ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

UNIKA I WIND FARM, ZAMBIA

Katete, Eastern Province, Zambia

Prepared for: Mphepo Power Limited

MPHEPO POWER

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BASIS OF REPORT

EXECUTIVE SUMMARY

A. PROJECT BACKGROUND

Mphepo Power Limited ("Mphepo") proposes to develop a 200 MW wind farm facility near Katete, Eastern Province, Zambia, known as the Unika I Wind Farm. The proposed facility would utilise wind turbines to generate electricity that will be fed into the National Power Grid via an aboveground transmission line. Mphepo received permission from the Ministry of Energy to proceed with the feasibility study. The Scoping Report and Terms of Reference (ToR) for the ESIA was approved by the Zambian Environmental Management Agency (ZEMA) in November 2019 (Ref: ZEMA/INS/101/4/1). The current ESIA process is part of the feasibility stage of the Project. Once the feasibility study is completed an implementation agreement will be concluded with the Ministry of Energy through the Zambia Electricity Supply Corporation Limited (ZESCO).

B. PROJECT DESCRIPTION

The proposed project entails the development of the Unika 1 Wind Farm which will consist of up to 68 wind turbines and have a generation capacity of up to 200 MW. Ancillairary infrastructure would include medium voltage (33 kV) transmission lines along the access roads towards a centralsied substation. The substation will be connected to the National Grid through a new 330 kV above ground power transmission line between the wind farm substation and the existing Msoro Substation. The transmission line is covered in a separate ESIA report.

An internal gravel road network will be constructed to facilitate movement between turbines during construction and operation. Some existing public roads and bridge structures will be upgraded to facilitate the heavy loads and vehicle sizes associated with the turbine equipment transport. The foundations, masts sections, main access roads and internal service roads would be constructed or upgraded from material sourced from quarries or borrow pits within and around the area. A single story Operations and Maintenance building with a workshop, store, control room, offices, telecoms and ablution facilities will be constructed.

C. PROJECT TECHNOLOGY

Wind Turbine Generators

- Up to 68 wind turbines (WTs).
- Individual capacity between 3.4 MW and 4.8 MW.
- Hub height from 120 m to 150 m.
- Rotor diameter range between 136 m and 158 m.
- Each turbine will have a: concrete foundation; hardstand areas; Laydown and assembly area; Electrical transformer; Public Safety Zone of up to 242 m around each wind turbine; and some turbines may have to be fenced off for safety reasons.

Electrical Connections and Transmission Line

- Underground and above ground medium voltage (33 kV) transmission lines along the access roads between the WTs.
- On site substation for collection of power from the wind turbines.

Access Roads

- Site acces from the T4 main road:
    - Some existing public roads and bridge structures will be upgraded to facilitate the heavy loads and vehicle sizes associated with the turbine equipment transport.

- An internal gravel road network:
    - Upgrading of existing roads within the area.
    - Constructing new access roads.
    - Access roads will be 4 to 5 m wide with road reserve of 20 m road reserve which includes drainage, turning points, passing/layby points and cabling.

Borrow Pits/Quarries

- Material sourced from quarries or borrow pits for: WT foundations; access roads and internal service roads, O&M bulding and substation.
- Material sourced from quarries or borrow pits within and around the area. Sources will be subject to further detailed investigations and approval by the Ministry of Mines and Minerals Development.

Additional Infrastructure

- Single story Operations and Maintenance (O&M) building to include a workshop, store, control room, offices, telecoms and ablution facilities will be constructed.

D. PROPOSED LOCATION

The strongly rural Project Site is located directly north of the nearest town Katete, Eastern Province, Zambia. The Project Site is approximately 33 350 hectares (ha) in size, while the footprint of the Unika I Wind Farm would be approximately 3 900 ha. The main access road is the T4 National Road (Great East Road), which is main route connecting the Zambian capital of Lusaka to the smaller towns of Nyimba, Katete and Chipata in the east.

E. PROJECT OBJECTIVES

The main objective of the Project is to develop wind power capacity and to transmit that power into the national and regional power transmission system to meet existing and future demands. Other objectives include:

- Diversifying energy sources in Zambia;
- Improving electricity supply distribution locally and nationally;
- Creating local employment and business opportunities;
- Improving the local economy of the Eastern Province; and
- Assisting the Chewa Development Trust (and associated socio-economic initiatives).

F. PROJECT ALTERNATIVES

Site Alternatives: Three possible sites were considered for the development of the project.

(1) a site to the west of the current Project Site:
(2) a site north east of the current Project Site; and
(3) the location of the current Project Site (preferred).

Technology:

- Wind power (preferred)
- Also considered solar power, hydropower and thermal power

Turbine generator alternatives:

- Vestas V136 4.2 MW with 132 m Hub Height (HH)

- Vestas V150 4.2 MW with 132 m HH
- Siemens Gamesa (SG) 3.4 MW - 145 with 127 m HH
- GE 158 4.8 MW with 121 m HH
- GE 158 4.8 MW with 141 m HH

Layout alternatives (considers all project components)

- *Initial layout*, contained wind turbines and access roads along the southern and eastern portions of the Project Site.
- *Current layout*, located in the north eastern part of the Project Site.

No-go alternative

Project not to be developed. Project Site area would remain the same. The land area would remain with its current environmental and social characteristics.

G. SHAREHOLDERS

Mphepo Power Limited is a registered company in Zambia consisting of a consortium of companies including:

- Buffalo Energy Ltd (Charlie Troughton and Will Dryer), 30 % shares.
- Oswald and Kapata CC (Linda Thompson), 30 % shares.
- Leighton Power Ltd (Sipho Phiri, Guy Phiri, Grant Henderson and Sundip Bhundia) , 30 % shares.
- Chewa Development Trust (Set up by Kalonga Gawa Undi on behalf of the Chewa People, the Chewa Development Trust, is managed by the Chewa Investment Committee), 10 % shares.

H. INVESTMENT COST

The total Project investment cost is estimated to be around USD 350 - 450 million.

I. THE MAIN FINDINGS FROM THE BASELINE STUDY

Climate - three distinct seasons: cool dry season from mid-April to August; hot and dry season from September to October; and a rainy season from November to April. The Project Site receives annual rainfall in the region of 450 mm to 1 000 mm. The area is dominated by prevailing easterly winds during the dry season while westerly winds are experienced in the wet months. Mean monthly temperatures ranging between about 17^{o}C in the cold season to about 32^{o}C in the hot season when humidity is relatively high.

Air Quality - currently no major sources of anthropogenic pollution such as industries in or near the Project Site.

Geology and Soils - The project area is underlain by biotite-hornblende gneiss and charno-enderbitic and metapelitic granulites towards the north, and granites to the north-east. Three main soil types of the project area are: 1. Soils formed from the underlying sedimentary and metamorphic rocks – Leached red brown loams; 2. Soils formed from the underlying acidic igneous or siliceous sedimentary rock – Sandveldt; and 3. Soils of the Luangwa and Lower Zambesi Valleys – Rock and rubble.

Hydrology and Drainage - Numerous extensive drainage systems were identified within the Project Site, many of which are interlinked and extend far beyond the boundaries of the Project Site. At a high level, these watercourses were classified as Inland Systems falling within the Middle Zambezi – Luangwa and Lower Zambezi Aquatic Ecoregions. The identified drainage systems comprised the following primary hydrogeomorphic (HGM) types: rivers with associated riparian vegetation and in some cases with associated floodplains, valley bottom wetlands (both channelled and unchannelled), and what are referred to locally (in Zambia) as ‘dambos’ (characterised by relatively even topography and situated in low-lying areas).

Hydrogeology - Majority of the Project Site falls within the BL-02 quaternary catchment of the Luangwa catchment. The Project Site area is underlain by as aquifers of limited potential or regions without significant groundwater. The stratum has intermediate characteristics with borehole yields typically 0.1 – 2 litres per second as a result of low yielding formations.

Landscape and Topography - In general the Project Site is comprised of a landscape of tall forested hills, elevated ridges and low-undulating hills, with broad, flat valleys extending between the hills. The valleys in-turn supports a number of ephemeral streams and well as seasonally flooded wetlands.

Land Use and Tenure - The Project Site is comprised of several different land-uses, and dominated by (1) rural settlements, (2) urban and peri-urban settlement at Katete Town, (3) small-scale agriculture, and (4) open public/communal land. All land in Zambia is vested absolutely in Government of Zambia and is held by the government in perpetuity and in trust on behalf of the people of Zambia. Under such an arrangements, land in Zambia essentially falls into two main categories – Customary and State Land. All land located within the Project Site and along the power transmission line route fall under Customary Land which is legally recognised and protected under the Lands Act, Chapter 184, and any customary land vested in or held by any person under customary tenure is similarly recognised.

Build Environment - The build environment mainly consists of the (1) Rural Settlements and (2) Urban and Peri-urban Settlement at Katete Town.

Noise and vibration - The Project Site is largely undeveloped with a rural character, though there are a significant number of communities dispersed in the area. Ambient sound levels are typical of a rural noise district. The results indicated a quiet environment where natural noises, mostly wind-induced as well as faunal noises, dominate. Anthropogenic noises increase ambient sound levels, especially closer to the communities and local towns.

Ecological Resources - Faunal habitat units identified within the Project Site include miombo woodland, degraded forest, freshwater habitat and agricultural areas. Very limited signs of mammal species were observed, several amphibian species were observed, several reptile species were observed, insect diversity and abundance were notably high, overall arachnid (spider) abundance and diversity of the Project Site was moderately high. At least thirteen bat species present on site. Avifaunal fieldwork recorded 248 species on site. The only Globally Red Listed species recorded on site, Martial Eagle, did not fly frequently but is included as a precaution. It is notable that vultures, large terrestrial bird species and waterfowl are almost entirely absent from our data collected on the Project Site.

Flora units identified within the Project Site include degraded forest habitat (comprising several forest tree species, where trees exceeded 8 m in height with large predominantly interlinking canopies), degraded miombo woodland habitat (the dominant vegetation type within the Project Site and that of southern Zambia), freshwater habitat (comprising streams and dambos) and transformed habitat (associated with cultivated fields and grazing for livestock). Alien invasive plant species identified within the Project Site were mostly associated with villages and in particular agricultural areas and livestock pens, where in some instances they were completely dominant, notably in the case Lantana.

Critical Habitat Assessment - No Critical Habitat occurs in the study area as no populations of threatened, restricted range or migratory/congregatory species occur that meet IFC PS6 thresholds, and the habitats are not threatened or unique and do not have key evolutionary processes. The Project Site includes a combination of Modified and Degraded Natural Habitat covering 69% and 31%, respectively. Only 11.5% of the Project Site (33 350 ha) is required for the Unika 1 Wind Farm (3 865 ha) and since the turbine footprint and roads comprise small footprints, it should be possible to microsite the infrastructure to avoid portions of Natural Habitat to a large degree. It will be important to avoid placing infrastructure on the forested ridgelines and in the wetland or stream course habitats. From the total 10 492 ha of Natural Habitat it is estimated that approximately 1.85 ha will be impacted by wind turbine laydown/assembly areas (assumed to be 3 680 m2 each) and approximately

13.5 ha will be impacted by new access roads (assuming total road reserve width of 20 m) based on the current layout. This amounts to approximately 0.15 % of the total Natural Habitat present on the Project Site.

Archaeological and Cultural Environment - The National Heritage Conservation Commission (NHCC) are reportedly interested in declaring part of the landscape in the area as a National Monument for the role that it plays in attracting and uniting people from three countries based on the Chewa ethnicity and the rich historical background of Mkaika Royal Place. Buffer zones have been recommended around the existing residential areas, the royal palace, royal graveyards and community graveyards as these areas are associated with the emergence of the Gule Wamkulu “spirits”. Preliminary observations from literatures and field surveys revealed no fossil finds and considering that the geology Project Site is not expected to yield any significant palaeontological resources.

Socio-Economic Environment - The Project Site is located in the Katete District in the Eastern Province of Zambia. The area also falls directly on Chewa Traditional Establishment land and under one separate Chiefdomship. The Katete District is formally administered by the District Council located at Katete Town. The town is located on the south-western boundary of the Project Site, and functions as the district administrative centre. The District Council is headed by District Council Chairman and assisted by the District Council Secretary and elected councillors. The mandate of the Council varies, but primarily concerns infrastructure development and management as well as local administration, while also supporting the offices of national government ministries. Katete District is divided into 18 wards of which the Project Site is located in the Matunga, Mkaika and Mphangwe Wards. The Project Site encompasses major portions of the Matunga and Mkaika Wards, while the Mphangwe only extends into the southern boundaries of the Project Site and includes Katete Town. Zambia supports a dual administrative structure comprised of formal government departments (i.e. the District Councils) and traditional structures. The traditional structures are founded on the Chewa Royal Establishment, which constitutes the Paramount Chief (or King), his advisors as well as a number of chiefs, indunas and headmen / headwomen. The traditional administration in the area is a complex and interconnected set of relationships and responsibilities. The Paramount Chief/King is the overall leader of the Chewa Kingdom and is supported by the Chewa Royal Establishment and the Royal Council (including the royal family, chiefs and other functionaries). The functions, powers and duties of the Paramount Chief are delegated to Chiefs, whom administer broad areas of the Kingdom (i.e. Chiefdoms). The Project is located in a single chiefdom under Chief M’bangombe, while the power transmission line may extend into an area located under Chieftainess Msoro. The chiefs are further supported by headmen/headwomen that administer one or more villages. The Chief and headmen may also be supported by indunas which function as advisors but have no specific powers. The areas controlled by the different headmen/headwomen is fluid. Headmen/headwomen are often selected based on their ties with major or founding clans of their respective villages. The headmen/headwomen provide direct administrative functions at the village level, and therefore play a direct role in supporting individual households as well as the administration of land. Households within the Katete District are predominately rural with a smaller percentage of urban households. According to Census 2010 data 92% of all households located in the Katete District engaged in some form of agriculture and 77% in livestock or poultry rearing, in the 12-months preceding the Census. There was limited electrical infrastructure in the Project Site in 2010, and there has been little further development of infrastructure outside of Katete Town. Candles, paraffin and other fuels sources are primarily used by district households for lighting, while only 3.4 % of households have access to electricity. Natural resource harvesting is common for rural communities within the Project Site, and there is a rich diversity or materials and locations from which such materials are collected. The most common form of natural resource harvesting is firewood collection, which is usually undertaken by women and children and is the most common fuel for cooking.

J. POTENTIAL IMPACTS

The assessment of the construction and operation of the Unika 1 Wind Farm shows there are no impacts that are assessed to higher than medium significance after mitigation. The rest of the impacts associated with the Project range from low to insignificant. The impacts of medium significance after mitigation include:

- Hydrological functioning and sediment balance (road crossings through channelled valley bottom wetlands and rivers);
- Avifauna (birds) Impacts: Collision of Birds with Blades (Operational Phase);
- Bats Impacts: Mortality of Bats during Commuting and/or Foraging (Operational Phase);
- Visual impacts (Presence of wind turbines in the landscape); and
- Visual impacts (Aircraft warning lights at night).

Impacts of medium to high **positive** benefits after mitigation include:

- Labour, Working Conditions, and Work-Seeker Influx;
- Disruption of Access and Mobility (pathways, roads); and
- Local Economic Development.

K. MITIGATION/ENHANCEMENT MEASURES

Mitigation and monitoring measures area contained in the Environmental and Social Management Plan (ESMP) will be implemented and the developer commits to enhancing community benefits through creation of local jobs and use of local suppliers, the benefits of the Unika I Wind Farm should outweigh the negative impacts.

The main Mitigation and Enhancement Measures include:

- Avoidance (Site alternatives): Appropriate land parcels for the development of the wind farm included environmental and social criteria such as land ownership, land use, protected areas and biodiversity. Sites with high biodiversity, sensitive features and within protected areas were screened out. The Forest Reserves located in the northern portions of the Project sites was also avoided. The site selected is located on communal land, used for subsistence agriculture and grazing, and with no Critical Habitat as defined by the IFC Performance Standards.

- Minimisation (Site layout alternatives): The layout of the wind farm was informed by the environmental and social baseline investigations and the meteoroidal data gathered, and designed in such a way as to avoid communities, rivers, streams, wetlands and forested areas (and in particular the inselbergs), much of it important bat roosting of foraging habitat and higher bird activity.

- Rehabilitation/ restoration: The Project Site is approximately 33 350 hectares (ha) in size. While the footprint of the Unika I Wind Farm site – estimated at 3 900 ha or 12 % of the Project Site - will result in the partial clearance of vegetation. Some areas affected by construction activities will be rehabilitated.

- Offset: No Critical Habitat occurs in the study area as no populations of threatened, restricted range or migratory/congregatory species occur that meet IFC PS6 thresholds, and the habitats are not threatened or unique and do not have key evolutionary processes. The Project Site includes a combination of Modified and Degraded Natural Habitat covering 69% and 31%, respectively. Only 11.5% of the Project Site (33 350 ha) is required for the Unika 1 Wind Farm (3 865 ha) and since the turbine footprint and roads comprise small footprints, it should be possible to microsite the infrastructure to avoid portions of Natural Habitat to a large degree.

- Enhancement measures:
    - Job creation and opportunities for local suppliers.
    - The Project is expected to invest approximately USD 300 - 450 million into the Zambian economy.
    - Drive demand for local goods and services, notably from Katete Town and surrounding major urban areas.
    - Construction leads to an economic boom, while operational expenditure will be lower but will be an ongoing benefit over the operational life of the Project.

- Upgrade and use existing public roads as well as community tracks in preference to the construction of new roads.
- In cases where district or rural tracks are upgraded, the Project will attempt to avoid the increase in width of the road reserve, where it results in the destruction of homes, loss of property or loss of farmland. Where this cannot be avoided, compensation will be provided consistent with the Resettlement Policy Framework/ Resettlement Action Plan.
- Allocating community development funds to the ongoing repairs and maintenance of local roads with the Community Development Trust.
- Collaborate with the Chewa Development Trust in terms of allocating community funds towards assisting in community development (e.g. health, education, sanitation, etc).

L. PROJECT LIFESPAN

The construction phase is estimated to take approximately 24-36 months to complete.

The construction of Unika 1 is anticipated to commence during Quarter 3 of 2023.

The Power Purchase Agreement (PPA) is anticipated to last 25 years. Beyond that duration, the Project may continue to operate subject to further approvals.

M. RECOMMENDATIONS

If mitigation and monitoring measures contained in the ESMP are implemented and the developer commits to enhancing community benefits through creation of local jobs and use of local suppliers, the benefits of the Unika I Wind Farm should outweigh the negative impacts.

N. LIST OF PREPARERS OF THE ESIA

Preparer	Task	Fields of expertise	Signature
Conroy van der Riet	Author ESIA	Environmental Assessments	
Stuart Heather-Clark	Reviewer ESIA	Environmental Assessments	
Marco Da Cunha	Social Assessment	Social management and resettlement planning	
Tobias Muyaba	In-country support & stakeholder engagements	Environmental Assessments, Stakeholder Engagements	
Christopher Hooton	Floral Assessment Faunal Assessment	Ecologist (Fauna and Flora)	
Amanda Mileson	Watercourse assessment	Ecologist (Wetlands)	

Preparer	Task	Fields of expertise	Signature
Jon Smallie	Avifaunal Assessment	Avifauna	
Jonathan Aronson	Bat Assessment	Ecologist (Bats)	
Morné de Jager	Noise Assessment	Environmental Acoustics	
Stephen Stead	Visual Assessment	Visual resource management and visual assessments	Stephen Stead
Kagosi Mwamulowe	Heritage Assessment	Heritage Management and Environmental Expert	

O. SIGNATURE OF THE PROJECT PROPONENT

Entity: Mphepo Power Limited

Name of authorised signatory: Linda Thompson

Siganture: ____________

NON-TECHNICAL SUMMARY

INTRODUCTION

Mphepo Power Limited ("Mphepo") is a registered company in Zambia consisting of a consortium of companies including, Buffalo Energy Ltd., Oswald and Kapata CC, Leighton Power Ltd. and the Chewa Development Trust (on behalf of Chewa King, Kalonga Gawa Undi, and the Chewa People).

Mphepo will be the Development Company while "Unika I" will be the Special Purpose Vehicle (SPV) to be established for the Project.

Mphepo proposes to develop a 200 MW wind farm facility near Katete, Eastern Province, Zambia, known as the Unika I Wind Farm. The proposed facility would utilise wind turbines to generate electricity that will be fed into the National Power Grid via an aboveground transmission line.

SLR Consulting (Africa) (Pty) Ltd (SLR), in collaboration with DH Engineering Consultants Ltd, has been appointed as the independent Environmental Assessment Practitioner to compile an Environmental and Social Impact Assessment (ESIA) for this project.

PURPOSE AND SCOPE OF THIS DOCUMENT

This Non-Technical Summary has been compiled as a summary of the Environmental and Social Impact Assess (ESIA) Report. It summarises the following:

- The impact assessment process including the stakeholder engagement undertaken;
- The relevant environmental laws and regulations, including international requirements;
- The project site and associated environmental and social features;
- The proposed project components and activities;
- The predicted impacts and their significance ratings; and
- The proposed mitigation and enhancement measures to mitigate and optimise the identified impacts.

ENVIRONMENTAL ASSESSMENT AND AUTHORISATION

The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997 provides the rules, regulations, and procedures for conducting EIAs.

The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997 In terms of the Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997 the submission of an "Environmental Impact Statement" (EIS) is required following the Scoping Phase.

The project must also be designed and implemented in accordance with International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (2012), which includes IFC Performance Standards 1 to 8 and relevant World Bank Environment Health and Safety (EHS) Guidelines.

As this process is required to follow local as well as international standards in order to access funding, the EIS will be referred to as an "Environmental and Social Impact Assessment Report" (ESIA Report) and be aligned with local legislation as well as the International Finance Corporation (IFC) Performance Standards (PSs). This proposed project has been registered with the Zambia Environmental Management Agency (ZEMA) with the Reference Number ZEMA/INS/101/4/1.

The ESIA process involved specialist data gathering, site visits and consultation with affected stakeholders to identify issues of concern that need to be addressed as part of the ESIA.

PROJECT DESCRIPTION

Overview of the Project

Mphepo proposes to develop a 200 MW wind farm facility near Katete, Eastern Province, Zambia, known as the Unika I Wind Farm. The Project Site is located directly north of Katete (Eastern Province, Zambia), and ± 440 km east of Lusaka, Zambia (Figure 1). The location of the wind farm within the broader Project Site is presented in Figure 2 and a simplified layout of the proposed Unika 1 Wind Farm is presented in Figure 3. An example of a wind farm in a rural landscape is shown below:

The project will also involve the construction of a 330 kV transmission line from the Project Site to the Msoro substation located ±30km north of the Project Site. The transmission line is covered in a separate ESIA report as it is planned to handover the transmission line to ZESCO or private developer for operation and maintenance. The need to meet the growing energy demand from Zambia's growing economy and the large number of un-electrified households (especially in rural areas) has been the major driver towards the introduction of renewable energy technology in the country. The Project would provide significant support to the Chewa Development Trust as infrastructure in the area is limited and the Eastern Province currently contributes less than 5 % to the GDP. The Project could also contribute to stabilising the power grid, reduce losses and provide power in provinces within Zambia that currently do not have significant generation capacity. The Project would also assist in power supply during periods when hydroelectric resources are low (particularly during the drier season).

Consideration of Alternatives

The study considered alternative sites, layouts, technology, and the No-Go alternative. Criteria used were: environmental (including biodiversity, fauna and flora, and habitat); social and community (presence or proximity to communities; land ownership, land use), technical (viability of options and if they can be efficiently implemented, maintained and operated) and financial (options that are viable and can be efficiently implemented, maintained and operated).

Site alternatives: Mphepo undertook a site selection exercise based on the following criteria: wind resource, existence of transmission lines and substations, land availability and ownership, land use, environmentally sensitive features and existing infrastructure. Three possible sites were considered for the development of the project. These included (1) a site to the west of the current Project Site, (2) a site north east of the current Project Site and (3) the location of the current Project Site.

Technology, Design and Layout alternatives: In this case wind power is preferred over solar power, hydropower and thermal power. At least five wind turbine design models were considered. The initial layout contained wind turbines and access roads along the southern and eastern portions of the Project Site. The current layout of the infrastructure (wind turbines, access roads, interconnectors, substation, etc.) is based on the areas with best available wind resources and the environmental and social constraint identified during the baseline and specialist investigations. The Unika 1 Wind Farm will be located in the north eastern part of the Project Site. All sensitive areas have been avoided as far as practical. Micro-siting of the wind turbines will still be required, which may have minor impacts on the current positions of the wind turbines. A few (less than 20) of the wind turbines would also have to be moved slightly during micro-siting in order to avoid sensitive areas in relation to ecology, bats, birds and noise.

No Go alternative: The no-go alternative is for the Project not to be developed. Should this be the case, then the Project Site area would remain the same. Should the Project not move forward, then the Project-related negative environmental impacts discussed would be averted. Should the Project not move forward, then the significant and crucial positive environmental, social and economic benefits would not be realised. This is not a preferable option.

Figure 1: Regional Locality Map Showing the Location of the Proposed Unika 1 Wind Farm Project Site

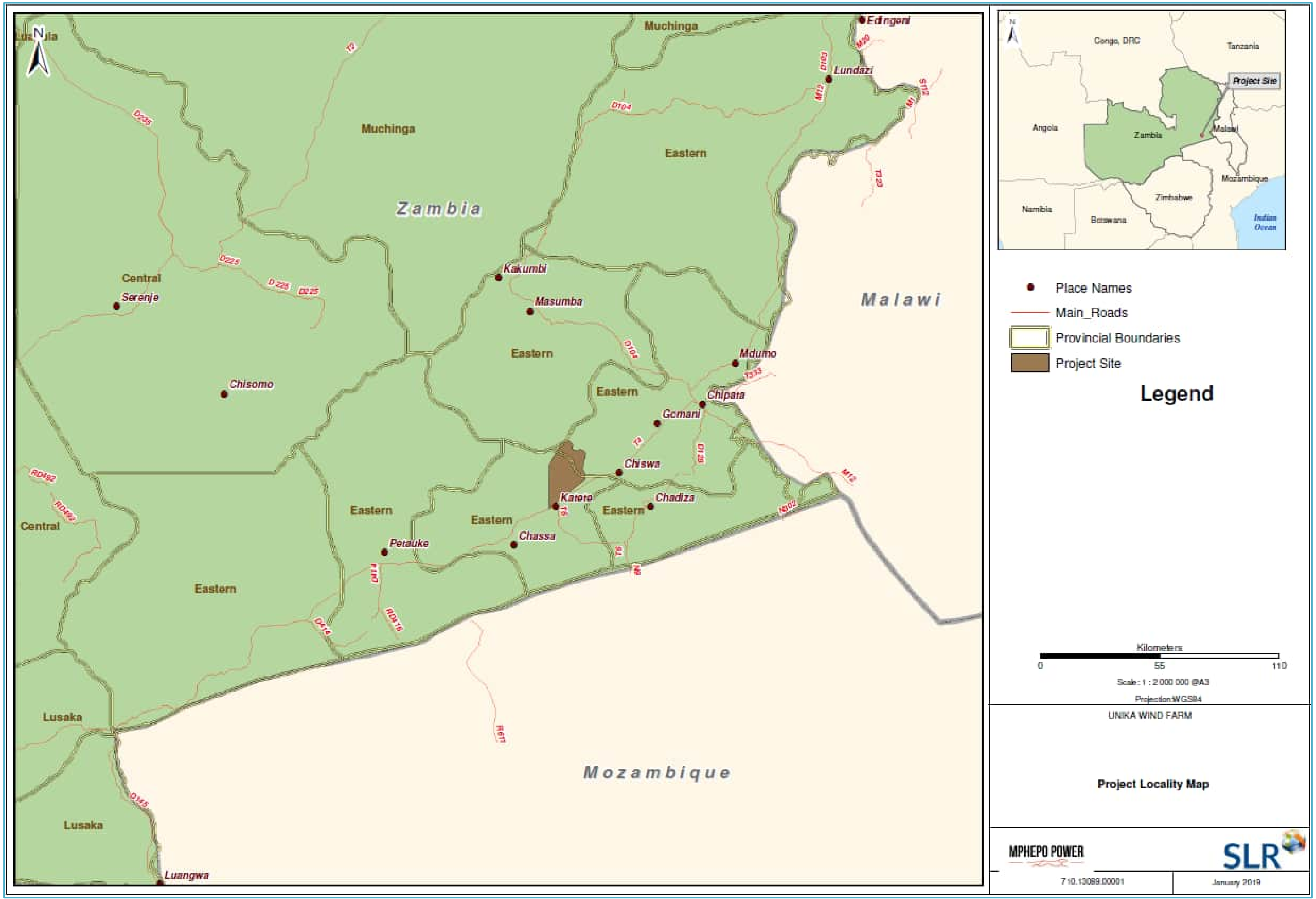


Figure 2: Location of the Unika I Wind Farm within the Project Site

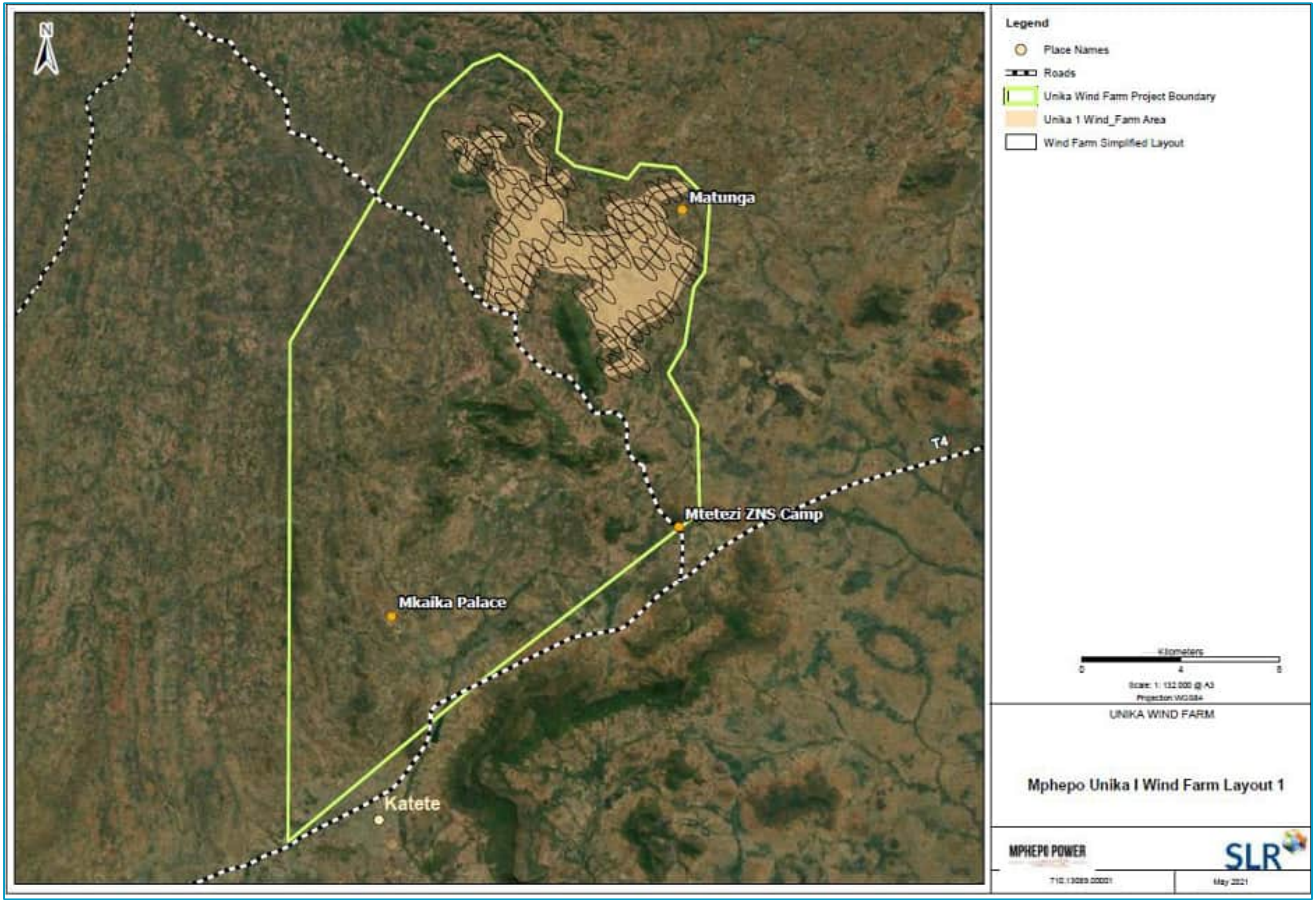
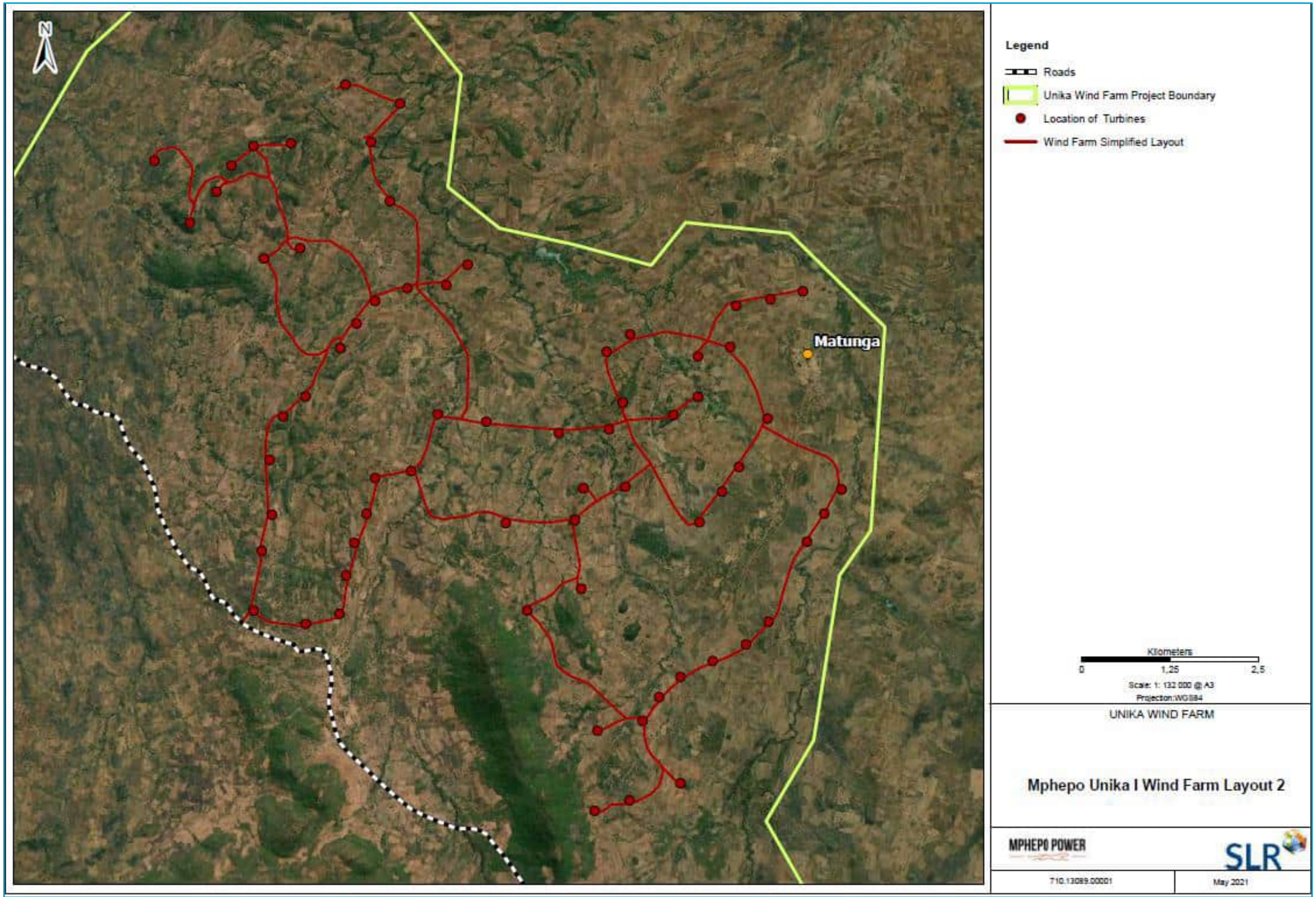


Figure 3: Simplified Layout of the Unika I Wind Farm



Description of the Project

The Project Site is approximately 33 350 hectares (ha) in size, while the footprint of the Unika I Wind Farm would be approximately 3 900 ha. The Project Site is strongly rural and populated by a number of small villages. The nearest town is Katete, which is a small but well established town located immediately southwest of the Project Site. The main access road is the T4 National Road (Great East Road), which is main route connecting the Zambian capital of Lusaka to the smaller towns of Nyimba, Katete and Chipata in the east.

Construction Phase

Construction of the project is expected to take 24-36 months and is envisaged to start in the third quarter of 2023 subject to conclusion of key contracts with ZESCO and other parties.

Construction will involve various activities including site preparation, establishment of access roads, establishment of wind turbine foundations, transport of wind turbine components and equipment, establishment of hardstand areas (for wind turbine assembly), assembly of wind turbine components (e.g. masts, nacelles, blades, etc) and interconnecting network, construction of an onsite substation and O&M building.

The raw water demand varies, based on the phase of the project, between an estimated 1 122 kl/month to a maximum of 6 480 kl/month. The potable water requirements range from 132 kl/month to 440 kl/month depending on the phase of construction. Surface water abstraction points as well as potential boreholes sites were identified.

The Project is expected to employ 500-700 persons during the construction phase, which will extend over 24 months. The operational phase will require a relatively small workforce of 10-15 skilled and 5-10 unskilled persons that are expected to be resident in Katete Town or surrounding villages.

Figure 4. An example of a wind turbine under construction

Operational Phase

Once the Project is completed and becomes operational, it will generate electricity and is expected to have a minimum life span of 25 years. Regular maintenance will be required to ensure the turbines are kept in optimal working order and may extend the life span beyond 25 years.

Day-to-day control of the turbines will be done remotely through the use of computer networks. The wind farm can operate in parallel with daily community activities (e.g. farming, grazing, etc.) due to the relatively small footprint of each of the turbines. The wind farm will be operated on a 24 hour, 7 days a week basis.

Once operational, the wind farm will be monitored locally and remotely. It is estimated that the operational phase of the project will provide employment for approximately 10-15 skilled staff members, who will be responsible for monitoring and maintenance when required. It is expected that 5-10 unskilled staff members will also be employed. It is most likely that the facility will be manned by the appointed O&M staff.

The wind turbines will be subject to periodic maintenance and inspection, and periodic oil changes will be required (mostly from gearboxes and electrical transformers).

Decommissioning

The proposed Project is expected to operate for at least 25 years. Once the plant reaches the end of its life, the wind turbines may continue to operate as their expected life time is 30 years; they may alternatively be refurbished or replaced to continue operations. The facility may be closed and decommissioned. If decommissioned, all components (excluding the turbine foundations and some of the access roads) would need to be removed and the site rehabilitated. Materials would need be recycled or disposed of in accordance with local regulations and international best practice.

AFFECTED ENVIRONMENT

Biophysical Environment

In general the Project Site is comprised of a landscape of tall forested hills, elevated ridges and low-undulating hills, with broad, flat valleys extending between the hills. The valleys in-turn supports a number of ephemeral streams and well as seasonally flooded wetlands.

The passive bat detectors recorded a high number of bat passes across the proposed wind power project indicating that the site provides suitable foraging and roosting opportunities for bats despite the somewhat degraded vegetation and altered landscape. The spatial patterns of activity suggest that all areas of the site are suitable, and indeed, utilised by bats. Free-tailed bats dominated the activity at both ground level and at height, and two roosts in local villages have been confirmed of these species. While these bats are adapted for flying in open areas and as such are likely to encounter wind turbine blades, the majority of the activity of these species was recorded at ground level. Most activity of the remaining 10 species/species complexes recorded by the passive detectors was also at ground level, but it is very likely that activity of some of the 11 species/species complexes will still be of such a magnitude within this range that risks will be high. Of the 54 species whose geographic distribution overlaps with the site, three are near-threatened (NT) globally based on IUCN Red List data including two high risk species (African straw-coloured fruit bat and Large-eared giant mastiff bat), although these were not physically recorded on-site in the specialist studies, and one low risk species (Striped leaf-nosed bat).

Various small passerine birds, large terrestrial birds and raptors were identified. Seven bird species were identified as high risk to wind turbine collisions. These include the Steppe Buzzard, Augur Buzzard, Brown Snake-Eagle, Black-chested Snake-Eagle, Wahlberg's Eagle, African Harrier-Hawk and Martial Eagle. The only Globally Red Listed species recorded on site, Martial Eagle, did not fly frequently but is included as a precaution. It was also concluded that one raptor species (Common or Steppe Buzzard) and at least 6 passerines (European Bee-eater, Southern Carmine Bee-eater, Barn Swallow, House Martin, Brown-throated Martin, African Palm Swift) showed signs of migrating over the Project Site.

Numerous extensive drainage systems were identified within the Project Site, many of which are interlinked and extend far beyond the boundaries of the Project Site. At a high level, these watercourses were classified as Inland Systems falling within the Middle Zambezi – Luangwa and Lower Zambezi Aquatic Ecoregions. The identified drainage systems comprised the following primary hydrogeomorphic (HGM) types: rivers with associated riparian vegetation and in some cases with associated floodplains, valley bottom wetlands (both channelled and unchannelled), and what are referred to locally (in Zambia) as 'dambos' (characterised by relatively even topography and situated in low-lying areas).

The following terrestrial habitat units were identified within the Project Site:

- Degraded Forest Habitat, comprising several forest tree species, where trees exceeded 8 m in height with large predominantly interlinking canopies. This habitat unit was observed primarily in the upper reaches of the large inselbergs and central mountainous areas of the Project Site This habitat however is continually being impacted upon and decreasing due to the harvesting of timber for charcoal production, leading to the encroachment of miombo woodland species;
- Degraded Miombo Woodland Habitat, the dominant vegetation type within the Project Site and that of southern Zambia. The characteristics of this habitat unit were varied, with some of the more degraded areas being noted to have fewer characteristic/typical miombo floral species. The woodlands typically comprised trees varying between 4 – 8 m in height but without densely interlocking canopies;
- Freshwater Habitat, comprising streams and dambos (wetlands). This habitat unit has been notably impacted upon as a result of vegetation clearance for agriculture (grazing and crop cultivation). The dambos and streams convey large amounts of water through the Project Site, however the large-scale removal of vegetation has resulted in increased peak water flows leading to erosion within the dambos and that of the stream banks; and
- Transformed habitat, associated with cultivated fields and areas where vegetation has been cleared in order to provide increased grazing for livestock, both in association with the areas surrounding the villages and at some distance from villages where new fields are being cleared

The Chiulukire West and Chivuna Hills Forest Reserves are associated with the north western corner of the Project Site, while the Matanta Forest Reserve is situated within the south western corner. These Forest Reserves have already been subjected to continuous wide scale impacts. The habitat degradation comes largely from collection of firewood, wood used for structures, the charcoal trade in rural areas in order to generate an income and agricultural activities.

No Critical Habitat occurs in the study area as no populations of threatened, restricted range or migratory/congregatory species occur that meet IFC PS6 thresholds, and the habitats are not threatened or unique and do not have key evolutionary processes.

The Project Site includes a combination of Modified and Degraded Natural Habitat covering 69% and 31%, respectively. Only 11.5% of the Project Site (33 350 ha) is required for the Unika 1 Wind Farm (3 865 ha) and since the turbine footprint and roads comprise small footprints, it should be possible to microsite the infrastructure to avoid portions of Natural Habitat to a large degree. It will be important to avoid placing infrastructure on the forested ridgelines and in the wetland or stream course habitats.

Social Environment

The Project Site is comprised of several different land-uses, and dominated by (1) rural settlements, (2) urban and peri-urban settlement at Katete Town, (3) small-scale agriculture, and (4) open public/communal land. There was limited electrical infrastructure in the Project Site in 2010, and there has been little further development of infrastructure outside of Katete Town. Candles, paraffin and other fuels sources are primarily used by district households for lighting, while only 3.4 % of households have access to electricity.

A number of heritage features were identified on the Project Site, including five sites of national heritage significance. None of these will be currently impacted by the wind farm infrastructure.

The area also falls directly on Chewa Traditional Establishment land and under one separate Chiefdomship. The traditional administration in the area is a complex and interconnected set of relationships and responsibilities. The Paramount Chief/King is the overall leader of the Chewa Kingdom and is supported by the Chewa Royal Establishment and the Royal Council (including the royal family, chiefs and other functionaries). The functions, powers and duties of the Paramount Chief are delegated to Chiefs, whom administer broad areas of the Kingdom (i.e. Chiefdoms). The Project is located in a single chiefdom under Chief M'bangombe, while the power transmission line will extend into an area located under Chieftainess Msoro. The chiefs are further supported by headmen/headwomen that administer one or more villages. The Chief and headmen may also be supported by indunas which function as advisors but have no specific powers.

The average farmland holdings is 2 hectares per household, and is allocated by major land-holdings clans and headmen/headwomen to individuals, and these holdings are inherited from father to sons. In many cases, any inherited land is granted equally to all sons (but excludes sisters) rather than the eldest. This has resulted in the division of land-holdings into smaller plots through multiple generations. The farmland is usually farmed in its entirety, and little land is left fallow or under some form of rotation. Staple crops for local households are maize, with sunflower, cotton and groundnuts functioning as important secondary crops. Natural resource harvesting is common for rural communities within the Project Site, and there is a rich diversity or materials and locations from which such materials are collected. The most common form of natural resource harvesting is firewood collection, which is usually undertaken by women and children and is the most common fuel for cooking. Firewood is generally collected from the open bush/community land in and around the household.

The majority of households (75%) are constructed of traditional or natural materials, or a mix of modern and natural materials. This includes mud and clays for mud-bricks, cut lumber and poles for the frames of traditional homes, as well as reeds and grasses for thatching. All materials are sourced locally on communal land. Interviews suggest that a key natural resource is the local streams which provide clays, reeds for thatching and fishing. Charcoal production is also commonly undertaken, mostly by males. Charcoal may be used as household fuel; however, it is more commonly sold along roadsides or to local buyers.

KEY ISSUES AND IMPACTS

The key positive and negative impacts of the development of the proposed Unika 1 Wind Farm are summarised in Table 1 below.

Alignment with the Mitigation Hierarchy

The mitigation hierarchy was followed to prioritise the avoidance and minimisation of impacts, as follows:

Avoidance: The initial search for appropriate land parcels for the development of the wind farm included environmental and social criteria such as land ownership, land use, protected areas and biodiversity. Sites with high biodiversity, sensitive features and within protected areas were screened out. The Forest Reserves located in the northern portions of the Project sites was also avoided. The site selected is located on communal land, used for subsistence agriculture and grazing, and with no Critical Habitat as defined by the IFC Performance Standards.

Minimisation: Once the Project Site was selected as the preferred site, detailed surveys were undertaken to confirm the use of the land for livelihoods by adjacent communities, the presence of cultural heritage sites, to confirm the status of the habitats on site and the use of those habitats by birds and bats. The layout of the wind farm was informed by the environmental and social baseline investigations and the meteoroidal data gathered, and designed in such a way as to avoid communities, rivers, streams, wetlands and forested areas (and in particular the inselbergs), much of it important bat roosting of foraging habitat and higher bird activity.

Rehabilitation: The Project Site is approximately 33 350 hectares (ha) in size. While the footprint of the Unika I Wind Farm site – estimated at 3 900 ha or 12 % of the Project Site - will result in the partial clearance of vegetation (for the roads, turbines, substation, ancillary infrastructure, etc). Some areas affected by construction activities will be rehabilitated (e.g. access roads not required for operations, hardstand areas, interconnector pathways, etc.).

Offset: No Critical Habitat occurs in the study area as no populations of threatened, restricted range or migratory/congregatory species occur that meet IFC PS6 thresholds, and the habitats are not threatened or unique and do not have key evolutionary processes. The Project Site includes a combination of Modified and Degraded Natural Habitat covering 69% and 31%, respectively (Table 17). Only 11.5% of the Project Site (33 350 ha) is required for the Unika 1 Wind Farm (3 865 ha) and since the turbine footprint and roads comprise small footprints, it should be possible to microsite the infrastructure to avoid portions of Natural Habitat to a large degree.

