of workers / Monitoring and reporting accidents	At work sites	Induction training, Toolbox talk, and worksite-based training	Records of training	Continuous	Contractor	ZESCO/CSC
Walk-through health and safety inspection and audit	At all work sites	Visual inspection and use of audit form	Inspection record with photo evidence	Weekly	CSC	ZESCO/CSC
PPE usage by workers	At work sites	Usage of PPE vs the number of workers and implementation of contractor's OHS plan	All workers should be provided with, and use necessary PPEs	Monthly	Contractor	ZESCO/CSC
Traffic Safety	Access Roads	Visual inspection to see whether proper traffic signs are placed and respected, if flag-persons for traffic management are in operation	Smooth flowing of traffic; risk situation avoided, and placement of traffic signs and flag-person	Monthly	Contractor	ZESCO/CSC
Workers and community grievances	In the project area	Numbers and types of grievances in workers' and community grievance registers	Minimal workers' grievances concerning poor PPE, injuries, mistreatment, etc. Minimal community grievances concerning the construction-related activities Grievances resolved successfully and timely	Monthly	CSC	ZESCO/CSC
During Operation and Maintenance						
Inspection as per Standard Operating Procedures	Tower locations	Visual Inspection of environmental related issues	Comply with ZESCO SOPs	Monthly	CSC	ZESCO/CSC

Parameter/ Activity	Location	Means of Monitoring	Compliance indicator/ threshold limits	Frequency	Implementation	Supervision
Bird collision	Along the OHL	Walk over surveys and interviews	Number of birds dead / injured	Three years: monthly	Expert ornithologist	ZESCO/CSC
Electromagnetic fields	Near the residential areas along the OHL alignment	Measurement with appropriate equipment	National standards	First time when OHL has been energized	CSC	ZESCO/CSC
Labour conditions (decommissioning phase)	Project area	Review of contractor and subcontractor payment records	All worker payments settled prior to completion of decommissioning works	Prior to completion of decommissioning works	Contractor	ZESCO / CSC

8.7.2 Performance indicators

For evaluating the performance of the monitoring plan, performance indicators are identified for efficient and timely implementation of measures/actions proposed in ESMP. The indicators are defined both for construction phase and for operation phase.

During construction:

- Number of inspections carried out by the CSC per month.
- Number of non-compliances observed by CSC or ESHS Specialists.
- Availability of environmental, social, and H&S specialists in contractors, CSC and ZESCO.
- Timely reporting of documents (as defined in ESMP and monitoring plan).
- Number of training imparted to Contractors/other capacity building initiatives.
- Numbers and types of community and worker's grievances received, proportion resolved, and average time to acceptable resolution.
- Environmental conditions compared with targeted standards and reference areas (e.g., for waste, air quality, noise, water quality).
- Number of construction-related accidents, incidents and near misses.
- Number of accidents, incidents and near misses during operation.
- Number of birds killed or injured.
- Etc.

During operation:

ZESCO will integrate the OHL line to its routine monitoring system and will apply the same principles as all other lines under its supervision.

8.7.3 ESMP Reporting and Review

During construction, Monthly Monitoring Reports will be compiled by the Contractor and submitted for review to the CSC and PMU. The CSC will be preparing Quarterly Reports (QR) with the progress of the project, including ESHS performance issues. The QR will be approved by the PMU and shared with the Financiers.

A Project Closure Report will be prepared at the end of the construction, by the CSC. The report will be approved by the PMU and shared with the Financiers.

8.8 Cost of ESMP

The cost of implementing ESMP during the construction phase is given in the table below. The ESMP costs during implementation and maintenance will be blended into the rest of ZESCO activities and is not calculate separately. Costs of the CSC are not included in the table below. Costs such as workers' camps with relevant facilities (e.g., water supply and sanitation for acceptable conditions) are not reflected in the table below. Similarly, medical services for the workers (e.g., site nurse or site clinic, or agreement with local health facilities) have not been costed. Corporate Social Responsibility initiatives by ZESCO and by the Contractor have also not been budgeted for below. These will be budgeted for separately by the Contractor and ZESCO.