Table 1. Impacts of Construction and Operation of the Unika 1 Wind Farm

Environmental component	Impact during construction & operation phase of the **Unika 1 Wind Farm**	CONSTRUCTION PHASE			OPERATIONAL PHASE		
		Project Components*	Significance without mitigation		Project Components*	Significance with mitigation	
			Without mitigation	With mitigation		Without mitigation	With mitigation
Biophysical Impacts	Impacts on Soil and Groundwater Quality	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Medium	Low	1, 4, 5, 7	Low	Insignificant
	Impacts as a result of Water Supply for the Project	1, 2, 3, 4, 5, 7, 8, 10	Medium	Very Low	1, 5, 7	Low	Insignificant
	Hydrological functioning and sediment balance (infrastructure outside of setback zones)	1, 2, 3, 5, 6, 9, 10	Insignificant	Insignificant	1, 2, 5	Insignificant	Insignificant
	Hydrological functioning and sediment balance (turbines located within delineated dambos)	1, 2, 5	Very low	Very low	1, 2, 5	Very low	Very low
	Hydrological functioning and sediment balance (road crossings through unchanneled valley bottom wetlands and dambos)	2, 5	Low	Very low	2, 5	Low	Very low
	Hydrological functioning and sediment balance (road crossings through channelled valley bottom wetlands and rivers)	2, 5	Low	Very low	2, 5	High	Medium
	Water Quality (infrastructure outside of setback zones)	1, 2, 3, 5, 6, 9, 10	Insignificant	Insignificant	1, 2, 5	Insignificant	Insignificant
	Water Quality (turbines located within delineated dambos)	1, 2, 5	Very low	Very low	1, 2, 5	Very low	Very low
	Water Quality (road crossings)	2, 5	Low	Very low	2, 5	Very low	Very low
Ecological Impacts	Impact of Noise on Fauna	1, 2, 3, 4, 5, 6, 7, 8, 10	Very Low	Very Low	1, 5	Low	Low
	Loss of Faunal Habitat and Species Diversity in the Degraded Miombo Woodland	1, 2, 3, 5, 6	Low	Very Low	1, 5	Low	Very Low
	Loss of Faunal Habitat and Species Diversity in the Degraded Forest	1, 2, 3, 5	Low	Very Low	1, 2, 3, 5	Low	Low
	Loss of Faunal Habitat and Species Diversity in the Freshwater Habitat	2, 3, 5, 10	High	Very Low	5	Low	Very Low
	Loss of Faunal Habitat and Species Diversity in the Agricultural Areas	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Very Low	Very Low	1, 2, 3, 4, 5, 7	Very Low	Insignificant
	Loss of Sensitive Faunal Species	1, 2, 3, 5, 6	Very Low	Very Low	2, 5	Low	Very Low
	Loss of Floral Habitat and Species Diversity in the Degraded Miombo Woodland.	1, 2, 3, 5, 6	Low	Very Low	1, 5	Low	Low
	Loss of Floral Habitat and Species Diversity in the Degraded Forest	1, 2, 3, 5	Low	Very Low	1, 2, 3, 5	Low	Low
	Loss of Floral Habitat and Species Diversity in the Freshwater Habitat	2, 3, 5, 10	Medium	Low	5	Medium	Low
	Loss of Floral Habitat and Species Diversity in the Agricultural Areas	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Very Low	Very Low	1, 2, 3, 4, 5, 7	Insignificant	Insignificant
	Loss of Sensitive Floral Species	1, 2, 3, 5, 6	Very Low	Very Low	2, 5	Very Low	Very Low
	Freshwater habitat and ecological structure (infrastructure outside of setback zones)	1, 2, 3, 5, 6, 9, 10	Insignificant	Insignificant	1, 2, 5	Insignificant	Insignificant
	Freshwater habitat and ecological structure (turbines located within delineated dambos)	1, 2, 5	Very low	Very low	1, 2, 5	Very low	Very low
	Freshwater habitat and ecological structure (road crossings)	2, 5	Very low	Very low	2, 5	Very low	Very low
	Ecological and Sociocultural service provision (infrastructure outside of setback zones)	1, 2, 3, 5, 6, 9, 10	Insignificant	Insignificant	1, 2, 5	Insignificant	Insignificant
	Ecological and Sociocultural service provision (turbines located within delineated dambos)	1, 2, 5	Very low	Very low	1, 2, 5	Very low	Very low
	Ecological and Sociocultural service provision (road crossings)	2, 5	Very low	Very low	2, 5	Very low	Very low
	Avifauna (birds) Impacts: Collision of Birds with Blades (Operational Phase)	-	-	-	1	High	Medium
	Avifauna (birds) Impacts: Destruction of Bird Habitat (Construction Phase)	1, 2, 3, 5, 6	Low	Low	-	-	-
	Avifauna (birds) Impacts: Disturbance of Birds (Construction & Operational phase)	1, 2, 3, 5, 6	Low	Low	1, 5	Low	Low
	Avifauna (birds) Impacts: Displacement of Birds & Barrier Effects (Operational Phase)	-	-	-	1, 3, 5	Low	Low
	Avifauna (birds) Impacts: Collision of birds with 33 kV connector overhead transmission lines	-	-	-	3	High	Medium
	Avifauna (birds) Impacts: Electrocution of birds from 33 kV connector overhead transmission lines	-	-	-	3	High	Medium
	Bats Impacts: Disturbance of Bat Roosts (Construction Phase)	1, 2, 3, 5, 6	Very Low	Insignificant	-	-	-
	Bats Impacts: Destruction of Bat Roosts (Construction Phase)	1, 2, 3, 5, 6	Medium	Very Low	-	-	-
	Bats Impacts: Modification of Bat Habitat (Construction Phase)	1, 2, 3, 5, 6	Medium	Very Low	-	-	-
	Bats Impacts: Creation of Bat Habitat in High-Risk Locations (Operational Phase)	-	-	-	1, 4, 7	Very Low	Very Low
	Bats Impacts: Mortality of Bats during Commuting and/or Foraging (Operational Phase)	-	-	-	1	Very High	Medium
	Bats Impacts: Mortality of Bats during Migration (Operational Phase)	-	-	-	1	High	Low
	Bats Impacts: Impact of Light Pollution on Bats (Operational Phase)	-	-	-	4, 7	Low	Insignificant

Environmental component	Impact during construction & operation phase of the **Unika 1 Wind Farm**	CONSTRUCTION PHASE			OPERATIONAL PHASE		
		Project Components*	Significance without mitigation		Project Components*	Significance with mitigation	
			Without mitigation	With mitigation		Without mitigation	With mitigation
Socio-economic Impacts	Physical and Economics Displacement	1, 2, 3, 4, 7	High	Low	-	-	-
	Communal Land and Natural Resources	1, 2, 3, 4, 5, 6, 7	Medium	Low	-	-	-
	Labour, Working Conditions, and Work-Seeker Influx	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Low Positive	Medium Positive	1, 4, 5, 7	Low Positive	Medium Positive
	Community Health and Safety	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Medium	Low	1, 4, 5, 7	Medium	Low
	Disruption of Access and Mobility (pathways, roads)	2, 5	Low	Low	5	High	High Positive
	Local Economic Development	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Very Low Benefits	Medium Benefits	1, 4, 5, 7	Very Low Benefits	Medium Benefits
	Cultural Heritage	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Insignificant	Insignificant	1, 4, 5, 7	Insignificant	Insignificant
	Noise Impacts on Surrounding Communities	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Very Low	Insignificant	1	Medium	Low
	Visual impacts (Presence of wind turbines in the landscape)	1	Medium	Low	1	Very High	Medium
	Visual impacts (Aircraft warning lights at night)	-	-	-	1	Very High	Medium

***Key for project components**: 1 - Wind Turbines, 2 - Electrical Connections, 3 - Transmission Lines, 4 – Substation, 5 - Access Roads, 6 - Borrow Pits, 7 - O&M Building, 8 - Construction Camp/Offices, 9 - Laydown Area, 10 - Batching Plant

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

An ESMP has been prepared as an annex to the ESIA which provides a framework for the implementation of environmental and social management measures for construction and operation that are required to minimise impacts to an acceptable level.

The ESMP also contains a Stakeholder Engagement Plan and External Grievance Mechanism.

The ESMP will be reviewed annually to provide for adaptive management based on impacts that are identified or new information that may influence detailed design or project implementation. The ESMP sets out the roles and responsibilities of the developer and contractor's staff to implement the provisions of the ESMP and to report results. It also provides an overview of training, communications, and monitoring and review requirements (i.e. inspections, audits, corrective actions) and emergency planning and response.

The ESMP also contains a Stakeholder Engagement for ongoing stakeholder engagements, and an External Grievance Mechanism that will be implemented throughout the Project to collect and handle any community concerns that are raised.

CONCLUSIONS

The aim of the ESIA process is to provide sufficient information to allow ZEMA to make an informed decision with regards to allowing the proposed Unika 1 Wind Fam to proceed. The ESIA provides this information and has been compiled in alignment with national legislation and the IFC Performance Standards.

Some impacts to soil and groundwater quality could be expected from construction activities, including storage and handling of hazardous substances (e.g. fuel, oil, chemicals, etc.), waste water discharge, batching, waste handling and storage, vehicle/equipment repairs, re-fuelling, etc. Apart from a requirement to store fuel and other hydrocarbons on site for the operational phase, limited hazardous chemicals are expected to be stored and handled, and the risk of pollution from these are minimal if good industry practice is implemented.

Groundwater, surface water and municipal water was identified as potential sources, and potential surface water abstraction points as well as potential boreholes sites were identified. water sources (surface and/or groundwater) need to either singularly or in combination satisfy this demand. Abstraction of large volumes of surface water, especially during the dry periods could result in impacts on downstream users and downstream freshwater ecology. Abstraction of groundwater could impact on surrounding groundwater users and impacts on springs, dambos, streams, rivers, etc, as a result of decreased recharge rates. The extent of these impacts will need to be verified once the water supply sources have been identified and secured.

In general, the Project Site includes areas of disturbed agricultural land, Miombo Woodland, Degraded Forest and Freshwater habitats. Complete vegetation clearance will not be required. The initial layout contained wind turbines and access roads along the southern and eastern portions of the Project Site. The current layout of the infrastructure (wind turbines, access roads, interconnectors, substation, etc.) is based on the areas with best available wind resources and the environmental and social constraints identified during the baseline and specialist investigations. The Unika 1 Wind Farm will be located in the north eastern part of the Project site. All sensitive areas have been avoided as far as practical. Micro-siting of the wind turbines will still be required, which may require minor adjustments to the current positions of the wind turbines. A few (less than 20) of the wind turbines would also have to be moved slightly during final placement in order to avoid sensitive areas in relation to ecology, bats, birds and noise.

The construction of the turbines and road crossings in or across freshwater systems may lead to further alterations to habitat and ecological structure, primarily through vegetation loss necessitated during pre-construction preparation, but also potentially by impeding or altering the movement of water through the landscape. Since the footprints of both the turbines and road crossings are anticipated to be relatively small in comparison to the full extent of the affected freshwater systems, the impact significance of these activities will likely be limited. The four wind turbines located within two dambos will result in unavoidable impacts, which can only be completely avoided by relocating the infrastructure outside of the freshwater systems.

Potential alteration of habitat, for example through the clearing of vegetation, is likely to lead to a reduction in the capability and capacity of freshwater systems to provide certain ecological services, such as sediment trapping or assimilation of excess nutrients. The perceived impacts on socio-cultural (goods and direct benefits) services are considered minimal except where very localised impacts may occur, for example where wind turbines and hardstand areas are placed within cultivated fields situated within the dambos.

No Critical Habitat occurs in the study area as no populations of threatened, restricted range or migratory/congregatory species occur that meet IFC PS6 thresholds, and the habitats are not threatened or unique and do not have key evolutionary processes. The Project Site includes a combination of Modified and Degraded Natural Habitat covering 69% and 31%, respectively. Only 11.5% of the Project Site (33 350 ha) is required for the Unika 1 Wind Farm (3 865 ha) and since the turbine footprint and roads comprise small footprints, it should be possible to microsite the infrastructure to avoid portions of Natural Habitat to a large degree. No infrastructure has been placed on the forested ridgelines and or stream course habitats.

The Project Site is not in or near an Important Bird Area, Protected Area, or any other sensitive feature for avifauna. A total of 248 bird species were recorded. None of these are Red Listed in Zambia. One species is Globally Red Listed (IUCN, 2021): Martial Eagle (Endangered); although only one individual as noted. No active nest sites of priority bird species were identified. Slightly higher flight frequency of some raptor species was recorded during the spring migration period, although nowhere near the concentrations of birds that can occur elsewhere in Zambia during this period. Elevated numbers of several small passerine species migrating during spring and autumn were also recorded. Impacts are expected to range from Insignificant to Medium post mitigation. Post construction bird monitoring of the wind farm must be conducted by a suitably qualified avifaunal specialist for at least the first two years of operation of the facility. If any significant impacts are detected this monitoring may need to continue longer. In particular, bird fatality estimates should include searches under turbines once a week, and twice a week during spring and autumn.

Bat activity at the proposed Project Site is mostly medium to high (particularly high in August, September, March and April). Numerous high-risk species, in terms of coming into contact with turbine blades, including across the free-tailed, fruit bat and plain-faced families, are present on site. This includes the potential (not confirmed) presence of two Near Threatened bat species; African straw-coloured fruit bat and Large-eared giant mastiff bat (whose broad scale geographic distribution overlaps with the site) and the confirmed presence of the Near Threatened Striped leaf-nosed bat. Therefore, the significance ratings for the majority of the impacts to bats posed by the development are predicted to be low to high before mitigation. After mitigation, all impacts are predicted to be very low to low apart from collision risk which might reduce to medium significance. The mitigation measures required relate to the design and avoiding the placement of turbines in areas that bats are most active (based on the pre-construction monitoring data), the use of ultrasonic deterrents, raising the cut in speed and blade feathering. The current turbine layout does not adhere to the bat sensitivity map and needs to be adjusted. Additional mitigation measures that must be considered are the choice of turbine model. The minimum distance between the blades and the ground must be maximised, the specialist recommends using a turbine model with ground clearance of minimally 50 m and that the rotor swept area be minimized. Due to the high amount of bat activity an initial operational minimization strategy will need to be implemented, alongside monitoring of bat activity and bat fatality using carcass searching. This includes the use of deterrents installed on turbines within the 200 m high sensitivity buffer, raising the cut in speed and blade feathering. It is crucial that the mitigation measures be tested in a controlled manner to determine their effectiveness. Adaptive management must be used based on the results of such testing. Monitoring of bat activity and bat fatality during the operational phase of the Project must be undertaken for two years, and must commence from the start of operations. Attention must be given to bat fatality levels during operation of the facility which should be assessed by a bat specialist on at least a quarterly basis but preferably monthly. An updated curtailment strategy taking into account updated seasonal activity and time periods for specific turbines that coincide with periods of increased bat activity and fatality, must be produced by a bat specialist, pending the results of the mitigation testing mentioned above. It is likely that residual impacts to bats will be greater in August, September, March and April as this is when bat activity is highest. The bat monitoring data collected and analysed suggest that the development of the Unika 1 Wind Farm can be achieved without unacceptable risks to bats provided the turbine layout adheres to all bat sensitivity and no-go areas and initial mitigation measures are followed. However, because of the significant number of turbines in bat buffers and limited amount of space available for development outside of sensitive areas, considerable effort and careful design, including active mitigation using curtailment and deterrents, will be needed to achieve these goals.

The land required by the Project falls under customary tenure and is mostly comprised of small-scale farmland held under exclusive rights by an individual. Although not a major land-use by total area, there are also numerous rural settlements within the study area. All land not under settlements or farmland is defined as communal land, which falls under the direct authority of the traditional authorities (the Chewa Royal Establishment). No individual has exclusive rights to communal land, and all resources (including fruit trees, water, grazing land etc.) are shared as a common resource. Under the current design iteration, all communities, community facilities and homesteads have been avoided. As such, it is very unlikely that the Project will lead to physical displacement. The Project will however lead to economic displacement – or the loss or restriction of access to private and communal land (but not the loss of any homes) that supports the livelihoods of local communities and households. The economic displacement will be both the loss of small-scale farmland owned by local households, as well as communal land held by the Chewa Royal Establishment. All land is communal, and no formal titled private land is expected to be affected.

The Project will pose some limited risks to community health and safety – including potential risks during the construction phase related to (1) construction traffic and movement of abnormal load materials and equipment, (2) transport of hazardous materials and waste, (3) soil and water contamination, (4) security control at work-sites, and (5) incidents and emergency events. Occupational health and safety issues for the workforce during both the construction and operational phases of the project are of concern due to the potential unfamiliarity of the local workforce with international good practice procedures. However, this can easily be mitigation through appropriate training and implementation of a health and safety management system throughout the construction and operational phase of the project. The operational phase will present a different profile of community health and safety risks – including (1) operational traffic, (2) transport of hazardous materials, (3) soil and water contamination, as well as (4) blade throw. Community health may also be affected by blade flicker, noise, and infrasound.

The benefits of job creation and opportunities for local suppliers should be noted. The Project is expected to employ 500-700 persons during the construction phase, which will extend over 24 months. The operational phase will require a relatively small workforce of 10-15 skilled and 5-10 unskilled persons that are expected to be resident in Katete Town or surrounding villages. In addition, the Project is expected to invest approximately USD 300-450 million into the Zambian economy. It is expected that the Project will drive demand for local goods and services, notably from Katete Town and surrounding major urban areas. The benefits will be most apparent during the construction phase. However, the short-term nature of construction often leads to an economic boom-and-bust, while operational expenditure will be lower but will be an ongoing benefit over the operational life of the Project.

Based on the current layout of the Unika 1 Wind Farm none of the heritage features identified will be impacted upon. As such Project is unlikely to impact on any cultural heritage features. The impact, for both construction and operation phases, is therefore considered to be Insignificant.

The potential noise impact of the Project was evaluated using a sound propagation model. Conceptual scenarios were developed for the construction and operational phases. With the modelled input data as used, this assessment indicated that a potential noise impact of a very low significance during the day for the construction phase and no additional mitigation is required, and a potential noise impact of (up to) medium significance before mitigation for night-time operational activities, with proposed mitigation available to allow the reduction of the potential noise impact to a low significance.

According to the Visual Impacted Assessment the Project, with mitigation, does not present a potential fatal flaw in visual terms. Mitigations have been provided and would need to be implemented. The rural and tribal setting and settlement pattern of the landscape has aesthetic value as a cultural landscape, and care should be taken to ensure that the proposed wind farm adds to the value of this cultural landscape, without resulting in landscape modifications that are visually intrusive. Wind farms have the potential to complement a rural settlement landscape, and with mitigation and the effective control of the aircraft warning lights at night, and the effective set-back of the turbines from the villages, it is likely that the village essence of this deep rural cultural landscape will be retained, albeit in a slightly modified form.

The assessment of the construction and operation of the Unika 1 Wind Farm shows there are no impacts that are assessed to higher than medium significance after mitigation. The rest of the impacts associated with the Project range from low to insignificant. The impacts of medium significance after mitigation include:

- Hydrological functioning and sediment balance (road crossings through channelled valley bottom wetlands and rivers);
- Avifauna (birds) Impacts: Collision of Birds with Blades (Operational Phase);
- Bats Impacts: Mortality of Bats during Commuting and/or Foraging (Operational Phase);
- Visual impacts (Presence of wind turbines in the landscape); and
- Visual impacts (Aircraft warning lights at night).

Impacts of medium to high positive benefits after mitigation include:

- Labour, Working Conditions, and Work-Seeker Influx;
- Disruption of Access and Mobility (pathways, roads); and
- Local Economic Development.

It is concluded that, if mitigation and monitoring measures contained in the Environmental and Social Management Plan (ESMP) are implemented and the developer commits to enhancing community benefits through creation of local jobs and use of local suppliers, the benefits of the Unika I Wind Farm should outweigh the negative impacts.

Mau o Yamba

Mphepo Power Limited ("Mphepo") ni kampani yo lembedwa mu Zambia. Mphepo ndiye iza nkala kampani ya chitukuko ndiponso "Unika I" idza nkala Special Purpose Vehicle (SPV) pali polojekiti.

Mphepo ili ufunika ku panga malo a munda wa mphepo pafupi ndi Katete, mu Eastern Province, Zambia (Unika I Wind Farm) nkani imene ikambidwa mu Environmental na Social Impact Assessment (ESIA). Pamodzi ndi iyi Unika I Wind Farm polojekiti, kuyenelanso ku mangidwa ntambo za magetsi zo lingana 330kv ku chokela pa malo a yakine a Unika Substation (iza mangidwa) ku fika kuli Msoro Substation imene ipezeka kuyenda 30km kumpoto chakumadzulo.

SLR Consulting Africa (Pty) Limited (SLR), ili ku sebenza na ba DH Engineering Consultants Ltd bana sankidwa na chitukuko ku nkala ba Environmental Assessment Practioner kuza panga ESIA pali polojekiti iyi.

Ba ESIA ba pezeka nayo nchito yo tenga malembo, ku tandalila malo ndi ku kambilana ndi onse ofunikila pa nkani zonse zinga funike ku yanganidwa ndi ba ESIA.

Kufotokhoza kwa Polojekiti

Ba "Mphepo" ba li ku funa ku manga malo a munda wa mphepo wa 200 mw pa fupi ndi Katete, Eastern Province, Zambia wa zina la Unika I Wind Farm. Malo a polojekiti iyi a pezeka kumpoto ya Katete (Eastern Province, Zambia), na 400 km kummawa a Lusaka, Zambia.

Iyi polojekiti iza nkala ndi nchito yo manga ntambo za magetsi za 330 kv kuchola pa malo a polojekiti ku za fika pa Msoro Substation yo pezeka 30 km kumpoto ya polojekiti. Ntambo za magetsi zi kambidwa mu malemba ina a ESIA ku lingana ndi mapulani yo peleka ntambo za magetsi kuli ba ZESCO olo kampani ina ya che osati ya boma mu ku sebenza ndi ku lungisa. Iyi polojekiti iza peleka mo chulukila nso zonse zo funika kuli ba Chewa Development Trust pakuti zo mangidwa mu malo aya ni zo belengeka mu Eastern Province.

Ntawi yo Manga

Nchito yo manga polojekiti idza funika ku tenga myezi ya 24 kapena 36 ndiponso iyenela ku yamba cha pakati pa 2022 ku lingana na ku sillizila kwa malembo ndi ba ZESCO na binanso

Zogwira Nchito

Pamene polojekiti iza siliziwa na ku yamba ku sebenza, iza yamba ku panga magetsi ndiponso iyenela ku sebenza na umoyo wo lingana zaka za 25.

Kambili kambili kuza funika kuti nchito yo lungisa ipitilize kamba ka kuti ma mashini a sungiwe bwino kuti azi sebenza kulingana na zaka zo pita 25.

Kuchotsa ntchito

Iyi polojekiti imene ikambidwa iyenela ku sebenza myaka za 25 pa chiyambi. Pamene polojekiti iza fika myezi iyi, ma mashini a mphepo aza pitiliza ku sebenza ku lingana na ntawi ya umoyo wa yo wa myaka za 30; aya ma mashini aza lungisidwa olo ku chosedwa na ku letapo inanso atsopano kuti nchito ipite pasogolo. Pina aya malo anga validwe ndi ku siya ku asebenzesa.

Malo a Polojekiti

Malo a polojekiti ni 33,350 hectares (ha) ku kula, komanso malo a Unika I Wind Farm ni 3,900 hectres (ha). Malo a polojekiti a pezeka patali ndi tawuni kumene ku pezeka minzi iñono yo belengeka. Towuni yo pezekako cha pafupi ni Katete nayo iñono yo mangidwa bwino kum'mwera chakumadzulo ya malo aya. Njila ya ikulu yo pita ni T4 National Road (Great East Road), ndiyo njila yo kumana Lusaka likulu la Zambia ndi ma tawuni ya Nyimba, Katete pamodzi ndi Chipata ku mawa.

Mtengo Wa Nchito Iyi

Ndalama zonse pamodzi za nchito iyi ni USD 350 ku za fika 450 millioni. Ntawi yo manga iyenela mu kotala lo yamba la 2023.

Zofunika ku Polojekiti

1. Ma Mashini ya Mphepo yo Pangila Magetsi

Unika I iza nkala ndi ma mashini a mphepo ali 68, pamodzi ndi ya 3.4 MW na 4.8 MW. Aya ma mashini aza nkala o siana mu ku talimpa kuchokela 120m ku fika 150m, ndi kuina kwa 136m na 158m. Mashini iliyonse iza nkala ndi kufika 531m² (ndiye kuti 13m ku chokela pakati na kuza mbila 2.5m ku fikanso 5m).

2. Kugwilizana kwa Ntambo za Magetsi

Ma mashini a mphepo a za kumana kamba ka ntambo za magetsi zili na mpamvu ya (33 kV). Kukumana kwa ma mashini ku za funika ntambo za m'mwamba na mobisa mu doti zonse zimene ziza pitana ndi miseo ya myotoka pakati pa ma WT. Migodi za ntambo yo bisa mudoti ni 1m ku fika 2 m ku kumba pansi ndi 0.5 m (ya imodzi ntambo) ku fika 2.5 m (ntambo zinayi) kuina.

3. Njila zo Pita

Aya malo a pezeka kuchoka pa msewu wa T4 wa ukulu pakati pa Lusaka, Katete ndi Chipata. Msewu wa mkati wa ma doti uza funika ku mangidwa ku segula njila pakati pa ma mashini ntawi yo manga ndi ku sebenza. Zina zache ziza funikanso ni zo konza misewu ndi ku panganso misewu yatsopano.

Misewu zo pitamo ziza nkala 4m ku fika 5 m mumbali kukula kulingana ndi migodi ya manzi mumbali mwake, po zungulukila, po pita/na po imilila na ntambo m'kati a malo o pangilapo misewu ya 20m. Misewu ndi kapangidwe ka ma bilichi ka za funika ku lungisidwa kamba ka zolema zo nyamula ndi ku siana-siana kwa ukulu wa myotoka ku lingana ndi mayendedwe a myotoka za ma mashini a magetsi.

4. Maziko

Malo a mlongoti, njila za myotoka nazo njila zo sebenzesa m'kati ziza mangidwa olo ku lungisidwa ku lingana ndi myala zo chokela kumene ba pwanyila myala olo ku migodi zo pezeka m'kati kapena m'bali a malo.

5. Zo Onjezelako zo Manga

Mu nyumba yo sebenzelamo ya Operations and Maintenance (O&M) ya 160m² muza pezeka workshop, malo yo sungilamo zintu, chipinda, maofesi, mafoni ndi kutsuka zonse zipangizo zimene ziza mangidwa.

Kuthekera kwakukulu kumakhudza zabwino ndi zoyipa

Chigawo cha chilengedwe	Zomwe zimachitika panthawi yomanga ndi kugwira ntchito kwa Unika 1 Wind Farm	GAWO LOMANGA Kufunika Popanda Kuchepesa		GAWO LA NCHITO Kufunika Ndi Kuchepesa	
		Popanda Kuchepesa	Ndi Kuchepesa	Popanda Kuchepesa	Ndi Kuchepesa
Zotsatira za Biophysical	Zokhudza Dothi ndi Madzi Apansi Pansi	Wapakati	Otsika	Otsika	**Zosafunikila**
	Zotsatira za Kupereka Madzi kwa Ntchitoyi	Wapakati	Otsika Kwambili	Otsika	**Zosafunikila**
	Ntchito ya Hydrological ndi matope ya bwino (zomangamanga kunja kwa madera obwerera)	**Zosafunikila**	**Zosafunikila**	**Zosafunikila**	**Zosafunikila**
	Kugwira ntchito kwa Hydrological ndi matope ya bwino (ma turbines omwe ali mkati mwa dambos)	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili
	Kugwira ntchito kwa hydrological ndi matope ya bwino (kuwoloka misewu kupyola madambo a m'chigwa ndi dambos)	Otsika	Otsika Kwambili	Otsika	Very low
	Kugwira ntchito kwa hydrological ndi matope ya bwino (kuwoloka misewu kudutsa madambo a m'chigwa ndi mitsinje)	Otsika	Otsika Kwambili	Apamwamba	Wapakati
	Ubwino wa Madzi (zomangamanga kunja kwa madera olepheretsa)	**Zosafunikila**	**Zosafunikila**	**Zosafunikila**	**Zosafunikila**
	Ubwino wa Madzi (ma turbines omwe ali mkati mwa ma dambos ojambulidwa	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili
	Ubwino wa Madzi (mawoloka misewu)	Otsika	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili
Zotsatira Zachilengedwe	Mphamvu ya Phokoso pa Nyama	Otsika Kwambili	Otsika Kwambili	Otsika	Otsika

Chigawo cha chilengedwe	Zomwe zimachitika panthawi yomanga ndi kugwira ntchito kwa Unika 1 Wind Farm	GAWO LOMANGA Kufunika Popanda Kuchepesa		GAWO LA NCHITO Kufunika Ndi Kuchepesa	
		Popanda Kuchepesa	Ndi Kuchepesa	Popanda Kuchepesa	Ndi Kuchepesa
	Kutayika kwa Malo Achilengedwe ndi Mitundu Yamitundumitundu mu Miombo Woodland Yowonongeka	Otsika	Otsika Kwambili	Otsika	Otsika Kwambili
	Kutayika kwa Malo okhala Zinyama ndi Mitundu Yamitundumitundu mu Nkhalango Yowonongeka	Otsika	Otsika Kwambili	Otsika	Otsika
	Kutayika kwa Malo okhala Zinyama ndi Mitundu Yamitundumitundu mu Malo okhala pamadzi Atsopano	Apamwamba	Otsika Kwambili	Otsika	Otsika Kwambili
	Kutayika kwa Zamoyo Zamoyo ndi Mitundu Yamitundumitundu M'madera Aulimi	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili	**Zosafunikila**
	Kutayika kwa Mitundu Yovuta Kwambiri ya Nyama	Otsika Kwambili	Otsika Kwambili	Otsika	Otsika Kwambili
	Kutayika kwa Malo a Zamaluwa ndi Mitundu Yamitundumitundu mu Miombo Woodland Yowonongeka.	Otsika	Otsika Kwambili	Otsika	Otsika
	Kutayika kwa Malo a Zamaluwa ndi Mitundu Yamitundumitundu mu Nkhalango Yowonongeka	Otsika	Otsika Kwambili	Otsika	Otsika
	Kutayika kwa Malo a Zamaluwa ndi Mitundu Yamitundumitundu mu Malo okhala pamadzi Atsopano	Wapakati	Otsika	Wapakati	Otsika
	Kutayika kwa Malo a Zamaluwa ndi Mitundu Yamitundumitundu mu Zaulimi	Otsika Kwambili	Otsika Kwambili	**Zosafunikila**	**Zosafunikila**
	Kutayika kwa Mitundu Yamaluwa Yamaluwa Yomva	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili
	Malo okhala ndi madzi abwino komanso zachilengedwe (zomangamanga kunja kwa madera obwerera)	**Zosafunikila**	**Zosafunikila**	**Zosafunikila**	**Zosafunikila**

Chigawo cha chilengedwe	Zomwe zimachitika panthawi yomanga ndi kugwira ntchito kwa Unika 1 Wind Farm	GAWO LOMANGA Kufunika Popanda Kuchepesa		GAWO LA NCHITO Kufunika Ndi Kuchepesa	
		Popanda Kuchepesa	Ndi Kuchepesa	Popanda Kuchepesa	Ndi Kuchepesa
	Malo okhala ndi madzi abwino komanso chilengedwe (ma mashini omwe ali mkati mwa dambos)	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili
	Malo okhala ndi madzi abwino komanso chilengedwe (mawoloka misewu)	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili
	Zachilengedwe ndi chikhalidwe cha anthu (zomangamanga kunja kwa madera obwerera m'mbuyo)	**Zosafunikila**	**Zosafunikila**	**Zosafunikila**	**Zosafunikila**
	Zachilengedwe ndi chikhalidwe cha anthu (ma mashini omwe ali mkati mwa dambos)	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili
	Ntchito zachilengedwe ndi chikhalidwe cha anthu (mawoloka misewu)	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili	Otsika Kwambili
	Zotsatira za Avifauna (mbalame): Kugunda kwa Mbalame Ndi Masamba (Ntchito Yogwira Ntchito)	-	-	Apamwamba	Wapakati
	Zotsatira za Avifauna (mbalame): Kuwonongeka kwa malo a mbalame (Gawo Lomanga)	Otsika	Otsika	-	-
	Zotsatira za Avifauna (mbalame): Kusokonezeka kwa Mbalame (Kumanga & Gawo la Ntchito)	Otsika	Otsika	Otsika	Otsika
	Zotsatira za Avifauna (mbalame): Kusamuka kwa Mbalame & Zolepheretsa (Ntchito Yogwira)	-	-	Otsika	Otsika
	Zotsatira za mileme: Kusokonezeka kwa B pa Roosts (Gawo Lomanga)	Otsika Kwambili	**Zosafunikila**	-	-
	Zotsatira za Mileme: Kuwonongeka kwa Mileme (Gawo Lomanga)	Wapakati	Otsika Kwambili	-	-
	Zotsatira za Mileme: Kusintha kwa Malo okhala Mleme (Gawo Lomanga)	Wapakati	Otsika Kwambili	-	-

Chigawo cha chilengedwe	Zomwe zimachitika panthawi yomanga ndi kugwira ntchito kwa Unika 1 Wind Farm	GAWO LOMANGA Kufunika Popanda Kuchepesa		GAWO LA NCHITO Kufunika Ndi Kuchepesa	
		Popanda Kuchepesa	Ndi Kuchepesa	Popanda Kuchepesa	Ndi Kuchepesa
	Zotsatira za Mileme: Kupanga Malo okhala Mleme M'malo Owopsa Kwambiri (Gawo Logwira Ntchito)	-	-	Otsika Kwambili	Otsika Kwambili
	Zotsatira za mileme: Kufa kwa mileme paulendo komanso/kapena posakasaka (gawo logwira ntchito)	-	-	Wapamwamba kwambiri	Wapakati
	Zotsatira za Mileme: Kufa kwa Mileme Panthawi Yosamuka (Gawo Logwira Ntchito)	-	-	Apamwamba	Otsika
	Mileme Impact: Kukhudza kwa Kuwonongeka kwa Kuwala pa Mileme (Njira Yogwirira Ntchito)	-	-	Otsika	**Zosafunikila**
Zokhudza Zachuma ndi Zachuma	Kusamuka Kwakuthupi ndi Zachuma	Apamwamba	Otsika	-	-
	Malo Ogwirizana ndi Zachilengedwe	Wapakati	Otsika	-	-
	Ntchito, Mikhalidwe Yogwirira Ntchito, ndi Kuchuluka Kwa Ofunafuna Ntchito	Zochepa Zabwino	Zapakati Zabwino	Zochepa Zabwino	Zapakati Zabwino
	Zaumoyo ndi Chitetezo cha Anthu	Wapakati	Otsika	Wapakati	Otsika
	Kusokonezeka kwa Kufikira ndi Kuyenda (njira, misewu)	Otsika	Otsika	Apamwamba	Zabwino Kwambiri
	Chitukuko chazachuma cha Local Economic Development	Zopindulitsa Zochepa Kwambiri	Ubwino Wapakatikati	Zopindulitsa Zochepa Kwambiri	Ubwino Wapakatikati
	chikhalidwe cholowa	**Zosafunikila**	**Zosafunikila**	**Zosafunikila**	**Zosafunikila**
	Phokoso Limakhudza Madera Ozungulira	Otsika Kwambili	**Zosafunikila**	Wapakati	Otsika

Chigawo cha chilengedwe	Zomwe zimachitika panthawi yomanga ndi kugwira ntchito kwa Unika 1 Wind Farm	**GAWO LOMANGA** Kufunika Popanda Kuchepesa		**GAWO LA NCHITO** Kufunika Ndi Kuchepesa	
		Popanda Kuchepesa	Ndi Kuchepesa	Popanda Kuchepesa	Ndi Kuchepesa
	Zowoneka (Kukhalapo kwa ma turbines amphepo pamalopo)	Wapakati	Otsika	Wapamwamba kwambiri	Wapakati
	Zowoneka (zowunikira zochenjeza za ndege usiku)	-	-	Wapamwamba kwambiri	Wapakati

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LIST OF ACRONYMS / ABBREVIATIONS

Acronym / Abbreviations	Meaning
ADLS	Aviation Detection Lighting Systems
BID	Background Information Document
CDT	Chewa Development Trust
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CLO	Community Liaison Officer
COVID – 19	Coronavirus disease 2019
CR	Critically Rare
D	Declining
DEM	Digital Elevation Model
DJOC	District Joint Operations Committee
DNPW	Department of National Parks and Wildlife
DOE	Department of Energy
EC	Electrical Conductivity
EIS	Environmental Impact Statement
EMA	Environmental Management Act (2011)
EN	Endangered
EOO	Extent of Occurrence
EPC	Engineering, Procurement and Construction
EPFI	Equator Principle Financial Institution
EPPCA	Environmental Protection and Pollution Control Act (1990)
ERB	Energy Regulation Board
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EW	Extinct in the Wild
GDP	Gross domestic product
GN	Guidance Note
GPS	Global Positioning System
GSM	Gravel, Sand and Mud
HH	Hib Height
HIA	Heritage Impact Assessment
IBA	Important Bird Areas
IFC	International Finance Corporation
ILO	International Labour Organisation

Acronym / Abbreviations	Meaning
IRENA	International Renewable Energy Agency
IUCN	International Union for Conservation of Nature
KOP	Key Observation Point
LC	Least Concern
LiDAR	Light Detection and Ranging
MetMast	Meteorological Mast
MGEE	Ministry of Green Economy and Environment
MoH	Ministry of Health
MOTA	Ministry of Tourism and Arts
MDWSEP	Ministry of Water Development, Sanitation and Environmental Protection
NBSAP	National Biodiversity Strategy and Action Plan
NCS	National Conservation Strategy (1985)
NEAP	National Environment Action Plan (1992)
NEP	Zambia National Energy Policy (2008)
NHCC	The National Heritage Conservation Commission
NHCC	National Heritage Conservation Commission
NPCC	National Policy on Climate Change (2017)
NPE	National Policy on Environment (2009)
NT	Near Threatened
O&M	Operations and Maintenance
PPA	Power Purchase Agreement
PS	Performance Standard
PSs	Performance Standards
R	Rare
RE	Regionally Extinct
SCC	Species of Conservation Concern
sp.	species
SPV	Special Purpose Vehicle
ToR	Terms of Reference
UNEP-WCMC	United Nations Environment Programme World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States dollar
VU	Vulnerable
WARMA	Water Resources Management Authority

Acronym / Abbreviations	Meaning
WPP	Wind Power Park
WTs	Wind Turbines
ZABS	Zambian Bureau of Standards
ZEMA	Zambian Environmental Management Agency
ZESCO	Zambia Electricity Supply Corporation Limited

UNITS OF MEASUREMENT

Unit	Full name
%	Percentage
°C	Degrees Celsius
dBA	Decibel A Scale
ha	Hectares
kl/month	Kilolitre / month
km	kilometre
kV	Kilovolt
m	metre
m/s	Metre per second
Mamsl (masl)	meters above (mean) sea level
mm	millimetre
mS/m	millisiemens per meter
MW	Megawatt
pH	Potential of hydrogen (acidity or basicity)
$PM_{2.5}$	Particulate Matter
$\mu g/m^3$	Micrograms (one-millionth of a gram) per cubic meter air

1. INTRODUCTION

1.1 PROJECT BACKGROUND

Mphepo Power Limited ("Mphepo") proposes to develop a 200 MW wind farm facility near Katete, Eastern Province, Zambia, known as the Unika I Wind Farm. The proposed facility would utilise wind turbines to generate electricity that will be fed into the National Power Grid via an aboveground transmission line.

Mphepo Power Limited is a registered company in Zambia consisting of a consortium of companies including, Buffalo Energy Ltd., Oswald and Kapata CC, Leighton Power Ltd. and the Chewa Development Trust (on behalf of Chewa King, Kalonga Gawa Undi, and the Chewa People).

Mphepo will be the Development Company while "Unika I" will be the Special Purpose Vehicle (SPV) to be established for the Project.

In terms of the Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997 the submission of an "Environmental Impact Statement" (EIS) is required following the Scoping Phase. As this process is required to follow local as well as international standards in order to access funding, the EIS will be referred to as an "Environmental and Social Impact Assessment Report" (ESIA Report) and be aligned with local legislation as well as the International Finance Corporation (IFC) Performance Standards (PSs).

This ESIA report provides, amongst other things, a description of the proposed project (including alternatives considered), the baseline environment, the ESIA process followed, an assessment of the key potential project-related environmental and social impacts (as screened during the Scoping phase), and the proposed mitigation and monitoring measures.

During 2017 Mphepo initiated pre-feasibility investigations to identify suitable wind power sites in Zambia, and identified a number of sites in the Eastern Province of Zambia.

Prior to the pre-feasibility study a team reached out to Chewa King, Kalonga Gawa Undi, to request permission and support for the Project. Mphepo secured a long terms Deed of Agreement with the Chewa Development Trust (CDT). Various traditional leaders that would be affected by the Project were consulted prior to the conclusion of any agreements, under the guidance of Kalonga Gawa Undi.

Mphepo received permission from the Ministry of Energy to proceed with the feasibility study. The Scoping Report and Terms of Reference (ToR) for the ESIA was approved by the Zambian Environmental Management Agency (ZEMA) in November 2019 (Ref: ZEMA/INS/101/4/1). The approval letter is presented under Annexure B, while the approved Scoping Report and ToR is presented under Annexure C. The current ESIA process is part of the feasibility stage of the Project. Once the feasibility study is completed an implementation agreement will be concluded with the Ministry of Energy through the Zambia Electricity Supply Corporation Limited (ZESCO).

1.2 SUMMARY PROJECT DESCRIPTION AND RATIONALE

1.2.1 Summary Description

The proposed Project entails the development of a 200 MW wind farm. Please refer to Section 3 below for further details on the proposed Project and associated components.

1.2.2 Rationale

The need to meet the growing energy demand from Zambia's growing economy and the large number of un-electrified households (especially in rural areas) has been the major driver towards the introduction of renewable energy technology in the country. The Zambia National Energy Policy (2008) (NEP) sets out a number of policy measures for electricity and renewable energy. The overall objective of the NEP is '*to ensure availability of dependable, affordable energy to support poverty reduction and sustained economic growth in an environmentally sound manner by encouraging the economically efficient supply and consumption of energy*'.

Policy measures to address energy and environmental issues include increasing the utilisation of renewable energy sources. The policy recognises that accessibility to electricity by the majority of the Zambians remains low and increasing access is a priority, and that renewable energy represents one of the best sources of electricity supply. Policy measures to address energy and environmental issue include increasing the utilisation of renewable energy sources

Wind power has become one of the most cost effective renewable energy technologies around the world, and is widely used in both the developing and developed world.

Wind power generation does not rely on fossil fuels as with coal/gas fired power plants, and therefore emit significantly less greenhouse gases or pollutants when compared to conventional thermal power technologies. In most cases, renewable energy technologies require less overall maintenance than generators that use traditional fuel sources.

Unlike other power generation technologies, people in the area can continue their daily lives on the Project Site once construction is finished.

All the power produced is intended to be delivered to the national grid, for the benefit of all Zambians. As an investment, the Projects would be transformative to the Katete region mainly through job creation and providing opportunities for local businesses. The upgrading of existing roads and construction of some new access roads would be beneficial to the people moving around in the Project Site as the current road network is very limited and generally in poor condition, particularly as a result of heavy rains and lack of regular maintenance.

The Project would provide significant support to the Chewa Development Trust as infrastructure in the area is limited and the Eastern Province currently contributes less than 5 % to the GDP. The Project could also contribute to stabilising the power grid, reduce losses and provide power in provinces within Zambia that currently do not have significant generation capacity. The Project would also assist in power supply during periods when hydroelectric resources are low (particularly during the drier season).

1.3 PROJECT OBJECTIVES

The main objective of the Project is to develop wind power capacity and to transmit that power into the national and regional power transmission system to meet existing and future demands. Other objectives include:

- Diversifying energy sources in Zambia;
- Improving electricity supply distribution locally and nationally;
- Creating local employment and business opportunities;
- Improving the local economy of the Eastern Province; and
- Assisting the Chewa Development Trust (and associated socio-economic initiatives).

1.4 BRIEF DESCRIPTION OF THE PROJECT LOCATION

The Project Site is located directly north of Katete (Eastern Province, Zambia), and ± 440 km east of Lusaka, Zambia (see Figure 1). The Project Site is approximately 33 350 hectares (ha) in size, while the footprint of the Unika I Wind Farm would be approximately 3 900 ha. The Project Site is strongly rural and populated by a number of small villages. The nearest town is Katete, which is a small but well established town located immediately southwest of the Project Site. The main access road is the T4 National Road (Great East Road), which is main route connecting the Zambian capital of Lusaka to the smaller towns of Nyimba, Katete and Chipata in the east.

Please refer to Section 3.1 for more detail on the Project location.

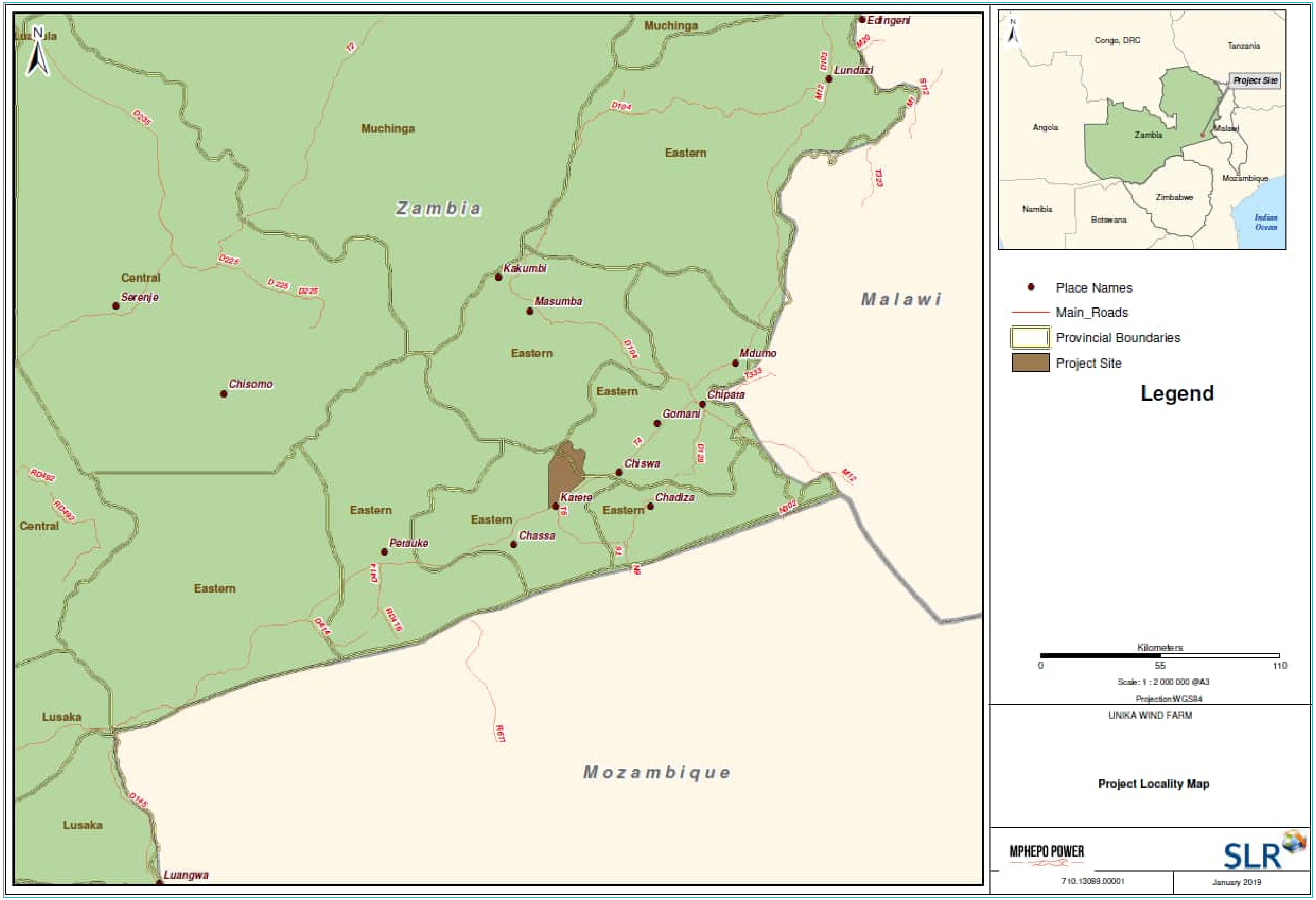


Figure 1: Location of the Project Site

1.5 PARTICULARS OF PROJECT COMPANY, ADDRESS, CONTACT DETAILS, SHAREHOLDERS AND DIRECTORS

Mphepo is a Zambian renewable energy company, focussed on the development of wind power in Eastern Province, Zambia. Mphepo is located at Figtree Office Park, 17 Warthog Road, Lusaka, Zambia. The contact person details at Mphepo is as follows:

Name: Ms. Linda Thompson

Title: Managing Director

Tel: +260 96 070 7388

Email: linda.thompson@mphepopower.com

Mphepo is a Zambian renewable energy company (Company Number 120170003750), focussed on the development of wind power in the Eastern Province of Zambia. Mphepo is a registered company in Zambia consisting of a consortium of companies (as shown in Figure 2 below) including, Buffalo Energy Ltd., Oswald and Kapata CC, Leighton Power Ltd. and the Chewa Development Trust (on behalf of Chewa King, Kalonga Gawa Undi, and the Chewa People).

Mphepo will be the Development Company while "Unika I" will be the Special Purpose Vehicle (SPV) to be established for the Project.

Further information on the companies, their directors and shareholding within Mphepo is provided in Table 1.

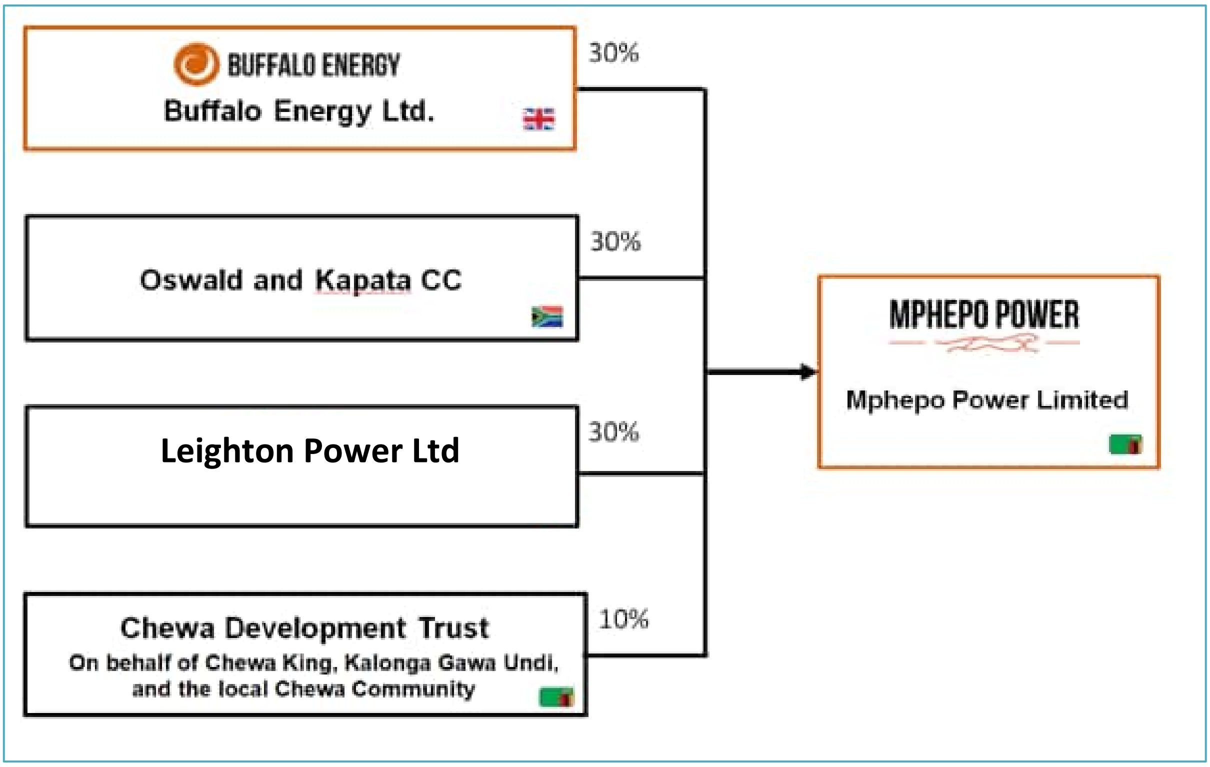


Figure 2: The structure of Mphepo Power Limited

Table 1: Shareholding and directors

Company	*Directors*	*Shareholding in Mphepo*
Buffalo Energy Ltd	Charlie Troughton and Will Dryer	30 %
Oswald and Kapata CC	Linda Thompson	30 %
Leighton Power Ltd	Sipho Phiri, Guy Phiri, Grant Henderson and Sundip Bhundia.	30 %
Chewa Development Trust	Set up by Kalonga Gawa Undi on behalf of the Chewa People, the Chewa Development Trust, is managed by the Chewa Investment Committee	10 %

1.6 TRACK RECORD & PREVIOUS EXPERIENCE OF ENTERPRISE ELSEWHERE

Mphepo as a company does not have a track record of wind farm developments; however various individuals within Mphepo have the following track record and experience:

- Buffalo Energy are based in Lusaka and have focused on solar and biomass development in Zambia. In 2021, their solar development company, Western Solar Power, were awarded Preferred Bidder status by Africa Greenco for the 25MW Ilute Solar Project near Sesheke, Western Province, Zambia alongside Serengeti Energy (previously responsAbility Renewable Energy Holding). The Project will reach financial close in 2022.

- Oswald & Kapata CC is registered in South Africa, but currently based in Zambia in order to develop The Unika I Wind Farm project. The company holds extensive expertise in both wind and solar development through its owner who has over 19 years of renewable energy development experience, incorporating a Joint Venture (via a South African development company that Oswald and Kapata was a shareholder in) with Mainstream Renewable Power and 9 years working for Mainstream. This includes heading up Mainstream's solar development in South Africa, winning two 50 MW solar projects, and developing large scale wind projects on the African continent.

An EPC Contractor with a proven track record and experience will be appointed by Mphepo to design and construct the Unika I Wind Farm.

1.7 TOTAL PROJECT COST/INVESTMENT

The total Project investment cost is estimated to be around USD 350 - 450 million.

1.8 PROPOSED PROJECT IMPLEMENTATION DATE

The construction phase of the project is anticipated to commence during Quarter 3 of 2023.

2. REGULATORY FRAMEWORK AND CORPORATE REQUIREMENTS

2.1 POLICY FRAMEWORK

2.1.1 National Policy on the Environment (NPE)

The National Policy on Environment (NPE), which was officially launched in 2009, is the overall policy on environment and provides environment and natural resources management policies to address current and future threats to the environment and to human livelihoods and provides policy guidelines for sustainable development. The NPE was preceded by the National Conservation Strategy (NCS), adopted in 1985, which saw the establishment of environmental legislation and institutions. The NCS was updated in 1992 through the National Environment Action Plan (NEAP) to meet the demands of economic liberalization and new technical information.

Amongst others, a specific objective of the NPE is to accelerate environmentally and economically sustainable growth in order to improve the health, sustainable livelihoods, income and living conditions of the poor majority with greater equity and self-reliance.

The development will be carried out in line with the energy sector objective of the NPE: 'to meet national energy needs with increased efficiency and environmental sustainability'.

A notable strategy relevant to the proposed Project include promoting the use of environmental guidelines and EIA before sites are developed and ensure application of a monitoring and auditing system for operating industries.

2.1.2 National Energy Policy

The Zambia National Energy Policy (2008) (NEP) sets out a number of policy measures for electricity and renewable energy (RE). The overall objective of the NEP is '*to ensure availability of dependable, affordable energy to support poverty reduction and sustained economic growth in an environmentally sound manner by encouraging the economically efficient supply and consumption of energy*'.

Policy measures to address energy and environmental issues include increasing the utilization of renewable energy sources.

The policy recognizes that accessibility to electricity by the majority of the Zambians remains low and increasing access is a priority, and that renewable energy represents one of the best sources of electricity supply. Policy measures to address energy and environmental issue include increased utilization of renewable energy sources.

2.1.3 National Policy on Climate Change

On the 3rd of March 2017, Zambia launched the long-awaited National Climate Change Policy aimed at stemming the impact of climate change and subsequent reduction of the country's annual economic growth due to crop failure and the impact of climate change on energy production. The National Climate Change Policy is an important policy development that introduces a well-structured and coordinated national strategy to effectively tackle the adverse effects of climate change.

The rationale for formulating the NPCC is to establish a coordinated national response to climate change. Currently, climate change issues are being addressed in a fragmented manner using various sectoral policies, strategies and plans and these have had limited overall effect.

The following are some of the principles that guide the policy:

- *Sustainable Climate Change response:* All climate change actions shall be environmentally sustainable and positively contribute to national economic growth and social development objectives, including poverty alleviation, access to natural resources and basic amenities, gender equality and equity and infrastructure development.

- *Compliant with international obligations:* All climate change interventions shall promote and fulfill relevant international obligations as enshrined in various Multilateral Environmental Agreements (MEAs) on Climate Change.

The overall objective of the NPCC is to provide a framework for coordinating climate change programmes in order to ensure climate resilient and low carbon development pathways for sustainable development towards the attainment of Zambia's Vision 2030.

2.2 NATIONAL LEGAL FRAMEWORK

2.2.1 Environmental Management Act, 2011

The Environmental Management Act (EMA) is the principal law on integrated environmental management and was enacted in April 2011 following adoption of the NPE. The EMA replaced and repealed the Environmental Protection and Pollution Control Act (EPPCA) of 1990, which was established under the NCS.

Relevant sections of the Act include:

- Part III: Integrated Environmental Management which requires the carrying out of Environmental Impact Assessment for certain types of projects;
- Part IV: Environmental Protection and Pollution Control which provide for conservation of natural resources; and
- Part VII: Public Participation which gives the public the right to be informed and participate in environmental decision making.

Part IV, Division 6 of the EMA deals with Noise. According to the EMA “noise” means any undesirable sound that is intrinsically objectionable or that may cause adverse effects on human health or the environment. It prohibits the emission of noise in excess of the noise emission standards. It also allows the grating of a permit allowing excessive emission of noise.

2.2.2 The Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997

As part of the implementation process the government through the EPPCA adopted a framework for environmental impact assessment for developmental projects in Zambia and the Environmental Impact Assessment (EIA) Regulations were established in 1997. These regulations continue to be in force under EMA.

2.2.3 Environmental Management (Licensing) Regulations, SI No. 112 of 2013:

Under this statutory instrument established in accordance with Section 43, the EMA controls and regulates the following areas relevant to the project:

Air and Water Pollution: Part II (Regulations 3-9) of SI 112 (2013):

These regulations (Statutory Instrument No. 72 of 1993) provide for the ZEMA to regulate the treatment and discharge of sewerage and other effluents into the natural aquatic environment.

Waste Management: Part III (Regulations 10-15) of SI 112 (2013):

These regulations provide definitions of waste and sets out the licensing requirements for transporters and waste disposal sites.

Hazardous Waste: Part IV (Regulations 18-30) of SI 112 (2013):

These regulations provide for the control of generation, collection, storage, transportation, pre-treatment, treatment, disposal, export, import and transboundary movement of hazardous waste as listed in Fifth Schedule or any waste specified in Sixth Schedule, if that waste exhibits characteristics found in the Seventh Schedule to these Regulations.

2.2.4 Natural Resources Management

Provision is made by the EMA for ZEMA to develop regulations for the conservation and protection of natural resources (Part IV Division 8 of EMA).

Use of natural resources will need to be managed sustainably in order to avoid their degradation or depletion and ensure the viability of the project.

In accordance with section 77 of the EMA the project shall not introduce any invasive alien species into any element or segment of the environment. Should any land dereliction or contamination occur as a direct result of project activities, the project will be responsible for carrying out rehabilitation works within such period as the ZEMA inspectorate may specify.

In addition, and subject to the provisions of the EMA, various natural resources shall be managed in accordance with specific Acts pertaining to environmental protection and management of these elements. For example, in relation to the present project, water resources shall be managed in accordance with the *Water Resources Management Act, 2011*; regional and urban planning shall be managed in accordance with the *Town and Country Planning Act*, etc. These and other relevant acts relating to environmental protection and management with regards to the project, and the compliance thereof, are discussed further in below.

Under the Act an inspector may carry out survey to assist in the proper management and conservation of natural resources, inspect land uses to determine their impact on the quality and quantity of natural resources; and publicise land use guidelines and natural resources conservation regulations.

2.3 OTHER RELEVANT NATIONAL LEGISLATION

The Acts outlined in Table 2 below have also been reviewed in order to assess Project alignment with other relevant existing laws that have a bearing on environmental management and the Project.

Table 2: Other relevant legislation

Ref	Legislative Instrument	Description	Relevance	Compliance
Constitution				
1	The Zambian Constitution	The Constitution of Zambia Act (as amended by Act No. 2 of 2016) is the fundamental law of the land and provides the framework on which all other laws stand. In particular, *Part IV – Bill of Rights* of the Constitution which enshrines fundamental human rights and protection of property, and *Part XIX: Land, Environment and Natural Resources* which establishes the principles of environmental and natural resources management and development and the protection and utilisation of environmental and natural resources. The Zambian Constitution recognises certain fundamental rights of relevance to the project: **Article 11:** states that every person in Zambia irrespective of race, place of origin, political opinions, colour, creed, sex or marital status, is entitled to fundamental right to life, liberty, security of the person and the protection of the law, freedom of conscience, expression, assembly, movement, association, protection of young persons from exploitation, protection for the privacy of his home and other property and from deprivation of property without compensation. **Article 16:** provides that property of any description shall not be compulsorily taken possession of, and interest in or right over property of any description shall not be compulsorily acquired, unless by or under the authority of an Act of Parliament which provides for payment of adequate compensation for the property or interest or right to be taken possession of or acquired. **Article 23:** guarantees protection from discrimination on the ground of race, tribe, sex, place of origin, marital status, political opinions, colour or creed. **Article 24**: guarantees protection of young persons from exploitation including employment which interferes with their education and well-being, physical or mental ill treatment, all forms of neglect, cruelty or exploitation and trafficking.	The project should not require the acquisition of land which will result in displacement and possible resettlement of persons or communities	Compensation may be required for land occupied by the project (e.g. turbines, roads, etc.). In line with Article 16 (and international guidelines) there must be adequate compensation before any personal property is compulsorily acquired. In this context Article 23, which protects against all forms of discrimination, is also very important with regards to women or the vulnerable who may not have any title to land (and therefore not entitled to any compensation) in a traditional society.
Natural Resources/Heritage				
2	The Water Resources Management Act, 2011	This Act establishes the Water Resources Management Authority and provides for the integrated management, development, conservation, protection and preservation of the water resource and its ecosystems. Sections of this Act relevant to the proposed	The project may involve the abstraction of ground water and/or surface water.	A "Permit to Access Water" may be required.

Ref	Legislative Instrument	Description	Relevance	Compliance
		project are Part IV which provides for efficient, sustainable and beneficial use of water in the public interest and that Zambia's water resource shall be protected and the use controlled and that all non-domestic water use shall require a permit. The Act also ensures the right to draw or take water for domestic and non-commercial purposes, and that the poor and vulnerable members of the society have an adequate and sustainable source of water free from any charges. Part VIII, of this act speaks of 'A person who uses water, as specified under subsection shall comply with any condition, limitation, restriction or prohibition imposed for that use by, or under, this Act or any other law." It also provides for the constitution, functions and composition of catchment councils, sub-catchment councils and water users associations; repeals and replaces the Water Act, 1949; and provides for matters connected with, or incidental to, the foregoing.	Section 46(2) of the Act requires a developer to discharge any trade or other effluent in accordance with the provisions of the EMA (2011), and steps must be taken by a developer to control or prevent any water pollution as may be required by the Water Authority (section 49).	The developer will ensure that the Water Resources Management Authority and the Department of Water Resource Development are involved during the project planning and implementation stages as well as for all the water needs of the development.
3	The Noxious Weeds Act, Cap 343	This Act provides for the declaration, control and eradication of noxious weeds. Particular and relevant to the current project are section 4, that put the onus of reveal and reporting of 'found'' Noxious Weed to the authorities.	Under this Act the project will be responsible for preventing the introduction and/or controlling the spread of common weeds.	The developer will ensure that undesirable invasive species are not introduced. Species declared as noxious weeds under the act (such as *Lantana camara*) are prohibited.
4	Mines and Minerals Development (Amendment) Act, 2016	An Act to revise the law relating to the exploration for, mining and processing of, minerals; provide for safety, health and environmental protection in mining operations; provide for the establishment of the Mining Appeals Tribunal; repeal and replace the Mines and Minerals Development Act, 2008; and provide for matters connected with, or incidental to, the foregoing. Part II of this act is relevant to current project as it speaks to the developer/supplier to carry out an Environmental Impact Assessment, describing activities that would be considered under this Act.	Material sources (e.g. borrow pits and/or quarry) may be required for various activities, including construction of towers bases, new access roads or upgrading of existing access roads.	All applicable by-laws will be adhered to, and mining permit applications will be applied for.
5	National Heritage Conservation Commission Act (No. 23 of 1989) and National Heritage Conservation Commission Amendment Act (No. 13 of 1994)	This Act provides for the establishment of the National Heritage Commission responsible for the conservation, restoration, rehabilitation, reconstruction, adaptive use and good management of heritage conservation. The relevant section of this act is Part V and it reads in part "Any person, who discovers what appears to be an ancient heritage or relic shall- (*a*) report his discovery to the Commission within fourteen days; (*b*) suspend his operations in the immediate vicinity of his discovery until thirty days after the delivery of his report, unless the Commission authorises their continuance;	The proposed development involves the construction of the infrastructure which may disturb cultural and natural heritage sites.	All measures will need to be undertaken to protect and conserve the cultural and natural heritage of the Project Site. For any new discoveries made of items of historical or archaeological interest during implementation of the project, the provisions of the NHCC Act shall apply, and the required

Ref	Legislative Instrument	Description	Relevance	Compliance
		and (c) deliver to the Commission as soon as practicable, or request the Commission to examine and remove, any object which is, or appears to be, a relic."		procedures for the reporting of such discoveries shall be followed.
Energy Regulation, Investment and Standards				
6	Energy Regulation Act No 23 of 2003	The Act of 1995 makes provision with respect to the production and distribution of energy in Zambia and establishes the Energy Regulation Board for purposes of control and licensing of energy undertakings. Part III of this act is relevant to the project and speaks to Licensing and formulation of measures to minimize the environmental impact of the production and supply of energy and the production, transportation, storage and use of fuels and enforce such measures by the attachment of appropriate conditions to licences held by undertakings.	The Project will undertake to generate electricity.	The Developer shall apply for a licence for energy generation in accordance with provisions of this Act prior to the commencement of the development. Permits will be required for the bulk storage of fuel on site during construction and operational phases.
7	Petroleum Act No. 10 of 2008	The Act provides for the regulation of the importation, conveyance and storage of petroleum products and other inflammable oil and liquids (e.g. petrol and diesel) for the protection of the public and the environment.	Any bulk fuel storage facilities associated with the project will be required to be constructed and operated in accordance with regulations as set out in the Act.	Petroleum products shall be transported to and/or stored on-site in compliance with the provisions of the Petroleum Act that is according to ZABS standards - ZS 385-3.
Land Use, Land Acquisition and Regional Planning				
8	The Urban and Regional Planning Act (Number 3 of 2015)	The Act provides for development, planning and administration principles, standards and requirements for integrated urban and regional planning processes and systems so as to ensure multi-sector and level cooperation and coordination; the Act endeavours to ensure sustainable urban and rural development by promoting environmental, social and economic sustainability in development initiatives and controls at all levels of urban and regional planning. The Act repeals the Town and Country Planning Act, 1962, and the Housing (Statutory and Improvement Areas) Act, 1975.	The proposed project is a development project that should be in compliance with this Act.	The necessary documentation will be submitted to the relevant authorities for approval for project implementation in accordance with the terms of the Act.
9	Lands Act No 20 of 1996	This Act provides for the continuation of Leaseholds and leasehold tenure; to provide for the continued vesting of land in the President and alienation of land by the President; to provide for the statutory recognition and continuation of customary tenure; to provide for the conversion of customary tenure into leasehold tenure; to establish a Land Development Fund and a Lands Tribunal; to repeal the Land	All land located within the Project Site falls under Customary Land which is legally recognised and protected under the Lands Act, Chapter 184, and any customary land	The Developer has developed a draft Resettlement Policy Framework as part of the ESIA (see Annexure I), and will ensure that a Resettlement Action Plan is developed and

Ref	Legislative Instrument	Description	Relevance	Compliance
		(Conversion of Titles) Act; to repeal the Zambia (State Lands and Reserves) Orders, 1928 to 1964, the Zambia (Trust Land) Orders, 1947 to 1964, the Zambia (Gwembe District) Orders, 1959 to 1964, and the Western Province (Land and Miscellaneous Provisions) Act, 1970; and to provide for matters connected with or incidental to the foregoing.	vested in or held by any person under customary tenure is similarly recognised.	implemented prior to construction commencing.
10	Local Government Act No. 2 of 2019	An Act to provide for an integrated local government system; give effect to the decentralisation of functions, responsibilities and services at all levels of local government; ensure democratic participation in, and control of, decision making by the people at the local level. The Act provides for an integrated local government system and gives effect to the decentralization of functions, responsibilities and services at all levels of Local Government. The part of this Act relevant to the project is Part II which provides for Local Governance of an area by a council. It outlines the functions of local authorities; provide for the review of tariffs, charges and fees within the area of a local authority; provide for the proceedings of the council and committees; provide for the role of traditional leadership in democratic governance; and provide for matters connected with, or incidental to, the foregoing.	Implementation and operation of new development will be subject to the procedures laid out by the local authorities.	All applicable by-laws will be adhered to.
11	Electricity Act No. 11 of 2019	The relevant sections of this Act to the project are Part II of the Act that regulates the generation, transmission, distribution and supply of electricity so as to enhance the security and reliability of the supply of electricity; provides for the sale and purchase of electricity within and outside the Republic; facilitates the achievement of the efficient, effective, sustainable development and operation of electricity infrastructure; provides the roles and responsibilities of various participants in the electricity sector; facilitates adequate levels of investment in the electricity sector; provides for a multi-year tariff framework; promotes transparency in the identification and allocation of risks, costs and revenues within and between participants in the electricity sector; ensures the protection and safety of consumers of electricity and the public; Part III of the act speaks to the maintenance, use and licensing for transmission of electricity either by overhead power lines or underground. The Act also repeals and replaces the Electricity Act, 1995; and provides for matters connected with, or incidental to, the foregoing.	The Project will undertake to generate electricity.	The developer will ensure that the implementation of the proposed project is in compliance with this Act.
Employment, Health, Safety and Human Rights				
12	Employment Act No. 3 of 2019	This is an Act to regulate the conditions of employment, prohibit discrimination at an undertaking; constitute the Skills and Labour Advisory Committees and provide for their functions; provide for the engagement of persons on contracts of employment and provide for the form and enforcement of the contracts of employment; provide for employment entitlements and other benefits; provide for the protection of wages of employees; provide for the registration of employment agencies; regulate the	The proposed Project will employ people both skilled and unskilled, whose employment conditions are subject to this Act.	The developer will ensure that all recruitment procedures and conditions of employment of persons under the project will comply with the provisions of the Act. The developer will also ensure

Ref	Legislative Instrument	Description	Relevance	Compliance
		employment of children and young persons; provide for the welfare of employees at an undertaking and to provide for employment policies, procedures and codes in an undertaking. Several sections of this Act are relevant to the proposed project, these are: • Part I which provides for equal opportunity employment and also prohibits forced labour. • Part III which provides for employment relationship and gives guidelines for contract of employment, minimum employment benefit, suspension and termination of contract of employment. • Part IV provides for the protection of wages. • Part V provides for the employment of young children and young persons (prohibition of employment of child in industrial undertakings). • Part VII provides for employee welfare.		that the contractors promote STDs & HIV/AIDS awareness among construction workers during project implementation.
13	Workers' Compensation Act No. 10 of 1999	The Act provides for the compensation of workers for disabilities suffered or diseases contracted during the course of employment. The Act provides for the merger of the functions of the Workers' Compensation Fund Control Board and the Pneumoconiosis Compensation of fund for the compensation of workers disabled by accident occurring, or diseases contracted in the course of employment. Section 8 of this Act relevant to this project provides that where any injury is caused to a worker by the negligence, breach of statutory duty or other wrongful Act or omission of the employer, or of any person for whose Act or default the employer is responsible, nothing in this Act shall limit or in any way affect any civil liability of the employer independently of this Act.	The nature of the proposed project is likely to cause injury, illness or death to workers on-site if safety measures are neglected.	In case of any accidents occurring to any worker, the developer and appointed contractors will treat such employees in accordance with these regulations.
14	Factories Act Cap 441 no 2 of 1966	An Act to make further and better provision for the regulation of the conditions of employment in factories and other places as regards the safety, health and welfare of persons employed therein and to provide for the safety, examination and inspection of certain plant and machinery. The parts of this Act relevant to this project are; Part v - Health: General Provisions which provides for cleanliness of workplaces, overcrowding, general ventilation, lighting and sanitary conveniences at the work place; Part vi - Safety: General Provisions which provides for the training and Supervision of inexperienced works and safety access to site, fire prevention and fighting and means of escape and warning in case of fire; Part vii – Safety: Lifting Machinery which provides for the construction and maintenance of hoist and lifts; Part ix – Welfare: General Provisions which provides for drinking water, washing facilities, accommodation for clothing and change rooms, facilities for sitting, first aid and welfare regulations and;	The project during operation and as a construction site is subject to provisions of the Act as a place of work.	All work procedures and workers Personal Protective Equipment (PPE) will be required to meet the provisions of this Act. Inspection procedures for the operation of all plant and equipment during construction and operation will be governed by this Act.

Ref	Legislative Instrument	Description	Relevance	Compliance
		Part xi which provides for the notification and investigation of accidents, dangerous occurrences and industrial diseases. The Act provides a framework for the setting of regulations to ensure the safety, health and welfare of persons employed on construction work sites and in factories.		
15	Occupational Health and Safety Act, No. 36 of 2010	The Act establishes the Occupational Health and Safety Institute and provides for its functions; parts relevant to the project are Part III providing for the establishment of health and safety committees at workplaces and Part IV which provides for the health, safety and welfare of persons at work; provides for the duties of manufacturers, importers and suppliers of articles, devices, items and substances for use at work; 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; and provides for matters connected with, or incidental to, the foregoing.	The project will involve procedures and activities with inherent risks to the occupational health and safety of employees and other persons (e.g. community members).	The developer and appointed contractors shall be obliged to comply with the provisions of the Act.
16	Solid Waste Regulation and Management Act No. 20 of 2018	This Act provides for the regulation of solid waste and management. The sections of this Act relevant to the proposed project are part ii which provides for the management of solid waste; part iii which provides for the regulation of solid waste and part iv which provides for the provision of solid waste services by licensed solid waste service providers.	During the implementation of the proposed Project various kinds of waste are expected to be generated	Bins will be introduced on site which will be used to collect waste and these will be collected by a licensed garbage collector at regular intervals.
17	Public Health Act, Chapter 295 of 1995	The Act provides for and regulates all matters connected with public health in the country under the Local Authority of each district as the enforcement Agency. The sections of this Act relevant to this project are part ix, section 75 which provides that buildings should be kept clean, gives guidelines for the construction of buildings and also guidelines for the management of waste.	For the proposed development, this will cover such matters as solid waste management, levels of hygiene and the standards of the general working environment.	Good housekeeping and proper waste management and disposal protocols will be adhered to by the contractor and the developer to avoid the spread of vermin and diseases.
18	Public Health (Infected Areas) (Coronavirus Disease 2019) Regulations, 2020	**Regulation 10 (1):** an authorised officer may prohibit or restrict the trade of food products and ready to eat foods from and in any location which may pose a danger to health of consumers and the traders. **Regulation 11.** An authorised officer shall prohibit or restrict trading in or vending of food in unsanitary conditions. **Regulation 12 (2):** an authorised officer may order the cleaning or closure of a public premise or burial of any contaminated water body where the authorised officer determines that public premises or a water body does not have sufficient sanitation and hygiene to prevent the occurrence or transmission of COVID – 19	During the construction of the transmission line, trading of food products and ready to eat food are expected on site.	The developer and the contractor will comply with the following measures; - All individuals accessing the site must adhere to the infection control measures (temperature testing, hand washing and sanitizing, and foot bath) on site and work areas.

Ref	Legislative Instrument	Description	Relevance	Compliance
		Regulation 14. A person who fails to comply with a direction, prohibition or restriction of an authorised officer or otherwise contravenes these regulations commits an offence and is liable, on conviction to a fine not exceeding two thousand five hundred penalty units or to imprisonment for term not exceeding six months, or both.		- Avoid physical hand contact such as handshakes. - Frontline staff (security, testers etc.) must use appropriate PPE.
19	Public Health (Notifiable Infectious Disease) (Declaration) Notice, 2020	**Regulation 3.** The ministry responsible for health may convert a suitable building to a hospital, observation camp or station for the purpose of placing a person suffering or suspected to be suffering from, or who has been in contact with a person suffering from COVID – 19. **Regulation 5 (2):** subject to sub - regulation (1) a person who intends to enter or leave an infected area may, before entering or leaving the infected area, be required to undergo the following; *(a) Medical examination;* *(b) Disinfection; or* (c) *Remain for a specified period in a hospital, an observation camp or station converted under regulation 3.* **Regulation 6.** The body of a person who has died from COVID – 19 shall be disposed of in conformity with the directions of an authorised officer. **Regulation 7.** An authorised officer may enter premises to search for a case of COVID – 19 or to enquire whether there is or has been a case of COVID – 19. **Regulation 8.** A person who becomes aware or has reason to suspect that another person has died or is suffering from COVID -19 shall immediately inform the nearest authorised officer in a local authority or public health facility. **Regulation 9.** A public ceremony or gathering of more than five persons, not being a family shall not be held in an infected area without the written permission of a local authority or Medical Officer of Health.	The implementation of the project is subject to provisions of the Public Health (Notifiable Infectious Disease) Notice, 2020.	All hygienic practices must be adhered to, to minimize exposure to COVID-19. These include social distancing, personal hygiene and frequently sanitizing any high touched areas. Further, avoid big crowds and travelling to work, employees to wear a face mask and ensure that they wash their hands with soap or sanitize. Reducing meetings and gatherings that bring people within 2 meters of each other for extended durations.
20	Roads and Road Traffic Act, 2002	<u>The Roads and Road Traffic Act, provides for the control of traffic, and for the regulation of drivers. The sections of this Act relevant to the proposed project are section 14 (2) which provides that building owners shall provide service roads to give access to the buildings: Section 110 which provides for the need for all drivers to have driving licenses; section 198 which provides for the conviction of a person driving under the</u>	Materials to use on-site during Project implementation will be transported by road. In addition, some of the access roads to be constructed may be	The developer will ensure that all transportation of materials to the site is in compliance with this Act. Approvals will be obtained for designating public roads.

Ref	Legislative Instrument	Description	Relevance	Compliance
		influence of drink and drugs and section 201 which provides that no person shall use or permit to be used a vehicle in dangerous conditions	designated as public roads after construction.	
21	Human Rights Commission Act (No. 39 of 1996)	The Act has only one part of which relevant to the project is Section II that covers the functions, powers and composition of Human Rights Commission which include investigation of human rights violations; investigation of any maladministration of justice; and proposing effective measures to prevent human rights abuse.	The proposed project will employ people whose employment conditions may be subject to this Act	The project will adhere to all laws and guidelines (including international standards) with regards to land acquisition, compensation and employment.

2.4 INSTITUTIONAL FRAMEWORK

The Zambia Environmental Management Agency (ZEMA) is a statutory body under the Ministry of Green Economy and Environment (MGEE) which facilitates at the national level the coordination of the various Ministries and regulatory bodies that play a role in in the management and conservation of the environment.

Government ministries, departments and local authorities work on behalf of the public to ensure that ecological, cultural, social and economic issues are addressed in line with existing government policy and legislation. Institutions with a supervisory and monitoring role relevant to the Project are described in Table 3.

Table 3: Institutions with a supervisory and monitoring role relevant to the Project

Institution	Responsibility
Zambia Environmental Management Agency (ZEMA)	ZEMA is responsible for the enforcement of the provisions of the EMA on environmental impact assessment, pollution control, natural resources management and solid waste management which includes establishment of landfill sites. The services provided by the ZEMA specifically in relation to EIA studies include: • Assisting the developer to determine the scope of EIA studies; • Reviewing project briefs, terms of reference, and environmental impact statements (EIS) and decision-making; • Disclosure of the EIS to the public through the media; • Holding public hearing meetings to discuss the EIS with stakeholders; • Conducting verification surveys of the affected environment; • Monitoring the project once implemented; • Conducting compliance audits of the project between 12 and 36 months after implementation; and • General administration of all the Regulations under the EMA. In addition to the Project Environmental Permit, ZEMA is responsible for the issuing of licenses relating to: • Emissions (air and waste water), • Waste management and • Hazardous waste management.
Water Resources Management Authority (WARMA)	A statutory body under the Ministry of Water Development, Sanitation and Environmental Protection (MDWSEP) which is responsible for the management of water resources and liaises with ZEMA on issues relating to water pollution. In accordance with the provisions of the Water Resources Management Act, WRMA will regulate and control the rates of water abstraction to ensure that available surface and underground water resources are not depleted and is responsible for issuing of water permits (previously known as 'water rights').
Department of National Parks and Wildlife (DNPW)	The research permit required supervision by an Area Ecologist during research fieldwork.
Ministry of Green Economy and Environment: Forestry Department	Consent will be required from the Forestry Department for the construction of the power transmission line as parts of the current preferred route run through the Chiulukire West and Chivuna Hills Forest Reserves.

Institution	Responsibility
The National Heritage Conservation Commission (NHCC)	The NHCC, which falls under the Ministry of Tourism and Arts (MOTA), is responsible for the identification of sites of cultural and historical interest and their conservation. In the case of new discoveries of cultural or historical sites, the NHCC will be the first agency to be notified and give guidance on how to handle and preserve them. The NHCC is responsible for issuing permissions to Remove/Alter/Destroy heritage sites and for establishing concession agreements for the management of heritage sites. The NHCC has undertaken a heritage impact assessment (HIA) as a component of the ESIA.
Ministry of Health (MoH)	The Ministry of Health is concerned with issues of health of the human population. This ministry works hand in hand with local authorities to ensure quality good health of the residents through provision of health services and health risks awareness. As such the MoH is responsible for monitoring the health status and trends of the communities in the Project Site through the Health Management Information System.
Ministry of Mines and Minerals Development	The main access roads and internal service roads would be constructed or upgraded from material sourced from quarries or borrow pits within and around the area (if available). All material will need to be sourced from quarries and/or borrow pits approved from the Ministry of Mines and Minerals Development.
Department of Energy (DOE)	The DOE falls under the Ministry of Energy and its functions, among others, are to develop and implement a Policy on Energy, integrate the Energy sector into Zambia's national and regional development strategies; to regulate the Energy sector through appropriate legislation including the development of new laws and bye-laws.
The Energy Regulation Board (ERB)	The ERB is the statutory body under the Ministry of Energy which has the mandate of regulating the energy sector in line with the provisions of the Energy Regulation Act of 2003. In order to carry out this role, the ERB, among other functions, ensures that all energy utilities in the sector are licensed, monitors levels and structures of competition, and investigates and remedies consumer complaints. The unit price of that electricity generated by the Project and sold to the national grid will be regulated by the ERB. ERB issues licenses for electricity generation plants and energy related facilities such as bulk fuel storage facilities.
Provincial Planning Office	Planning permission for the Project will be sought through the Provincial Planning Office (Western Province)
District Councils	The district councils are responsible for issuing Building Permits, Fire Permits and permissions for establishment of waste disposal sites (landfills).

The traditional administration in the Project area is a complex and interconnected set of relationships and responsibilities. The Paramount Chief / King is the overall leader of the Chewa Kingdom and is supported by the Chewa Royal Establishment and the Royal Council (including the royal family, chiefs and other functionaries).

The functions, powers and duties of the Paramount Chief are delegated to Chiefs, whom administer broad areas of the Kingdom (i.e. Chiefdoms). The Project is located in a single chiefdom under Chief M'bangombe. The chiefs are further supported by headmen / headwomen that administer one or more villages. The Chief and headmen may also be supported by indunas which function as advisors but have no specific powers.

The areas controlled by the different headmen / headwomen is fluid. Headmen / headwomen are often selected based on their ties with major or founding clans of their respective villages. The headmen / headwomen provide direct administrative functions at the village level, and therefore play a direct role in supporting individual households as well as the administration of land

The traditional leaders and other structures relevant to the Project include:

- Chewa King, Kalonga Gawa Undi;
- Chief M'bangombe;
- Headmen / headwomen of the villages within the Project area.

- Indunas of the Project area.

2.5 INTERNATIONAL AGREEMENTS AND CONVENTIONS

Zambia is a party to a number of international and regional conventions related to the environment and natural resources management which influence the country's policies and legislation.

The environmental treaties and conventions most relevant to the project are set out in Table 4.

Table 4: International treaties and conventions of relevance to the Project

Name of Convention (Date of ratification)	Description	Relevance to the Project
Convention on Biological Diversity (1992)	The Convention is relevant in that land clearing activities have potential to cause loss of habitat and associated biodiversity and habitat disturbance. In addition, the IFC Performance Standard 6 (Biodiversity Conservation and Sustainable Natural Resource Management) reflects the objectives of the Convention to conserve biological diversity and promote use of renewable natural resources in a sustainable manner.	The Project will be executed sustainably in such a way as to conserve natural aquatic, woodland and wildlife habitat as far as possible and minimize disturbance to the site ecosystem.
United Nations Framework Convention on Climate Change (1996)	The Convention is relevant as the clearing of land for the Project has the potential to contribute to climate change since loss of vegetation deprives the earth of the carbon sink which help mitigate global warming.	The Project will ensure a conservative approach to vegetation clearing so as to limit loss of vegetation.
African Convention on the Conservation of Nature and Natural Resources (1968)	This convention aims at enhancing environmental protection, to foster the convention and sustainable use of natural resources and to harmonies and coordinate policies in these fields.	This convention is relevant to the planning, construction and operation phases of the Project.
Convention on the Protection of World Cultural and Natural Heritage (ratified 1984)	Provides for the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage which are of outstanding universal value from the point of view of history, art or science.	The Project will implement the necessary procedures to protect cultural and natural heritage.
UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage	The purposes of this Convention are to safeguard the intangible cultural heritage; to ensure respect for the intangible cultural heritage of the communities, groups and individuals concerned; to raise awareness at the local, national and international levels of the importance of the intangible cultural heritage, and of ensuring mutual appreciation thereof; and to provide for international cooperation and assistance.	The Project will implement the necessary procedures to protect cultural and natural heritage.
Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) (ratified 1993)	This is an international agreement between governments to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Protection of the biodiversity in the surrounding area of the Project.

Name of Convention (Date of ratification)	Description	Relevance to the Project
Basel Convention on the control of transboundary movements of hazardous wastes and their disposal (1999)	International treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries	Waste management during the construction and operation of the Project will be managed accordingly

In addition, Zambia is a signatory to various **International Labour Organisation (ILO) Conventions** which are relevant to working conditions and regulation on site during construction and operation of the Project. These include[1]:

- C138 - Minimum Age Convention, 1973 (ratified 1976)
- C182 - Worst Forms of Child Labour Convention, 1999 (ratified 2001)
- C111 - Discrimination (Employment and Occupation) Convention, 1958 (ratified 1979)
- C017 - Workmen's Compensation (Accidents) Convention, 1925 (ratified 1964)
- C148 - Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (ratified 1980)
- C155 - Occupational Safety and Health Convention, 1981 (ratified 2013)

2.6 EQUATOR PRINCIPLES

The Equator Principles are a risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in projects and are primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making. Equator Principle Financial Institutions (EPFIs) commit to implementing the Equator Principles in their internal environmental and social policies, procedures and standards for financing projects and will not provide Project Finance or Project-Related Corporate Loans to projects where the client will not, or is unable to, comply with the Equator Principles.

In order to facilitate potential access to funding for project development potential borrowing organisations need to consider the Equator Principles and environmental and social risk management as part of the ESIA process.

There are 10 principles as shown below, and these require that Projects conduct an ESIA process in compliance with the IFC Performance Standards on Environmental and Social Sustainability.

1. Review and categorisation
2. Social and environmental assessment
3. Applicable environmental and social standards
4. Environmental and Social Management System and Equator Principles Action Plan
5. Stakeholder Engagement
6. Grievance mechanism
7. Independent review
8. Covenants
9. Independent monitoring and reporting
10. Reporting and Transparency

[1] Source: http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200_COUNTRY_ID:103264

2.7 IFC PERFORMANCE STANDARDS ON ENVIRONMENTAL AND SOCIAL SUSTAINABILITY (2012)

The IFC's Environmental and Social Performance Standards (international PSs) define IFC clients' responsibilities for managing their environmental and social risks an provides an international benchmark for identifying and managing environmental and social risk and has been adopted by many organizations as a key component of their environmental and social risk management. The IFC Performance Standards encompass eight topics as shown in Table 5.

Table 5: IFC Performance Standards and their applicability to the Project

IFC Performance Standard	Applicability to this project
PS1: Assessment and Management of Environmental and Social Risks and Impacts PS1 establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client's management of environmental and social performance throughout the life of the project.	Yes An Environmental and Social Impact Assessment needs to be conducted and an Environmental and Social Management Plan needs to be developed
PS2: Labour and Working Conditions PS2 asks that companies treat their workers fairly, provide safe and healthy working conditions, avoid the use of child or forced labour, and identify risks in their primary supply chain.	Yes Various people will be employed which will require measures for managing labour and working conditions
PS3: Resource Efficiency and Pollution Preventions PS3 guides companies to integrate practices and technologies that promote energy efficiency, use resources—including energy and water—sustainably, and reduce greenhouse gas emissions.	Yes The Project will require various resources and activities (especially during construction) could lead to pollution
PS4: Community, Health, Safety and Security PS4 helps companies adopt responsible practices to reduce such risks including through emergency preparedness and response, security force management, and design safety measures.	Yes Project activities (e.g. construction, transport, power distribution, etc.) could pose a risk to community health and safety
PS5: Land Acquisition and Involuntary Resettlement PS5 advises companies to avoid involuntary resettlement wherever possible and to minimize its impact on those displaced through mitigation measures such as fair compensation and improvements to and living conditions. Active community engagement throughout the process is essential.	Yes Although no physical displacement is anticipated, economic displacement is expected as a result of the placement of Project infrastructure. Land rights are also required.
PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources PS6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and managing living natural resources adequately are fundamental to sustainable development.	Yes The Project could have impacts on biodiversity and living resources which will require management/mitigation measures
PS7: Indigenous Peoples PS7 seeks to ensure that business activities minimize negative impacts, foster respect for human rights, dignity and culture of indigenous populations, and promote development benefits in culturally appropriate ways. Informed consultation and participation with IPs throughout the project process is a core	No There are no Indigenous Peoples as defined by the IFC

IFC Performance Standard	Applicability to this project
requirement and may include Free, Prior and Informed Consent under certain circumstances.	present within the Project area of influence
PS8: Cultural Heritage PS8 aims to guide companies in protecting cultural heritage from adverse impacts of project activities and supporting its preservation. It also promotes the equitable sharing of benefits from the use of cultural heritage.	Yes The Project could have impacts cultural heritage which will require management/mitigation measures

2.8 CORPORATE STANDARDS AND GUIDELINES

For purpose of this Project, Mphepo aims to align with the Equator Principle and IFC Performance Standards on Environmental and Social Sustainability (2012). In addition, Mphepo has the following policies currently in place that will guide the Project development:

- Health and Safety Policy;
- Anti-Bribery & Anti-Corruption Policy;
- Employment Equity Policy;
- HIV/AIDS Policy and
- Sexual Harassment Policy.

In addition, the Engineering, Procurement and Construction (EPC) contractor will need to have detailed standards and guidelines in place for environmental, health, safety and social management prior to construction commencing.

3. DESCRIPTION OF THE PROJECT

3.1 LOCATION AND LAYOUT OF THE PROJECT

The Project Site is located directly north of Katete (Eastern Province, Zambia), and ± 440 km east of Lusaka, Zambia (see Figure 1). The Project Site is approximately 33 350 hectares (ha) in size, while the footprint of the Unika I Wind Farm would be approximately 3 900 ha. The Project Site is strongly rural and populated by a number of small villages. The nearest town is Katete, which is a small but well established town located immediately southwest of the Project Site. The main access road is the T4 National Road (Great East Road), which is main route connecting the Zambian capital of Lusaka to the smaller towns of Nyimba, Katete and Chipata in the east.

The coordinates of the Project site boundary are included in the Table 6 below.

The Project Site is located on traditional land, controlled by Kalonga Gawa Undi Mkhomo V, the King of the Chewa people. Landmarks within the Project Site include Mkaika Palace, Kachingwe Cobalt and the Mtetezi military camp. A number of villages namely Isibaki, Chimoto Kachngwe, Sumbwi, Pindu, Chamani, Undi, Mchaela Chimbundu and Mbangombe Villages are found on the south-western area of the Project Site. Other villages located within the Project Site area include Gomani, Sunku, Mkokeza, Katimba, Malanda, Mlangali, Phindani, Tambala and Sakoba.

A map showing the Project Site boundary and Unika I Wind Farm area located within the Project Site boundary is presented in Figure 3. A simplified layout is presented in Figure 4, while a detailed layout of the Unika I Wind Farm is presented in Figure 5. This layout has been divided into three sheets to provide a closer view of the layout, and these are presented in Figure 6, Figure 7 and Figure 8 below.