Table 8-3 Environmental and Social Management Plan (ESMP) Implementation Budget

No.	Item Description	Unit	Quan-tity	Unit Cost (USD)	Total Cost (USD)	Responsi-ble entity
1. Environmental Management						
1.1	Setup an ESMS	lumpsum			10,000	Contrac-tor
1.2	Prepare specific management plans	lumpsum			10,000	Contrac-tor
1.3	Dust Suppression during Construction (Water spraying)	Month	12	1,000	12,000	Contrac-tor
1.4	Noise Reduction Measures (Acoustic Barriers)	Site	5	3,000	15,000	Contrac-tor
1.5	Sediments Control (Silt fences, sedi-ment traps)	Site	10	1,200	12,000	Contrac-tor
1.6	Dust monitoring	Monthly cost	12	500	6,000	Contrac-tor
1.7	Noise Monitoring (Monthly)	Monthly cost	12	500	6,000	Contrac-tor
1.8	Install bird diverters (km 19 to 28)	Unit	1000	75	75,000	Contrac-tor
1.9	Pancake Survey and Management	lumpsum			50,005	Contrac-tor
1.10	Water Sampling and analysis	lumpsum			8,000	Contrac-tor
1.11	Train staff on ESMP Implementation (own staff and subcontractors	Month	12	1,000	12,000	Contrac-tor
Subtotal Environmental Management					**216,005**	
2. Social safeguards						
2.1	RAP Expenses					
2.1.1	Compensation for Land	Lump Sum	-	-	135,963.83	ZESCO
2.1.2	Compensation for crops (USD 73,090) and fruit trees (USD 52,505.15)				125,595.15	ZESCO / Contrac-tor
2.1.	Compensation the structures				23,627.10	ZESCO

No.	Item Description	Unit	Quan-tity	Unit Cost (USD)	Total Cost (USD)	Responsi-ble entity
3						
2.1.4	Housing for the Vulnerable PAHs				410,000.00	ZESCO
2.1.5	Livelihood Restoration				99,795.00	ZESCO
2.1.6	Relocation Allowances for the PAHs	Lump Sum	-	-	339,393.96	ZESCO
2.1.7	RAP Implementation				92,098.90	ZESCO
	RAP Subtotal				**1,226,473.88**	
2.2	Stakeholder Engagement				40,000.00	ZESCO
2.3	Grievance Redress Mechanism				60,000.00	ZESCO
2.4	Community health, safety and security				45,000.00	ZESCO
2.5	Occupational Health and Safety				80,000.00	Contractor
2.5	Cultural / archaeological site protection				15,000.00	Contractor
Subtotal Social Safeguards					**1,466,473.88**	
3. Health, Safety and Security						
3.1	Personal Protective Equipment (PPE) for Workers and visitors	Set	500	50	25,000	Contractor
3.2	First Aid Kits (Construction Sites)	Unit	10	100	1,000	Contractor
3.3	Fire Extinguishers (Construction Sites)	Unit	70	150	10,500	Contractor
3.4	Emergency Response Training (own staff and subcontractors)	Month	12	1,000	12,000	Contractor
3.5	Site Safety Signage (Hazard Awareness)	Site	10	300	3,000	Contractor
3.6	Security personnel	Month	12	2,000	24,000	Contractor
3.7	Communicable Diseases Prevention Measures (Sanitizers, Masks)	Month	12	500	5,000	Contractor
3.8	Stakeholder engagement meetings	Month	12	50	6,000	Contractor
Subtotal Health, Safety and Security					**86,500**	
4. Auditing						
4.1	Independent Environmental Audit (Annual)	Item	2	120,000	240,000	ZESCO
4.2	Labour Audit (Annual)		2	35,000	70,000	Contractor
Subtotal Auditing					**310,000**	
Total (USD)					**2,078,973.88**	
Contingency (10%)					**207,897.38**	

No.	Item Description	Unit	Quan-tity	Unit Cost (USD)	Total Cost (USD)	Responsi-ble entity
Grand total (USD)					**2,286,871.26**	

9 Decommissioning and Rehabilitation Plan

9.1 Objectives

The Decommissioning and Rehabilitation Plan for the Malawi-Zambia 400kV Interconnector Project is designed to ensure that the project site is restored to an environmentally sustainable state at the end of its operational life. The state of the art in OHL decommissioning and the environmental standards after 30 or 40 years of project operation is currently unknown. As a consequence, this plan focuses on minimizing environmental impacts, restoring habitats, ensuring public safety and complying with the present national and international environmental standards. The estimated costs are in current figures rather than estimating future values.