Table 6: Co-ordinates of the Project site boundary

Reference point	Latitude (South)	Longitude (East)
B1	14° 4'10.75"	32° 0'48.02"
B2	13°56'59.25"	32° 9'47.72"
B3	13°55'4.31"	32° 9'44.92"
B4	13°53'56.72"	32° 9'6.36"
B5	13°53'19.56"	32° 9'28.19"
B6	13°52'4.09"	32° 9'40.00"
B7	13°51'43.31"	32° 9'54.47"
B8	13°50'10.07"	32°10'0.83"
B9	13°49'27.07"	32° 9'17.13"
B10	13°49'22.06"	32° 8'29.44"
B11	13°49'41.71"	32° 8'13.65"
B12	13°49'24.74"	32° 7'3.96"
B13	13°49'5.89"	32° 6'40.30"
B14	13°48'14.39"	32° 6'46.38"
B15	13°47'21.86"	32° 6'3.44"
B16	13°46'58.66"	32° 5'24.66"
B17	13°47'12.09"	32° 4'50.93"
B18	13°48'3.48"	32° 3'54.64"
B19	13°53'15.63"	32° 0'50.45"
B20	14° 2'42.45"	32° 0'48.45"

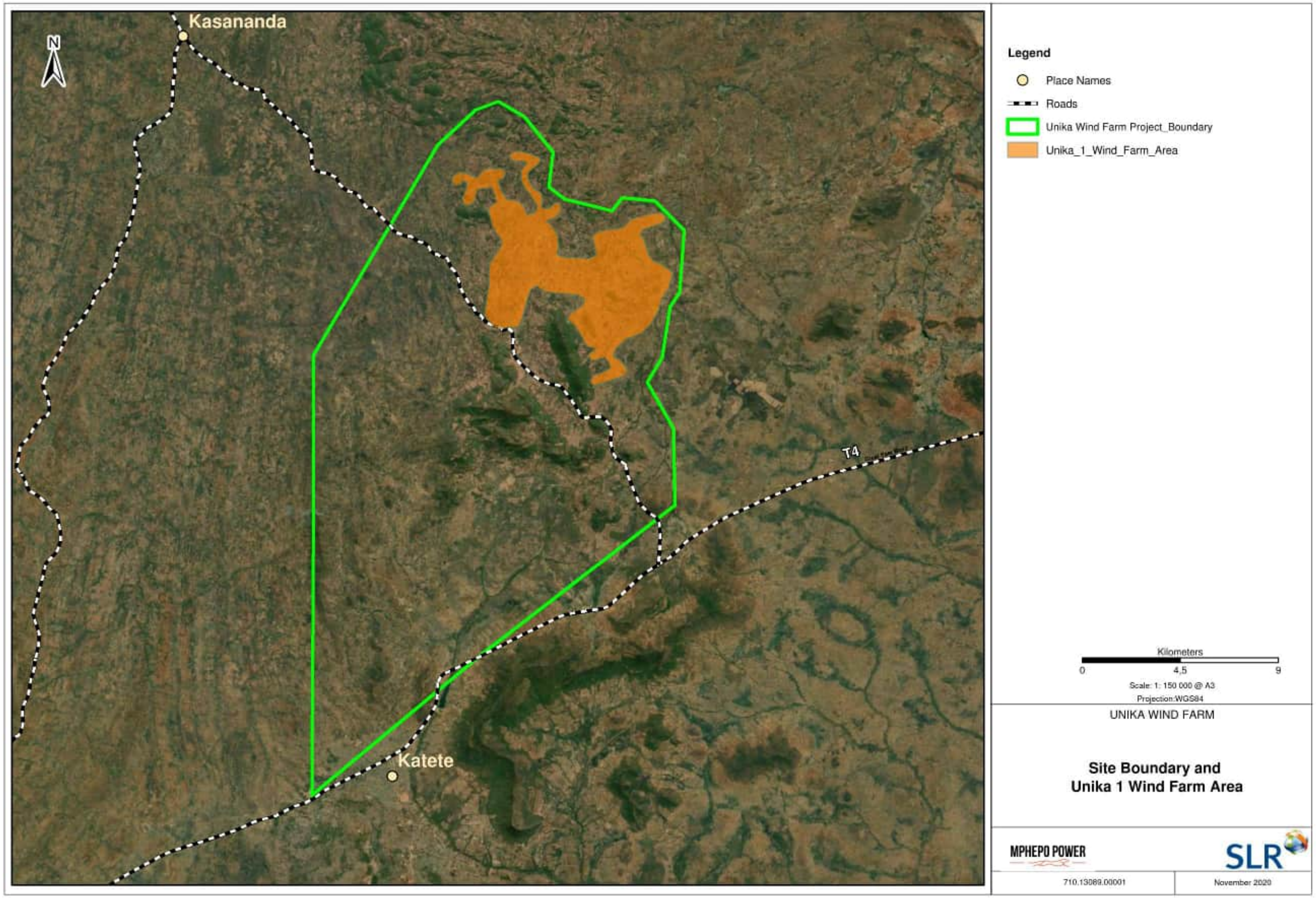


Figure 3: Project Site Boundary and location of Unika I Wind Farm

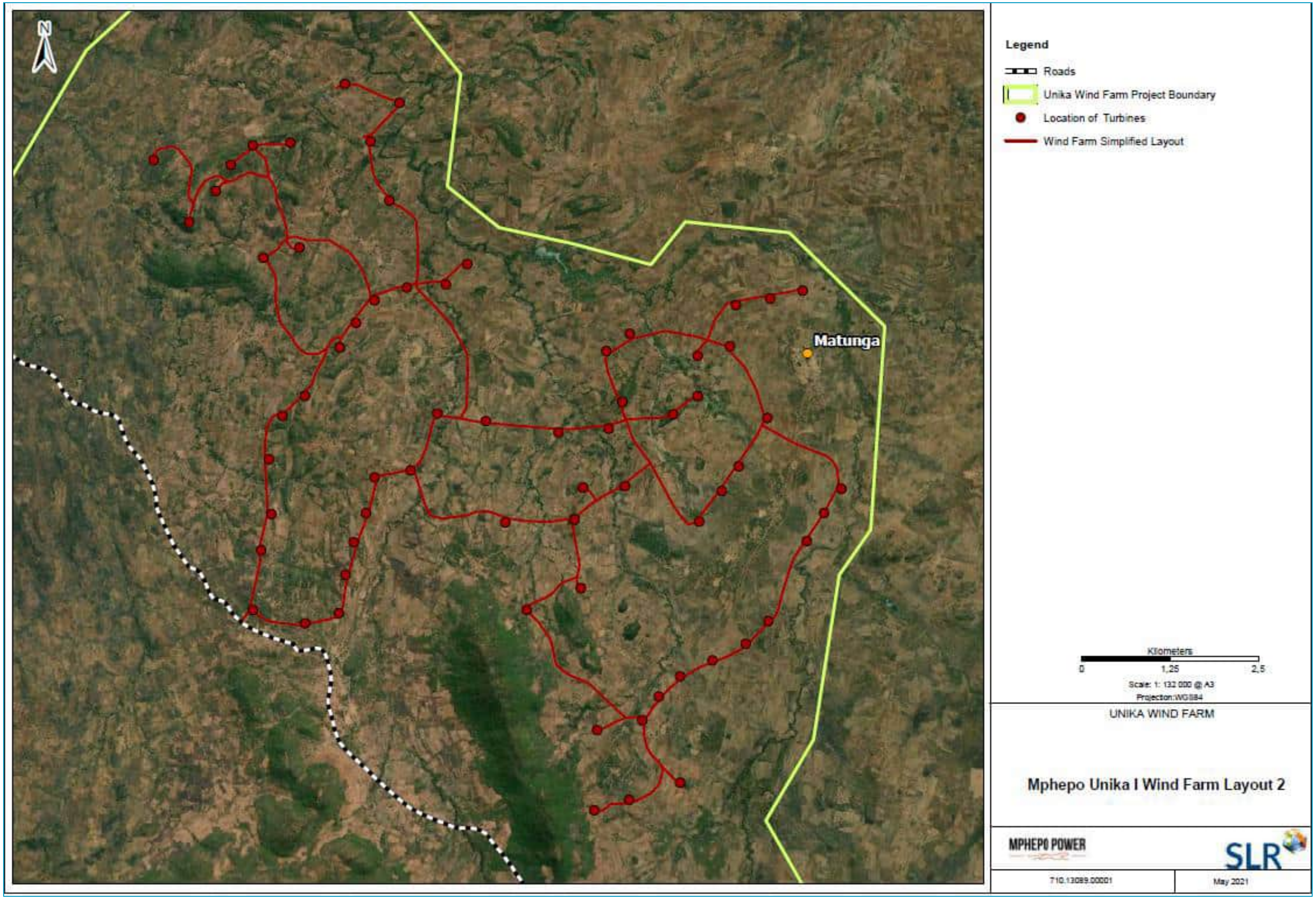


Figure 4: Simplified Layout of the Unika I Wind Farm

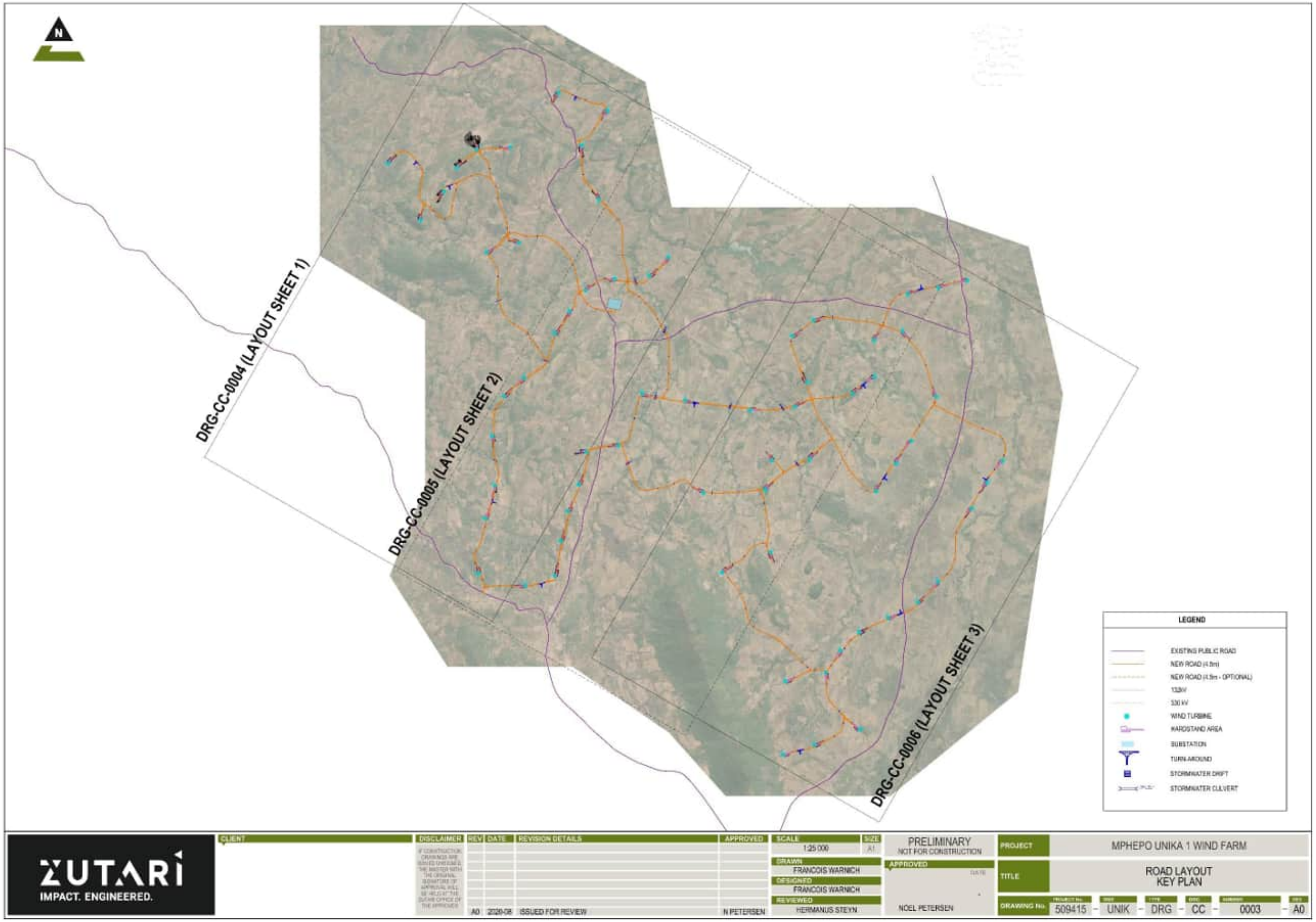


Figure 5: Detailed Layout of the Unika I Wind Farm

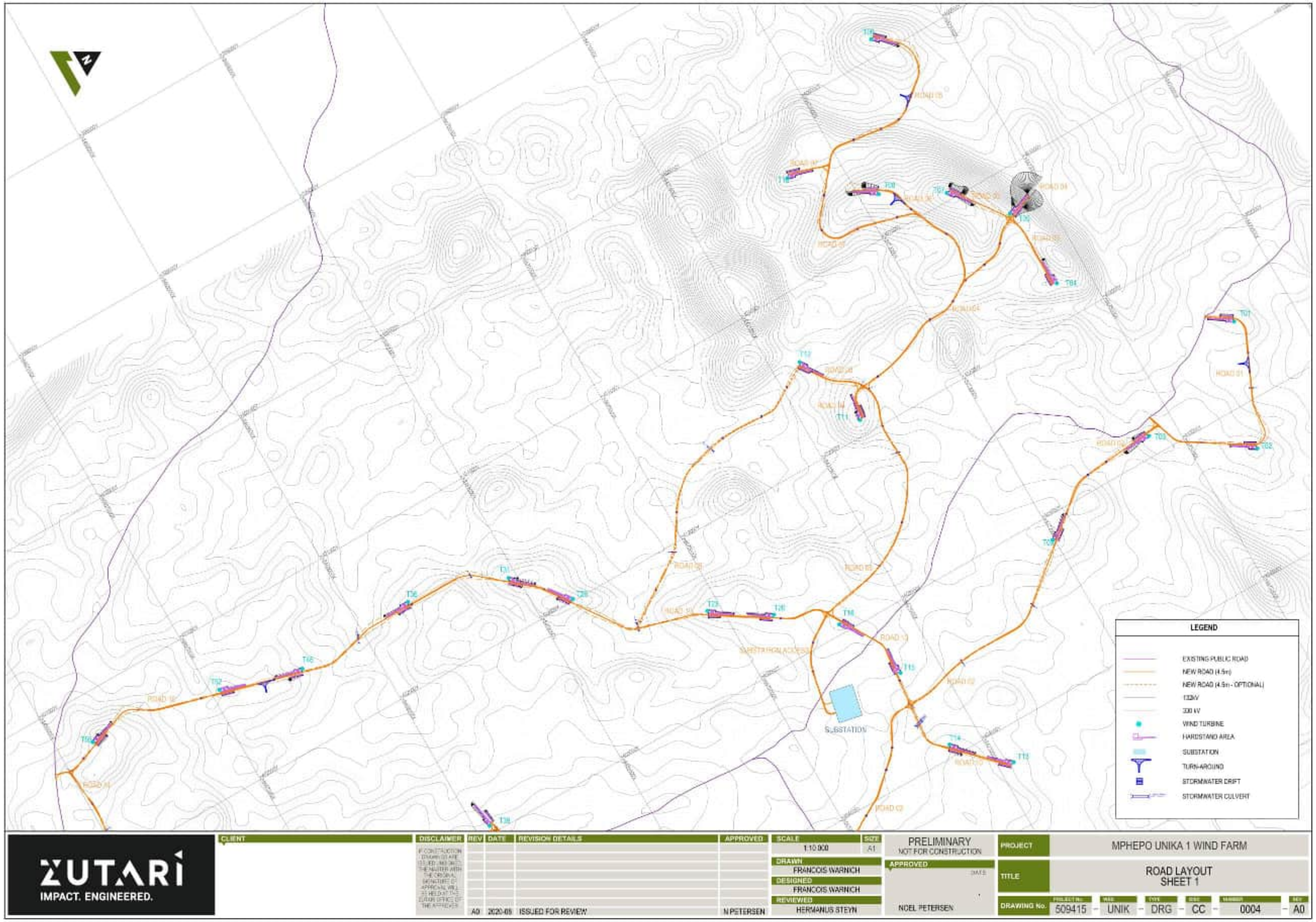


Figure 6: Unika I Wind Farm Layout (Sheet 1)

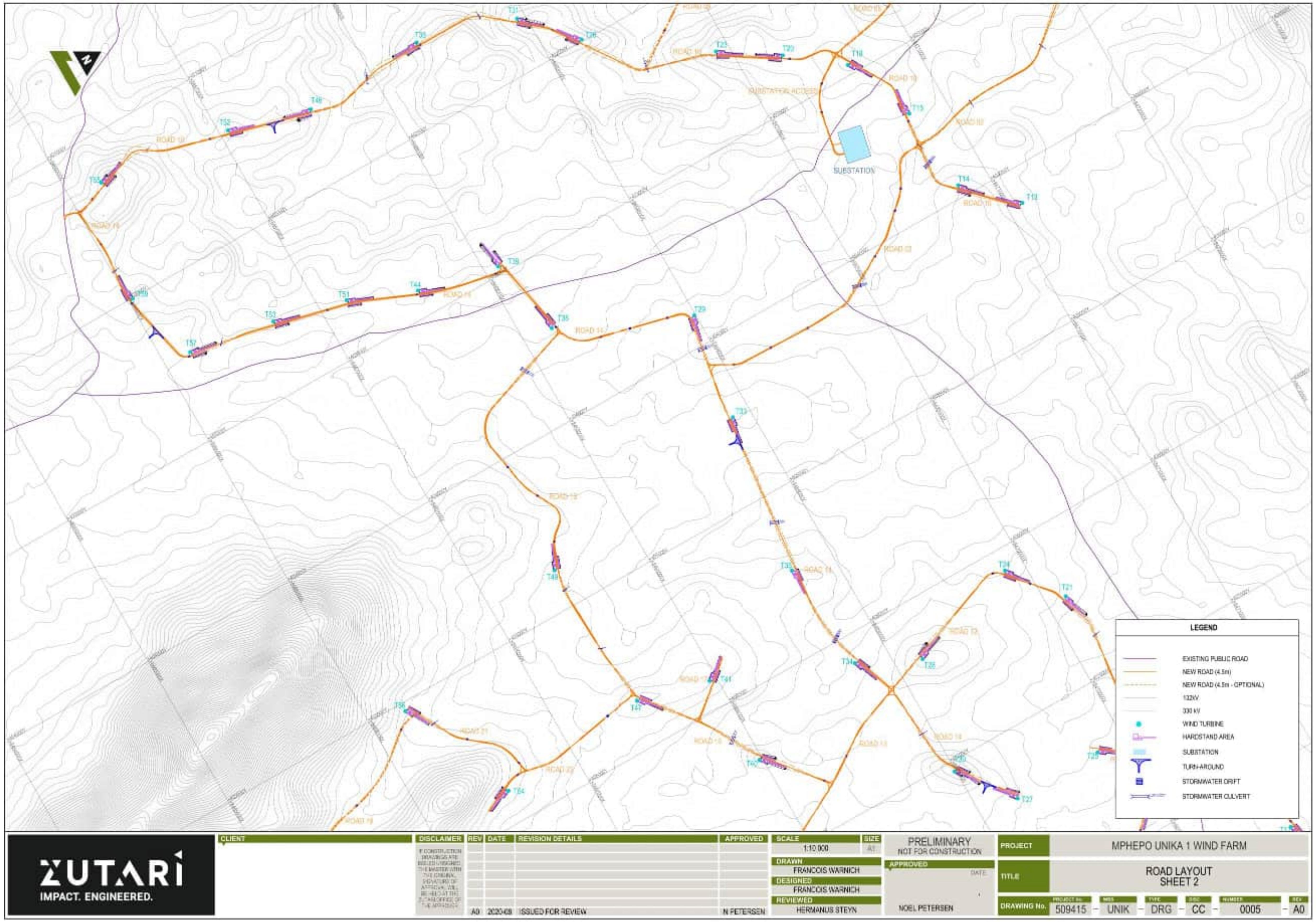


Figure 7: Unika I Wind Farm Layout (Sheet 2)

Figure 8: Unika I Wind Farm Layout (Sheet 3)

3.2 NATURE OF THE PROJECT

3.2.1 Project Components

This subsection provides a detailed description of each project component including details such design, dimensions, extent, capacity and other details as relevant.

Wind Turbine Generators

Wind Turbine Generator components are provided in Table 7 and Figure 9. Specific dimensions were based on the Vestas V136 4.2 MW[2] as "Typical" model (chosen based on its MW and hub height which is in the middle of the range of technology being considered for the project). It should be noted that technical specifications are subject to change depending on the exact model procured by the proponent and design alterations by the manufacturers driven by technological advancements. Hence, dimensions are provided within a specific range or referenced as typical dimensions.

Table 7: Wind Turbine Generator components

Component	Description

General	Unika 1 will consist of:
	• Up to 68 wind turbines (WTs) individual capacity of between 3.4 MW and 4.8 MW.
	• Mphepo is considering the following wind turbine generator alternatives:
	  ○ 4.2 MW with 132 m Hub Height (HH)
	  ○ 3.4 MW with 127 m HH
	  ○ 4.8 MW with 121 m HH
	  ○ 4.8 MW with 141 m HH
	• Typical wind turbine components are white or grey (where concrete is used)
	• Typical Recyclability rate 88.5% of the wind turbine (excluding foundations).

Nacelle Contains the gearbox, generator, control equipment, wind speed instrument and yawing mechanism. The nacelle turns the turbine to face into the wind to maximise power output.	Typical Nacelle Dimensions: • Height for transport 3.5m • Height installed (in this case including Vestas CoolerTop) 8.4m • Length 12.96m • Width 3.98m
Hub	Typical Hub Dimensions: • Transport height 3.5m • Transport width 3.7m

[2] 2022 Vestas Wind Systems A/S. 4MW Platform brochure.

Component	Description
Component which holds the three blades, controls their pitch and connects them to the main shaft of the wind turbine.	• Transport length 5.5m
Tower Typically, three sections when made of tubular steel or modular when concrete.	The tower is measured from the ground level to where the bottom of the nacelle. It houses cables from the nacelle, an electrical transformer at the base and a ladder system for maintenance personal to access the nacelle. The hub height is measured from the ground level to the middle of the hub. The turbines will range in hub height from 120 m to 150 m.
Rotor diameter Measured as the furthest extent between the tips of any two of the rotor blades.	Rotor diameter range of between 136 m and 158 m. Typical rotor blade dimensions: • Length 66.7 m; • Chord 4.1 m (Chord refers to a straight line between the leading edge of a blade and its trailing edge); • On a rotor diameter of 136 m the Swept area will be 14,527 m^2
Concrete foundation	Each turbine will have a concrete foundation up to 531 m^2 (i.e. 13 m radius from the centre point), to a depth of approximately 2.5 m to 5 m (Figure 16 and Figure 17).
Hardstanding areas	During construction there will be hardstanding areas at each turbine location that will be used as a laydown and assembly area (Figure 18 and Figure 19).
Electrical transformer	Each turbine will have an electrical transformer, either on the inside or beside it outside.
Fence	Some turbines may have to be fenced off for safety reasons, but the land-use surrounding the turbines may continue, up to a distance of 5 m to 10 m from the concrete foundation.
Public Safety Zone	Consistent with international good practice, a Public Safety Zone will be established around each wind turbine. The Public Safety Zone has been determined using the wind turbine blade tip height plus 10 %. For the largest turbines considered this equates to a 242 m radius around each wind turbine. No residential houses, public facilities or buildings are permitted within this zone; however, agriculture and grazing will be permitted.

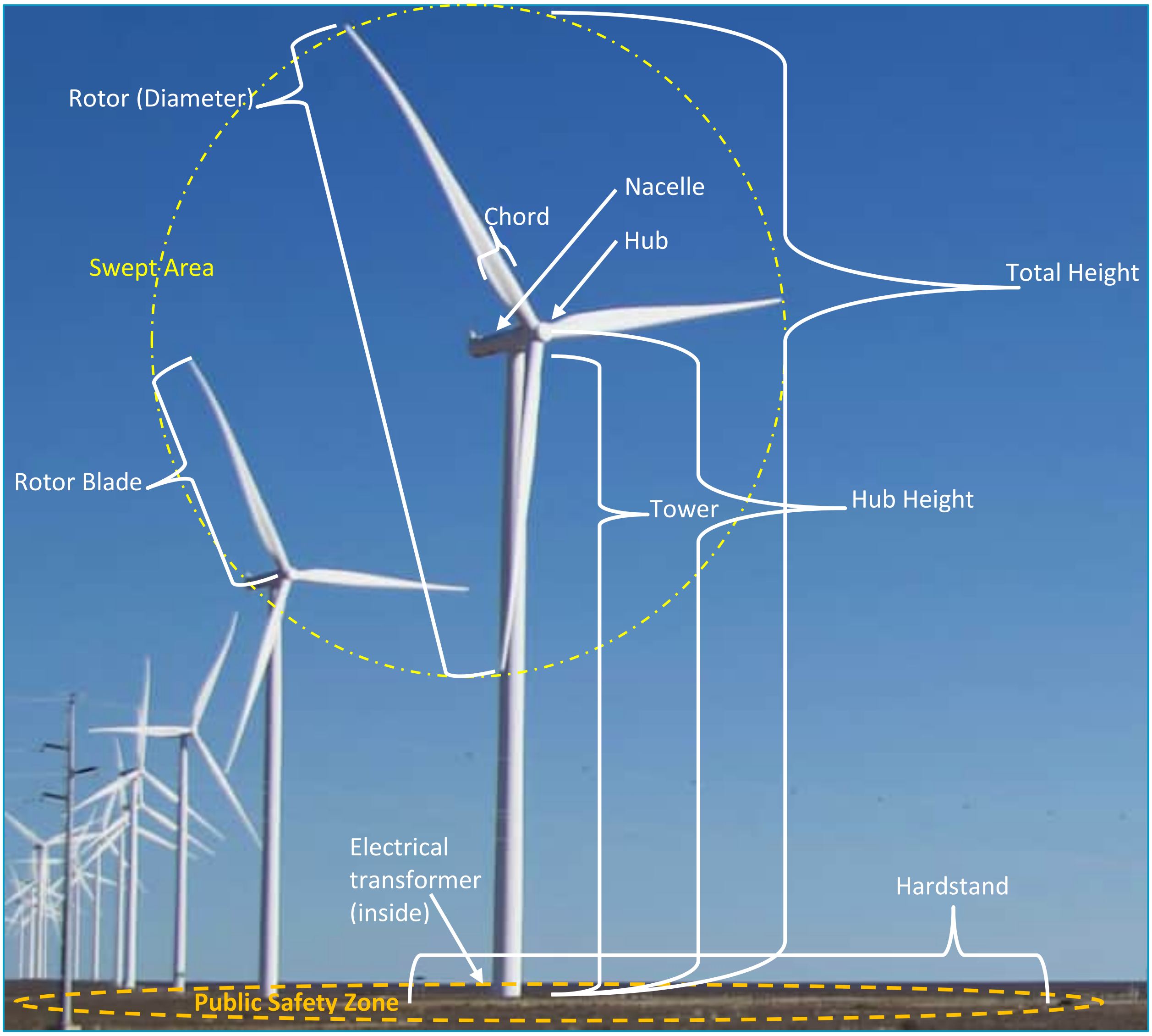


Figure 9: Wind Turbine Generator components

Electrical Connections and on-site Transmission Lines

The wind turbines will be connected to the on-site substation by means of medium voltage (33 kV) cables. The interconnecting network will consist of underground and above ground transmission lines that will run along the access roads between the WTs. Trenches for underground cables will typically be 1-2 m deep and 0.5 m (single circuit) to 2.5 m (four circuit) wide. Cables will typically be laid at the bottom of the trenches on suitable bedding material after which the trenches will be covered up and topsoil replaced for rehabilitation purposes.

Substation

A substation (approximately 30 000 m^2) will be constructed within the site (see location in Figure 11) for collection of power from the wind turbines (example of substations provided in Figure 10 and Figure 21). The substation will then be connected to the National Grid through a new 330 kV power transmission line to be constructed above ground between the wind farm substation and the existing Msoro Substation (located 30km north of the Project Site). The substation will contain transformers to increase the voltage of the electricity from 33 kV to 330 kV for transmission into the Msoro Substation. The transmission line is covered in a separate ESIA report as it is planned to handover the transmission line to ZESCO or private developer for operation and maintenance.

Figure 10: Example of typical substation associated with a wind farm

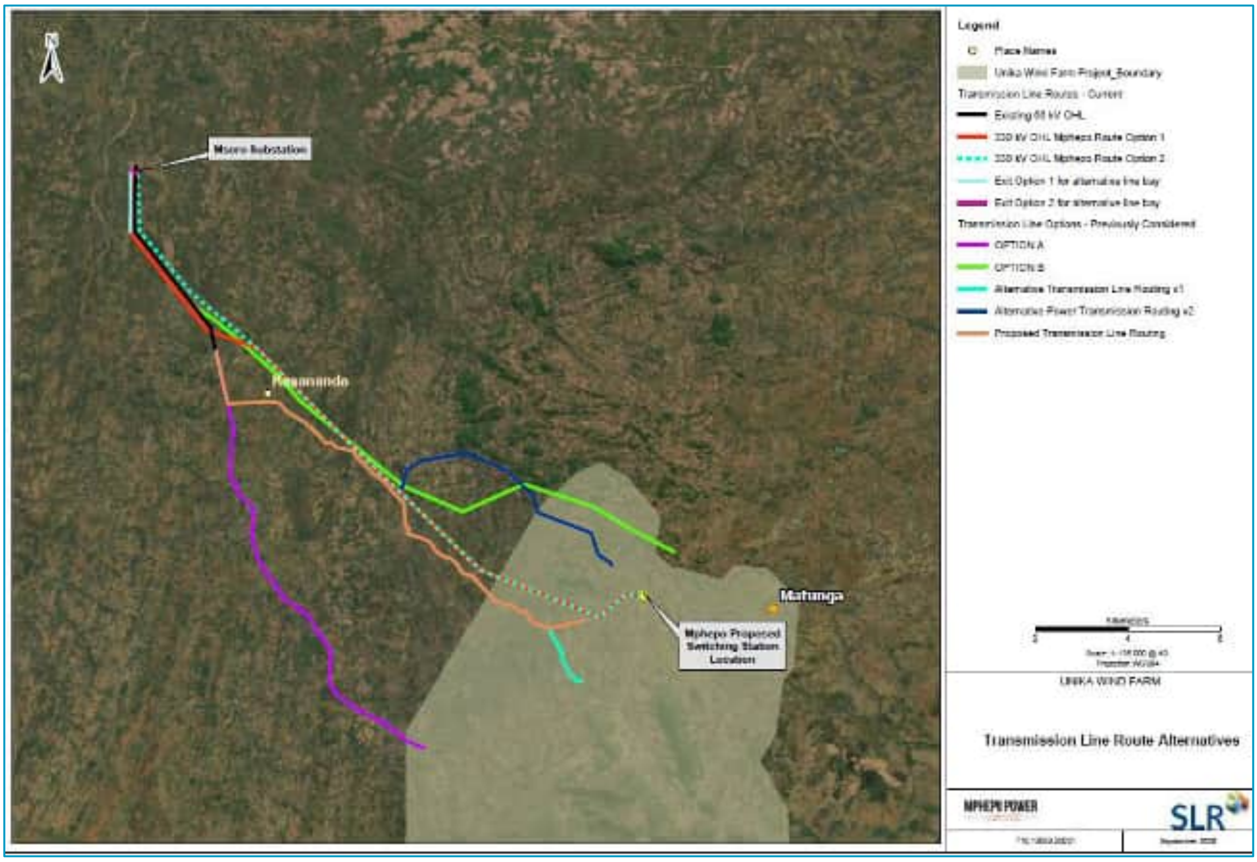


Figure 11: Location of Substation on Project Site

Access Roads

The site will be accessed from the T4 main road running between Lusaka, Katete and Chipata. An internal gravel road network will need to be constructed to facilitate movement between turbines during construction and operation. This will include upgrading of existing roads within the area as well as constructing new access roads. The total length of new roads to be constructed is about 61,4 km and total existing roads to be upgraded is about 28,1 km. Road upgrades will depend on the current condition of the road, intended use of the road and upgrades my only be undertaken where required, i.e. not the entire road. Access roads will be 4 m to 5 m wide including drainage, turning points, passing/layby points and cabling within a road reserve of 20 m. Some existing public roads and bridge structures will need to be upgraded to facilitate the heavy loads and vehicle sizes associated with the turbine equipment transport. Further details on establishment of access roads are provided in Section 3.3.2.

Borrow Pits/Quarries

The turbine and substation foundations, main access roads and internal service roads would be constructed or upgraded from material sourced from quarries or borrow pits within and around the area. Bedding material may also be required for trenched cables if the *in-situ* material is found to be unsuitable.

Zutari (previously Aurecon) conducted an investigation during 2020 to identify construction material sources. A number of potential quarries, borrow pits and sources of sand were identified within and around the Project Site (see Figure 12). Some of these are existing. These sources will be subject to further detailed investigations. All material must be sourced from quarries and/or borrow pits approved by the Ministry of Mines and Minerals Development.

Additional Infrastructure

A single-story Operations and Maintenance (O&M) building of approximately 160 m^2 with a workshop, store, control room, offices, telecoms and ablution facilities will be constructed. The proposed design of the O&M building is provided in Figure 22.

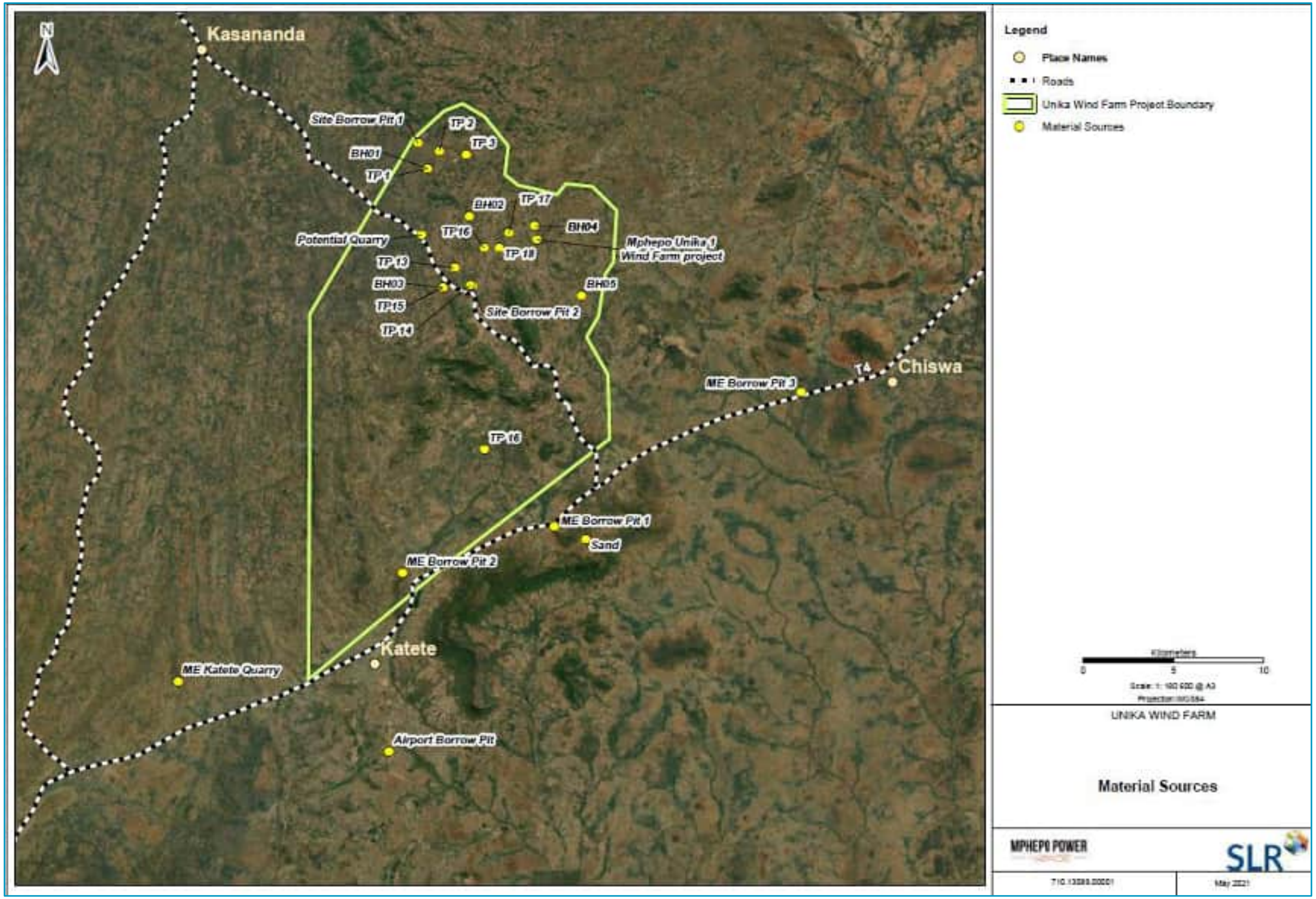


Figure 12: Locations of potential materials sources

3.2.2 Resources and Raw Materials Required

Resources that will be required to manufacture the wind turbines and associated components, as well as other resources required to construct the wind farm include:

- The resources associated with the wind turbine equipment manufacturing (e.g. steel, cast iron, copper, strategic metals, plastic, rubber, lubricants, resins, carbon fibre, fibreglass, etc.);
- Copper for grid connection and connections between turbines and substations;
- Material sources for construction of roads and turbine foundations;
- Construction materials for building structures (e.g. cement, brick, timber, etc.);
- Electricity for general construction and power supply to equipment/buildings;
- Cement/concrete, materials and steel for the turbine foundations;
- Fuel and chemicals for construction equipment and vehicles;
- Water for construction, sanitation and drinking;
- People for labour;
- Food for labour force; and
- The resources associated with maintenance of construction equipment and vehicles (e.g. metal, plastic, rubber, oil, lubricants, etc.).

The resources associated with the maintenance of the wind turbines and general infrastructure (e.g. steel, cast iron, copper, plastic, rubber, lubricants, carbon fibre, fibreglass, fuel, chemicals, cement, brick, timber, etc.).

3.2.3 Production Capacity

The Unika I Wind Farm will have a production capacity of 200 MW. All power generated will be fed directly into the ZESCO national grid.

3.2.4 Schedule and Life of Project

The construction phase is estimated to take approximately 24-36 months to complete. The construction of Unika 1 is anticipated to commence during Quarter 3 of 2023.

The Power Purchase Agreement (PPA) is anticipated to last 25 years. Beyond that duration, the Project may continue to operate subject to further approvals.

3.2.5 Products and By-Products

The main product associated with the Project is electricity.

Waste by-products may result from the manufacture, transportation, installation, maintenance, removal, and disposal of the wind generation equipment. This includes carbon dioxide, various chemicals, building rubble, etc. During the operational phase waste by-products (e.g. waste oil, damaged equipment, etc.) are expected to be generated, but at a much lower level when compared to the construction phase.

3.2.6 Processes

As depicted in Figure 13, a wind turbine turns energy in the wind into electricity using the aerodynamic force created by the rotor blades, which work similarly to an airplane wing or helicopter rotor blade. When the wind flows across the blade, the air pressure on one side of the blade decreases. The difference in air pressure across the two sides of the blade creates both lift and drag. The force of the lift is stronger than the drag and this causes the rotor to spin. The rotor is connected to the generator, either directly or through a shaft and a series of gears that speed up the rotation. This translation of aerodynamic force to rotation of a generator creates electricity. The generated electricity is then directed to transformers where the voltage is increased before being directed to the electricity grid.

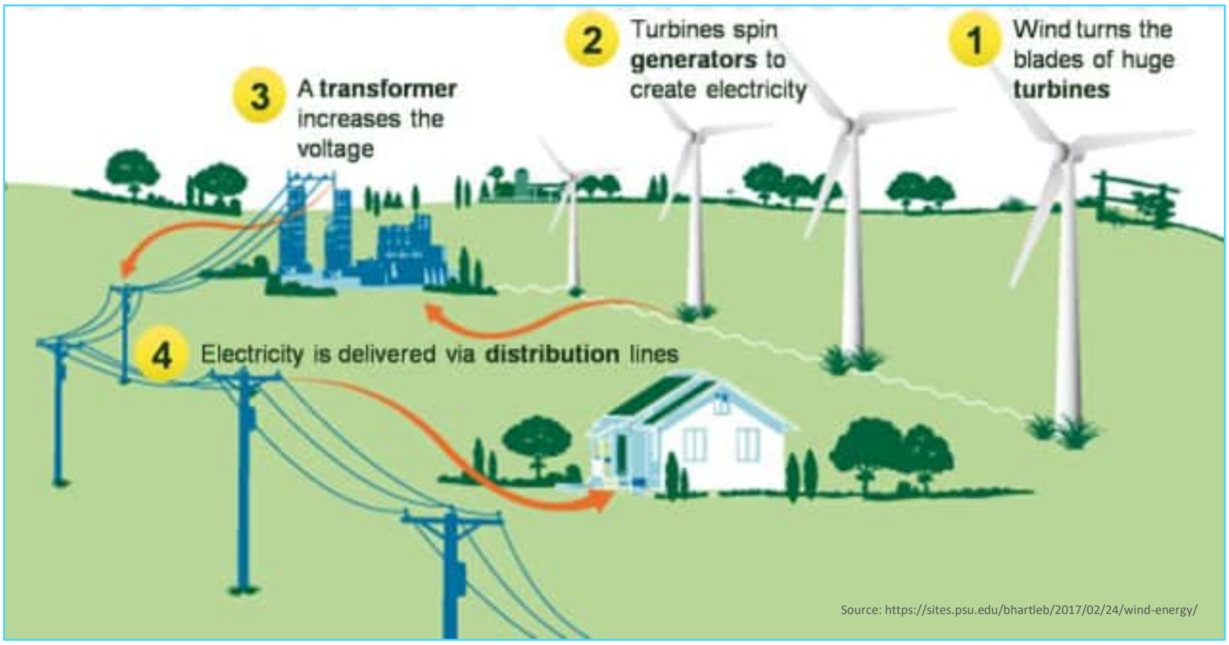


Figure 13: Wind generation process

3.3 MAIN PROJECT ACTIVITIES

The Project will be carried out in the following phases:

- Planning phase;
- Construction phase;
- Operational phase; and
- Decommissioning phase.

These phases are described in more detail below.

3.3.1 Planning Phase

During the planning phase Mphepo will assess the key parameters required for the construction and operation of the Project. This phase includes:

- An Environmental and Social Impact Assessment (ESIA) which investigates the impacts on the surrounding biophysical environment and on the local community;
- Specialist investigations (e.g. on impacts related to bats, birds, noise, terrestrial ecology, aquatic ecology, visual aspects and the social environment) to inform the ESIA, ESMP and layout of the Project;
- Engagement with the traditional leadership, communities and key government authorities (e.g. Katete Council, District Commission, Ministry of Energy, Ministry of Roads, Ministry of Forestry, etc.)
- Establishing grid code requirements and connections;
- Establishing Zambian power requirements and support;
- Wind data gathering via a Meteorological Mast and LiDAR units;
- Developing the design and layout of the wind farm and access roads;
- Identification of material resources; and
- Conducting hydrological, geohydrological and geotechnical investigations.

Information collected during the planning phase was used to adapt the Project design and layout.

Prior to initiating construction, a number of other surveys may also be required including, but not limited to, topographic surveys, geotechnical surveys, surveys to confirm the turbine micro-siting footprint, road surveys, etc.).

3.3.2 Site Preparation and Construction Phases

A number of temporary structures will be constructed during construction. These include general laydown area of a maximum of 10 000m^2 and a site compound for all contractors which would be approximately 5 000m^2 in size (example provided in Figure 14).

Figure 14: Example of General laydown area and construction camp[3]

The locations, size and type of wind turbines have been determined using information gathered from the planning phase, including the environmental and social considerations described in the ESIA. Prior to the installation of the wind turbines, the site will be prepared as required (this would include construction of on-site access roads and turbine foundation construction). This can take between 3 and 6 months. A significant portion of the labour for the Project is expected to come from the surrounding towns and villages, and preference would be to employ local people. It is not anticipated to accommodate workers on-site at this stage, but rather in the town of Katete. A maximum of 700 workers is anticipated on site during the peak of the construction phase.

Once the turbine equipment has arrived on site, it will take approximately 3 - 9 months to complete assembly, depending on the size of the turbines. This will be followed by the completion of the internal electrical connections, as well as turbine function testing to verify proper operation.

[3] Source: Biotherm Energy – Kipeto Wind Farm Kenya

Where possible; materials, plant and equipment, will be sourced from local suppliers. The bulk of the specialist wind turbine equipment (mast, nacelle, blades, etc.) will be imported from China, Europe or the USA and will be shipped via South Africa, Namibia, Tanzania or Mozambique.

There will also be a central batching plant for mixing concrete.

The construction phase will take approximately 24-36 months to complete.

The construction phase will broadly include the activities described below.

Site Preparation

This phase will include clearance of vegetation at the footprint of each turbine and excavations for foundations. These activities will require the stripping of topsoil, which will need to be stockpiled for rehabilitation later on. Site preparation will be undertaken in a systematic manner to reduce the risk of erosion. In addition, site preparation will include search and rescue of floral species of concern (where required).

Establishment of Access Roads

Access/haul roads to the Project Site, as well as internal access roads within the Project Site, will need to be established prior to the commencement of construction. Access to the site is likely to be from the T4 main road. As far as possible, existing access roads would be utilised, and upgraded where required. Within the site itself, access will be required between the turbines for construction purposes (and later for maintenance access). Laybys and turnarounds will need to be constructed along the access roads to accommodate heavy vehicle access and circulation. A typical turnaround point is presented in Figure 15.

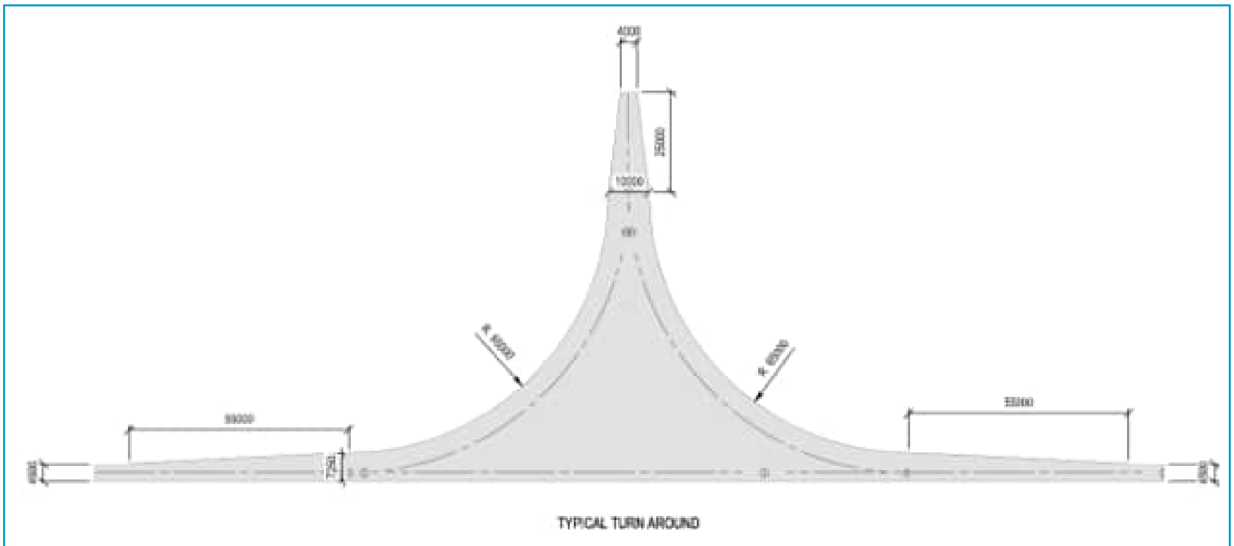


Figure 15: Typical turnaround point

These access roads will have to be constructed in advance of any components being delivered to site, and will remain in place after completion for future access (and possibly access for replacement of parts if necessary). It is proposed that in preparing the access roads, a portion of it will be constructed as a permanent access road and the remainder as a temporary access road that can be de-compacted and returned to its pre-construction condition. Roads that remain could be proclaimed as public roads, while the short access roads to each turbine (leading from the main access roads) could be proclaimed as private roads.

Foundation construction

Concrete foundations will be constructed at each turbine location. Foundation spaces will be mechanically excavated to a depth of approximately 2.5 - 5 m with a diameter of 23 - 24 m (see Figure 16). Concrete will be batched at an appropriate location on-site. The reinforced concrete foundation will be poured and will support the mounting rings for the wind turbines. The foundation will then be left up to a week to cure. If the geological conditions dictate, the use of alternative foundations will be considered (e.g. reinforced piles). An example of a foundation under construction id provided in Figure 17.

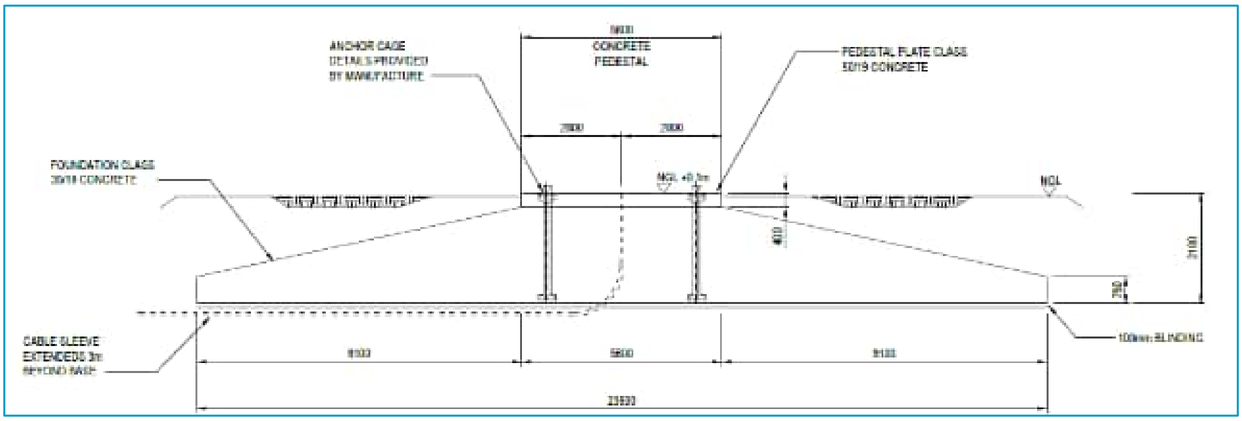


Figure 16: Typical wind turbine foundation

Figure 17: Example of a foundation under construction[4]

Transport of Turbine Components and Equipment to Site

The wind turbine, including tower sections and blades, will be brought on-site by the supplier in sections. Mphepo is also considering concrete towers in order to avoid overland transport of the tower sections.

Turbine units which must be transported to site consist of the tower/mast (comprised of segments), the nacelle (weighing approximately 80 tons) and the rotor blades (each of up to 80 m in length). The

[4] Source: Biotherm Energy – Kipeto Wind Farm Kenya

individual components are defined as abnormal loads in terms of Zambia Road Traffic Ac, 2002 by virtue of the dimensional (e.g. blades) and load limitations (e.g. the nacelle).

In addition, components of various specialised construction, lifting equipment and counter weights are required on site to erect the wind turbines, and these also need to be transported to the site. In addition to the specialised lifting equipment, the normal civil engineering construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement mixers, etc.).

The components required for the establishment of the substation (including transformers) will also need to be transported to the site as required.

The large equipment to be transported to the site during the construction phase may require alterations to the existing road infrastructure (widening on corners, removal of traffic islands, etc.), accommodation of street furniture (electricity, street lighting, traffic signals, telephone lines, etc.) and protection of road-related structures (bridges, culverts, portal culverts, retaining walls, etc.) as a result of the abnormal loads. The equipment is most likely to be transported via Great East Way (T4) from the direction of Beira Port (closest port), and then to the Project Site via the D538 District Road.

The equipment will be transported to the site using appropriate routes, and the dedicated access/haul road to the site itself. A transportation study of the entire route will be required to will deal with external roads in this regard.

Establishment of Hardstand Areas

Hardstand areas will need to be established at each turbine position for the laydown and assembly of wind turbine components. The hardstand area will include a blade laydown area, crane pad an area to assembly the crane boom. A typical hardstand layout is presented in Figure 18. This area would be required to be compacted and levelled to accommodate the assembly crane, which would need to access the crawler crane from all sides. The crane pad will be constructed with concrete.

Laydown and storage areas will be required for the normal civil engineering construction equipment which will be used on site. An example of a hardstand area under construction is presented in Figure 19.

An example of a wind turbine under construction is presented in Figure 20.

Construction/Assembly of the Turbines

Large lifting cranes will be required on site as it will need to lift the tower sections into place. The nacelle, which contains the gearbox, generator and yawing mechanism, will then be placed on top of the assembled tower. The next step will be to assemble the rotor (i.e. the blades of the turbine) on the ground. It will then be lifted to the nacelle and bolted in place. A small crane will likely be needed for the assembly of the rotor while a large crane will be needed to put it in place.

Turbines will be appropriately spaced to minimise wake effects and wind turbulence.

The lifting cranes will be required to move or be transported between the turbine sites.

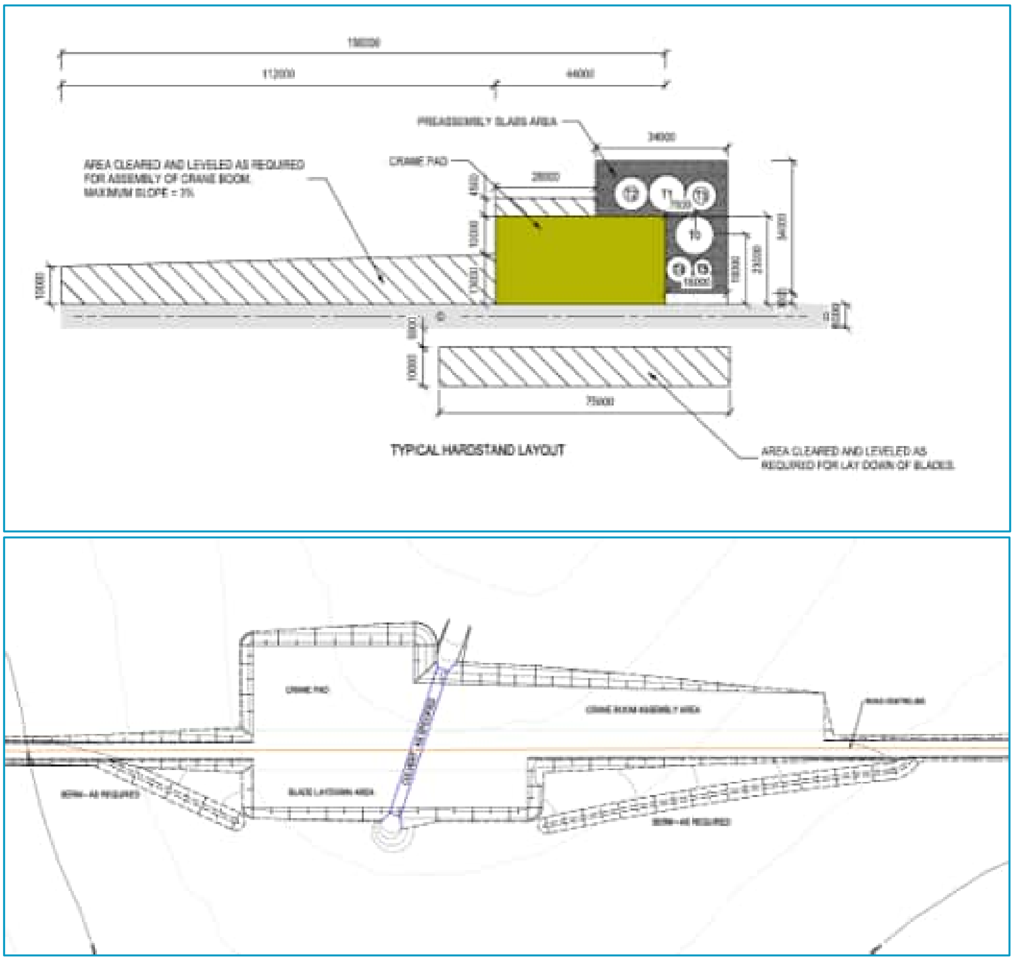


Figure 18: Typical hardstand layout (top) and interface (bottom)

Figure 19: Example of hardstand area under construction[5]

Figure 20: Example of wind turbine under construction[6]

Construction of an on-site Substation

An electrical substation will be constructed within the Project Site. The turbines will be connected to the on-site substation via underground and above ground cabling. The position of the substation will be informed by the final positioning of the wind turbines as the layout of the turbines will determine the optimum position for the construction of a substation. The substation will be constructed with a high-voltage (HV) yard footprint of up to 30 000 m^2. An example of a substation is presented in Figure 21.