Table 9-1 Decommissioning and Rehabilitation Plan

Aspect	Mitigation/Enhancement Measure	Frequency of Monitoring	Time Frame	Performance Indicator	Estimated Cost (USD)
1. Vegetation Clearing	Replant indigenous tree and grass species in cleared areas in dialogue with local stakeholders	Quarterly	6 months	80% vegetation cover restored within two years	25,000
2. Soil Erosion	Implement erosion control measures (terracing, silt fences)	Monthly	12 months	Stabilized soil, minimal visible erosion	10,000
3. Waste Management	Clear all waste and debris, segregate and dispose responsibly	Bi-weekly	3 months	No waste left on site, waste disposal records maintained	24,000
4. Soil Contamination	Conduct soil testing, remove contaminated soil, and remediate	Twice	6 months	Soil contamination below threshold limits	27,500
5. Surface Water Protection	Remove facilities, install silt traps and sediment barriers, revegetate, monitor water quality	Monthly	12 months	Water quality within acceptable ZEMA standards	35,000
6. Groundwater Protection	Remove underground cables, if any, seal boreholes, conduct water quality testing	Quarterly	12 months	Groundwater quality meets ZABS standards	16,000
7. Access Road Restoration	Rehabilitate access roads in dialogue with stakeholders, remove temporary culverts and bridges	Quarterly	12 months	Access roads returned to natural state	120,000
8. Fauna Protection	Avoid work during breeding seasons, establish buffer zones	Monthly	6 months	No evidence of wildlife disturbance	40,000
9. Noise Control	Schedule work during daylight hours, use noise-dampening equipment	Weekly	3 months	Noise levels below 85 dB(A) at sensitive receptors	3,000
10. Dust Management	Regular watering of exposed areas, dust suppression measures	Weekly	3 months	Dust levels within permissible limits	25,000
11. Community Health and Safety	Restrict site access, provide PPE for workers, safety signage	Daily	6 months	Zero accidents, compliance with safety standards	25,000
12. Social Impact Management	- Provide notice of project closure, offer skills training. - Conduct stakeholder engagement meetings. - Manage stakeholder	Once	3 months	Workers notified, training conducted for affected workers	50,000

Aspect	Mitigation/Enhancement Measure	Frequency of Monitoring	Time Frame	Performance Indicator	Estimated Cost (USD)
	grievances through the project Grievance Redress Mechanism.				
13. Visual Impact	Remove all structures, restore natural topography	Once	6 months	Area restored to natural visual state	80,000
14. Final Site Inspection	Conduct final site audit, document compliance	Once	1 month	Compliance report approved by regulatory authority	40,000

9.2 Implementation Responsibility

The following persons will be involved in decommissioning and rehabilitation works:

- **Environmental and Social Manager:** Oversees the overall decommissioning and rehabilitation process, ensures compliance with environmental and social standards, and coordinates the rehabilitation team.
- **Site Supervisor:** Manages on-site activities, including vegetation restoration, soil stabilization, and waste management.
- **Environmental and Social Officer:** Monitors air quality, noise, soil, water quality, and ensures compliance with environmental regulations.
- **Health and Safety Officer:** Ensures worker safety through PPE provision, training, and adherence to safety protocols.
- **Community Liaison Officer:** Manages social impacts, including worker notification and community engagement.
- **Site Engineer:** Responsible for the dismantling and removal of transmission towers, conductors, and other infrastructure.

The Contractor shall ensure that all worker payments, including those of subcontractors, are fully settled prior to completion of decommissioning activities.

9.3 Monitoring and Reporting

Regular monitoring will be conducted and all findings will be documented in monthly and final decommissioning reports. A final site inspection will be carried out by the Environmental and Social Manager to verify compliance and assess the effectiveness of the rehabilitation measures.

10 Stakeholder Engagement

10.1 Introduction

Stakeholder engagement for the project is aligned with both the Zambian requirements, European Investment Bank (EIB) Environmental and Social Standards (ESS 2), WB ESS 10, and international best practice. Public consultation is a critical component of the ESIA process, as it helps to identify potential local environmental and socio-economic issues associated with the proposed project. Moreover, it offers a platform for project stakeholders to provide input into the planning and implementation processes of the project.

The Zambian Environmental Management Act No. 12 of 2011 underscores the importance of public consultation and participation, as articulated in Part VII of the Act. Furthermore, the Environmental Impact Assessment (EIA) Regulations of 1997 demand continuous public involvement throughout the EIA process, beginning with the scoping phase and extending through the preparation of the Terms of Reference (ToR) for the ESIA studies. The Fourth Schedule of these Regulations provides detailed guidance on conducting EIA studies, with a pronounced emphasis on public engagement.

In compliance with Zambian environmental legislation and international best practices, several public consultation meetings were held in the project area, and additional meetings have been planned at various stages of the ESIA process.