[5] Source: Biotherm Energy – Kipeto Wind Farm Kenya
[6] Source: Mainstream Renewable Power – Perdekraal Wind Farm South Africa

Figure 21: Example of a substation[7]

Establishment of Ancillary Infrastructure

A single story Operations and Maintenance (O&M) building with a warehouse/workspace, office, telecoms, security and ablution facilities will be constructed on the Project Site (see Figure 22). The establishment of these buildings will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with this construction will be required.

[7] Source: CONCO

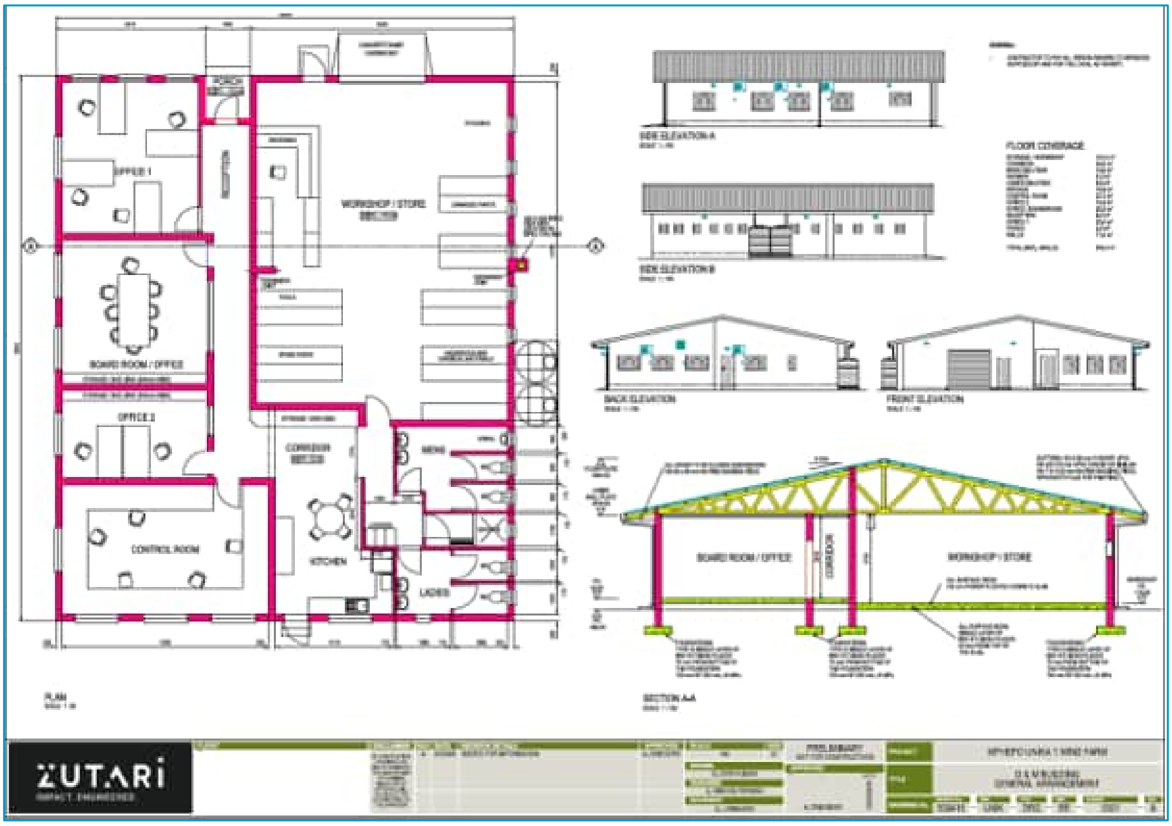


Figure 22: Proposed design of the O&M building

Connection of Wind Turbines to the On-site Substation

Each wind turbine will be connected to an optimally positioned substation underground and aboveground electrical cables though a 33 kV collection system (i.e. when the electrical cables are 'collected' in a bundle from the turbines to the substation). The installation of these cables will require the excavation of trenches, approximately 1 - 2 m in depth. The underground cables will be located within the 20 m road reserve of the access roads.

Connecting the Substation to Power Grid

A proposed 330 kV transmission line will connect the on-site substation to the national electricity distribution network at the Msoro Substation which lies approximately 30 km north-west of the Project Site. The connection point to the ZESCO power grid will be confirmed through a network planning exercise. As noted above, the transmission line is covered in a separate ESIA report as it is planned to handover the transmission line to ZESCO for operation and maintenance

Commissioning

Prior to the start-up of the wind turbines, a series of checks and tests will need to be carried out. This will include both static and dynamic tests to make sure the turbines are working within appropriate limits.

Grid interconnection and unit synchronisation will also need to be undertaken to confirm the turbine and unit performance. Physical adjustments may be needed such as changing the pitch of the blades. The schedule for these activities will be subject to site and weather conditions.

Site Rehabilitation

Site rehabilitation will be conducted in a progressive manner as construction is completed in specific areas (e.g. rehabilitation will commence around each turbine location once construction of that particular turbine is completed). On full commissioning of the facility, any new access roads which are not required during the operational phase, or requested to stay in place by the community, would need be closed and rehabilitated.

3.3.3 Operational Phase

Once the Project is completed and becomes operational, it will generate electricity and is expected to have a minimum life span of 25 years. Regular maintenance will be required to ensure the turbines are kept in optimal working order and may extend the life span beyond 25 years.

Day-to-day control of the turbines will be done remotely through the use of computer networks. The wind farm can operate in parallel with daily community activities (e.g. farming, grazing, etc.) due to the relatively small footprint of each of the turbines.

The wind farm will be operated on a 24 hour, 7 days a week basis. The operational phase of the project will mainly comprise of the following activities:

- Vegetation management for under and around the modules to allow maintenance and operation at full capacity;
- Monitoring and maintenance of all components including wind turbines, substations and ancillary equipment;
- Bird and bat monitoring;
- Office management and maintenance of the welfare facilities;
- Supervision of the electricity production; and
- Site security monitoring

Once operational, the wind farm will be monitored locally and remotely. It is estimated that the operational phase of the project will provide employment for approximately 10-15 skilled staff members, who will be responsible for monitoring and maintenance when required. It is expected that 5-10 unskilled staff members will also be employed. It is most likely that the facility will be manned by the appointed O&M staff.

Each turbine will be operational except under circumstances of mechanical breakdown, extreme weather conditions, extremely low wind speeds or maintenance activities.

The wind turbines will be subject to periodic maintenance and inspection, and periodic oil changes will be required (mostly from gearboxes and electrical transformers). Any waste products (e.g. waste oil, damaged turbine equipment, damaged electrical equipment, etc.) would need to be disposed of at appropriately licenced disposal sites (where they cannot be recycled).

3.3.4 Decommissioning Phase

The proposed Project is expected to operate for at least 25 years. Once the plant reaches the end of its life, the wind turbines may continue to operate as their expected life time is 30 years; they may alternatively be refurbished or replaced to continue operations. The facility may be closed and decommissioned. If decommissioned, all components (excluding the turbine foundations and some of the access roads) would need to be removed and the site rehabilitated. Materials would need be recycled or disposed of in accordance with local regulations and international best practice.

The activities described below are likely to be associated with the decommissioning phase of the wind farm.

Site Preparation

Site preparation activities will include confirming the integrity of the access to the site to accommodate required equipment, heavy vehicles and lifting cranes, preparation of the site (e.g. lay down areas, construction platform) and the mobilisation of decommissioning equipment.

Disassembly of Existing Turbine

Large cranes will be required again to disassemble the wind turbines. These components will be re-used, recycled (where possible and practical) or disposed of in accordance with regulatory requirements. This phase will have similar activities as described for the construction phase above.

Clearing of other Infrastructure

The other infrastructure such as the O&M building, sub-station, etc. will either be removed from site, or re-used as deemed fit and approved by the relevant authorities and Chewa Development Trust (for example, the O&M building can be re-used as a community centre).

Access Roads

Some access roads may remain. The extent and number of the roads to remain on site is currently not known, but will need to be approved by the relevant authorities and Chewa Development Trust. All other access roads would need to be closed and rehabilitated.

4. PROJECT ALTERNATIVES

4.1 IDENTIFICATION OF ALTERNATIVES

During the planning phase of the Project several key alternatives were considered. These key alternatives considered include the following:

- Site alternatives;
- Technology alternatives;
- Design and layout alternatives; and
- No-Go alternative.

Other alternatives that have been considered include:

- Availability of wind resource;
- Turbine size, make and model;
- Number and layout of turbines and connection routes;
- Sources of raw materials required for construction;
- Routes of the power transmission line corridor between the Project Site and Msoro substation;
- Routes for new access roads;
- Ports to deliver project components and construction materials;
- Transport routes from the port to the Project Site to deliver components, equipment and construction materials;
- Grid capacity and distance to grid connection;
- Availability of space;
- Land use;
- Topography/Site gradients;
- Existing infrastructure;
- Geotechnical aspect; and
- Inputs from the turbine design teams, wind monitoring data, bird and bat monitoring data and various specialist investigations currently underway (including social, visual, terrestrial ecology, aquatic ecology, botanical and heritage investigations).

Throughout the assessment of these alternatives the following criteria were used:

- Environmental - including biodiversity, fauna (including birds and bats) and flora, and habitat;
- Social and community - including land ownership, land use and proximity to communities;
- Financial – including life cycle costs balanced against initial capital expenditure and operational costs; and
- Technical – considering whether the options are viable if they can be efficiently implemented, maintained and operated.

4.2 ANALYSES OF ALTERNATIVES

The below subsection provides a comparative analysis of alternatives.

4.2.1 Site Alternatives

Mphepo undertook a site selection exercise based on the following criteria: wind resource, existence of transmission lines and substations, land availability and ownership, land use, environmentally sensitive features and existing infrastructure. Three possible sites were considered for the development of the project. These included (1) a site to the west of the current Project Site, (2) a site north east of the current Project Site and (3) the location of the current Project, Unika I, Site (Table 8).

Table 8: Summary of alternative sites considered

Component	West alternative	Northeast alternative	Unika I alternative
Availability of wind: based on the Global Wind Atlas for Zambia, which is the most used method for screening wind resources, data collected through the meteorological mast and LiDAR units. The Global Wind Atlas indicated mean winds speeds of 7.50 to 9.50 m/s. According to the meteorological mast and LiDAR devices used to collect date on site the mean wind speeds range from 4.88 m/s to 8.88 m/s, with the highest wind speeds occurring June-September.	Good	Good	Very good
Grid connection: Mphepo identified corridors for development through identifying feasible connection types to existing network infrastructure. Additionally, maximum distances were calculated for the nearest infrastructure connection based on an estimate of grid connection costs. The Msoro substation is the closest suitable substation to the Project Site.	Feasible	Feasible	Feasible
Size of the site: Mphepo looked for site locations that have large continuous, high lying areas and ridges as this is more suitable for development of a wind farm.	Good	Good	Very good
Land use and ownership: Mphepo opted to select an area for which they could secure a Deed of Agreement and that is relatively free from residential dwellings that would result in physical displacement.	Fair	Fair	Good
Environmental issues: It was also important to select an area that is free from environmentally sensitive receptors (e.g. primary forests and protected areas) which were also considered as part of the initial screening.	Fair	Fair	Good
Existing infrastructure: Site selection also ensured that the potential project avoided major infrastructure which may obstruct the development or where the project may impact on existing infrastructure such as existing telecommunications networks and airports. Existing roads for access was preferable.	Fair	Fair	Good

Summary of site alternatives:

Although all three sites were deemed feasible in terms of the proposed development the preferred alternative site, Unika I, as assessed in the ESIA is more advantages in terms of resource quality (better wind), suitable developable land, and the least amount of environmental and land use constraints.

4.2.2 Technology alternatives

Power generation alternatives

At the preferred Unika I site several power generation options could be considered. However, wind energy has been identified as the most optimal at the proposed site. The hilly terrain is not conducive for solar power and according to the World Bank/IFC Photovoltaic Power Potential Map for Zambia the south-eastern area of Zambia has an average to low potential. Thermal power plants are not considered a feasible alternative for this Project mainly due to the need for alternative power generation in Zambia, the reliance on fossil fuels, the greenhouse gas emissions associated with such projects, and the cost of establishing a thermal power plant. Hydropower is dependent on water, and due to the location of the Project Site this option is not favourable as the closest major river is the Luangwa River located approximately 70 km north-west of the Project Site, and outside the project land consent area. There were reports in 2017 of proposed project to build a hydro-power plant on the Luangwa River already. A summary of power generation alternatives considered at the Unika I site are provided in Table 9 below.

Table 9: Summary of power generation alternatives considered at the Unika I site

Criteria	Wind power	Solar power	Hydro power	Thermal power
Terrain and location suitability	Suitable	Not suitable	Not suitable	Suitable
Resource availability	High	Low	Very low	Medium
Cost (affordable energy)	Cost effective	Not cost effective (low potential yield at site)	Not cost effective (too far from water resource)	Cost effective
Greenhouse gases or pollutants	Low	Low	Low	High
Dependable	Yes	Yes	Yes	Yes
Construction period	Short, 2-3 years	Short, 2-3 years	Medium 4-7 years.	Long 5-10 years

Summary of generations alternatives:

Wind power is the most technically feasible and cost-effective energy generation technology for the proposed site.

Wind Turbine alternatives

The choice of Wind Turbine Generator is largely technical and typically has little impact on the outcome of the ESIA if it falls within the range of technical specifications assessed.

GeneralUnika 1 will consist of:

- Up to 68 wind turbines (WTs) individual capacity of between 3.4 MW and 4.8 MW.
    - Fewer turbines may be constructed if turbines with higher generation are feasible based on the wind resource quality.
    - The aim is to construct an up to 200MW facility, thus 42 WTs at 4.8MW and 59 WTs at 3.4MW.
- Mphepo is considering the following wind turbine generator alternatives:
    - 4.2 MW with 132 m Hub Height (HH)
    - 3.4 MW with 127 m HH
    - 4.8 MW with 121 m HH
    - 4.8 MW with 141 m HH
- Typical wind turbine components are white or grey (where concrete is used).
- Typical Recyclability rate 88.5% of the wind turbine (excluding foundations).

The nacelle, hub and rotor depend on the WT model chosen and there is no discernible difference in terms of ESIA parameters to which model is chosen.

The wind turbine tower alternatives are based on material, which will either be steel or concrete. The choice on whether to use steel or concrete is based on availability and cost factors. Steel is most often imported whilst concrete is mostly cast near the development site to reduce transport costs and constraints. There is no discernible difference in terms of ESIA parameters between steel or concrete towers.

Each turbine will have a concrete foundation up to 531 m^2 (i.e. 13 m radius from the centre point), to a depth of approximately 2.5 m to 5 m. Turbine foundations are fairly standard and my differ in size due to geotechnical considerations and tower material (concrete towers have smaller foundation requirements). However, there is no discernible difference in terms of ESIA parameters when it comes to turbine foundations.

During construction there will be hardstanding areas at each turbine location that will be used as a laydown and assembly area. The exact postioning of the hard stand area in relation to the turbine will differ for each turbine. However, there is no discernible difference in terms of ESIA parameters when it comes to turbine foundations.

Each turbine will have an electrical transformer, either on the inside or beside it outside. There is no discernible difference in terms of ESIA parameters when it comes to electrical transformer.

Some turbines may have to be fenced off for safety reasons, but the land-use surrounding the turbines may continue, up to 5 m to 10 m from the concrete foundation. There is no discernible difference in terms of ESIA parameters when it comes to turbines being fenced or not.

Consistent with international good practice, a Public Safety Zone will be established around each wind turbine. The Public Safety Zone has been determined using the wind turbine blade tip height plus 10 %. For the largest turbines considered this equates to a 242 m radius around each wind turbine. No residential houses, public facilities or buildings are permitted within this zone; however, agriculture and grazing will be permitted. The end size of the Public Safety Zone will be determined by the tip height of the WTs installed. There is no discernible difference in terms of ESIA parameters when it comes to the Public Safety Zone.

Summary of wind turbine alternatives:

Turbine alternatives are assessed within a range and therefore there aren't any specific preferred alternatives. There is no discernible difference in terms of ESIA parameters of the turbine components referenced above.

As noted previously, Mphepo is considering the following wind turbine generator alternatives:

- Vestas V136 4.2 MW with 132 m Hub Height (HH)
- Vestas V150 4.2 MW with 132 m HH
- Siemens Gamesa (SG) 3.4 MW - 145 with 127 m HH
- GE 158 4.8 MW with 121 m HH
- GE 158 4.8 MW with 141 m HH

4.2.3 Design and Layout alternatives

The initial layout contained wind turbines and access roads along the southern and eastern portions of the Project Site. The current layout of the infrastructure (wind turbines, access roads, interconnectors, substation, etc.) is based on the areas with best available wind resources and the environmental and social constraint identified during the baseline and specialist investigations. The Unika 1 Wind Farm will be located in the north eastern part of the Project Site as shown in Figure 23. All sensitive areas have been avoided as far as practical. Micro-siting of the wind turbines will still be required, which may have minor impacts on the current positions of the wind turbines. A few (less than 20) of the wind turbines would also have to be moved slightly during micro-siting in order to avoid sensitive areas in relation to ecology, bats, birds and noise.

Access Roads alternatives

The site will be accessed from the T4 main road running between Lusaka, Katete and Chipata. An internal gravel road network will need to be constructed to facilitate movement between turbines during construction and operation. This will include upgrading of existing roads within the area as well as constructing new access roads. The total length of new roads to be constructed is about 61,4 km and total existing roads to be upgraded is about 28,1 km. Road upgrades will depend on the current condition of the road, intended use of the road and upgrades my only be undertaken where required, i.e. not the entire road. Access roads will be 4 m to 5 m wide including drainage, turning points, passing/layby points and cabling within a road reserve of 20 m. Some existing public roads and bridge structures will need to be upgraded to facilitate the heavy loads and vehicle sizes associated with the turbine equipment transport. The internal gravel road network is based on the most practical way of connecting the WTs and ancillary infrastructure like the substation and O&M building. Slight changes in the WTs or ancillary infrastructure location would require adjustments to the internal road layout. Consequently, the internal gravel road network has no pertinent alternatives but rather options to optimise the route and avoid constraints.

Electrical Connections and on-site Transmission Lines alternatives

The wind turbines will be connected to the on-site substation by means of medium voltage (33 kV) cables. The interconnecting network will consist of underground and above ground transmission lines that will run along the access roads between the WTs. Trenches for underground cables will typically be 1-2 m deep and 0.5m (single circuit) to 2.5 m (four circuit) wide. There are no specific alternatives to be assessed when it comes to on site electrical connections and on-site transmission lines. Typically, the on-site transmission lines follow the access roads because it's the most practical to construct and reduces the project footprint. These transmission lines which feed into the on-site substation will mostly be buried in trenches and will only be above ground in areas where trenching is severely constraint. As with the gravel road network the electrical connections and on-site transmission lines has no pertinent alternatives but rather options to optimise the route and avoid constraints.

Substation alternatives

A substation (approximately 30 000 m^2) will be constructed within the site for collection of power from the wind turbines. The substation will contain transformers to increase the voltage of the electricity from 33kV up to 330kV for transmission into the Msoro Substation. The substation size will depend on the scale of the wind farm constructed with due consideration of potential future expansion. The substation position as indicated is at the prefered location in terms of technical and environmental considerations with no distinct drawbacks that would warrant the assessment of alternative sites and therefore no other alternative substation locations will be assessed.

Borrow Pits/Quarries alternatives

The turbine and substation foundations, masts sections, main access roads and internal service roads would be constructed or upgraded from material sourced from quarries or borrow pits within and around the area. Bedding material may also be required for trenched cables if the *in-situ* material is found to be unsuitable.

Zutari (previously Aurecon) conducted an investigation during 2020 to identify construction material sources. Several potential quarries, borrow pits and sources of sand were identified within and around the Project Site (see Figure 12). Some of these are existing. These sources will be subject to further detailed investigations. All material must be sourced from quarries and/or borrow pits approved by the Ministry of Mines and Minerals Development. No alternatives or in depth assessment will be undertaken as part of this ESIA.

Additional Infrastructure alternatives

A single-story Operations and Maintenance (O&M) building of approximately 160 m^2 with a workshop, store, control room, offices, telecoms and ablution facilities will be constructed. The proposed design of the O&M building is provided in Figure 22.

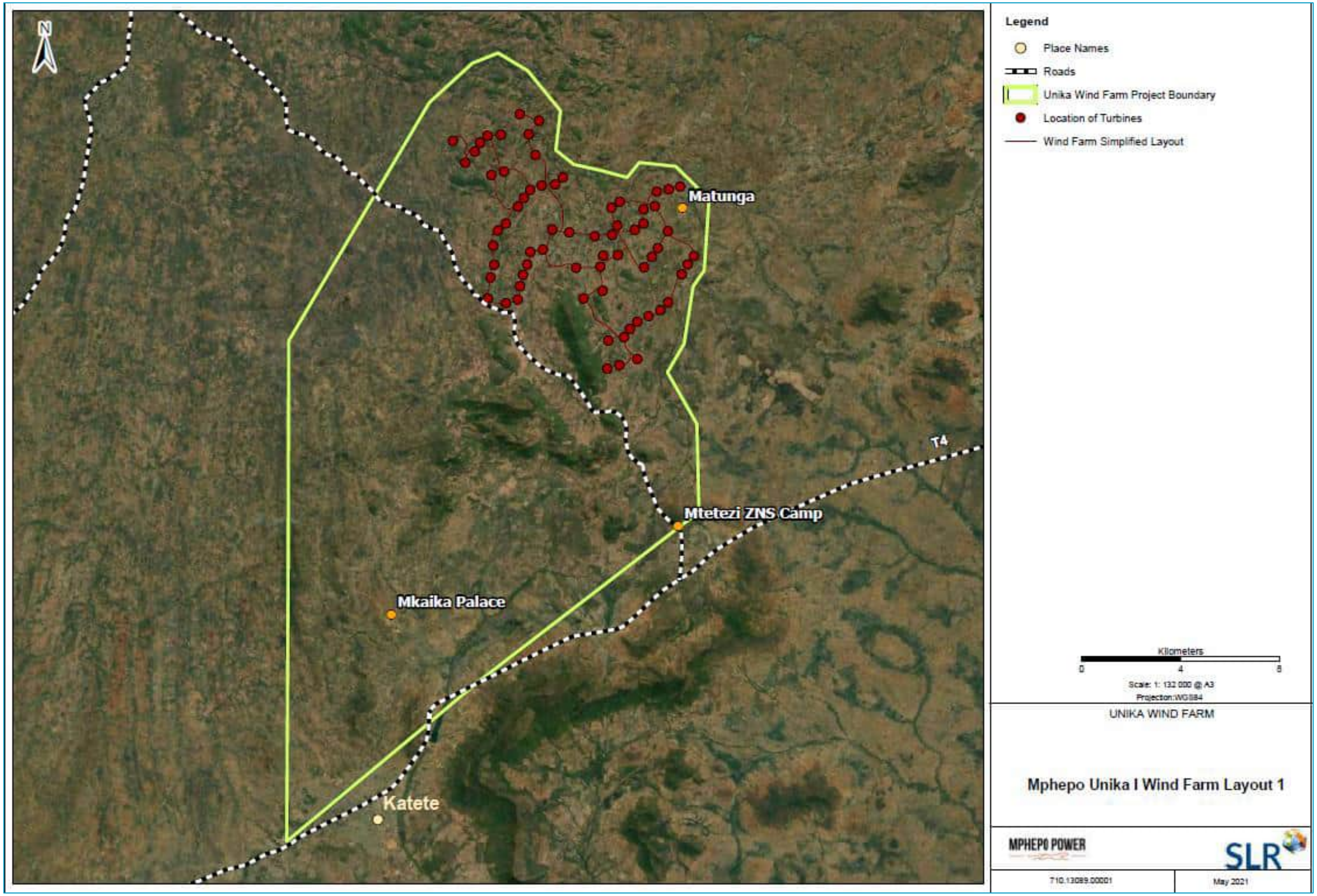


Figure 23: Location of Unika 1 Wind Farm within the Project Site boundary

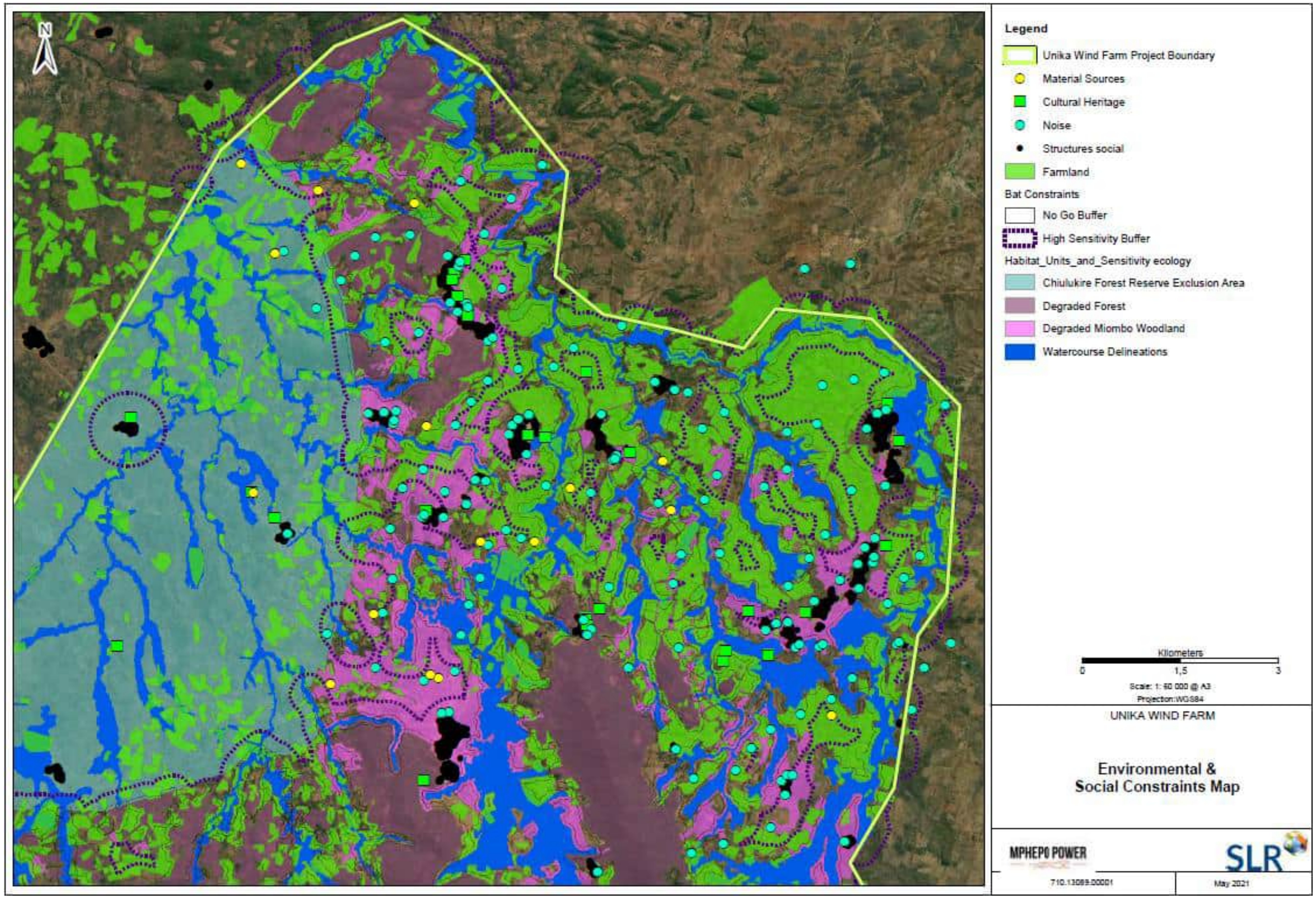


Figure 24: Environmental and Social Constraints map (combined)

4.2.4 No-Go Alternative

The no-go alternative is for the Project not to be developed. Should this be the case, then the Project Site area would remain the same. The land area would remain with its current environmental and social characteristics as described in Section 6.

Should the Project not move forward, then the Project-related negative environmental impacts discussed would be averted. Should the Project not move forward, then the significant and crucial positive environmental, social and economic benefits would not be realised.

In conclusion, the ESIA investigated all the potential positive and negative impacts as a result of the Project development. In the case of this Project, it is important to weigh the significant positive environmental, social and economic impacts incurred from the Project, against the negative environment and social impacts anticipated at the Project Site specific level.

The 'no project' alternative is not a preferable option.

4.3 MITIGATION HIERARCHY

Implementing the mitigation hierarchy is crucial when considering alternative sites and alternative infrastructure layouts.

The mitigation hierarchy is defined as:

- **Avoidance**: measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on certain components of biodiversity.
- **Minimisation**: measures taken to reduce the duration, intensity and / or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible.
- **Rehabilitation/restoration**: measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/ or minimised.
- **Offset:** measures taken to compensate for any residual significant adverse impacts that cannot be avoided, minimised and / or rehabilitated or restored, in order to achieve no net loss or a net gain of biodiversity8. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation or averted risk, protecting areas where there is imminent or projected loss of biodiversity.

The mitigation hierarchy was applied to the project as summarised in Table 10 below

Table 10: Project implementation of the mitigation hierarchy

Mitigation hierarchy	Action
Avoidance:	**Site alternatives:** The initial search for appropriate land parcels for the development of the wind farm included environmental and social criteria such as land ownership, land use, protected areas and biodiversity. Sites with high biodiversity, sensitive features and within protected areas were screened out. The Forest Reserves located in the northern portions of the Project sites was also avoided. The site selected is located on communal land, used for subsistence

8 In terms of IFC PS6, no net loss is typically required for significant adverse impacts on natural habitat, while net gain is required for impacts on Critical Habitat

Mitigation hierarchy	Action
	agriculture and grazing, and with no Critical Habitat as defined by the IFC Performance Standards.
Minimisation:	**Site layout alternatives:** Once the Project Site was selected as the preferred site, detailed surveys were undertaken to confirm the use of the land for livelihoods by adjacent communities, the presence of cultural heritage sites, to confirm the status of the habitats on site and the use of those habitats by birds and bats. The layout of the wind farm was informed by the environmental and social baseline investigations and the meteoroidal data gathered, and designed in such a way as to avoid communities, rivers, streams, wetlands and forested areas (and in particular the inselbergs), much of it important bat roosting of foraging habitat and higher bird activity.
Rehabilitation/ restoration:	The Project Site is approximately 33 350 hectares (ha) in size. While the footprint of the Unika I Wind Farm site – estimated at 3 900 ha or 12 % of the Project Site - will result in the partial clearance of vegetation (for the roads, turbines, substation, ancillary infrastructure, etc). Some areas affected by construction activities will be rehabilitated (e.g. access roads not required for operations, hardstand areas, interconnector pathways, etc.).
Offset:	No Critical Habitat occurs in the study area as no populations of threatened, restricted range or migratory/congregatory species occur that meet IFC PS6 thresholds, and the habitats are not threatened or unique and do not have key evolutionary processes. The Project Site includes a combination of Modified and Degraded Natural Habitat covering 69% and 31%, respectively (Table 17). Only 11.5% of the Project Site (33 350 ha) is required for the Unika 1 Wind Farm (3 865 ha) and since the turbine footprint and roads comprise small footprints, it should be possible to microsite the infrastructure to avoid portions of Natural Habitat to a large degree.

5. STAKEHOLDER ENGAGEMENT

5.1 COMMITMENT TO STAKEHOLDER ENGAGEMENT

Mphepo is committed to free, prior, and informed engagement with stakeholders. Effective stakeholder engagement and public consultation is a cornerstone for successful project development. It involves working closely with interested and affected parties through the Project's life to ensure stakeholder are well-informed about plans, impacts, and risk and have meaningful opportunities to provide input into decisions which may affect them.

A structured, effective and culturally appropriate engagement program is required in order to build and maintain positive community relationships, and by extension, a Project's social license to operate.

5.2 STAKEHOLDER ENGAGEMENT PRINCIPLES

The key principles guiding the Project's approach to stakeholder engagement are as follows:

- To be open and transparent with stakeholders;
- To be accountable and willing to accept responsibility as a corporate citizen and to account for environmental and social impacts associated with the Project activities;
- To have a relationship with stakeholders that is based on trust and a mutual commitment to acting in good faith;
- To respect stakeholders' interests, opinions and aspirations;
- To work collaboratively and in cooperatively with stakeholders to find solutions that meet common interests;
- To be responsive to stakeholders;
- To be pro-active and to act in anticipation of the need for information or potential issues;
- To be fair and engage with stakeholders such that they feel they are treated fairly and their issues and concerns are afforded fair consideration;
- To be accessible and within reach of stakeholders so that they feel heard and to provide comprehensive information; and
- To proactively anticipate, identify and include all stakeholders.

These principles have informed the Project's approach to stakeholder engagement.

5.3 SUMMARY OF STAKEHOLDER ENGAGEMENT UNDERTAKEN

A Community Liaison Officer (CLO) has been appointed by Mphepo, and is responsible for disseminating information and coordinating community communications through the course of the Project (in particular the Chewa Development Trust and local community leaders).

An External Grievance Mechanism has been developed (and is included in the Unika I Wind Farm Stakeholder Engagement Plan) and will need to be implemented prior to construction to enable community members and other stakeholders to raise issues of concern. This will serve to receive and facilitate resolution of affected communities' concerns and grievances about the Project.

5.3.1 Scoping Phase Engagement

A summary of the key stakeholder engagement/public participation activities undertaken during the Scoping Phase is presented in Table 11. Further details of these activities can be found in the Scoping Report included under Annexure C.

Table 11: Summary of Scoping Phase stakeholder engagement

Date	Description
12 February 2019	Initial meetings with the Katete council and local traditional leaders of the Project Site.
18 – 23 March 2019	Focus group meetings with village leaders to inform the social baseline conditions and land uses.
09 April 2019	Meeting with District Joint Operations Committee (DJOC) members, Heads of Department from Government agencies and District Council Members.
05 – 10 June 2019	Preparation and distribution of notice letters (in Lusaka and Katete) and Background Information Document (BID) via hand, email and sms to identified stakeholders to inform them of the Project and the Public Scoping Meeting.
05 & 12 June 2019	Advertisements of the project and invitation to Public Scoping Meeting were published twice in the Daily Mail and Daily Nation newspapers.
19 June 2019	Public meeting for the Scoping Phase of the Project was held in Katete.
12 February 2020	Final Scoping Report and Terms of Reference made available on the SLR website.

5.3.2 ESIA Phase Engagement

All stakeholders identified during the Scoping Phase and additional engagements were notified that the ESIA Report (including a Non-Technical Summary) was publicly available on the SLR website, prior to holding the Public Disclosure Meetings. This afforded them the opportunity to review the report and to enable them to raise questions at the Public Disclosure Meetings.

The Public Disclosure Meetings were held prior to the submission of the ESIA Report to ZEMA. At these meeting the findings of the ESIA Report (Non-Technical Summary) were presented and discussed with the affected communities and stakeholders.

ZEMA may also require public hearings to be held after submissions of the ESIA Report to ZEMA.

A summary of the key stakeholder engagement/public participation activities undertaken during the ESIA Phase for both the Wind Farm and Transmission Line has been included in the ESIA Report (see Annexure D). A summary of the key stakeholder engagement/public participation activities undertaken during the ESIA Phase is presented in Table 12.

Table 12: Summary of ESIA Phase stakeholder engagement

Date	Description
01 - 04 February 2022	Notifications sent via email and/or delivered to all persons on stakeholder database regarding the EIA public disclosure and notice of public meetings to be held 14-18 February 2022 (and the link to the SLR website). This included placement of the notices in the Zambia Daily Mail and Daily Nations newspapers.
02 February 2022 to date	The complete draft ESIA, the ESIA Non-Technical Summary, ESIA Annexures (including Specialist Reports) and ESMP were made available on the SLR website.
10-11 February 2022	Additional run of placement of the notices in the Zambia Daily Mail and Daily Nations newspapers.
14 – 18 February 2022	Public Disclosure meetings for the ESIA phase of the Project were held at the following venues: • 14 February: Chieftainess Msoro Palace, Mambwe District • 15 February: School in Mbangombe, Katete District • 17 February: Mambwe Council Hall, Mambwe District • 18 February: Pangani Lodge, Katete

5.3.3 Stakeholder Concerns

The issues raised during the public meetings for the Scoping phase relate to the following:

- How will people benefit from the Project;
- Size (spatial extent) and output of the Project;
- Distances between the wind turbines;
- Emergency response measures that will be in place;
- Occupational health and safety arrangements for workers;
- Effective communication required with key stakeholders;
- Impact on livelihoods and restoration/management;
- Timeframes for construction;
- Parties involved in the implementation of the Project;
- Wind resource availability at the site; and
- Interactions with ZESCO undertaken by the Project company to date.

The issues raised during the stakeholder engagements for the ESIA phase relate to the following:

- Likelihood of airborne and other health diseases as a result of the Project;
- How local employment will be sourced and managed, and transparency of the process;
- Job creation/opportunities, local employment and community benefits;
- Occupational health and safety policies and arrangements for workers;
- Labour skills/qualifications and skills development;
- Clearance of trees for the Transmission Line (and associated costs);
- Impact on livelihoods and compensation/restoration management:
- Access to Project information after ZEMA approval;
- Shareholding by the CDT and distribution of benefits;
- Size (spatial extent) and output of the Project;
- Timeframes for construction commencement;
- Possibility of road improvements;
- Impacts of noise and air quality and mitigation measures to reduce the effects on the local communities;
- Measures for waste management;
- Project infrastructure;
- Investment costs;
- Agreements with Traditional Leaders;
- Health and safety hazards related to the wind turbines and other electrical installations;
- Connection with other MetMast projects in the area;
- Wayleave size and future maintenance of the Transmission Line;
- Security during construction and operation;
- Impacts on farming, livestock and grazing land; and
- Measures to prevent contamination of water bodies.

6. ENVIRONMENTAL BASELINE CONDITIONS

6.1 CLIMATE

The proposed Project Site is found in Katete which is characterized by three distinct seasons: cool dry season from mid-April to August; hot and dry season from September to October; and a rainy season from November to April. The Project Site receives annual rainfall in the region of 450 mm to 1 000 mm with the mean annual rainfall being in the order of 850 mm. The months between December and February typically receive 70% of the annual rainfall.

The temperatures experienced within the Project Site are moderate with the mean monthly temperatures ranging between about 17°C in the cold season to about 32°C in the hot season when humidity is relatively high.

The area is dominated by prevailing easterly winds during the dry season with fresh winds experienced in the months of July and August. Winds from the south-east are also experienced during the dry months while westerly winds are experienced in the wet months.

According to the IRENA Global Atlas for Renewable Energy the wind speeds in this area range from 4 – 8 meters per second.

According to the meteorological mast and LiDAR devices used to collect date on site the mean wind speeds range from 4.88 m/s to 8.88 m/s, with the highest wind speeds occurring June-September.

Climate-induced changes are already exerting considerable stress on Zambia's vulnerable sectors which will haul people into further poverty. Floods and droughts have increased in frequency. Climate change impacts will have negative impacts on different sectors and increase people's vulnerability. Zambia's Mean annual temperature has increased by 1.3°C since 1960, an average rate of 0.29°C per decade. The mean annual rainfall over Zambia has decreased by an average rate of 1.9mm per month (2.3%) per decade since 1960. The mean annual temperature is projected to increase by between 1.2 to 3.4°C by the 2060s, and between 1.6 to 5.5°C by the 2090s. Projections of mean rainfall do not indicate large changes in annual rainfall however, the proportion of total rainfall that falls in heavy events is projected to increase annually, which could lead to intensity of extreme events, especially floods.

6.2 AIR QUALITY

There are currently no major sources of anthropogenic pollution such as industries in or near the Project Site. Possible sources of impact on the local air quality include:

- The T4 National Road (Great East Road) which supports large volumes of both heavy and commuter traffic, while traffic within and surrounding Katete is typical of any urban settlement. Medium to small vehicles and motorcycles were noted on the access roads within the Project Site;
- Households within Katete Town will likely use electricity for cooking and lighting, while rural households remain dependant on wood and charcoal for cooking, resulting in localised air emissions in communities within and around the Project Site;
- Fugitive dust along gravel access roads and from areas cleared of vegetation; and
- Smoke from bush clearing and charcoal making that takes place in certain areas within the Project Site.

According to the Global Health Observatory (GHO) data for Zambia the annual mean concentrations of fine particulate matter ($PM_{2.5}$) ranges between 15-25 µg/m^3.

6.3 GEOLOGY AND SOILS

The local geology comprises basement rocks (granites and gneisses), mafics and syenites. The project itself is underlain by biotite-hornblende gneiss and charno-enderbitic and metapelitic granulites towards the north, and granites to the north-east (Aurecon, 2020). Karoo and younger sediments occur to the south areas of the site. Previous investigations reported folded gneisses and quartzite of the Basement Complex intruded by syenite, granites and basic intrusions, with low grade metasediments interspersed in between the basement rocks (Yockiyo Engineering Co., Ltd, 1995).

The characteristics of the local soils underlaying the project area, are summarized as follows:

- Soils formed from the underlying sedimentary and metamorphic rocks – Leached red brown loams (generally eastern footprint): The soils are non-differentiated ferrisols (highly weathered soils), generally sandy clays with more inert clay.
- Soils formed from the underlying acidic igneous or siliceous sedimentary rock – Sandveldt. These are non-differentiated, coarse-grained sandy soils with a clay content increasing with depth. They are generally yellowish-red to light yellowish-brown where well drained and grey brown where poorlydrained. These soils can be expected at the southeast portion of the general site.
- Soils of the Luangwa and Lower Zambesi Valleys – Rock and rubble (far western towards northern footprint): Broken, non-differentiated hilly country rock with mainly lithosols/skeletal soils (shallow soils of imperfectly weathered rock fragments), and flatter area with much surface rock or laterite crust.

6.4 HYDROLOGY AND DRAINAGE

Numerous extensive drainage systems were identified within the Project Site, many of which are interlinked and extend far beyond the boundaries of the Project Site. At a high level, these watercourses were classified as Inland Systems falling within the Middle Zambezi – Luangwa and Lower Zambezi Aquatic Ecoregions. The identified drainage systems comprised the following primary hydrogeomorphic (HGM) types: rivers with associated riparian vegetation and in some cases with associated floodplains, valley bottom wetlands (both channelled and unchannelled), and what are referred to locally (in Zambia) as 'dambos' (characterised by relatively even topography and situated in low-lying areas).

Whilst there were distinct differences between the different HGM types (e.g. between the rivers with associated riparian zones and dambos), it was noted during the fieldwork that conditions were largely homogenous within each group of the various drainage systems. For example, dambos were all characterised by the same floral species composition and vegetation communities throughout the Project Site, and the rivers had distinctive riparian zones characterised by woody species (with species composition unvaried).

The boundaries of the aquatic features/watercourses were delineated using terrain units, vegetation and soil morphological characteristics. The watercourse delineation map is presented in Figure 25.

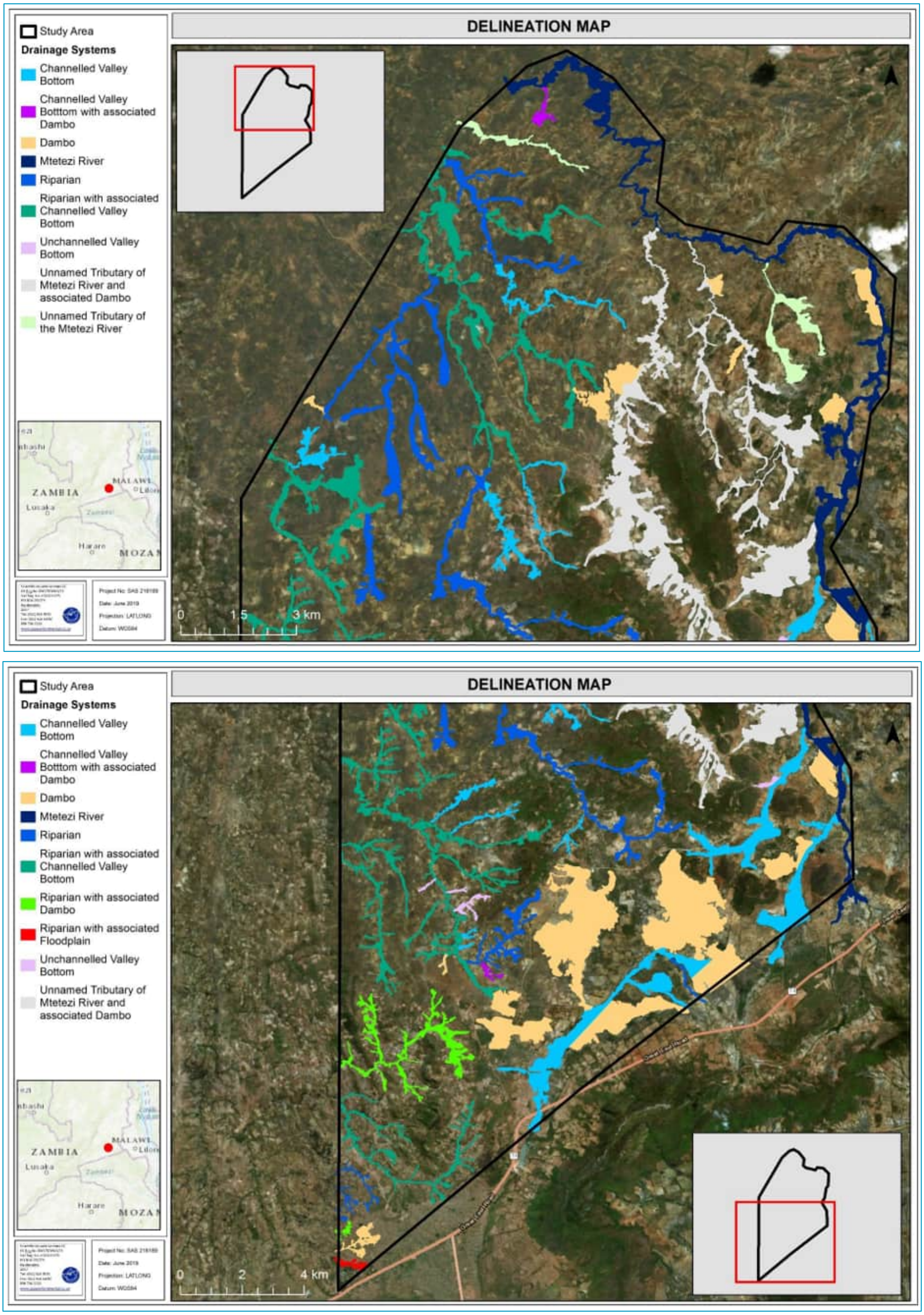


Figure 25: Conceptual depiction of the aquatic features delineation in relation to the Project Site

6.4.1 Mtetezi River

Hydraulic regime

The hydraulic regime of the Mtetezi River has been altered primarily by the presence of impoundments, both within the Project Site and downstream thereof. The Katete dam is located south of the Project Site and provides the town of Katete with water. Although no instream infrastructure was noted within the reach of the river within the Project Site, the T4 road traverses the river, necessitating a bridge crossing.

Geomorphology and sediment balance

Although the entire reach of the river could not be accessed and assessed those areas which were surveyed were noted to be moderately incised. This was attributed to vegetation clearing in the adjacent areas, leading to increased runoff entering the river and potentially at increased velocity, causing scouring and bank incision. Apart from the aforementioned impoundments, no other significant impacts on the geomorphological regime were noted. Increased sediment is expected due to cultivation adjacent to the river in some areas.

Water quality

Significant rainfall occurred during the week of the field work, resulting in large volumes of sediment being transported into the river, causing turbidity. Due to steep inclines at the assessment points as well as the depth and velocity of the water at the time of assessment, it was not possible to safely access the river to assess basic water quality parameters. Based on water quality parameters obtained in other river systems within the Project Site, and taking into account the surrounding land-uses, water quality is expected to be relatively unimpaired.

6.4.2 Riverine Systems (excluding the Mtetezi River)

Hydraulic regime

The hydraulic regimes of the various riverine systems have not been notably impacted, except where some instream infrastructure, such as weirs and road crossings (informal and formal) has been constructed. The occurrence of heavy rains at the start of the site assessment enabled assessment of how such infrastructure causes alterations to flow regimes, with flow being concentrated at specific points either around or through the centre of such infrastructure. Additionally, it was apparent that debris occasionally becomes lodged against instream infrastructure, impeding flow and causing turbulence. Aside from these impacts however, no formal abstraction (e.g. pump stations) or unnatural water inputs were observed.

Geomorphology and sediment balance

The proximity of subsistence agriculture in close proximity to the rivers has resulted in increased volumes of sediment transported into the rivers. This in turn has resulted in scouring and bank incision. Where bank incision was observed, in most instances it was not considered severe.

Water quality

Although information pertaining to the reference state of these rivers is scarce, it is considered possible that the clearing of vegetation and disturbance of soils has contributed to the increased turbidity of the rivers. It must be noted that the assessment took place during a period of relatively high rainfall though, and therefore this may be considered a natural state due to the dispersal of sediment in stormwater runoff. Basic water quality parameters (temperature, pH and Electrical Conductivity [EC]) were measured at five sites. At all five sites, pH ranged from 7.07 to 7.60, and EC ranged between 1.2 mS/m to 3.0 mS/m. These results indicate that water quality is relatively unimpaired, save for increased turbidity and possibly increased nutrients.

6.4.3 Valley Bottom Wetland Systems

Hydraulic regime

No impacts on the hydraulic regime were observed within the valley bottom systems, with the exception of very few informal road crossings which may potentially impede flow and cause accumulation of natural debris (e.g. branches, grass stalks etc.) Within the channelled valley bottom systems, no impacts on hydraulic connectivity or flow regimes were observed. Some impacts on the vadose zone (i.e. the movement of water through soils, specifically the recharge zone) may have occurred due to soil disturbances relating to agriculture. The hydraulic regime is deemed to be in a largely natural state.

Geomorphology and sediment balance

Soil disturbances and informal road crossings were the most commonly observed impacts on the geomorphological processes of these wetland systems. Vegetation loss due to agriculture is likely to have contributed to increased sediment inputs, in turn leading to an altered sediment budget and possibly changes to sediment distribution within the wetlands. Although some stream bank incision was apparent in certain systems, erosion was not considered severe at the time of the assessment and is therefore not considered a significant modifier.

Water quality

Water quality parameters, where measured, indicated that aside from turbidity, water quality is relatively unimpaired. This is as anticipated due to the remote geographical setting and the fact that the rivers are more regularly utilised for domestic purposes. Increased nutrients are expected due to increased faecal matter from domestic livestock in these areas.

6.4.4 Dambos and Floodplain Wetland Systems

Hydraulic regime

Disturbances to the soils within dambo areas may have led to altered movement of groundwater within the vadose zone of the wetlands, in turn potentially altering the hydraulic regime of these systems. Additionally, the increased woody component within these systems may have resulted in increased water use.

Geomorphology and sediment balance

Once again, the primary impact on geomorphological processes is disturbances to soils, and informal road crossings. Movement of sediment through the wetlands is driven largely by movement of surface water, thus is likely to only be transported through the dambos during the rainy season. Some patches of erosion were observed within areas subjected to long-term cultivation, however re-establishment of pioneer graminoid species, as observed in some of these areas, should mitigate the erosion.

Water quality

Although surface water was present in some dambos at the time of the assessment, it was due to rainfall received and is not likely to be present during the dry season. Based on water quality parameters recorded in the various riverine and channelled valley bottom systems, water quality within the dambos is likely to be relatively unimpaired, although potentially has high sediment loads due to the disturbances to soils.

6.4.5 Recommended Buffer Zones

There is no clear guidelines on wetland resource management in Zambia. However, whilst buffer zones are considered important to provide protection of basic ecosystem processes (in this case, the protection of freshwater ecological services), reduce impacts on freshwater resources arising from surrounding activities (e.g. by removing or filtering sediment and pollutants), provision of habitat for aquatic and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits. It should be noted that buffer zones are not considered to be effective mitigation against impacts such as water quality and quantity degradation, hydrological changes arising from stream flow reduction, impoundments or abstraction which require site-specific mitigation measures.

In the absence of Zambian guidelines consideration was given to regional guidelines. A 30 m buffer is often stipulated by ZEMA while in South Africa, legislation stipulates a 32 m development setback around wetlands and rivers. Therefore, the precautionary principle, which is considered an important component in Integrated Environmental Management, was applied and a 32m buffer is therefore recommended as a setback for the non-linear components of the proposed projects and for any linear developments running parallel to the freshwater systems. The Preliminary Guidelines for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries was applied. Although developed primarily with the South African context in mind, the tool nevertheless is flexible enough to allow for regional application. On that basis, a 10 m buffer is considered the absolute minimum for all non-permanent infrastructure during the construction phase where a wider buffer cannot be implemented. The buffers in relation to the proposed infrastructure footprint is presented in Figure 26. These buffers should be taken into consideration during Project planning in order to ensure that no infrastructure is unnecessarily placed within or close proximity rivers, steams, wetlands, dambos, etc.

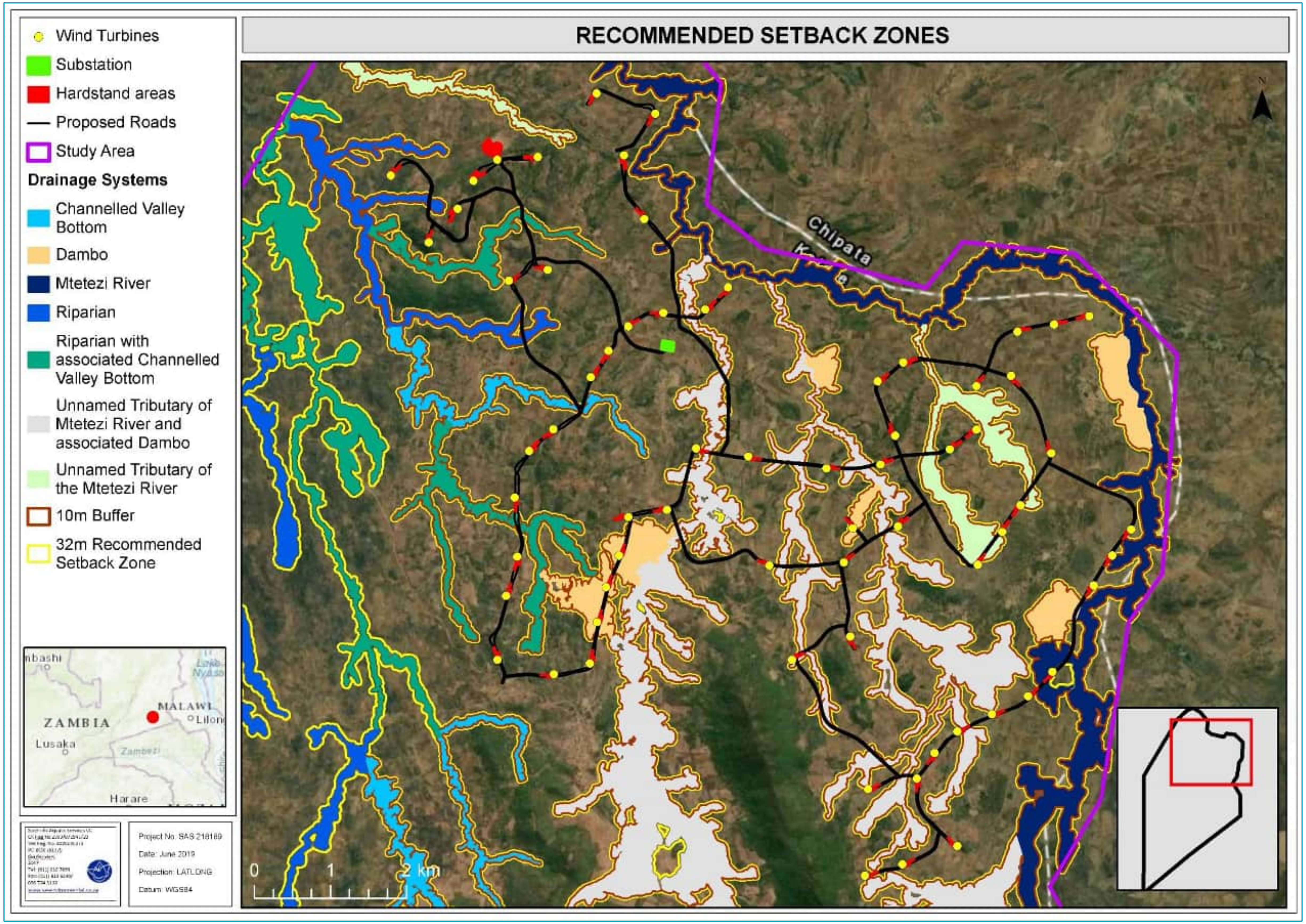


Figure 26: Recommended setback zones (buffer) around freshwater habitats

6.5 HYDROGEOLOGY

Ancient (Precambrian) crystalline basement rocks comprising gneisses and granitic rocks with some meta-sediments are dominant in the eastern and southern parts of Zambia. Groundwater is mainly restricted in the crystalline basement rocks which are the dominate rock types. Consequently, water availability is a more significant problem in these areas. Nonetheless, groundwater is present within fractures and joints in the basement rocks and within the weathered overburden, which is typically of the order of 10–15 m thick, but up to 30 m thick in places. Sporadic thermal or saline springs occur in parts of Southern, Central and Eastern Provinces. Chemical data are available for groundwater in Zambia, and specifically for the Project site area, is very limited. Available data suggest the groundwater generally has low concentrations of dissolved constituents.

The basement complex (bedrock) is composed of hard, crystalline or re-crystallised rocks of igneous or metamorphic origin (granites, metaquartzites/gneisses) with negligible primary porosity and permeability. Potential composite aquifers are developed within the weathered overburden and fractured bedrock of these crystalline rocks, and are commonly referred to as basement-, hard rock-, bedrock- or weathered-fractured rock aquifers.

Majority of the Project Site falls within the BL-02 quaternary catchment of the Luangwa catchment (see Figure 27). A small part the south eastern corner of the site falls within the BZ-10 quaternary catchment of the Zambezi catchment. The Project Site area is underlain by as aquifers of limited potential or regions without significant groundwater. The stratum has intermediate characteristics with borehole yields typically 0.1 – 2 litres per second as a result of low yielding formations (e.g. basement gneiss).

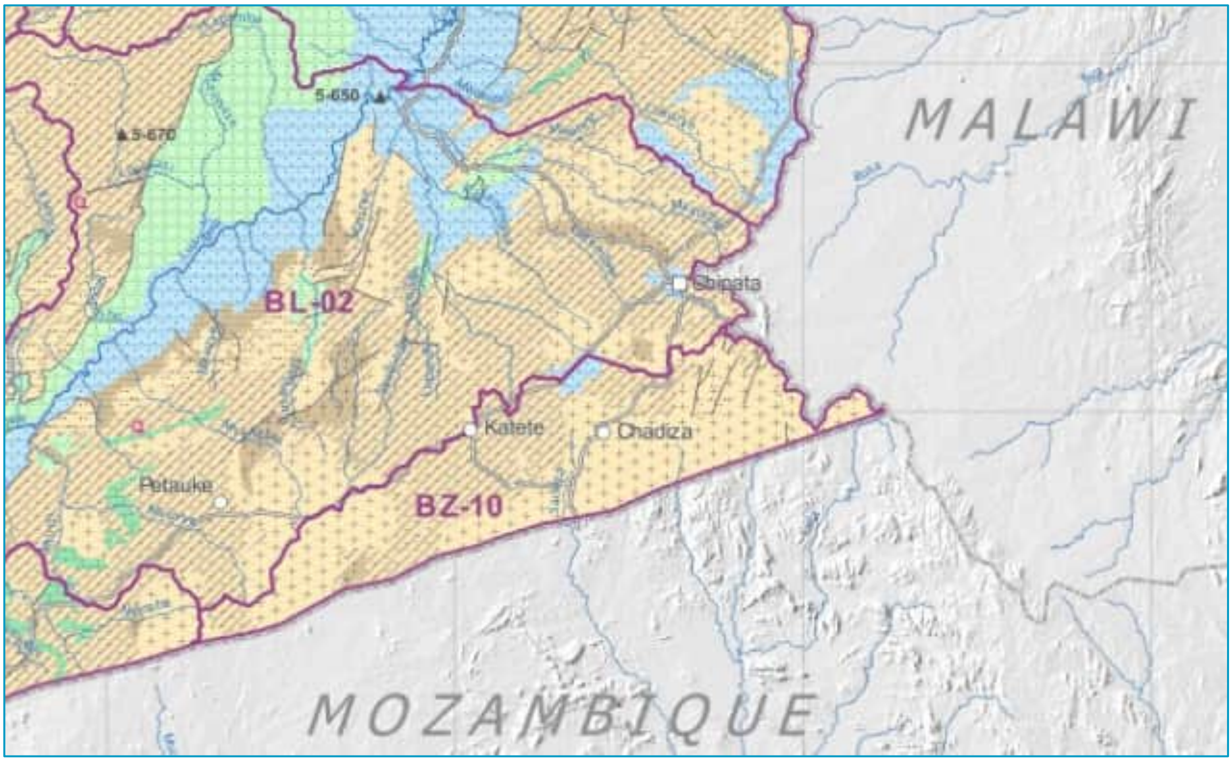


Figure 27: Quaternary catchments

The project area falls within the "Lower Luangwa Aquifer System, Katete Chadiza" according to the National Aquifer Assessment Study several 100 boreholes were drilled around Katete and Chadiza to supply potable water to the rural population. Many boreholes turned out to be dry or low yielding, with the success rate depending on the thickness of regolith (Aurecon, 2020). The regolith is typically 10 to 15 m thick, but can be up to 30 m thick. Below this, the unweathered bedrock can be fractured to depths of about 60 - 70 m. The static water table is usually 20 to 30 m below surface. Generally, boreholes are drilled between 50 to 60 m deep (Aurecon, 2020)

A study in the Mbala district in Zambia, which is also underlain by the Basement Complex, was done to determine the regional groundwater quality in the area. A total of 59 water samples were collected from 59 boreholes and analysed for physical, chemical and microbiological parameters. Results were compared to the Zambian Bureau of Standards (ZABS) guideline values for drinking water and the WHO guideline values where present. In general, most water parameters complied with ZABS drinking water guideline values. In a few instances pH, sodium, sulphate, iron and manganese exceeded drinking water guidelines (Aurecon, 2020).

6.6 LANDSCAPE AND TOPOGRAPHY

In general the Project Site is comprised of a landscape of tall forested hills, elevated ridges and low-undulating hills, with broad, flat valleys extending between the hills. The valleys in-turn supports a number of ephemeral streams and well as seasonally flooded wetlands (Figure 28).

In order to better understand the topography, a regional Digital Elevation Model (DEM) was generated. The data is generalised, and although will not reflect smaller topographic features, is very effective in understanding the broader landscape character which is mapped in Figure 29. Graphical representation of the terrain was also implemented with West to East and North to South profile lines cutting through the Project Site and extending beyond the area approximately five km on either side. The purple tick marks represent the opposite direction profile line, and the green tick marks the approximate outer boundary of the Project Sites, with the profile also depicting the terrain six km on either side of the project boundary as these areas could influence (or be influenced by) the proposed landscape modification.

As is depicted in the West to East profile (Figure 30), the hills located within the Project Site are strongly accentuated due to the flatter terrain to the west and east. Along this axis, the elevation ranges from a western low of approximately 900 mamsl, to a high of just below 1 375 mamsl in the centre. Although the profile below depicts a single hill, in the landscape, there are numerous other small hills which also range from 200 m to 300 m in height. Smaller cone shaped hill features are also apparent on this profile, which due to their conical shape, create interesting topographic features in the landscape.

The North to South Profile (Figure 31) reflects less of a dramatic visual picture due to the higher ground to the south outside of the Project Site. Also apparent is the flatter, southern extents of the Project Site, which are less undulating due to fewer drainage lines. The northern extent of the Project Site depicts rough terrain to the north of the central hill range. These areas are fairly difficult to access and as such less settlement has taken place.

Although the hilly terrain does add value to the surrounding landscape, the form and scale of the hills do not create significant topographic features that are unique to the region. Larger and more interesting hill features are located to the south of the proposed Project Site, which do add to the landscape character. However, there are numerous ridgelines, peaks on the hills, as well as conical shaped, steep sided hills.

Figure 28: Images of the Project Site Landscape

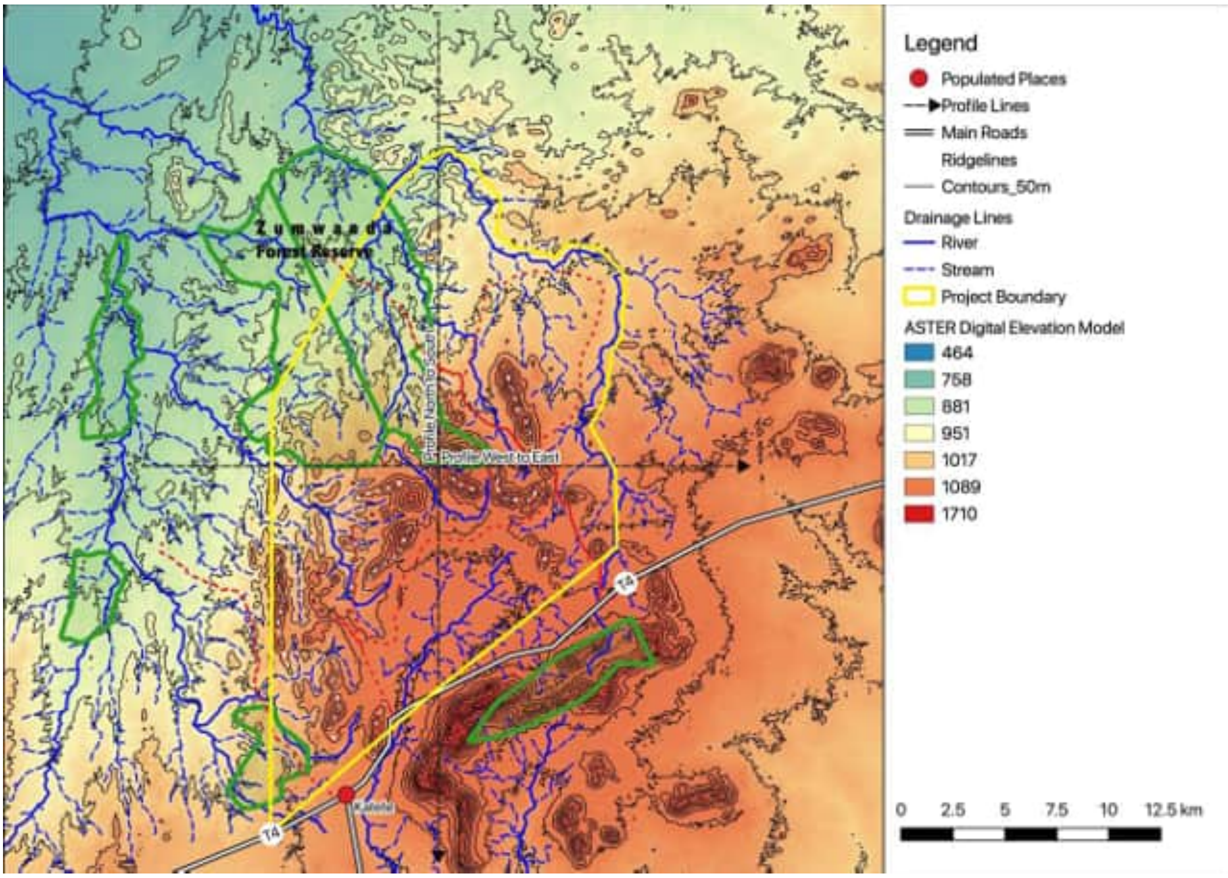


Figure 29: Regional Digital Elevation Map

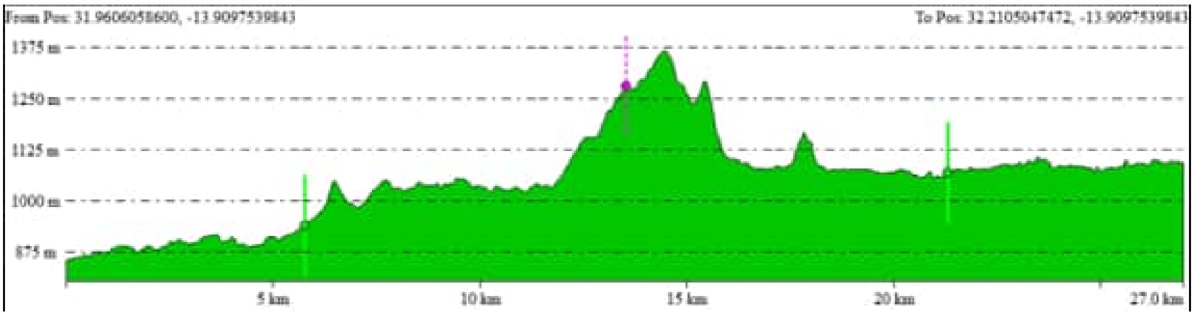


Figure 30: West to East Topographical Profile

Figure 31: North to South Topographical Profile

6.7 LAND USE AND TENURE

6.7.1 Land Use

The Project Site is comprised of several different land-uses, and dominated by (1) rural settlements, (2) urban and peri-urban settlement at Katete Town, (3) small-scale agriculture, and (4) open public/communal land. Each land-use is described in more detail below:

- ***Rural Settlements:*** There are a number of rural villages that vary considerably in size – varying from large villages (supporting hundreds of households) to smaller isolated hamlets (supporting 1 to 5 households) and single isolated farmsteads. The rural villages also tend to be located on elevation ridges, while avoiding the valley flats and the local hills. The larger villages tend to function as local centres and are generally clustered along main district roads. Smaller satellite villages and hamlets have grown around the larger villages and this is normally in response to population growth. The distribution of villages and households is depicted in Figure 32. The locations of the wind turbines in relation to these villages and households is depicted in Figure 34.

- ***Urban and Peri-urban Settlement at Katete Town:*** Katete Town is the closest town located approximately 5 km south west of the study area. The town functions as the administrative centre of the Katete District and is the only true urban centre in the area with a total population of 21 458 individuals in 2010 (Central Statistics Office of Zambia, 2012). Katete contains both urban and peri-urban residential development, and interviews suggest that the town is expanding northward into the Project Site. The land, administrated by the Katete Town Council (which is designated State Land), is formally limited to 100 m north of the T4, however much of the urban and peri-urban residential areas have expanded into customary land. The Katete Town Council has considered converting all residential areas located on customary land to state and titled land; however, no specific boundaries or agreements have been reached.

- ***Small-Scale Agriculture:*** Small-scale agriculture is the dominant land-use, and accounts for approximately 34 % of the total Project area (or 116 of the 336 kilometres squared)[9]. The distribution of the farmland is largely restricted to the low-lying valley flats interspersed between high hills. The distribution of farmland in the Project area is depicted in Figure 33 overleaf. There are noticeable forms of farming that include large dryland farm plots that concentrated on maize production and are entirely rain-fed. There are also smaller garden plots that are localised to local seasonal streams and drainage areas, where the soil-moisture content support water-thirsty crops.

- ***Open Communal Land:*** Communal land encompasses all lands that are not held under private ownerships, and generally covers the open bush as well as natural or transformed vegetation. This land-use type is not actively farmed but is commonly used by local village for natural resource harvesting as well as grazing of livestock. Communal land is administered by the traditional authorities.

[9] *Based on desktop mapping of active farmplots using Google Earth imagery dated between 2013 and 2016.*

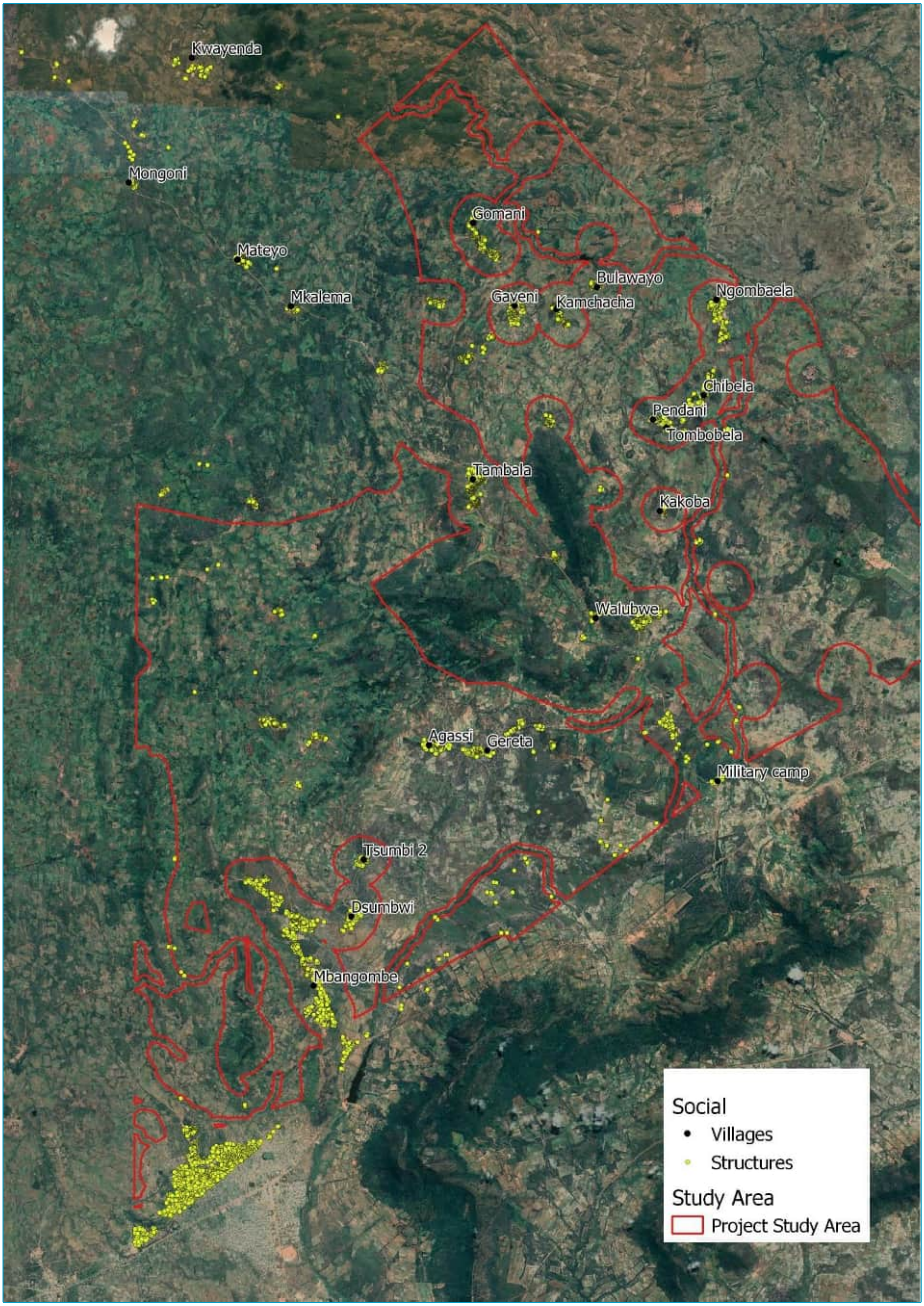


Figure 32: Distribution of Household Structures and Villages

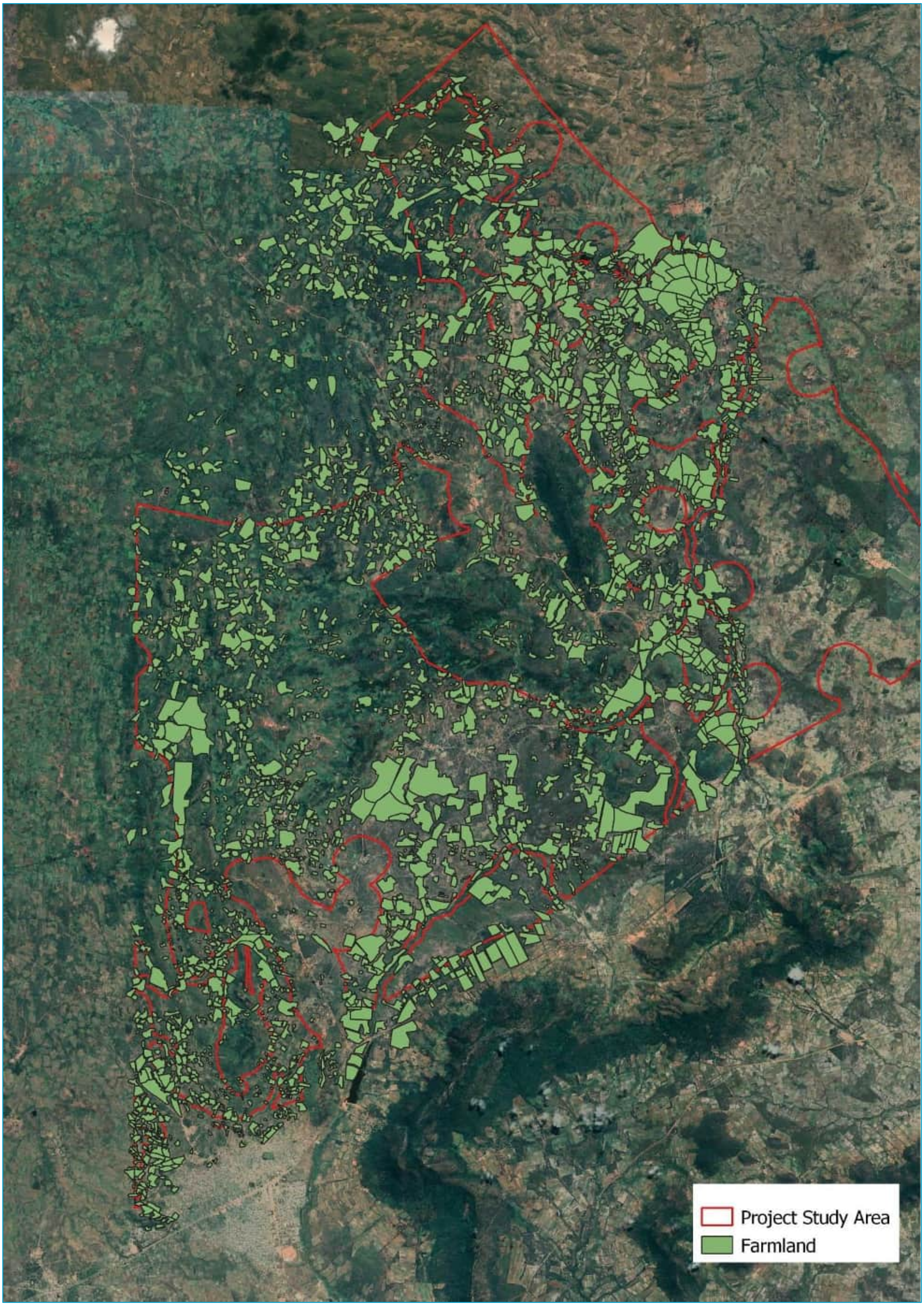


Figure 33: Distribution of Farmland.

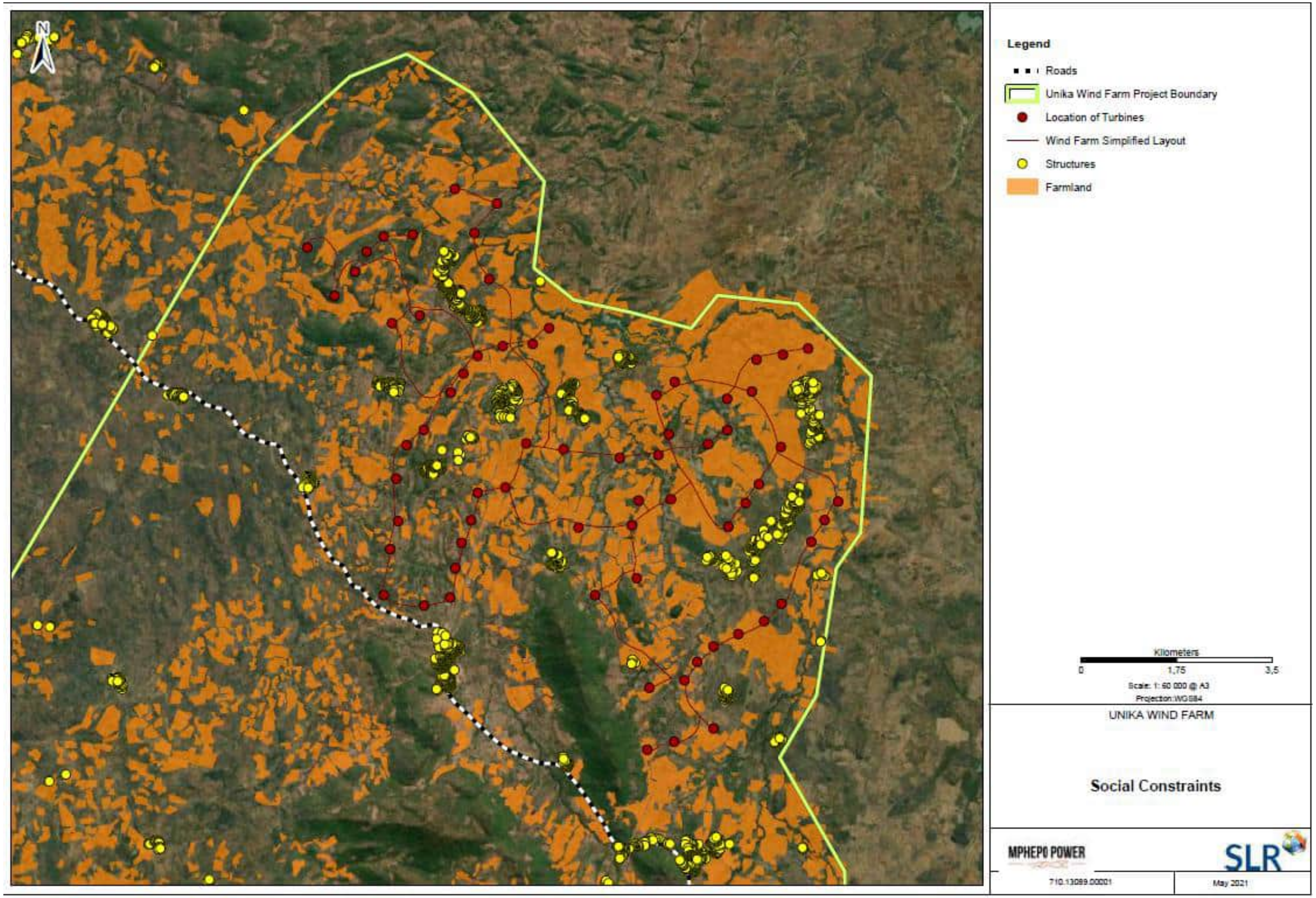


Figure 34: Locations of wind turbines in relation to structures

6.7.2 Land Ownership and Tenure

All land in Zambia is vested absolutely in Government of Zambia and is held by the government in perpetuity and in trust on behalf of the people of Zambia. Under such an arrangements, land in Zambia essentially falls into two main categories – Customary and State Land.

All land located within the Project Site and along the power transmission line route fall under Customary Land which is legally recognised and protected under the Lands Act, Chapter 184, and any customary land vested in or held by any person under customary tenure is similarly recognised.

The administration of the Project Site customary land is via the Chewa Royal Establishment and the local chiefs. The chiefs, with support from headmen/headwomen, are granted powers to allocate land to individuals or families for their personal use (i.e. farming) and occupation (i.e. establishment of homes). Interviews suggested that such allocation is done verbally, and there is little written evidence or certification of rights been granted.

Historical land ownership would have been secured for large tracts of land by the original family-clans in the area. Any clan lands would have, over time, been divided and granted to family members of the clans. Any family member granted land is thereafter deemed to be the exclusive owner of their land. However, the clan may place certain restrictions on how the land is sold or disposed of.

The allocation and administration of land is undertaken directly by the headmen/headwomen, with support from a village committee and via direct consultation of the villagers. The headmen/headwomen generally have strong ties to the major family-clans in of the villages they administer. The relationship between clans and headmen/headwomen therefore has a major influence on land administration at the village level.

In addition to the above individual land arrangements, customary tenure also relates to community, common, or forest land within a village, as well as communal grazing land. Such land will not be under any form of individual exclusive right but is freely and openly used by local communities.

All land not held under customary tenure is deemed to be state land. With respect to the project this is limited to the Katete Town Council Land as well as land held by the Ministry of Defence, although the latter is being contested as customary land. Any attempt to convert customary land to state land, may only be undertaken under national law and only after the approval of the chief and the local authorities in whose area the land to be converted.

6.8 BUILD ENVIRONMENT

The build environment mainly consists of the (1) Rural Settlements and (2) Urban and Peri-urban Settlement at Katete Town, which has been described in more detail under the Land Use section above. Examples of rural, peri-urban and urban environments are presented in Figure 35.

Figure 35: Examples of rural, peri-urban and urban environments

6.9 NOISE AND VIBRATION

The Project Site is largely undeveloped with a rural character, though there are a significant number of communities dispersed in the area. Ambient sound levels are typical of a rural noise district.

A number of ambient noise measurements were collected during February 2019. Measurements were collected in 10-minute periods for a period of 1 hour. Noise levels ranged from 29.2 – 47 dBA ($L_{Aeq,f}$) or 21.5 – 31.7 dBA (L_{AF90}) as indicated in Table 13 below.

The results indicated a quiet environment where natural noises, mostly wind-induced as well as faunal noises, dominate. Anthropogenic noises increase ambient sound levels, especially closer to the communities and local towns. The data is similar to sound level measurements measured at other, similarly natural locations.

Available data indicated that wind-induced noises start to increase at wind speeds 3 – 4 m/s, becoming significant (and frequently the dominant noise source in rural areas) at wind speeds higher than 10 – 12 m/s. Most wind turbines reach their maximum noise emission level at a wind speed of 8 – 10 m/s. At these wind speeds increased wind-induced noises (wind howling around buildings, rustling of leaves in trees, rattling noises, etc.) could start to drown other noises, including those being generated by wind turbines.

Table 13: Summary of ambient sound levels measured onsite

Measurement name and location (WGS 84)	$L_{Amax,I}$	$L_{Aeq,I}$	$L_{Amin,f}$	$L_{Aeq,f}$	L_{AF90}	Comments
	dBA	dBA	dBA	dBA	dBA90	
MPWF5TSL01 (-13.996717°, 32.063896°)	67.0	44.3	20.2	39.8	24.8	Quiet location with wind induced noises generally defining ambient sound levels. Bird sounds audible and dominating when close to microphone. People walking or cycling past raising noise levels at times. Insects audible at times. Large group of people passing on bicycles during measurement 5, significantly raising noise levels for around 60 seconds. Car passing measurement 6 with cyclist with large radio.
MPWF5TSL02 (-13.961734°, 32.071422°)	69.5	45.2	17.7	43.8	21.5	Wind induced noises from maize leaves the dominant sound at times. Birds and some insects. Voices of passersby at times. Sound levels peaking with wind gusts. Motorcycle passing during measurement 3. Motorcycle passing during measurement 5.
MPWF5TSL03 (-13.939922°, 32.121561°)	65.5	47.4	21.7	43.9	26.2	Quiet with birds and wind induced noises dominating. Sound of running water just audible. Frogs audible at time dominating sound level during event with call up to 58 dBA. Wind through maize leaves dominating during wind gusts. Wind increasing resulting in sound level of approximately 42 dBA for around 30 seconds. Main source of noise is frogs and birds.
MPWF5TSL04 (-13.853300°, 32.104418°)	51.9	34.2	17.3	29.2	21.5	Birds calls dominant. Some insect sounds. Very low winds all measurements.
MPWF5TSL05 (-13.867597°, 32.079747°)	76.2	49.7	26.2	47.0	31.7	Some wind induced noises likely dominant. Crickets and birds audible. Cicada species audible. Possibly frogs audible. Natural noises dominant. Sound from town with wood cutting and voices of kids. Vehicle passing during measurement 2.
MPWFSTSL06 (-13.966362°, 32.155850°)	73.9	46.8	25.0	43.4	28.3	Natural noises dominate with birds being the main source of noise. Background noise due to water flowing in river. Voices audible in distance. Traffic on tar road audible at times. Passersby at times increasing noise level.
MPWF5TSL07 (-13.931836°, 32.140911°)	58.3	39.4	22.9	34.6	29.1	Wind induced noises dominate with light winds. Stream running audible in far distance. Lots of broad leaved trees. Birds audible. Voices barely audible in far distance. Natural sounds dominate. Thunder in distance at times. Chopping of wood in far distance during last measurement. Humidity increasing with light rain end of measurement (not influencing measurement).
MPWFSTSL08 (-13.834341°, 32.129462°)	69.8	46.0	21.3	37.9	26.2	Bird sounds dominating with light drizzle of rain audible. Wind through leaves at times. Voices barely audible at times. Insects audible. Thunder in distance not impacting on sound level. Wind reducing third measurement with lighter drizzle. Voices from passersby raising noise level 5th measurement.

Due to the rural nature of the site and surrounds there are no major sources of vibration.

6.10 ECOLOGICAL RESOURCES

6.10.1 Fauna

The following faunal habitat units were identified within the Project Site:

- **Miombo Woodland**: This habitat unit has been subjected to disturbance from the local communities as it is predominantly associated with the low lying flat and undulating areas between the other habitat units. Vegetation clearing for agriculture, fuel, building materials and charcoal production has resulted in the loss of habitat for faunal species. These impacts combined with the increased human presence in the Project Site has resulted in a markedly low abundance of mammal species in this habitat, however, the abundance and diversity of invertebrates and reptiles does not appear to have suffered the same fate. This habitat sensitivity is considered to be Intermediate.

- **Degraded Forest:** This habitat unit predominantly encompasses the mountainous and inselberg areas and is characterised by large tall trees with interlinking canopies. This habitat is continually being impacted upon and decreasing in extent and diversity due to the harvesting of timber for fuel, building materials and charcoal production, leading to the encroachment of miombo woodland species. Although this habitat unit has been subject to anthropogenic activities and impacts, it is still considered capable of providing habitat and resources to a number of faunal species. This habitat sensitivity is considered to be Moderately High.

- **Freshwater Habitat:** This habitat unit comprises of the streams and dambos (wetlands) associated with the Project Site. This habitat unit has been impacted upon as a result of vegetation clearance for agriculture (grazing and crop cultivation). The dambos and streams convey large amounts of water through the Project Site, however the large-scale removal of vegetation has resulted in increased peak water flows; leading to erosion within the dambos and that of the stream banks. The streams and associated riparian vegetation still provide movement corridors for faunal species and as such are considered important for habitat connectivity. In addition, the freshwater areas provide suitable and stable habitat for insect species, notably those often associated with water bodies as well as a diversity of amphibian and reptile species. This habitat sensitivity is considered to be Moderately High.

- **Agricultural Areas:** Associated with cultivated fields and areas where vegetation has been cleared in order to provide increased grazing for livestock, both in association with the areas surrounding the villages and at some distance from villages where new fields are being cleared. This habitat still provides rudimentary habitat and food resources for faunal species, notably insects and arachnids. It is possible that reptiles and small mammals will also utilise this habitat periodically. This habitat sensitivity is considered to be Moderately Low.

Mammals

During the field assessment very limited signs of mammal species were observed. During interviews it was ascertained that over the years the cutting down of the forests and woodlands (for charcoal fuel, building materials, charcoal production and agriculture) and the intensified subsistence hunting has resulted in a significant decrease and loss of mammals from the region. It is likely that because of the habitat loss and increased persecution levels that the remaining species have either sought refuge in the more inaccessible areas of the forest habitat or have migrated to areas which are deemed safer and have a decreased human presence.

The Forest habitat in this regard in the higher mountainous areas is still likely to harbour a few mammal species, notably those which are shy and secretive, such as the *Potamochoerus larvatus* (Bushpig), *Otolemur crassicaudatus* (Brown Greater Galago) and *Cercopithecus mitis* (Blue Monkey), although these species are likely to be under increased persecution as they are hunted for the bush meat trade.

In addition, the freshwater systems may play host to *Ichneumia albicauda* (White-tailed Mongoose). The small predatory mammal *Otocyon megalotis ssp. virgatus* (Eastern Bat-eared Fox) is also likely to occur in the Project Site. The Miombo Woodlands and Freshwater Habitats are likely to provide habitat to smaller less conspicuous mammal species of the Rodentia family as well as small scrub hares. In addition, the freshwater systems and associated riparian areas may provide movement corridors for mammal species, allowing them to traverse the Project Site under cover, minimising detection. Food resources are deemed adequate for the remaining species in the Project Site; however, the continued habitat modification has had a notable impact on such resources as well as the overall habitat integrity for mammals.

No mammal SCC were observed during the fieldwork. Although not observed, it is possible that the following species may occur within the Project Site: *Eidolon helvum* (African Straw-coloured Fruit-bat, NT), *Otomops martiensseni* (Large-eared Free-tailed Bat, NT), *Hipposideros vittatus* (Commerson's Leafnosed Bat, NT) and *Aonyx capensis* (African Clawless Otter, NT).

Of these species the proposed wind turbines pose the greatest threat to the bats, which are likely to utilise the large forest canopies and caves/crevices amongst the mountains for roosting. Bat mortalities are well documented with regards to wind turbines. The impact of the turbines on *Aonyx capensis* is likely to be minimal to non-existent, as this species inhabits the freshwater systems with surface water and placement of turbines within these habitat units is unlikely. In addition to these species, although unlikely to occur in the Project Site due to poaching and the medicinal trade, *Smutsia temminckii* (Temminck's Ground Pangolin, VU) probably once did inhabit the Miombo Woodland in the Project Site.

Mammal sensitivity is considered to be Moderately High

Amphibians

During the field assessment several amphibian species were observed, notably in the freshwater habitats associated with the Miombo Woodlands and the Forests. The abundance and diversity of amphibian species in the Project Site is largely attributable to the large areas of standing water and damp soils as well as a high level of food resources in the form of abundant insects. Amphibian species are often a good bio-indicator of ecosystem health, notably that of freshwater systems, as they are generally susceptible to pollution and unnatural toxicants in the water. Although the Project Site has been subjected to extensive habitat alteration, land use changes and forest clearing, it is evident that the water systems are still in good health. The Dambos, forest streams and streams in the Miombo Woodlands all provide high levels of suitable habitat both for foraging and breeding of amphibian species. The interconnectedness of the freshwater habitat further ensures that the overall habitat integrity for amphibian species remains moderately high, allowing for the free and relatively easy movement of such species throughout the Project Site.

Additional species that are expected to occur within the Project Site include but are not limited to *Sclerophrys gutturalis* (Guttural Toad), *Leptopelis bocagii* (Bocage's Tree Frog), *Breviceps poweri* (Power's Rain Frog), *Phrynobatrachus natalensis* (Natal Puddle Frog), *Tomopterna marmorata* (Marbled Sand Frog), *Sclerophrys pusilla* (Eastern Flat-backed Toad), *Arthroleptis xenodactyloides* (Dwarf Squeaker), *Hyperolius marginatus*, *Hemisus marmoratus* (Shovel-nosed Frog), *Schismaderma carens* (African Split-skin Toad) and frogs of the Genus Ptychadena (Ridged/Grass Frogs).

All the aforementioned species are likely to occur within the Freshwater Habitat and the associated areas of increased moisture surrounding these freshwater systems.

No amphibian SCC were observed within the Project Site. The available databases further do not indicate the possible current or historical occurrence of amphibian SCC in the Project Site.

Amphibian sensitivity is considered to be Moderately High.

Reptiles

During the field assessment several reptile species were observed throughout the Project Site but not in close proximity to the villages. Although the habitat within the Project Site has been degraded, reptile species show remarkable resilience to such degradation, often able to continue thriving in these changed environments. This is largely due to their ability to live in and amongst human populations with ease, whilst still finding adequate food resources to sustain themselves. The smaller lizards' and skinks' primary food resource is that of the abundant insect life in the Project Site, whilst the larger predatory snakes and lizards will rely on larger prey items such as rodents, other reptiles, amphibians and nestlings of bird species. Although not photographed, during the site assessment individuals of *Naja mossambica* (Mozambique Spitting Cobra) were often observed, as well as a snake most likely of the Genus Amblyodipsas (Purple-glossed Snakes). Both of these snakes were observed in and around the freshwater habitat, most likely foraging for small mammals and amphibians.

Reptile sensitivity is considered to be Moderately High.

Insects

Insect diversity and abundance was notably high throughout the Project Site. This can be attributed to the high levels of food resources as well as increased and varied habitats that suit a diversity of insects. Flowering and fruit producing plants as well as the graminoid layer all provide increased food resources to insects, whilst the smaller insects themselves are preyed upon by larger predatory insects. A high abundance of insects is imperative for the overall functioning of the ecosystem, as the insects play an important role as pollinators as well as nutrient recyclers. Although habitat degradation is evident, the Project Site is still considered to be an important area in terms of habitat provision for insects, notably the hillsides, forests and freshwater habitats.

In addition, insect overall provide the staple and important food resource for a variety of other species, without which many would not be able to survive.

No insect SCC were observed within the Project Site. The available databases do not indicate the possible current or historical occurrence of insect SCC in the Project Site.

Insect sensitivity is considered to be Moderately High.

Arachnids

Arachnid species are notoriously hard to detect over a relatively short period of time, which can often lead to the under estimation of diversity and abundance. As such, it is necessary to take into consideration the habitat conditions for arachnids as well as available resources, whilst also consulting available databases. During the field assessment particular attention was paid to searching out arachnid species, as they are known to be secretive and often elusive. By searching under rocks, fallen logs, shrubs and tree canopies, it was noted that the overall arachnid abundance and diversity of the Project Site was moderately high. This abundance and diversity of arachnid species can be sustained due to the increased levels of suitable habitat and high abundance of food resources, predominantly that of insects. Vegetation clearance has had an impact on the habitat integrity for arachnids, however the more open and cleared areas are now favoured by ground hunting spiders such as those belong to the Family Ctenidae (Wandering Spiders) and Family Lycosidae (Wolf Spiders). Like amphibians, a high abundance and diversity of arachnids further helps maintain insect population numbers, which if left uncontrolled would become problematic as well as possibly destructive.

No arachnid SCC are known to occur in the Project Site according to the available databases at the time of the assessment, with all species observed being considered common and widespread.