10.2 Stakeholder Engagement Activities Undertaken

The following stakeholder engagement activities have been undertaken at the time of preparing this report. Both GOPA and ZESCO personnel participated in all the stakeholder engagement activities.

(a) **Site Investigation Exercise for Route Selection (June 2–6, 2024)**

A multidisciplinary team of environmental and social experts from GOPA and ZESCO conducted a site investigation to assess environmental, ecological, socio-economic, and archaeological constraints along three alternative transmission line routes in Chipata and Vubwi Districts with the aim of selecting the preferred line route with minimal adverse effects. Structured meetings were held in 12 locations across Chipata and Vubwi Districts. A site investigation report was prepared discussing the three line route options and the preferred route.

(b) **Scoping Consultations (July 29 – August 3, 2024)**

The purpose of the scoping meetings was to present the project information to the stakeholders with the view of getting input from them regarding key issues which shall be taken into consideration in the development of the Terms of Reference for ESIA studies, project design and decision making throughout the project lifecycle. Structured meetings were held in 12 locations across Chipata and Vubwi Districts. A scoping report and the ESIA Terms of Reference (TORs) were prepared and submitted to ZEMA for approval. The scoping report, TORs and the ZEMA letter of approval are given in the appendices.

(c) **Scoping Disclosure (25th - 30th December 2024)**

The purpose of the scoping disclosure meetings was to provide feedback to the stakeholders regarding the key issues raised during the scoping meetings, which will be taken into consideration in the development of the Terms of Reference for ESIA studies, project design and decision making throughout the project lifecycle. A total of 11 meetings were held in the project area.

(d) **Baseline Socio-economic Survey (December 2024 - January 2025)**

A baseline socio-economic survey was conducted in the project area to collect information about the demographic, economic, and social characteristics of households along the proposed power line route. Structured questionnaires and focus group discussions were used in data collection. The survey, especially focus group discussions, provided a platform for stakeholder engagement.

(e) Entitlement Matrix and Grievance Redress Mechanism (GRM) Disclosure (18th – 22nd August, 2025)

A total of ten meetings were held in the project area to present the Entitlement Matrix of the RAP and disseminate the Grievance Redress Mechanism. Two meetings were at district level in Chipata and Vubwi while the remaining eight were held in the villages along the power line corridor. The procedure for submitting handling, feedback and appeals were disseminated to the stakeholders in the project area. The feedback received during the meeting was used to finalise the Entitlement Matrix and the GRM.

(f) Environmental and Social Impact Assessment (ESIA) Report and Resettlement Action Plan (RAP) Disclosure (8th to 13th April 2026)

The disclosure meetings were held as a statutory requirement under the Environmental Management Act No.12 of 2011 read together with The Environmental Management (Environmental Impact Assessment), Regulations, Statutory Instrument No. 3 of 2026. The purpose of the disclosure meetings was to present the findings of the ESIA studies to the stakeholders in the project area and enable them to discuss the findings and provide feedback. The meetings were advertised in the Zambia Daily Mail and two local radio stations based in Chipata. In addition, meeting posters were also placed in public places like schools, health centres and markets in the project area.

A total of nine meetings were held in Chipata and Vubwi districts, of which two were held at district level and seven were at community level in the villages along the power line corridor. During the meetings, participants expressed appreciation for being accorded an opportunity to discuss the ESIA and RAP documents and emphasised the need to follow and implement all the recommendations of the ESIA report and the RAP. It was emphasised that local people should be given priority for employment and sub-contract works during project implementation.

Minutes of the meetings and attendance registers are given in Appendix 4.

10.3 Target Groups for Stakeholder Engagement

Stakeholders who were targeted for engagement and consultation in the project area include the following:

- Government departments;
- Civic Leaders (Ward Councillors, Ward Development Committee members);
- NGOs, interest group associations and religious organisations;
- Traditional Leaders (Chiefs, indunas and Village Headmen / Headwomen);
- Local community members (general public), including the vulnerable groups.

10.4 Stakeholder Engagement Methods Employed

The following methods were employed in stakeholder engagement.

- **Public Meetings and Workshops:** Meetings and workshops in affected communities to present information about the project in general, ESIA and RAP, and to obtain feedback. The meetings were conducted in English for the district level meetings and in ChiChewa and Ngonu (local languages) for village level meetings.
- **Focus Group Discussions:** Targeted discussions with specific groups, such as women, youth, and vulnerable populations, to understand their unique perspectives, concerns and suggestions.
- **Surveys and Questionnaires:** Surveys to collect quantitative and qualitative data on stakeholder views and concerns using questionnaires.
- **Interviews:** One-on-one interviews with key stakeholders, including Government officials, community leaders, NGO and interest group representatives.