Arachnid sensitivity is considered to be Moderately High.

Faunal Species of Conservational Concern

Species listed in Table 14 below whose known distribution ranges and habitat preferences according to the IUCN include the Project Site have been taken into consideration.

The species listed in Table 14 all have a relatively high probability of occurring within the Project Site, and are most likely to occur within and around the Degraded Forest and Freshwater Habitats, as these habitats provide suitable movement and refuge areas, as well as areas for foraging and roosting.

Table 14: A summary of the potential mammal SCC that may occur within the

Scientific name	Common name	Threat Status
Eidolon helvum	African Straw-coloured Fruit-bat	Near Threatened
Aonyx capensis	African Clawless Otter	Near Threatened
Otomops martiensseni	Large-eared Free-tailed Bat	Near Threatened
Hipposideros vittatus	Commerson's Leafnosed Bat	Near Threatened

6.10.2 Bats

Habitats

The habitat on site comprises four major units; Miombo woodland, degraded forest, freshwater habitat and agricultural areas. Both the Miombo and forest units are largely disturbed due to vegetation clearing for cultivation, livestock grazing, charcoal production and fuel wood harvesting.

A number of free-tailed bats and plain-faced bats roost in trees in woodland habitats, including in dead trees. Evidence suggests that trees with larger trunks are preferentially selected by bats and therefore the existence of older, larger trees at the site will increase the sensitivity of the site to wind energy development. However, most of these older trees have been harvested and impacted by local communities and there are few of such trees remaining on site. There are numerous fruiting trees available in the study area which could be accessed by fruit bats including mango, banana and fig trees. Through conversations with villagers and catching bats, it was confirmed that fruit bats do forage at fruit trees in the villages.

The density of woodland vegetation does not appear to influence bat presence as some species will be present in higher or lower density woodland respectively. Plain-faced bats might favour roosting in areas with higher tree density but still forage in areas with an open canopy. Free-tailed bats will roost in lower density woodland areas.

The freshwater habitat is important for bats because it provides water to drink and attracts insects upon which bats forage. The linear nature of the streams also provides routes along which bats can navigate and commute. In some places the streams are also associated with riparian vegetation which provides foraging areas for bats as well as roosting spaces in trees. These areas are therefore important for habitat connectivity.

Roosting potential across the site is high as there are numerous places for bats to roost including in buildings amongst the villages, trees, cracks and crevices between rocks in inselbergs, and road culverts. There are no large caves at or near the site that contain major bat roosts. Two roosts in buildings were confirmed for the study area one of which (at Mkangazi School) contained approximately 30 to 50 Angolan free-tailed bats. At Matunga village, an unused bio-digester is used as a night roost by Egyptian slit-faced bats and 14 individuals were caught at three nets set up in this village. Banana bats were confirmed by local farmers to roost in furled banana leaves but could not be located during the fieldwork searches. Bats roosting among cracks and crevices could not be found in the inselbergs examined.

Bat Species

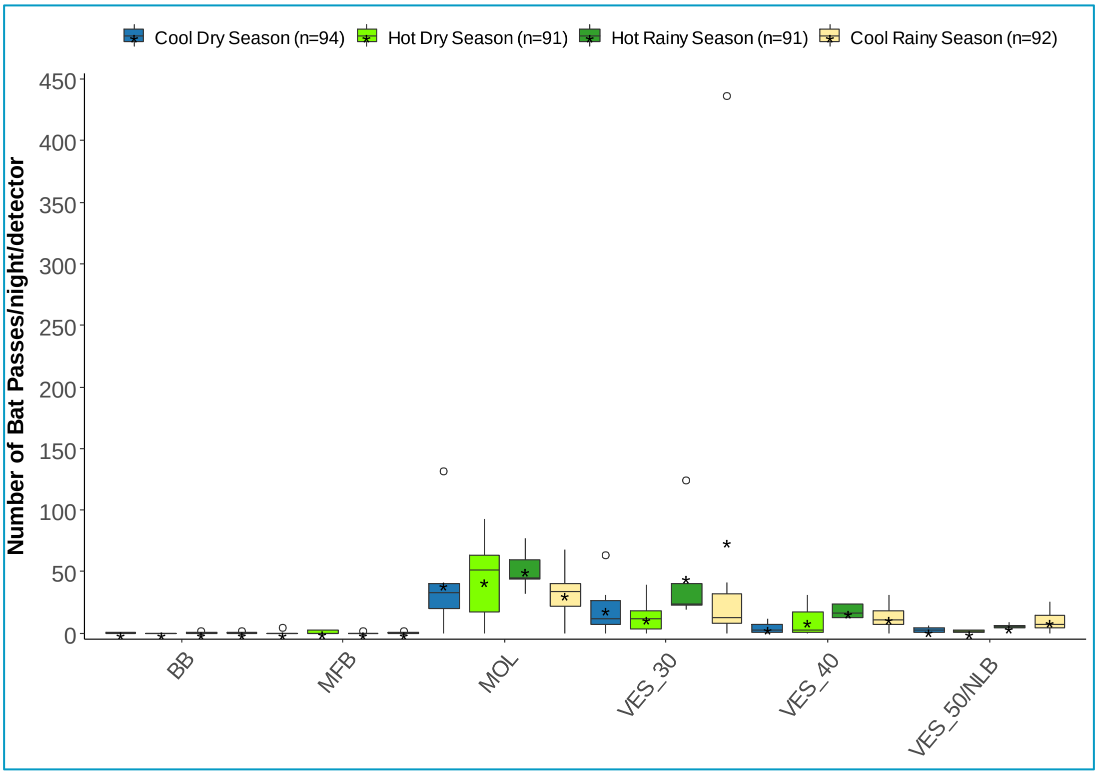
Based on the analysis of the acoustic monitoring data, at least eleven species or species complexes were identified (Table 15). In addition, two epauletted fruit bat species and one species of slit-faced bat were captured. Thus, there at least thirteen species present on site, but likely to be more than this. Five of these were confirmed through live captures. Free-tailed bats were the most commonly recorded bats on site, followed by lower frequency plain-faced bats of the VES_30 complex.

Table 15: Bat Species/Species Complexes Confirmed

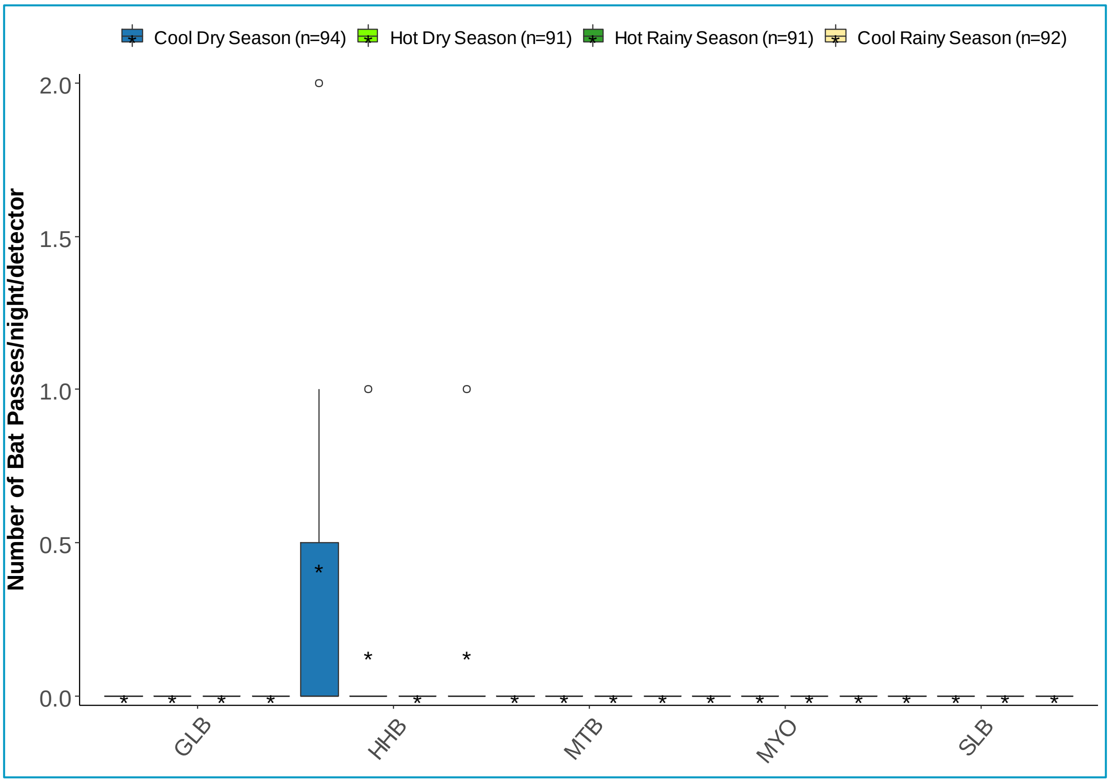
Identification	WT Collision Risk	Code	Total Passes	Median Passes/Night	Total Caught
Taphozous mauritianus Mauritian tomb bat	**High**	MTB	4	0	-
Hipposideros gigas Giant leaf-nosed bat	**Low**	GLB	6	0	-
Hipposideros vittatus Striped leaf-nosed bat	**Low**	SLB	34	0	-
Rhinolophus hildebrandtii Hildebrandt's horseshoe bat	**Low**	HHB	892	0	-
Neoromicia nanus	**High**	BB	4,761	0	-

Identification	WT Collision Risk	Code	Total Passes	Median Passes/Night	Total Caught
Banana Bat					
Mops midas Midas free-tailed bat	**High**	MFB	6,564	0	-
Mouse-eared bats *Myotis species*	**High**	MYO	14	0	-
Vespertilionidae 30 kHz - 35 khz Plain-faced bats	**Medium-High**	VES_30	65,355	13	-
Vespertilionidae 35 kHz - 43 khz Plain-faced bats	**Medium-High**	VES_40	30,375	5	-
Vespertilionidae 45 kHz -55 khz/*Miniopterus natalensis* Plain-faced bats and Long-fingered bats	**Medium-High**	VES_50/ NLB	17,166	2	-
Molossidae Free-tailed bats	**High**	MOL	105,825	43	-
Scotoecus hindei/albigula Dark-winged lesser house bat	**Medium-High**	DHB	-	-	2
Nycteris thebaica Egyptian slit-faced bat	**Low**	ESB	-	-	14
Epomophorus crypturus Peters's epauletted fruit bat	**High**	PFB	-	-	2
Epomophorus labiatus Little epauletted fruit bat	**High**	LFB	-	-	15
Mops condylurus Angolan free-tailed bat	**High**	AFB	-	-	20

Median activity of free-tailed bats was 42 passes per night per monitoring location (i.e. seven microphones), ranging from 0 to up to 1,026 passes per night across the study area (Graph 1). These bats were recorded on all but one sample night across the study area. The Midas free-tailed bats were only recorded on ca. 71 % of the sample nights with median activity of 0 passes per night, suggesting that there is interspecific variation in activity with the family. Similarly, median activity of VES_30 bats was higher than other plain-faced bats (Graph 1). Banana bats and Hildebrandt's horseshoe bats had low median activity and were recorded on ca. 73 % and 60 % of sample nights, with the total number of passes per night peaking at 688 and 68 respectively (Graph 2). The Striped leaf-nosed bat, Giant leaf-nosed bat, Mauritian tomb bat and Myotis species all had a median activity of 0, each having less than 35 passes over all the sample nights.



Graph 1: Box and Whisker Plot of Relative Occurrence of Selected Bat Species per season at the Unika 1 WPP (* = mean).



Graph 2: Box and Whisker Plot of Relative Occurrence of Selected Bat Species per season at the Unika 1 WPP (* = mean).

Spatio-Temporal Bat Activity Patterns

A total of 230, 994 bat passes were recorded from 368 sample nights across all detectors. An additional 673 passes were recorded during the drive transects. Bats were recorded on all sample nights across the study area but this varied according to height. For example, bats were only recorded on 51 % of nights sampled by the 100 m microphone at ZMet whereas at 10 m ("ground level") bats were recorded almost every night (Table 16). There was little difference in total, mean or median activity between the ground based detectors although ZM1 had a higher total, mean and median activity than ZM2 through ZM5 and ZMet_10m, situated in an agricultural field, had the lowest activity at 10 m (Graph 3).

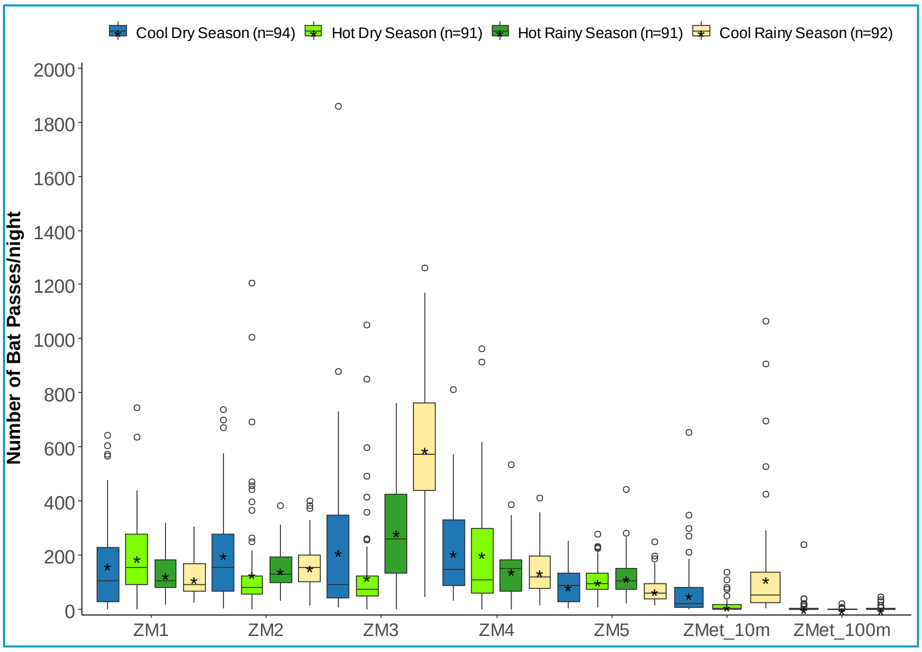
Bats were recorded along most of the drive transect routes but activity was concentrated in specific areas (Figure 2). Just under four times more bat activity was recorded during the transect undertaken in the cool dry season compared to the hot dry season. Activity was concentrated along the routes driven in the middle and southern portions of the study areas with less activity recorded on the northern transect (where turbines are proposed). Density was particularly high near the villages in the south and near the inselbergs in the middle of the site where, combined, approximately 40 % of the bat calls recorded during the drive transects were recorded.

Table 16: Acoustic Monitoring Summary

Detector	Altitude (masl)	# of Sample Nights	% of Sample Nights with Bat Activity	Median; Mean Bat Passes/night	Total Bat Passes
ZM1	699	311	99.4	118, 154.1	47,938
ZM2	781	261	99.6	122, 160.2	41,808
ZM3	805	215	99.1	124, 262.0	56,324
ZM4	854	222	99.5	126, 170.9	37,947
ZM5	714	310	100.0	86, 96.4	29,892
ZMet_10m	761	242	89.7	22, 66.8	16,173
ZMet_100m	851	242	51.2	0, 3.8	912

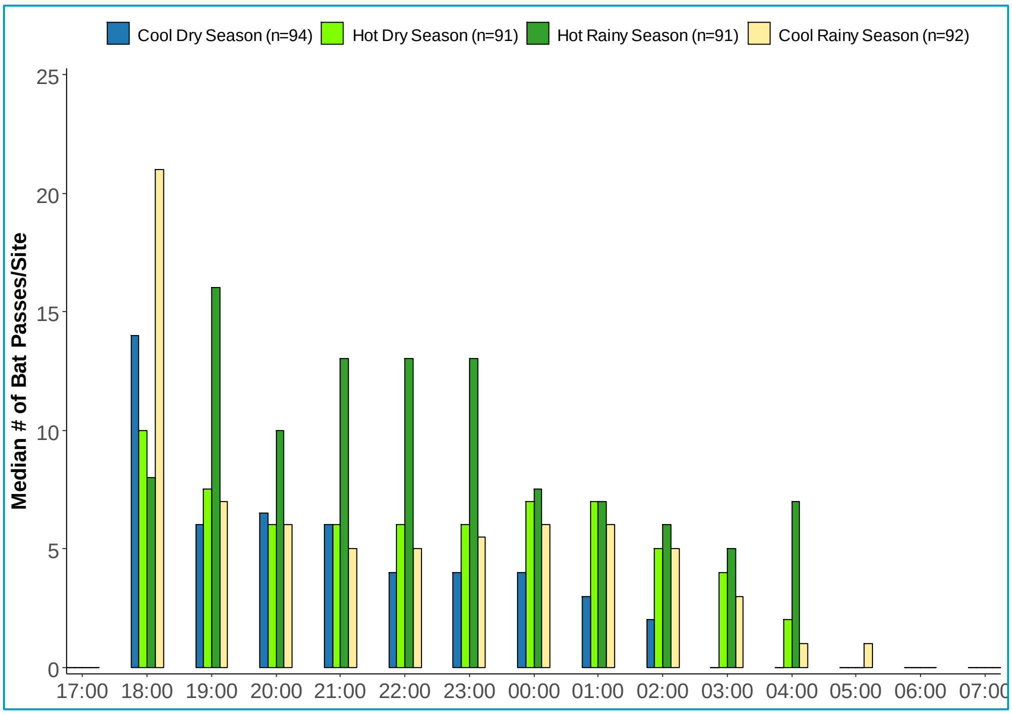
Approximately 25 % of total free-tailed bat activity was recorded at ZM4, where mean activity was 120.6 passes/night. Over 78 % of Midas free-tailed bats were recorded at ZM3, with a mean of 24.0 passes/night. Plain-faced bats were recorded most often at ZM3, which accounted for ca. 28 % of total activity respectively while Banana bats were recorded most frequently at ZMet_10m, accounting for ca. 68 % of total activity. Approximately 86 % of Hildebrandt's horseshoe bat activity was recorded at ZM1 and ZM2. The Giant leaf-nosed bat was only recorded once at ZM2 and ZM5 and twice at ZM1 and ZM4 while the Striped leaf-nosed bat was recorded at all ground based microphones. The Mauritian tomb bat was recorded at only two detectors (ZM1 and ZM4) while Myotis species were recorded at all ground based masts except ZM4 and ZMet_10m. Free-tailed bats, Midas free-tailed bats, Banana bats and all plain-faced bats were recorded at 100 m, although free-tailed bats accounted for 72 % of the activity.

The sampling period included 91 sample nights in the hot dry season and hot rainy season, 92 nights in the cool rainy season and 94 nights in the cool dry season. Median activity across the study area was highest in the hot rainy season (128 passes/night) followed by the cool rainy season (92 passes/night), the cool dry season (90 passes/night) and the hot dry season (81 passes/night). The Giant leaf-nosed bat, Striped leaf-nosed bat, Mauritian tomb bat and Myotis species were not recorded in the cool dry season while the free-tailed bats were recorded the most in the cool dry season. The VES_50/NLB, VES_40, VES_30 species complexes were all recorded notably more often in the cool rainy season compared to all other seasons (except for VES_40 in the hot dry season, where passes were only slightly lower) and had little difference in activity between the cool dry, hot dry and hot rainy seasons.



Graph 3: Box and Whisker plot showing the distribution of bat passes at each monitoring location (* = mean).

Bats were recorded by the detectors between 17:00 and 07:00 regardless of season. In the cool dry season there was a single peak in median activity between 18:00 and 19:00 where after activity declined towards dawn (Graph 4). In the hot dry season, activity also peaked between 18:00 and 19:00 and decreased until dawn with only a slight rise between 00:00 and 02:00. The cool rainy season had the highest peak activity of all seasons (from 18:00 to 19:00) with a median of 21 passes per hour per detector, after which activity decreased until dawn (with only a slight increase from 00:00 to 02:00). Activity in the hot rainy season peaked later than all other seasons (from 19:00 to 20:00) after which it declined, increased slightly and remained constant from 21:00 to 00:00 then declined towards dawn (with only a slight peak from 4:00 to 5:00).



Graph 4: The median number of bat passes/hour summed across all locations per season. Each time on the x-axis represents a one hour period (i.e. 17:00 = 17:00 – 18:00).

Discussion

The passive bat detectors recorded a high number of bat passes across the proposed wind power project indicating that the site provides suitable foraging and roosting opportunities for bats despite the somewhat degraded vegetation and altered landscape. The spatial patterns of activity suggest that all areas of the site are suitable, and indeed, utilised by bats. In addition, while bat activity peaked in the first few hours after sunset, activity still remained relatively high for most of the night. The high magnitude of bat passes recorded, and suitable habitat available on site, suggest that the project presents a potentially high risk to bats based on 368 nights of sampling.

Free-tailed bats dominated the activity at both ground level and at height, and two roosts in local villages have been confirmed of these species. While these bats are adapted for flying in open areas and as such are likely to encounter wind turbine blades, the majority of the activity of these species was recorded at ground level. Most activity of the remaining 10 species/species complexes recorded by the passive detectors was also at ground level. However, there are no data available for the site on bat activity between 10 m and 100 m and it is very likely that activity of some of the 11 species/species complexes will still be of such a magnitude within this range that risks will be high. For example, evidence from South Africa suggests that based on the ecology of the species being killed at operational wind farms, some are colliding with turbine blades in the lower reaches of the rotor swept zone (e.g. 30 m to 50 m depending on turbine size).

Of the 54 species whose geographic distribution overlaps with the site, three are near-threatened (NT) globally based on IUCN Red List data including two high risk species (African straw-coloured fruit bat and Large-eared giant mastiff bat), and one low risk species (Striped leaf-nosed bat).

Mist netting for bats was successful in confirming the presence of fruit bats through capture. Two Peters's epauletted fruit bat individuals, and 15 Little epauletted fruit bats were captured. Captures were distributed over a large area suggesting that fruits bats are widely distributed across the area. Evidence from South Africa has shown that fruit bats can be killed by wind turbines and they are generally considered to be at high risk from wind turbine collisions. While not captured in the study area, the African straw-coloured fruit bat has the potential to be present on site given its distribution in Zambia and there are records of this bat as close as 60 km from the site. This is well within the movement capabilities of this bat which is near-threatened with a decreasing population. These bats were not observed roosting on the site (although not all areas of the site were able to be surveyed because of limited road access), were not captured and overall, there is a low to medium likelihood that this species will be encountered on site. Furthermore, this species occurs in large numbers elsewhere in Zambia where seasonally, 5 – 10 million individuals aggregate between October and January at Kasanka National park, approximately 240 km North West of the proposed site. Thus, in the context of the distribution of this species in Zambia, the proposed site may represent a least impact scenario to this species (see Figure 36).

Calls from the Large-eared giant mastiff bat may be among the free-tailed bat calls recorded but it has not been possible to determine if any represent this particular species, and none were captured on site during the mist-netting.

Based on echolocation data, Striped leaf-nosed bats were recorded in low numbers at all of the six sampling locations. The Giant leaf-nosed bat was also recorded in low numbers. These two species are difficult to distinguish based on echolocation and morphology and genetic studies are needed to differentiate them. While they were separated acoustically in this study to be cautious, it is possible that the calls only represent the Striped leaf-nosed bat. There is taxonomic uncertainty regarding these two species but nonetheless, their presence on site is concerning because the Giant leaf-nosed bat is not often encountered in Zambia, and the Striped leaf-nosed bat is near threatened across its global range but its status in Zambia is unknown, and there are no active conservation measures for either of these species in Zambia, or elsewhere in Africa. The risk from wind turbine blade collision for these species is predicted to be low. Leaf-nosed bats typically have broad wings with an intermediate aspect ratio and are able to hunt insects in and around clutter by using short-range high-frequency echolocation and high manoeuvrability to catch insects in flight. Some species also hunt insects by making short flights from a perch. They therefore are typically clutter or clutter-edge foragers and their morphological adaptations limit their use of open spaces and high altitudes as foraging areas. Thus impacts may be avoided by the correct placement of wind turbines, which, if feasible should avoid areas 200 m from the edges of woodlands, forest, inselbergs, freshwater habitat (dambos and streams). In addition, ensuring turbine blades do not sweep close to ground level is a critical design parameter that can contribute to impact avoidance. These measures may reduce direct fatality impacts to these two Leaf-nosed bats (as well as other species) through collision but indirect impacts through habitat modification and disturbance are key considerations too.

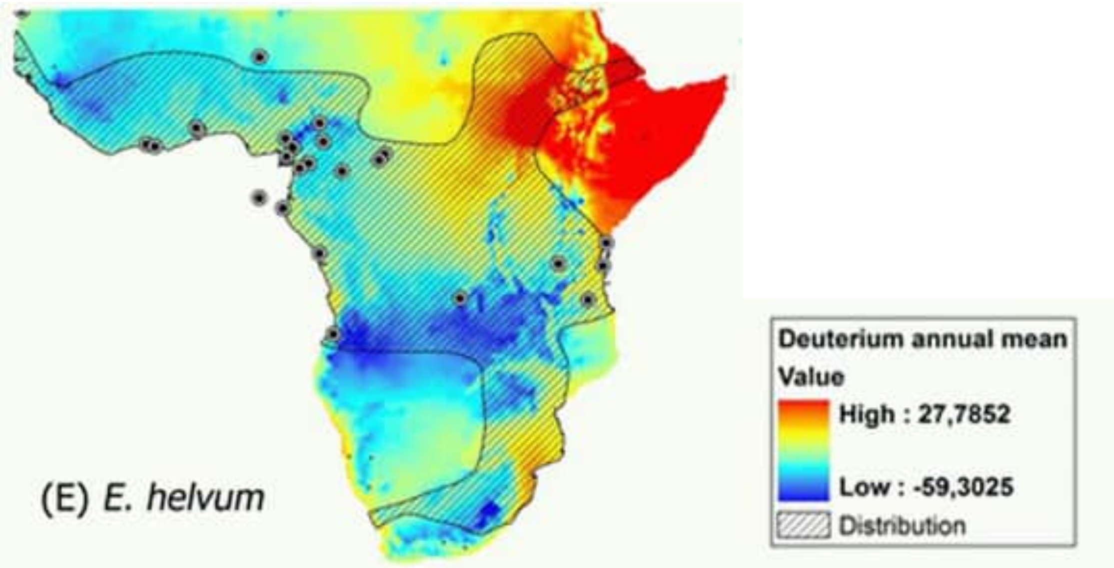


Figure 36: Movement ecology of Straw-Coloured Fruit Bat (Eidolon helvum)[10]

[10] Source: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0045729

6.10.3 Avifauna/Birds

The proposed site is in the Miombo Woodland vegetation type, either Drier or Wetter Miombo. On the steeper relief the vegetation seems more intact than in the flatter areas where much transformation has taken place for cropping. There is little open surface water on site, with only a few dams identified. A number of streams traverse the site. One larger river (the Mtetezi River) runs along the eastern boundary of the site. These streams and rivers will need to be buffered as they are home to sensitive riverine vegetation, avifauna and serve as flight paths for certain bird species.

Approximately 750 bird species have been recorded in Zambia. The Southern African Bird Atlas Project has no cards (Counts) submitted for pentads near the Project Site (Figure 37), the closest being in the Nyanje Hills and South Luangwa National Park areas. The avifaunal fieldwork recorded 248 species on site.

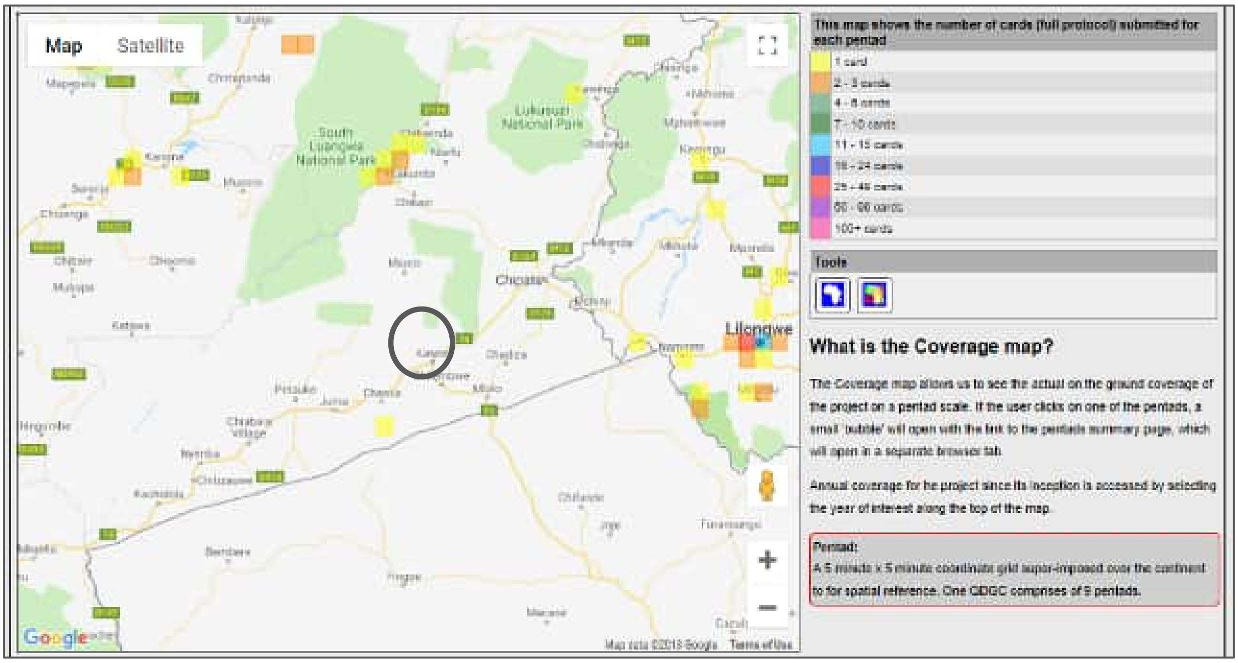


Figure 37: SABAP2 coverage of the Project Site

Zambia has 42 Important Bird Areas (IBA – BirdLife International) covering approximately 10 538 250 ha (or 14% of the country). The Project Site is not in any of these IBA's, the closest IBA being Nyanje Hills IBA, approximately 40 km south-west of the Project Site (Figure 38).

This IBA is approximately 5 000ha in size and consists of a high density of granite inselbergs. The site is important for the localized and specialized Boulder Chat, Black Stork, Augur Buzzard, Black Eagle, Lanner Falcon, Peregrine Falcon, Freckled Rock Nightjar, African Black Swift, African Rock Martin, Striped Pipit, Familiar Chat, Mocking Chat, Rock loving Cisticola, White-necked Raven, Red-winged Starling and Cinnamon-breasted Rock Bunting. These birds occur here in spite of heavy transformation of vegetation around the inselbergs. None of the above listed species are either regionally or globally threatened (Dowsett et al, 2008; IUCN 2018).

South Luangwa National Park IBA is located approximately 60 km north-east of the Project Site (Figure 38). The bird data from this site is probably less relevant to Project Site than that of Nyanje hills IBA, since Luangwa is a large protected area with the significant Luangwa River.

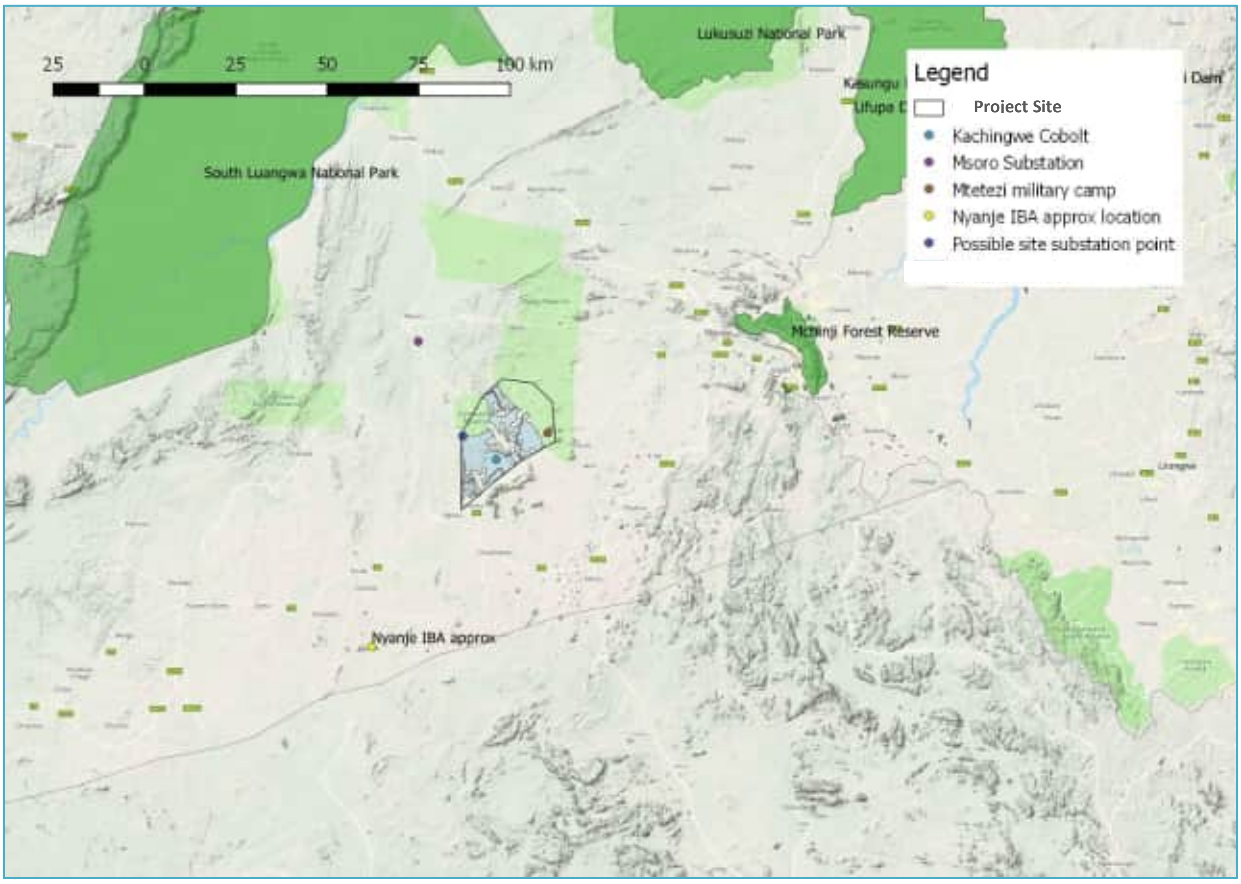


Figure 38: The Project Site relative to known avifaunal features in the landscape.

Habitat description

The site is comprised predominantly of Miombo Woodland. In describing bird usage of an area, a description of the micro habitats available to birds is typically more useful than a vegetation description as it takes account of land use and anthropogenic factors in addition to vegetation. The following bird micro habitats on and near site were identified: woodland; hills; arable lands; streams, rivers; dams; and human settlement (Figure 39). The more natural of these micro habitats such as streams, rivers and woodland are more sensitive from an avifaunal perspective.

Small passerine bird species abundance & diversity

Walked transects on site made a total of 887 records of 2 022 individual birds across 123 different species. Species diversity peaked in autumn with 97 species, followed by spring (61), winter (54) and summer (44). Over the full year and across all species an abundance of 56.22 birds per kilometre was recorded. None of the 123 passerine species are Red Listed either in Zambia or Globally (IUCN, 2021). The five most abundant species across the whole year were: Black-winged Red Bishop *Euplectes hordeaceus*; Yellow-fronted Canary *Crithagra mozambicus*; Bronze Mannikin *Spermestes cucullatus*; Blue Waxbill *Uraeginthus angolensis*; and Dark-capped Bulbul *Pycnonotus tricolor.* Interestingly, four of the five most abundant species were seed-eaters. These were recorded in the open areas around drainage lines and wetlands where sufficient tall grass exists, and crops are nearby. Dark-capped/Black-eyed Bulbul is the only non seed-eater amongst the top five, but is amongst the top 20 most widespread (common) species in Zambia.

European Bee-eater *Merops apiaster* was the sixth most abundant species but was recorded only in spring and autumn. These were mostly small flocks of birds in migration over the site.

Figure 39: Examples of micro habitats on site

Large terrestrial birds & raptor abundance & diversity

Our driven transects on site recorded a total of nine records of nine individual birds across six raptor species. Species diversity was highest in spring (four species) followed by autumn (3), summer (2) and winter (0). Despite the driven transect survey method being designed for both large terrestrial species and raptors, all six species were raptors.

The most abundant species were: Brown Snake-Eagle *Circaetus cinereus*; Augur Buzzard *Buteo augur* and Lanner Falcon *Falco biarmicus*. Over the full year and across all six species an abundance of 0.03 birds/km was recorded. None of the six raptor species recorded during driven transects are Red Listed either in Zambia or Globally (IUCN, 2019) (although the globally endangered Martial Eagle was recorded during vantage point surveys – see below). The tall woodland and poor road conditions make visibility and detectability of birds whilst driving challenging and the number of raptors detected from driven transects underestimates actual bird diversity and abundance.

Focal site surveys

The focal site surveys recorded far fewer water birds than expected. Focal Site 1 was the Katete Dam just south of site, and Focal Site 2 was Mtetetzi Dam on the Mtetezi River in the north. It was expected that these dams will concentrate water-fowl such as ducks, geese and others, particularly since these open water habitats are scarce in this landscape. Very few water fowl species were recorded during the course of the year. The most notable records were flocks of White-faced Whistling Duck *Dendrocygna viduata* recorded in winter and autumn. Significant human fishing pressure on the dams in the form of nets was noted, and this may contribute to the low abundance of water-fowl.

A third focal site, the hill south of the site (off site) was surveyed using a vehicle transect. The area was surveyed for any sensitive habitats such as cliffs and roosts. Six raptor species were recorded in this area: African Goshawk *Accipiter tachiro*; African Harrier-Hawk *Polyboroides typus*; Augur Buzzard; Brown Snake-Eagle; European Honey Buzzard; and Steppe Buzzard. No sensitive features were present on this hill, and it does not present any particularly different habitat for avifauna from that on the site itself.

Incidental observations

During the year a total of 83 records of 797 individual priority birds were made incidentally. This comprised of 32 species. Species richness was highest in autumn (16 species) followed by spring (10), winter (9) and summer (7)[11]. The top five most abundant species recorded by incidental observations through the year were: Barn Swallow *Hirundo rustica*; European Bee-eater; Southern Carmine Bee-eater *Merops nubicoides*; House Martin *Delichon urbicum*; and African Palm Swift *Cypsiurus parvus*. The high abundance of these species is entirely due to a few records of large flocks of the birds in autumn, presumed to be during migration events.

Combining all data collection methods and incidental records, a total of 248 bird species were recorded on site. Species diversity peaked in autumn (178 species) followed by spring (148), winter (121) and summer (95).

Large bird species flight activity

A total of 240 hours of vantage point observation were conducted on site across the four seasons. During this time, a total of 269 records were made of 335 individual birds representing 28 species. All but two of these species (Black Stork *Ciconia nigra* & White Stork *Ciconia ciconia*) are raptors. No other large terrestrial, water fowl or other large priority bird species were recorded flying on site. Twenty-six species were therefore raptors, which is considered a high diversity of raptor species. Species diversity was highest in autumn (21 species), followed by winter (14), spring (10), and summer (9). Collectively, the 28 species combined flew at a passage rate of 1.40 birds/hour of observation (within the 2km radii of vantage points).

Species flight activity

The most frequently recorded species flying on site through the full year was Common Buzzard (0.296 birds/hr), followed by Augur Buzzard (0.241 birds/hr); Brown Snake-Eagle (0.188 birds/hr), Black-chested Snake-Eagle (0.121 birds/hr); and Wahlberg's Eagle *Hieraaetus wahlbergi* (0.088 birds/hr) (Table 17). The top three most recorded species (Common Buzzard, Augur Buzzard & Brown Snake-Eagle) account for over 50% of all flight activity.

One of the recorded species is Globally Red Listed by the IUCN (2021): Martial Eagle (Endangered) which was recorded flying twice over the ridge on the southwestern edge of the windfarm layout (west of T46, 56 and 58).

[11] Since this data are not the product of formal data collection they need to be used cautiously

Table 17: Summary priority bird flight data recorded during vantage point surveys.

Common name	Taxonomic name	Birds	Records	Birds/hr
Common Buzzard	*Buteo buteo*	71	49	0.2958
Augur Buzzard	*Buteo augur*	58	44	0.2417
Brown Snake-Eagle	*Circaetus cinereus*	45	37	0.1875
Black-chested Snake-Eagle	*Circaetus pectoralis*	29	26	0.1208
Wahlberg's Eagle	*Hieraaetus wahlbergi*	21	17	0.0875
African Harrier-Hawk	*Polyboroides typus*	20	19	0.0833
Lanner Falcon	*Falco biarmicus*	14	10	0.0583
European Honey-Buzzard	*Pernis apivorus*	13	10	0.0542
Lizard Buzzard	*Kaupifalco monogrammicus*	12	12	0.0500
African Hawk-Eagle	*Aquila spilogaster*	12	6	0.0500
African Goshawk	*Accipiter tachiro*	6	6	0.0250
Gabar Goshawk	*Micronisus gabar*	5	5	0.0208
Dickinson's Kestrel	*Falco dickinsoni*	4	4	0.0167
Black Stork	*Ciconia nigra*	3	2	0.0125
Western Banded Snake-eagle	*Circaetus cinerascens*	3	3	0.0125
Shikra	*Accipiter badius*	3	3	0.0125
Black-shouldered Kite	*Elanus caeruleus*	2	2	0.0083
Red-necked Falcon	*Falco chicquera*	2	2	0.0083
White Stork	*Ciconia ciconia*	2	2	0.0083
Martial Eagle (EN)	*Polemaetus bellicosus*	2	2	0.0083
African Cuckoo Hawk	*Aviceda cuculoides*	1	1	0.0042
Black Sparrowhawk	*Accipiter melanoleucus*	1	1	0.0042
Eurasian Hobby	*Falco subbuteo*	1	1	0.0042
Long-crested Eagle	*Lophaetus occipitalis*	1	1	0.0042
Ayres's Hawk-Eagle	*Hieraaetus ayresii*	1	1	0.0042
Booted Eagle	*Hieraaetus pennatus*	1	1	0.0042
Lesser Spotted Eagle	*Clanga pomarina*	1	1	0.0042
Ovambo Sparrowhawk	*Accipiter ovampensis*	1	1	0.0042

Species flight height

Table 18 presents the recorded flight height data summary for the 28 species. Since the final turbine model is not yet available, we used the stated specifications in the project description of a hub height range from 120 to 150m above ground and the rotor diameter to range from 136 to 158m. This gives a lowest and highest blade tip of 41m and 229m respectively. Almost all species flew on average within the rotor swept area as stated above. The only exceptions were Dickinsons Kestrel *Falco dickinsoni* (mean height of 11m), Black-shouldered Kite *Elanus caeruleus* (35m), Red-necked Falcon *Falco chicquera* (15m) and Booted Eagle *Hieraaetus pennatus* (473m – above rotor). All of these species have relatively small sample size (i.e. they were recorded flying fairly seldom). In the case of Booted Eagle the data is skewed by one very high flight.

Table 18: Large bird species flight height data summary

Common name	Taxonomic name	Mean flight height (m)
Common Buzzard	*Buteo buteo*	82.12
Augur Buzzard	*Buteo augur*	89.90
Brown Snake-Eagle	*Circaetus cinereus*	100.23
Black-chested Snake-Eagle	*Circaetus pectoralis*	110.29
Wahlberg's Eagle	*Hieraaetus wahlbergi*	99.89
African Harrier-Hawk	*Polyboroides typus*	80.11
Lanner Falcon	*Falco biarmicus*	125.29
European Honey-Buzzard	*Pernis apivorus*	144.38
Lizard Buzzard	*Kaupifalco monogrammicus*	99.46
African Hawk-Eagle	*Aquila spilogaster*	83.58
African Goshawk	*Accipiter tachiro*	50.00
Gabar Goshawk	*Micronisus gabar*	103.57
Dickinson's Kestrel	*Falco dickinsoni*	11.40
Black Stork	*Ciconia nigra*	62.50
Western Banded Snake-eagle	*Circaetus cinerascens*	153.44
Shikra	*Accipiter badius*	40.00
Black-shouldered Kite	*Elanus caeruleus*	35.00
Red-necked Falcon	*Falco chicquera*	15.00
White Stork	*Ciconia ciconia*	50.00
Martial Eagle	*Polemaetus bellicosus*	150.00
African Cuckoo Hawk	*Aviceda cuculoides*	100.00
Black Sparrowhawk	*Accipiter melanoleucus*	54.00
Eurasian Hobby	*Falco subbuteo*	55.00
Long-crested Eagle	*Lophaetus occipitalis*	30.00
Ayres's Hawk-Eagle	*Hieraaetus ayresii*	100.00
Booted Eagle	*Hieraaetus pennatus*	473.33
Lesser Spotted Eagle	*Clanga pomarina*	150.00

Common name	Taxonomic name	Mean flight height (m)
Ovambo Sparrowhawk	*Accipiter ovampensis*	40.00

Spatial location of flight activity

The spatial location of all recorded flight paths was plotted and is presented in Figure 40 and Figure 41. There is little that can be concluded in terms of flight paths on site, although it is evident that the raptors in particularly chose to soar in close association with the hills and steeper topography. This is one of the reasons that inselbergs have been classified as sensitive.

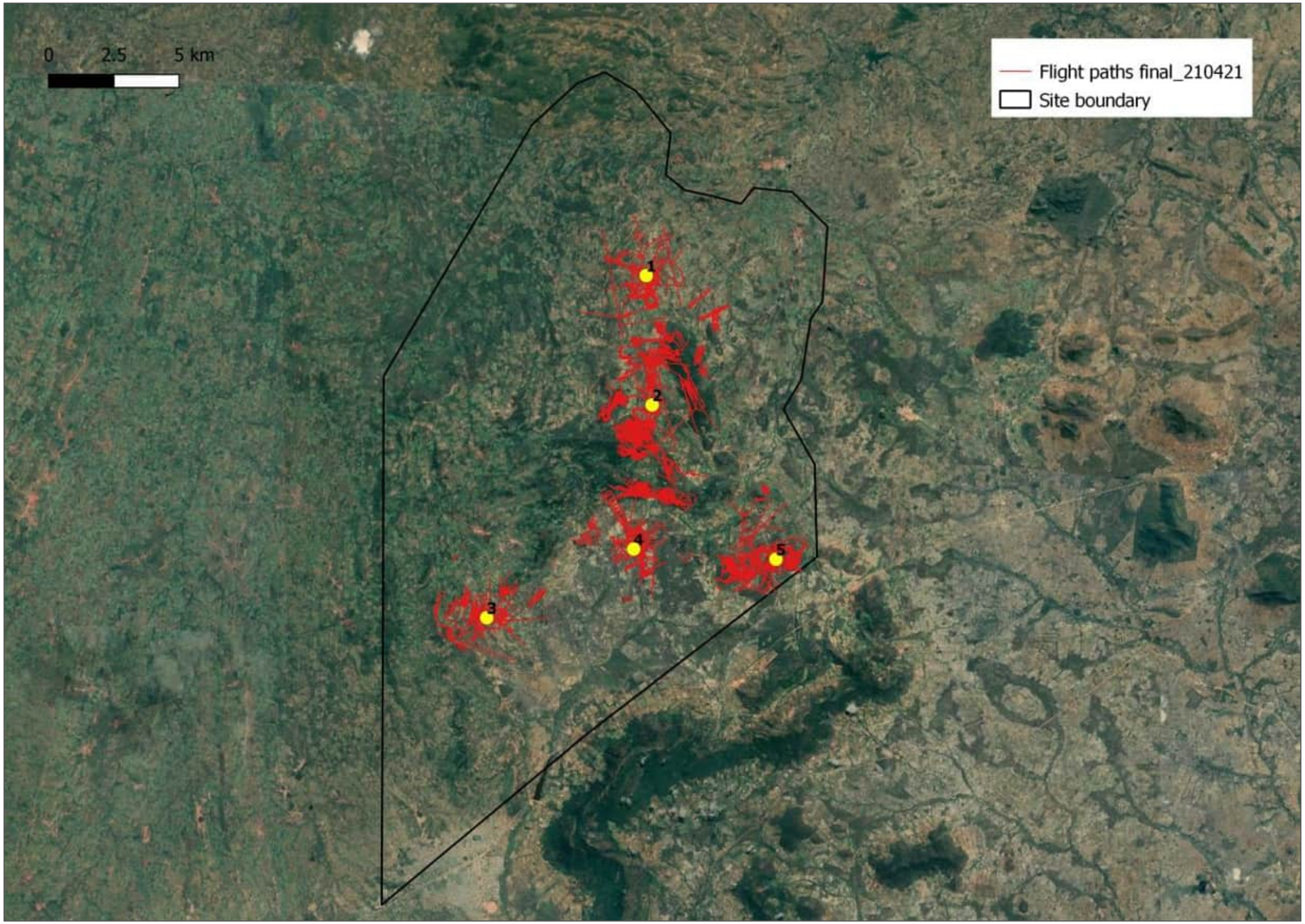


Figure 40: All priority species' flight paths – full site

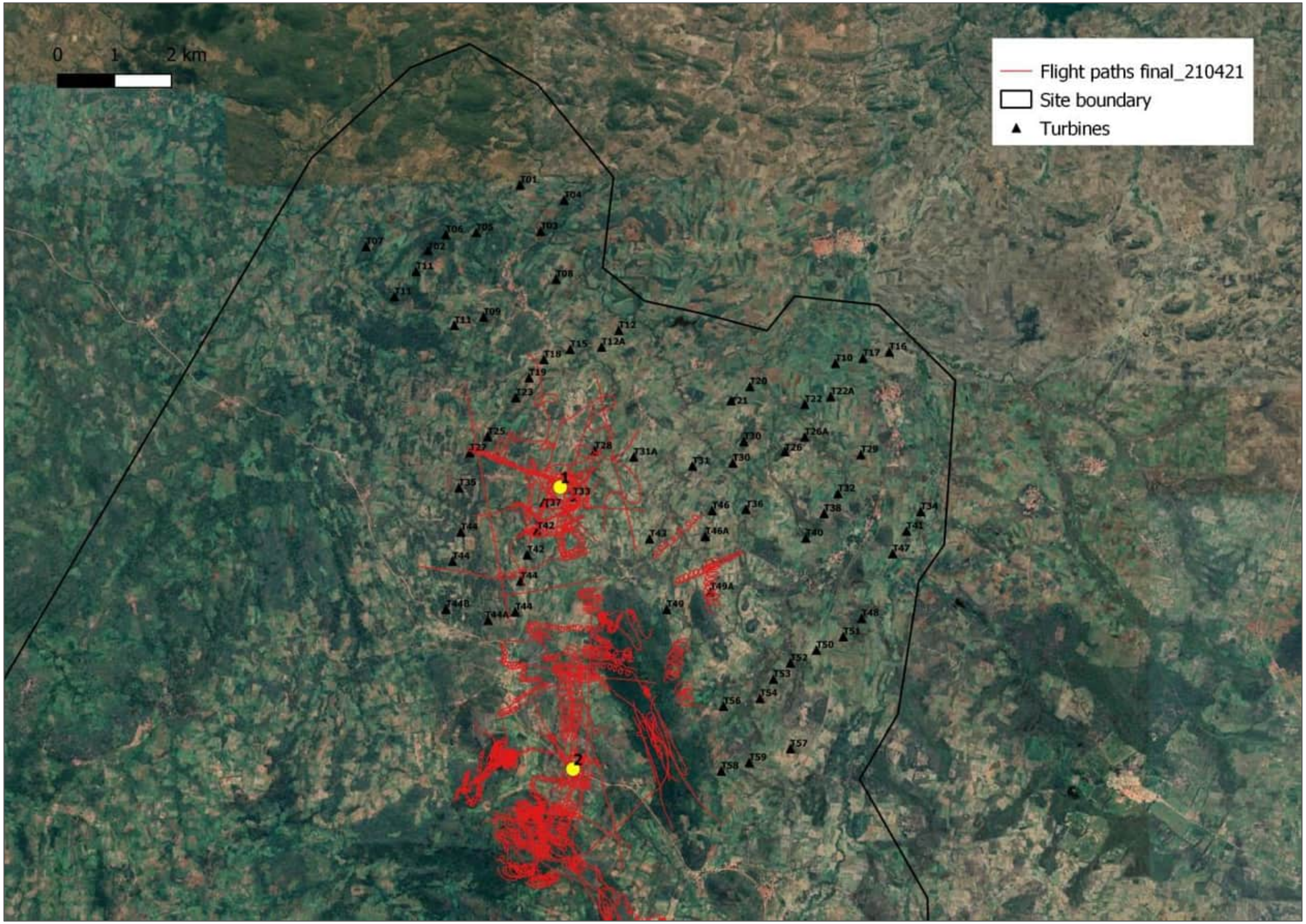


Figure 41: All priority species' flight paths – proposed layout

Bird migration

Birds in migration do not always select the habitat beneath them, which means that even though the Project Site comprises somewhat degraded habitat, significant numbers of birds could fly over the site in spring and autumn. Migratory bird species are often of particular interest with respect to wind farms as migration can concentrate large numbers of birds in both space and time, thereby presenting a high risk of turbine collision. Each individual country also has a responsibility to protect migratory species as impacts on the species within its' boundaries have international consequences. Zambia serves as a passage corridor for many migrants, and a resident area for some of those migrants. In other words, when a migrant bird species is recorded in Zambia at certain times of year, it may be either during its migration southwards or northwards or during its' residence during the summer months. Many Palaearctic species pass through Zambia in much higher numbers than those that over-winter in Zambia. This passage is sometimes concentrated, so that it is not uncommon to see hundreds of (for example) Steppe Buzzard, Lesser Spotted *Aquila pomarina* or Steppe Eagle *Aquila nipalensis* in a day.