10.5 Information Dissemination Methods Employed

The following methods were employed to disseminate information during stakeholder engagement.

- **Project Brochures, Posters and Flyers:** Distribute printed materials providing information on various aspects of the project in both English and Chichewa.;
- **Information Boards:** Set up boards (in both English, Chichewa and Ngoni) in community centers, local Government offices, and other strategic locations with project updates and contact information for further inquiries.
- **Radio Announcements:** Use local radio stations to broadcast project information in both English, ChiChewa and Ngoni, especially in remote areas where access to digital platforms may be limited.

10.6 Grievance Redress Mechanism

A GRM is set up by ZESCO, to collect, record, manage and resolve grievances during project construction. The GRM is described in detail at the Stakeholder Engagement Plan (SEP), with the main functions given below:

(a) Informal Grievance Redress Channel

Community Liaison Officers (CLOs): CLOs will be stationed in the project area to serve as the first point of contact for community members to raise concerns informally. They will document and attempt to resolve grievances on the spot. CLOs will be appointed early in the project so that complaints arising from the RAP process are dealt with expeditiously.

Grievance Log: All grievances received informally will be logged, including the nature of the grievance, actions taken, and resolution status.

If the grievance is unresolved at this stage, the complainant is advised to visit the Project Office to formally submit the complaint.

(b) Formal Grievance Redress Channel

Grievances that can be addressed by project officers, will be recorded in the grievance register, including the action taken to resolve the issue. However, complaints which are more complex will be referred to the Project Implementation (PIU) Grievance Resolution Committee (GRC).

<u>PIU Level</u>

The PIU Grievance Resolution Committee (GRC) will comprise the Project Manager, Site Engineer, Environmental Officer, Social Specialist, Human Resources Officer, Safety Officer and other experts deemed essential. Grievances that cannot be resolved by field officers will be referred to this PIU Grievance Resolution Committee for resolution. When a grievance is resolved at this level, feedback will be provided to the complainant. If the grievance is not resolved at this level, it will be referred to the district level.

<u>District Level</u>

Grievances that cannot be resolved at the Project Implementation Unit level will be forwarded to the District Grievance Resolution Committee for consideration and resolution. Since the project covers two districts (Chipata and Vubwi), each district will have its own Committee. The GRC will be chaired by the District Commissioner or his/her representative. Other members of the Committee include selected District Heads of Government Departments, ZESCO representative, NGOs, religious groups and other institutions deemed relevant. When a grievance is resolved at this level, feedback will be provided to the complainant. If the grievance is not resolved, it will be referred to the provincial level.

<u>Provincial (Regional) Level</u>

Grievances that cannot be resolved at the District level will be referred to the Provincial Grievance Resolution Committee for consideration and resolution. The Provincial GRC will be chaired by the Provincial Permanent Secretary or his/her representative. Other members of the Committee include selected Provincial Heads of Government Departments, Human Rights Commission, ZESCO representative, NGOs, religious groups and other institutions deemed relevant. When a grievance is resolved at this level, feedback will be provided to the complainant. If the grievance is not resolved, it will be referred to the national level for consideration and resolution.

The National Level

At national level, the Grievance Resolution Committee will be composed of high-level representatives from selected Government ministries and departments, human rights groups, ZESCO representative, NGOs, religious groups and other institutions deemed relevant. The National GRC will be chaired by the Ministry of Energy Permanent Secretary or his/her representative.

The National Grievance Resolution Committee will receive unresolved grievances from the provincial level. When a grievance is resolved at this level, feedback will be provided to the complainant. If the grievance is not resolved, the aggrieved party has the liberty to seek judicial arbitration in the courts of law.

Judicial level

If the aggrieved party is not satisfied with resolution outcomes of the Project grievance mechanism process, they are at liberty to seek judicial arbitration in the courts of law. Stakeholder meetings will ensure that it is communicated that stakeholders have this option, and will not be prevented from accessing the legal system to bringing the matter before the appropriate judicial authority if they are dissatisfied with resolution outcomes in the project grievance mechanism process, in accordance with the Laws of Zambia. However, costs associated with accessing the judiciary will be borne by complainants themselves and the Project will bear its own legal costs.

However, the aim of the Grievance Redress Mechanism is to ensure that all grievances are resolved in an amicable, timely and efficient manner, preferably at the first level of the GRM process.

So far, no grievances have been received.

10.7 Planned Stakeholder Engagement Activities

Stakeholder engagement will continue throughout the project cycle and the Stakeholder Engagement Plan will be updated from time to time. Stakeholder engagement will also be conduced at decommissioning stage to ensure that all the pending issues are addressed and closed out before completely decommissioning the site.

Below are the planned stakeholder engagement activities to be undertaken in the project area (Chipata and Vubwi):

- ESIA/RAP Public Disclosure meeting under the auspices of the Zambia Environmental Management Agency (ZEMA) in May 2026). ZEMA will decide the method of disclosure.

11 Conclusion

The **Malawi–Zambia 400 kV Interconnector Project** has been subjected to a comprehensive environmental and social impact assessment (ESIA), evaluating all environmental, socio-economic and cultural dimensions of potential impacts across the project's lifecycle.

Environmental Impacts

The corridor traverses a mosaic of Miombo woodland, grassland, riparian habitats, and cultivated lands. The primary biophysical impacts identified include vegetation loss and habitat modification, grassland disturbance, soil erosion, and localized water quality degradation, particularly near stream crossings and boreholes. Other risks include faunal disturbance, and noise and dust emissions during construction.

These impacts are assessed as minor to moderate in significance and are generally temporary, localized, and reversible with the application of robust mitigation measures. Importantly, no critical biodiversity hotspots or high-value protected areas are directly intersected, and effective environmental management (erosion controls, invasive species management, water quality monitoring, and fauna protection protocols) can reduce residual effects to acceptable levels.

Socioeconomic and Cultural Impacts

On the social side, the project brings **both positive and negative consequences**.

- **On the positive side,** the project will generate **employment opportunities** for local communities, mainly during the construction phase; **economic benefits at local, national, and regional levels** by strengthening power trade and energy security during operation; alignment with **regional integration goals**, supporting broader economic transformation.
- **On the negative side,** the project will cause **physical and economic resettlement and land tenure disruption; population influx and increased pressure on social amenities**, particularly schools, clinics, and water supply points; **health risks**, including a heightened risk of **HIV/AIDS and other communicable diseases**, as well as localized community safety and security concerns; **traffic safety risks** linked to construction activities, and the potential for **cultural heritage disturbance** in sensitive areas. These social impacts, most of which will be experienced during construction, are assessed mainly as **minor to moderate in significance**, reflecting the fact that—while potentially disruptive—they are manageable and mitigable through structured safeguards, stakeholder engagement, and targeted social programs.

Balancing Benefits and Risks

The ESIA has demonstrated that the overall residual environmental impacts are manageable, with most falling into the minor to moderate category when mitigations are applied. The socio-economic dimension is more complex, as the project introduces both notable risks (resettlement, health, and livelihood disruption) and transformative benefits (regional energy integration, employment, economic growth).

With rigorous adherence to mitigation measures—including the development and implementation of a comprehensive **Resettlement Action Plan (RAP)**, robust health and safety programs, community engagement, and an Environmental and Social Management Plan (ESMP)—the identified risks can be reduced to levels acceptable under Zambian law and international lender standards.

Strategic Alignment

The project directly supports Zambia's national development priorities, the Southern African Power Pool (SAPP) regional integration agenda, and global commitments under the Paris Agreement and the UN Sustainable Development Goals (SDG 7: Affordable and Clean Energy, SDG 13: Climate Action).

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13 Declaration of authenticity of report contents

I,..The undersigned certifies that the proposed construction of the Malawi-Zambia 400kV Transmission Line Interconnector project across the Chipata and Vubwi districts of Zambia was carried out in compliance with Zambian environmental regulations and international best practices, and that this Environmental and Social Impact Assessment Report accurately describes the current environmental and socioeconomic conditions of the project area, the anticipated impacts of the project, and the appropriate mitigation measures to address the identified impacts.

*For and on behalf of **ZESCO Limited**.*

…………………………………………………………………………………...

Name:…………………..

Position:………………..

ZESCO Limited

14 Appendices

- Approved ToR for the ESIA
- Scoping report, minutes of the consultative meetings and signed list of meeting attendees
- Maps
- ESIA Consultation (Minutes and comments from the public during disclosure) and adverts
- Specialised study Reports (e.g. water, soil, air, flora, fauna, archaeology, geotechnical)
- Raw data for the studies of baseline information gathered (water, soil, air, flora, fauna)
- Stakeholder Engagement Plan