The spring and autumn site visits of this monitoring programme specifically aimed to establish if peaks in temporary higher abundance on site occur. The mean data (derived from multiple years) was consulted on migrant bird species arrival and departure dates in Dowsett *et al* (2008) for approximately 33 species of Palaearctic migrants (Table 19). Arrival dates for Palaearctic migrants in Zambia range from 27 August to 15 December. However, the priority species amongst these are the raptors due to their proven susceptibility to wind turbine collision, and their ecological importance. For these species, (shown in bold in Table 19) arrival dates range between 5 October and 13 November with most being between 22 October and 31 November. The spring site visit was therefore conducted between 20 & 30 October 2019 in order to achieve the best possible returns in terms of being on site at the right time to stand a chance of recording migrating birds. The intra-African migrant data from Dowsett *et al* (2008) was also consulted, although these species are less important for the purposes of this assessment. These species show a more dispersed set of dates and were more difficult to focus survey efforts on. The autumn migration 'last dates' range from 7 March to 6 April (Table 19), with many species' last dates falling between about 18 and 31 March. The best time for the autumn survey site visit was therefore estimated to be 23 March to 2 April 2020.

Table 19: Summary of arrival & departure dates for palearctic migrants

Species	Mean first arrival	SD	Mean last date	SD
Caspian Plover	27-Aug	10.7		
Eurasian Bee-eater	04-Sep	9.1	21-Apr	7.1
Ringed Plover	19-Sep	12.3		
Green Sandpiper	19-Sep	18.1	28-Mar	11.6
Turnstone	21-Sep	14.7		
Willow Warbler	24-Sep	6.9	27-Apr	11.6
Eurasian House Martin	27-Sep	10.5	29-Apr	12.9
Eurasian Sand Martin	28-Sep	14.6	05-May	14.5
Eurasian Swift	01-Oct	13.6	25-Mar	20.0
Common Buzzard	**05-Oct**	**10.7**	**06-Apr**	**18.6**
Spotted Flycatcher	05-Oct	10.0	18-Apr	10.5

Species	Mean first arrival	SD	Mean last date	SD
Yellow Wagtail	07-Oct	9.4	29-Apr	15.2
Garden Warbler	07-Oct	9.6	03-Apr	12.8
Eurasian Hobby	**15-Oct**	**13.8**	**30-Mar**	**10.4**
Lesser Grey Shrike	20-Oct	5.4	16-Apr	5.5
Honey Buzzard	**22-Oct**	**11.8**	**01-Apr**	**20.4**
Eurasian Golden Oriole	22-Oct	17.9	24-Mar	18.0
Red-backed Shrike	24-Oct	8.3	22-Apr	7.6
Lesser Kestrel	**26-Oct**	**9.0**	**31-Mar**	**14.8**
Lesser Spotted Eagle	**27-Oct**	**17.3**	**18-Mar**	**18.1**
Steppe Eagle	**27-Oct**	**15.3**	**27-Mar**	**16.7**
Pallid Harrier	**29-Oct**	**15.2**	**07-Mar**	**15.7**
Tree Pipit	01-Nov	12.9	24-Mar	12.5
Montagu's Harrier	**02-Nov**	**16.0**	**10-Mar**	**21.8**
Blue-cheeked Bee-eater	04-Nov	12.1	18-Mar	12.0
Sedge Warbler	07-Nov	13.8	26-Apr	8.1
Eurasian Roller	09-Nov	10.9	07-Apr	14.8
Eastern Red-footed Falcon	**13-Nov**	**13.6**	**24-Mar**	**13.8**
Common Whitethroat	14-Nov	12.8	08-Apr	10.1
Whinchat	16-Nov	15.4	27-Feb	22.1
Great Reed Warbler	20-Nov	10.3	04-Apr	8.8
Marsh Warbler	14-Dec	13.8	08-Apr	11.5
Thrush Nightingale	15-Dec	10.6	13-Mar	11.8

The findings from the spring site visit with respect to bird migration at the site were as follows:

- Many migrant small passerine species were recorded on site, such as flycatchers, warblers, swifts, and bee-eaters amongst others. Most of these species did not show any form of congregation, nor were they in higher than normal abundance. They were not recorded flying in any direct or migratory manner.
- One clear exception was the European Bee-Eater *Merops apiaster*, which was recorded several times a day flying over site in a migratory manner in groups of 10-30 birds. These birds typically flew approximately 80-100 metres above ground in a north-south direction.
- The flight activity was higher in general for raptors. Much of this flight activity was that of Steppe or Common Buzzard.
    - Steppe Buzzard appeared to be on site in higher than normal numbers and in small congregations (<5 birds). Although these birds were not seen in any direct flight movement, they may have been on a short stopover to feed and rest. Considerate is likely that at least some of these birds were on a brief stopover whilst migrating southwards.

However, the survey did not record any more heightened migration events for the species such as those cited by Dowsett *et al* (2008) of several hundred buzzards in a day. A passage rate of approximately 0.92birds/hour (55 birds in 60 hours of vantage point observation) during spring was recorded.

  - A second palearctic migrant raptor recorded was European Honey Buzzard. Single birds were recorded flying four times (passage rate of 0.067 birds/hour).

- One intra-African migrant, Wahlberg's Eagle was recorded flying on site, but the site visit was too late to capture migration behavior (mean arrival in Zambia cited as 11 August by Dowsett *et al,* 2008). This species was recorded flying 8 times (8 individual birds) for a passage rate of 0.13birds/hour).
- One key migratory raptor which was not recorded on site was the Amur Falcon *Falco amurensis*. Dowsett *et al* cites 13 Nov as its mean first arrival, so they survey may have been a few days early or alternatively the species may typically pass through the area further east or west.

The findings from the autumn site visit with respect to bird migration at the site were as follows:

- Once again many migrant small passerine species were recorded on site but did not show any form of congregation, nor were they in higher than normal abundance.
- European Bee-eater was again recorded migrating in high numbers, in groups of between 20 and 70 birds. While Southern Carmine Bee-eater was recorded in groups ranging from 6 to 40 birds. Barn Swallow, House Martin, Brown-throated Martin and African Palm Swift were also recorded in large groups indicating migration. One group of 12 Pale-billed Hornbill was also recorded.
- No increased frequency or abundance of raptor flights was recorded.

It was concluded that one raptor species (Common or Steppe Buzzard) and at least six passerines (European Bee-eater, Southern Carmine Bee-eater, Barn Swallow, House Martin, Brown-throated Martin, African Palm Swift) showed signs of migrating over the Project Site. In the case of Steppe Buzzard this presents increased turbine collision risk as compared to the remainder of the year, but not to the extent typically associated with migration events. For the small passerines migration definitely exposes this group at risk of collision with turbines. During non-migration these species would not be at significant risk of turbine collision.

Description of priority bird species for impact assessment

Taking the above data into account we have identified the below listed species as being of top priority for this impact assessment, based on being recorded flying on site in excess of twenty times each during the year. Most of these species are not Red Listed but flew frequently on site. The only Globally Red Listed species recorded on site, Martial Eagle, was only recorded twice in 240 hours of vantage point surveys across four seasons but is included as a precaution.

It is notable that vultures, large terrestrial bird species and waterfowl are almost entirely absent from the survey data collected on the Project Site. There is very little open water on site which explains the lack of waterfowl on site. However, given the scarcity of dams and lakes in the project area it is surprising that waterfowl were not concentrated at the few water sources that do occur, which may reflect a relative lack of these species in the broader landscape.

It was also expected to possibly find various stork species on site, as well as Secretarybird and Southern Ground Hornbill *Bucorvus leadbeteri*. None of these species were recorded. This does not mean that they will never use the site but does indicate they are not prevalent on site and they may visit the site only occasionally.

Steppe (Common) Buzzard

Steppe Buzzard is a Palaearctic-breeding migrant species which spends the summer months in sub-Saharan Africa (non-breeding range for the species). It is typically one of the most abundant raptor species throughout its' range. It prefers to forage over open habitats including grassland, savannah open woodland, and agricultural lands (Hockey *et al*, 2005). Although it mainly hunts from a perch it does also spend extensive time in flight. In Zambia most birds are passing through rather than resident (mid-

October-November & first half of March) (Dowsett *et al,* 2008). Peak passage rates cited by Dowsett *et al* are of 500 birds per hour at Mbala in spring and up to 800 birds per hour at some places in autumn. We recorded the species frequently on site throughout the year, and in slightly higher frequency during spring as discussed in Section 4.2.7. However, we did not record abundance anywhere near that cited by Dowsett above. We believe that the collision risk is not unacceptably high. This species holds no particular conservation concern, being classified as Least Concern Globally and not listed in Zambia.

Augur Buzzard

Augur Buzzard is fairly common locally but with a discontinuous distribution through Africa. It is a resident species typically found in hilly country with rocky outcrops. It spends most of the day perched as it hunts mostly from the perch. We recorded the species on site during winter, spring and autumn in fairly high frequency and believe it will be at risk of collision with turbines. This species holds no particular conservation concern, being classified as Least Concern Globally and not listed in Zambia.

Brown Snake-Eagle

Brown Snake-Eagle is distributed widely in sub-Saharan Africa, mainly in mesic woodland areas. It is locally common where it occurs. It is sometimes resident but can also be nomadic in response to environmental conditions. It overlaps in range with Black-chested Snake-Eagle but prefers to use more wooded habitat. It is mostly solitary and hunts from the perch more than while soaring (Hockey *et al,* 2005). This species was recorded in all seasons on the Project Site. We believe this species will be at moderate risk of turbine collision. This species holds no particular conservation concern, being classified as Least Concern Globally and not listed in Zambia.

Black-chested (breasted) Snake-Eagle

Black-chested Snake-Eagle is distributed through much of Africa and is uncommon to common where it occurs . It is primarily a nomadic species which uses a range of habitats from desert to open grassland and closed deciduous woodland. In Zambia it is most abundant in the dry season (March to October). It generally occurs singly but can also gather into aggregations of up to 50 birds. Most hunting is done hovering or soaring which places it at risk of collision with turbines. We recorded the species flying on site in all four seasons and we believe the risk of turbine collision for this species will be moderate. This species holds no particular conservation concern, being classified as Least Concern Globally and not listed in Zambia.

Wahlberg's Eagle

Wahlberg's Eagle is a common intra-African migrant raptor. It is distributed through much of Africa excluding the extremes of rain forests and arid areas. It favours well wooded areas and spends much time soaring over its territory. We recorded the species flying in summer, spring and autumn on the Project Site and believe the species to be at medium risk of turbine collision. This species holds no particular conservation concern, being classified as Least Concern Globally and not listed in Zambia.

African Harrier-Hawk

African Harrier-Hawk (or Gymnogene) is distributed throughout sub-Saharan Africa. It is typically resident and sedentary in woodland areas. It is distributed throughout Zambia and fairly common throughout. It displays a wide variety of foraging methods including from the perch, walking on ground and clambering around in foliage, high and low soaring. This species was recorded in all seasons and we believe it will be moderate risk of turbine collision. This species holds no particular conservation concern, being classified as Least Concern Globally and not listed in Zambia.

Martial Eagle

Martial Eagle is a large eagle that is distributed through much of Africa excluding west Africa and is widespread almost throughout Zambia. It is uncommon across its' distribution range, with the greatest abundance in large formally protected areas. It is mostly resident in any given area when adult. It prefers open woodland, drainage lines, savannah and forest edges. This species spends most of the day on the wing hunting, soaring and occasionally hovering. This species was recorded only twice on site in autumn. This species is expected to be at low risk of turbine collision, however the consequence of any fatalities will be high. Although this species is not Red Listed in Zambia it is Globally listed as Endangered and deserves as much protection as possible.

Applicability of IFC Performance Standards

Performance Standard 6 (PS6) - Biodiversity Conservation & Sustainable Management of Living Natural Resources is relevant to this avifaunal impact assessment. One species which is currently Globally Red Listed (IUCN 2021) was recorded on site, the Martial Eagle (Endangered – two records of single birds in flight). The Project Site does not qualify as critical habitat for Martial Eagle for the following reasons:

- It is widely distributed with a distribution range across Africa of 26 million km^2 and with large territory sizes (estimated at 175 km^2 in Kenya)
- This species was recorded at very low frequency with only two flight records during approximately 40 days on site.
- No records of these species perching, roosting or breeding (or any behaviour suggestive of breeding) were made. If Martial Eagle was resident or breeding on the Project Site, they would have been more frequently observed during vantage point surveys;
- The majority of the natural vegetation and fauna on site is already highly impacted by human activities and cannot be considered to be in natural condition or optimal foraging habitat for Martial Eagle;
- The woodland habitat which is dominant on site is not limited or unique in the immediate area or even in Zambia as a whole, in fact making up 80% of Zambian woodland according to Dowsett *et al* (2008). As stated in Dowsett *et al* (2008) habitat destruction has generally not been a threat to most bird species in Zambia to date, perhaps since sufficient habitat is protected in the national park network; and
- The Project site does not fall inside any form of protected area or Important Bird Area with the nearest formally protected area being the South Luangwa National Park, 60 km away where Martial Eagles are more regularly seen

6.10.4 Flora

The following terrestrial habitat units were identified within the Project Site:

- **Degraded Forest Habitat,** comprising several forest tree species, where trees exceeded 8 m in height with large predominantly interlinking canopies. This habitat unit was observed primarily in the upper reaches of the large inselbergs and central mountainous areas of the Project Site This habitat however is continually being impacted upon and decreasing due to the harvesting of timber for charcoal production, leading to the encroachment of miombo woodland species;

- **Degraded Miombo Woodland Habitat**, the dominant vegetation type within the Project Site and that of southern Zambia. The characteristics of this habitat unit were varied, with some of the more degraded areas being noted to have fewer characteristic/typical miombo floral species. The woodlands typically comprised trees varying between 4 – 8 m in height but without densely interlocking canopies;

- **Freshwater Habitat**, comprising streams and dambos (wetlands). This habitat unit has been notably impacted upon as a result of vegetation clearance for agriculture (grazing and crop cultivation). The dambos and streams convey large amounts of water through the Project Site, however the large-scale removal of vegetation has resulted in increased peak water flows leading to erosion within the dambos and that of the stream banks; and

- **Transformed habitat**, associated with cultivated fields and areas where vegetation has been cleared in order to provide increased grazing for livestock, both in association with the areas surrounding the villages and at some distance from villages where new fields are being cleared.

Figure 42 provides the extent and locations of these terrestrial habitat units.

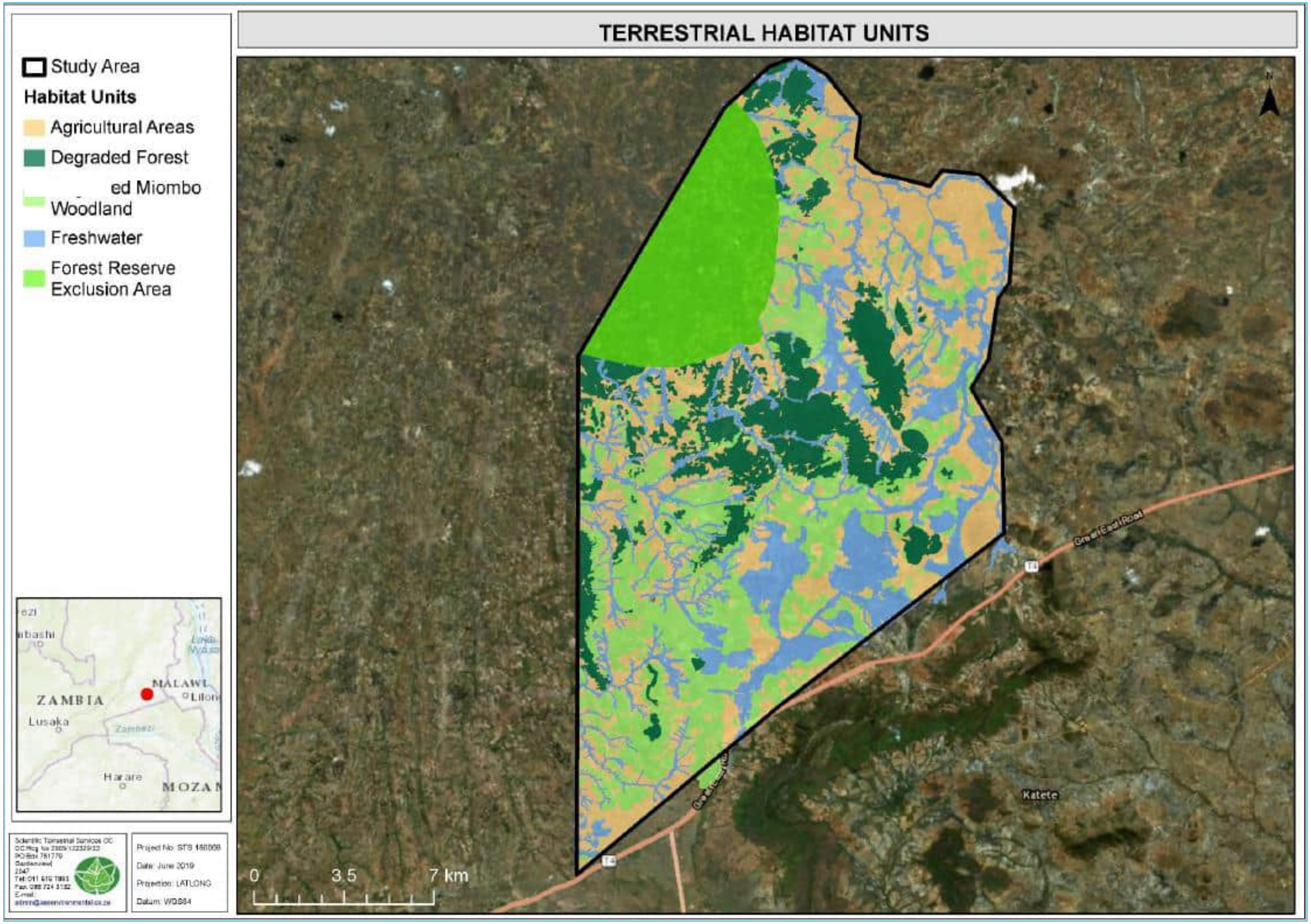


Figure 42: Conceptual illustration of the habitat units within the study area

Degraded Forest

The Degraded Forest habitat has, over the years, been subjected to continuous wide scale impacts. The habitat degradation comes largely from collection of firewood, wood used for structures and the charcoal trade in rural areas in order to generate an income. This has led to the extensive felling and removal of older large trees at a rapid rate. Due to the demand of wood many of the younger intermediate sized trees are also being harvested, with the net result being that the forest environment is unable to recover. This continuous deforestation has led to an encroachment of miombo woodland species along the outer borders of this habitat unit, as well as the overall retraction of the forested areas. In addition to the deforestation, slash and burn activities were regularly observed in order to clear forested lands for crop production. These anthropogenic activities have led to the forest habitat becoming isolated and fragmented, occurring only in areas where the terrain is not suitable for agriculture, or where areas bear cultural significance. This has led to the overall loss of habitat integrity, driving species diversity loss and the degradation of the overall forest habitat.

Floral species observed in this habitat unit include, but are not limited to *Julbernardia globiflora, Brachystegia bussei, Adenia senensis, Lannea discolour, Cassia singueana, Diospyros kirkii, Pericopsis angolensis, Pterocarpus angolensis, Pterocarpus chrysothrix, , Dalbergia martini, Dichrostacys cinerea, Brachystegia utilis, Acacia nigrescens, Commiphora africana, Erythrina abbyssinica, Brachystegia boehmi, Diplorhyncus condylocarpon, Pseudolacnostylis maprouneifolia* and *Brachystegia longifolia* amongst others.

Only two floral species occur within this habitat unit which can be considered of conservation concern, not so much due to their conservation status but rather due to their continued decline due to increased harvesting. Although only listed as Least Concern (LC) by the IUCN, the tree species *Pterocarpus tinctorius* (*chrysothrix*) (Makula) is highly exploited in Zambia which has resulted in the Government banning the harvesting and trading of this species. The tree species *Pterocarpus angolensis* (Mukwa/Bloodwood) is listed as LC by the IUCN but due to continued harvesting is noted to be decreasing across its range. However, currently this species is still fairly widespread across Zambia.

Habitat Sensitivity of this unit is considered to be Moderately High.

Degraded Miombo Woodland

The miombo woodland habitat is the dominant habitat within the Project Site, however, due to this it is also the habitat that has been subjected to the highest degrees of disturbance and vegetation clearing. These impacts have resulted in the degradation of the habitat integrity, detracting from the unique landscape that this habitat unit is. The characteristics of this vegetation community varied across the Project Site due to varying levels of anthropogenic impacts and activities. Although numerous miombo woodland species were present, it was evident that in the more degraded areas where charcoal burning activities were higher, *Parinari curatelifolia* appeared to be more dominant. In these areas coppices and miombo saplings were evident, however larger trees had been harvested for charcoal production. In areas where less disturbance was observed the habitat unit was dominated by the miombo species *Julbernadia paniculata* and *Brachystegia boehmi*.

Floral species observed in this habitat unit include, but are not limited to *Ochna schweinfuthiana, Dyospyros kirkii, Lannea discolour, Julbernadia paniculata, Brachystegia boehmi, Pterocarpus angolensis, Dichrostachys cinerea, Terminalia sericea, Swartzia madagascariensis, Albizia harveyii, Burkea africana, Kigelia africana, Hexalobus monopetalus, Dyplorynchus condylocarpon, Cassia abbreviata, Strychnos cocculoides, Afromomum alboviolaceum, Ledebouria revoluta, Boophone disticha, Chlorophytum clarae* and *Costus spectabilis*.

The tree species *Pterocarpus angolensis* (Mukwa/Bloodwood) was observed in this habitat unit. This species is listed as LC by the IUCN but due to continued harvesting is noted to be decreasing across its range. However, it must be noted that currently this species is still fairly widespread across Zambia. In addition, *Boophone disticha* was observed in this habitat unit. Although not formally protected this species is often harvested for medicinal purposes or plant collections.

Habitat Sensitivity of this unit is considered to be Intermediate.

Agricultural Areas

The agricultural areas have been cleared to make way for agricultural crops such *Zea mays* (Maize), *Glycine max* (Soybean) and *Cucurbita* sp (pumpkin) which are grown throughout the Project Site. Large tracts of the low-lying lands have been cleared for cultivation, whilst in the western portions of the Project Site, even the uneven, steep hillsides are used for cultivation activities. It was noted that larger trees are often left along the field boundaries, presumably as a wind break but also as it would require unnecessary time and effort to remove them. Larger fruit bearing trees, notably *Mangifera indica* (mango) are left in place and fields cultivated around them. This is attributed to their importance as a food resource in the region.

The agricultural areas have been significantly transformed and bear no similarity to the reference Miombo Woodland vegetation type of the region. Although the agricultural lands are important for food production, they are not considered important for floral species, with a moderately low floral species diversity and a notable loss of habitat integrity. The agricultural areas are furthermore not considered unique areas of habitat nor do they contribute to the overall conservation status or value of the region. Floral species observed in this habitat unit include, but are not limited to *Uapaca siberiana, Terminalia sericea, Ficus sycamorous, Vangueria infausta, Brachystegia boehmi, Dichrostachys cinerea, Diospiros kirki* and *Mangifera indica*.

No floral Species of Conservation Concern (SCC) were encountered within this habitat unit. Vegetation clearance activities in these areas have left limited natural vegetation remaining.

Habitat Sensitivity of this unit is considered to be Moderately Low.

Freshwater Habitat (Dambos and Streams)

The freshwater habitat was observed extensively throughout the Project Site. The dambos and riparian areas were noted to have increased floral species diversity, as is to be expected, with many of the floral species observed in these areas not occurring within the other habitat units, particularly orchid species. The riparian areas are still largely intact and of moderately high integrity, although the agricultural lands do encroach heavily upon the riparian vegetation. However, the dambos located around the villages have been significantly impacted upon as a result of vegetation clearance and crop cultivation, leading to species diversity and habitat loss in these areas. The freshwater habitat unit is considered important in terms of ongoing species conservation and habitat provision, whilst also being unique in the landscape in terms of species diversity. Although the freshwater habitat has been subjected to several anthropogenic impacts, the overall integrity and diversity of is still considered Moderately High.

Species observed in the freshwater habitat include *Cyperus esculenta, Platycoryne buchanania, Cyperus* sp., *Kyllinga pumila, Habenaria schimperiana, Gnidia chrysantha, Ascolepis protea, Hypoxis nyasica, Drocera* sp., *Popowia obovata, Senegalia polyacantha, Ficus sycamorous, Mucuna coriacea, Stereospermum kunthianum, Vitex doniana, Piliostigma thonningii, Pseudolacnostylis maprouneifolia, Antidesma venosum, Grewia caffra* and *Markhamia obstifolia*.

Although no SCC were observed in the freshwater habitats, the dambos do provide habitat for unique floral species such as *Habenaria schimperiana* (Orchid), *Drosera sp.* (Sundew), *Boophone disticha* and *Hypoxis nyasica*, which although not formally protected are often harvested for medicinal purposes or plant collections.

Habitat Sensitivity of this unit is considered to be Moderately High

Floral Species of Conservation Concern

An assessment considering the presence of any floral Species of Conservation Concern (SCC), as well as suitable habitat to support any such species was undertaken. Threatened species are species that are facing a high risk of extinction. Any species classified in the IUCN categories as Critically Endangered (CE), Endangered (EN) or Vulnerable (VU) is a threatened species. SCC are species that have a high conservation importance floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare (CR), Rare (R) and Declining (D).

There is no specific list of protected floral species for Zambia, thus all floral species observed were cross referenced with the IUCN database in order to ascertain their conservation and threat status.

None of the floral species as identified during the field assessment had a conservation status higher than that of Least Concern (LC) on the IUCN database. However, species such as *Pterocarpus tinctorius* (*chrysothrix*) and *Pterocarpus angolensis* are of concern as their known population numbers are declining due to overharvesting. In addition to these woody species, small bulbous species such as *Boophone disticha* and *Habenaria schimperiana*, although of LC according to the IUCN, are also considered under pressure due to harvesting for medicinal purposes and species collections.

Alien Invasive Plant Species

Alien invasive plant species identified within the Project Site were mostly associated with villages and in particular agricultural areas and livestock pens, where in some instances they were completely dominant, notably in the case of *Lantana camara* (Lantana). Table 20 lists the exotic and invader species identified during the assessment along with their basic methods of control. Aline invasive plant species will require control. The only two exceptions on the list below are that of *Mangifera indica* (mango) and *Psidium guajava* (guava) which have an important social and economic use in the communities as a seasonal supply of food. Removal or destruction of these trees should be avoided where possible.

Table 20: Exotic or invasive species

Scientific name	Common name	Control
Bidens pilosa	Spanish Blackjack	Pre-emergence herbicide
Mangifera indica	Mango	None, agricultural use
Psidium guajava	Guava	None, agricultural use
Lantana camara	Lantana	Mechanical control, herbicide

Medicinal Plant Species

The majority of the plants identified in the Project Site all have medicinal properties and are considered to be common to the region, especially within the Degraded Forest and Miombo Woodlands. Local traditional healers may have to be consulted when planning the Project footprint. A list of the traditional medicinal plants species is presented in Table 24 of the Scoping Report (Annexure C).

6.10.5 Aquatic Ecology

Mtetezi River

Ecostatus

Although not formally assessed, the Mtetezi River is considered to be of moderate to high ecological integrity. Clearing of vegetation has occurred in some areas to make way for crop cultivation, although this is not extensive. The remaining vegetation comprised indigenous woody species representative of the vegetation throughout the Project Site and greater surrounds. Impoundments will have had an impact on the hydraulic regime of the system, however, except for the T4 road bridge, no other instream impacts (such as road crossings or weirs) were observed.

Habitat and biota

Due to the connectivity to surrounding undisturbed areas, relatively remote locality and inaccessibility of the river, it is expected that it provides an important faunal migratory corridor. Although minimal fauna was observed during the site assessment, snakes were encountered often in riparian areas. As noted above, vegetation clearing has occurred in some areas, but where clearing has not occurred the floral species composition and structure remains largely natural.

Goods and Services Provision

The Mtetezi River forms the eastern border of the Project Site, flowing in a northerly and north-eastern direction. Access to the river is hindered along much of the reach within the Project Site by dense vegetation and hilly terrain, thus reliance on the river is not as high as anticipated in such a rural area. Many of the villages located in the eastern portion of the Project Site have access to community boreholes, thus reliance on the river for water is moderate although impoundments were noted and it is likely that these are utilised by local communities for watering of cattle, swimming and fishing. Additionally, it was observed during the site visit that fishing in the river occurs daily.

Riverine systems (excluding the Mtetezi River)

Ecostatus

Due to the nature of the terrain, the majority of riverine systems that were assessed were close to human settlement, and therefore have undergone various impacts such as altered geomorphologic regimes (e.g. increased sediment loads originating from adjacent crop fields). More remote and inaccessible reaches of the various rivers are likely to remain in a largely natural condition, with impacts mostly limited to those occurring upstream such as impaired water quality due to discharge of domestic effluent.

Habitat and biota

Instream habitat in the majority of the rivers observed comprised a combination of biotopes, including sand, gravel and mud (GSM), rocks and overhanging vegetation, although very little instream vegetation was observed.

In terms of riparian habitat, as with the Mtetezi River, the rivers within the Project Site are considered to be important faunal migratory corridors as they provide connectivity to undisturbed, natural areas. Additionally, reptile and amphibian species were observed within several of these systems, indicating that breeding and foraging habitat is available and utilised.

Goods and Services Provision

Although some of the larger villages within the Project Site have access to communal boreholes and are able to obtain groundwater for domestic purposes such as cooking, the rivers are utilised extensively for bathing, washing of clothes, fishing and as previously mentioned, crop cultivation within the floodplains. In those areas where natural vegetation remains, it was apparent that the rivers provide a level of ecological services such as flood attenuation and sediment trapping. In addition, as with the Mtetezi River and indeed most of the drainage systems in the Project Site, biodiversity maintenance is deemed high, as the connectivity to undisturbed areas provides refugia and foraging habitat for fauna.

Valley bottom wetland systems

Ecostatus

With the exception of conversion of wetland areas from 'natural' conditions to agricultural land, the related encroachment of woody species as a result, and limited informal road crossings, very few other impacts were observed within these systems. As a result, the ecological integrity of the valley bottom wetland systems is considered to be in a largely natural state. These systems are considered important not only for maintenance of biodiversity and habitat provision, but also for the recharge of larger drainage systems within the Project Site. Thus, retention of habitat and hydraulic connectivity is critically important.

Habitat and biota

With the exception of those areas cleared for crop cultivation, vegetation remains in a largely natural state although it was noted when delineating the watercourses that woody species have encroached in some areas, transforming the temporary zones from grassland to bushveld. This could potentially result in increased water use over time, as well as influencing the distribution of wetland-dependent faunal species which have a preference for open spaces. Nevertheless, the habitat remains in a largely natural state as this encroachment is presently limited in extent and severity.

Goods and Services Provision

At the time of the fieldwork, reliance on the valley bottom wetland systems for socio-cultural service provision was not as high when compared to the riverine systems or the dambo areas. In areas where terrestrial arable land is limited and therefore at a premium, the valley bottom wetland systems were utilised for subsistence farming. Although not directly observed, it is very likely, particularly in the more remote areas, that channelled valley bottom wetlands are relied upon for water provision both for domestic and agricultural purposes.

Dambos and floodplain wetland systems

Ecostatus

As with all watercourses within the Project Site, the primary modifiers of the dambo systems are related to subsistence agriculture, although due to the relatively flat terrain the extent of cultivation within the dambos is greater than in the other habitat types. Overall, the dambos are deemed to be in a largely natural to modified ecological condition, and reinstatement of natural conditions could occur with little to no human intervention.

These expansive wetland systems are considered very important for the provision of ecological (i.e. indirect services such as flood attenuation, trapping of sediment, and biodiversity maintenance) and for direct socio-cultural benefits in particular, crop cultivation, charcoal manufacturing and provision of grazing for livestock. Interviews revealed that, traditionally, local residents avoided cultivation within these wetland areas; however, due to increased populations and lack of available arable land the communities surrounding the wetlands have been forced to encroach into the wetlands.

Habitat and biota

The dambos provide essential habitat for a variety of faunal and floral species, including (as depicted above) *Drosera* sp., numerous orchid species (e.g. *Platycoryne buchanania*, *Habenaria schimperiana*), *Ascolepis protea* and *Hypoxis nyasica* amongst many others. Faunal species observed included *Hyperolius marmoratus*, *Arthroleptis stenodactylus* and *Phrynobatrachus mababiensis* along with numerous species belonging to the *Odonata* (dragonfly, damselfly) order.

Goods and Services Provision

The low-lying, extensive dambos appeared to be the most utilised of all the watercourses within the Project Site in terms of socio-economic uses. Because of the relatively flat topography these systems are generally easily accessed and are therefore preferred in terms of agriculture (both crop cultivation and livestock husbandry) as well as charcoal manufacturing.

6.10.6 Protected Areas

Protected areas located in the general region of the Project Site (as shown in Figure 38 above) include:

- South Luangwa National Park located approximately 60 km north-west;
- Lukusuzi National Park located approximately 100 km north-east;
- Kasungu National Park located approximately 120 km north-east;
- Lusandwa Forest Reserve located approximately 50 km west;
- Dzalanyama Forest Reserve located approximately 120 km south-east; and
- Mchinji Forest Reserve located approximately 50 km east.

According to the World Database on Protected Areas (UNEP-WCMC, 2016), the Chiulukire West and Chivuna Hills Forest Reserves are associated with the north western corner of the Project Site, while the Matanta Forest Reserve is situated within the south western corner (Figure 43). As highlighted above, these Forest Reserves have already been subjected to continuous wide scale impacts. The habitat degradation comes largely from collection of firewood, wood used for structures, the charcoal trade in rural areas in order to generate an income and agricultural activities.

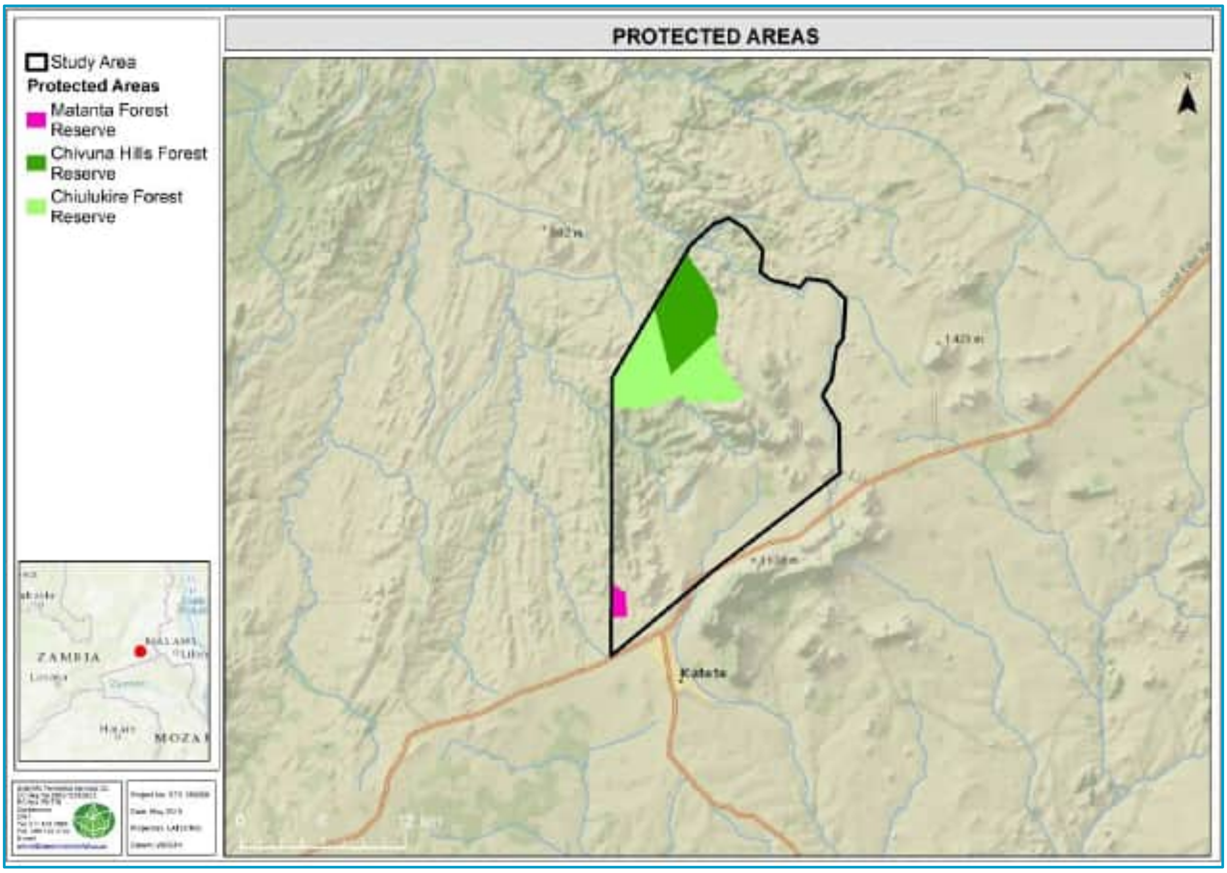


Figure 43: Protected Forest Reserves associated with the study area

There are no Alliance for Zero Extinction (AZE) sites in Zambia based on their “AZE sites 2018” map.

6.11 CRITICAL HABITAT ASSESSMENT

6.11.1 Overview

Alignment with International Finance Corporation Performance Standard 6 (IFC PS6) (Biodiversity and Conservation of Living Natural Resources (IFC 2012) requires project developers to follow a differentiated risk management approach to habitats based on their biodiversity values (see Box 1 below). This requires the classification of habitats and quantification of the extent of adverse impacts on the different habitat status categories to determine the level of mitigation required to compensate for significant impacts on habitats of different biodiversity value. This chapter summarises the status of habitats in the Project area in alignment with IFC definitions and thresholds in order to determine the implications for the Project.

PS6 addresses the requirements for determination of habitats as 'Modified Habitat', 'Natural Habitat', and 'Critical Habitat' and sets out specific guidance for projects which may have residual impacts on these.

Definitions are as follows:

Natural Habitat: *"areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition"*

Modified Habitat: *"areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands.*

Critical habitats: *areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.*

Critical Habitats can be represented by Modified or Natural Habitats depending on whether either category meets the thresholds the Critical Habitat set out in the Guidance Note 6 (IFC, 2018).

Clause GN43 of the GN6 indicates that Natural Habitats should not be interpreted as untouched or pristine habitats, may have undergone historic or recent anthropogenic impact and should be assessed by comparing current and historic conditions to determine the degree of impact. If the habitat still largely contains the principal characteristics and key elements of its native ecosystem such as complexity, structure and diversity then it should be considered a Natural Habitat regardless of the presence of some invasive species, secondary forest, human habitation or other human induced alteration.

In light of the above, categorising habitats as 'Natural' or 'Modified' based on their condition needs to recognise that in practice, Natural and Modified habitats exist on a continuum ranging from largely untouched, pristine natural habitats to intensively managed modified (including transformed) habitats. Land which has been or is used for shifting agriculture, hunting, grazing or selective timber harvesting may still be classified as natural habitat depending on the degree of transformation or degradation.

Box 1: Summary of IFC requirements for Modified, Natural and Critical Habitats

Implications of Projects in Natural Habitats

IFC PS6 Clause 14 requires that:

The client will not significantly convert or degrade natural habitats unless all of the following are demonstrated:

- *No other viable alternatives within the region exist for development of the project on modified habitat;*
- *Consultation has established the view of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation, and*
- *Any conversion or degradation is mitigated according to the mitigation hierarchy.*

In terms of the above, "significant conversion or degradation is: i) the elimination or severe dimunition of the integrity of a habitat caused by a major and/or long-term change in land or water use or ii) a modification that substantially minimises the habitat's ability to maintain viable populations of native species.

Clause 15 states:

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

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

Note: no net loss is defined as the point at which project-related impacts on biodiversity are balanced by measures taken to avoid and minimise the project's impacts, to undertake on site restoration, and finally to offset significant residual impacts, if any, on an appropriate geographic scale.

Implications of Projects in Critical Habitat

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

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

6.11.2 Methodology

This habitat status assessment was based primarily on the 2019 site assessment reports produced by SAS Environmental Group[12] (SAS) on vegetation, fauna and freshwater habitat within the Project Site and the bird (WildSkies 2019) and bat (Arcus 2019) specialist reports. These were used to confirm the presence/absence of Species of Conservation Concern (SCC), habitat condition and the nature of habitat disturbance. The spatial information on Habitat Units and Freshwater Classification were used to derive revised habitat status mapping and to quantify the extent of habitat types and status in Project Site. The spatial data included null geometries and other data quality issues that were rectified so that it could be used to calculate habitat areas.

[12] SAS (2019). Terrestrial, aquatic and wetland ecological studies to inform the environmental and social impact assessment for the proposed Unika windfarm development in the Eastern Province of Zambia. Sections B (Floral Assessment), C (Fauna Assessment) & D (Freshwater Ecology, Goods and Services Assessments.

The spatial layer included the two habitat types: i) agricultural areas and ii) freshwater habitats while the separate Freshwater Classification included twelve classes of wetland, river and riparian features thereby adding detail to the freshwater habitat feature class.

Since a large portion of the wetland mapping was dominated by agricultural activities and in some cases entirely transformed by the cultivation, a separate layer of agricultural areas was therefore delineated using a combination of 2020 Google Earth[13] and ESRI[14] imagery. The agricultural layer included only areas dominated by agricultural activities such that the principal characteristics and key elements of the natural ecosystem have been lost. Degraded areas used for cattle grazing or where small, isolated cultivated patches are couched within otherwise largely undisturbed freshwater where the key characteristics and elements of the natural ecology remain were not included. In cases of uncertainty, the Precautionary Principle was applied and these areas were excluded from the agriculture layer.

The three layers (Habitat Units, Freshwater Classifications and Freshwater Agricultural Areas) were then combined to define habitat classes of similar habitat status and degree of degradation. The following habitat types were defined:

- Degraded Forest;
- Degraded Miombo Woodland;
- Terrestrial Agricultural Areas;
- Freshwater Habitat (Wetlands);
- Freshwater Habitat (Rivers, Streams and Riparian Zones);
- Freshwater Agricultural Areas.

The descriptions of the habitats and species, and their degree of degradation, were then used to assess whether the IFC definitions of Natural and Modified Habitat apply to each habitat type. Each habitat type was then assessed against the IFC criteria for Critical Habitat. Habitat type mapping is presented in Figure 44 and Figure 45 and a Habitat Status map in Figure 46.

6.11.3 Summary of Habitat Types, Threats and Conservation Status

The total study area consists of approximately 34,316 hectares of degraded forest, degraded miombo woodland, watercourses, settlements and agricultural areas.

The primary sources of habitat modification observed within the study area are:

- Clearing for construction of settlements, roads and other infrastructure;
- Clearing around settlements;
- Clearing (often by burning) for development of croplands;
- Intensive grazing by domestic animals;
- Harvesting of timber for the charcoal industry;
- Erosion of watercourses due to large scale vegetation clearing; and
- Presence of alien invasive vegetation.

Areas dominated by settlement or agriculture areas transformed by other categories of disturbance such that the key characteristics and elements of the natural ecosystem have been lost, have been classified as modified habitat, with the remainder classified as natural habitat. Minor infrastructure and agriculture, including roads and isolated cropland, has been included in areas of natural habitat where the scale of the disturbance is such that the general area is still dominated by natural ecological processes.

[2] CNES/Airbus and Maxar (2020). Google Earth imagery. [Online] Available from: www.earth.google.com.
[3] ESRI World Imagery (2020). Source: ESRI, Digital Globe, Geoeye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Portions of two forest reserves overlap with parts of the study area; Chiulukire West with 7,778 ha and Matanta with 1,152 ha (see Figure 44). According to the Zambian Wildlife Authority, the National Forest Reserve management category corresponds to an IUCN VI protected area category[15], although the IUCN's Protected Planet lists the IUCN Management Category as 'Not Reported'[16]. The forest reserves have been proclaimed in terms of the Forest Act (39 of 1973). Neither appear to be protected in the conventional sense and protection appears to be largely for the purpose of sustainably managing the harvesting of timber, firewood and other forest resources[17]. A large portion of land in both forest reserves appears to be actively farmed and constitutes modified habitat. The remaining habitat within the overlapping portions of forest reserve include degraded forest, degraded miombo woodland and watercourses, although no forest habitat occurs within the overlapping portion of the Matanta reserve.

The study area does not overlap with Chivuma Hills Forest Reserve. It does however overlap with the Chiulukire West and Matanta Forest Reserves. A breakdown of the hectarage and proportion of land cover of the study area within each overlapping reserve portion is as follows:

Chiulukire West:

- Freshwater: 3,784 ha (49%)
- Degraded Forest: 1,927 ha (25%)
- Agriculture: 1,554 ha (20%)
- Degraded Miombo: 513 ha (7%)

Matanta:

- Agriculture: 937 ha (81%)
- Freshwater: 123 ha (11%)
- Degraded Miombo: 92 ha (8%)

The habitats falling within the two Forest Reserve portions within the study area is included and discussed in the relevant habitat sections below, and generally appear to be degraded. The Chivuna Hills Forest Reserve appears to be in a similar state of habitat degradation.

[4] As for 3 above.
[5] IUCN, 2020. Protected Planet. [Online] Available From <www.protectedplanet.net>
[6] Zambian Wildlife Authority (2008). REMNPAS Information Portal: Description of the current National Protected Area System. [Online] Available From: <http://zm.chm-cbd.net/remnpas/prot-areas-system/current-protected-area-system/description-current-national-protected-area>

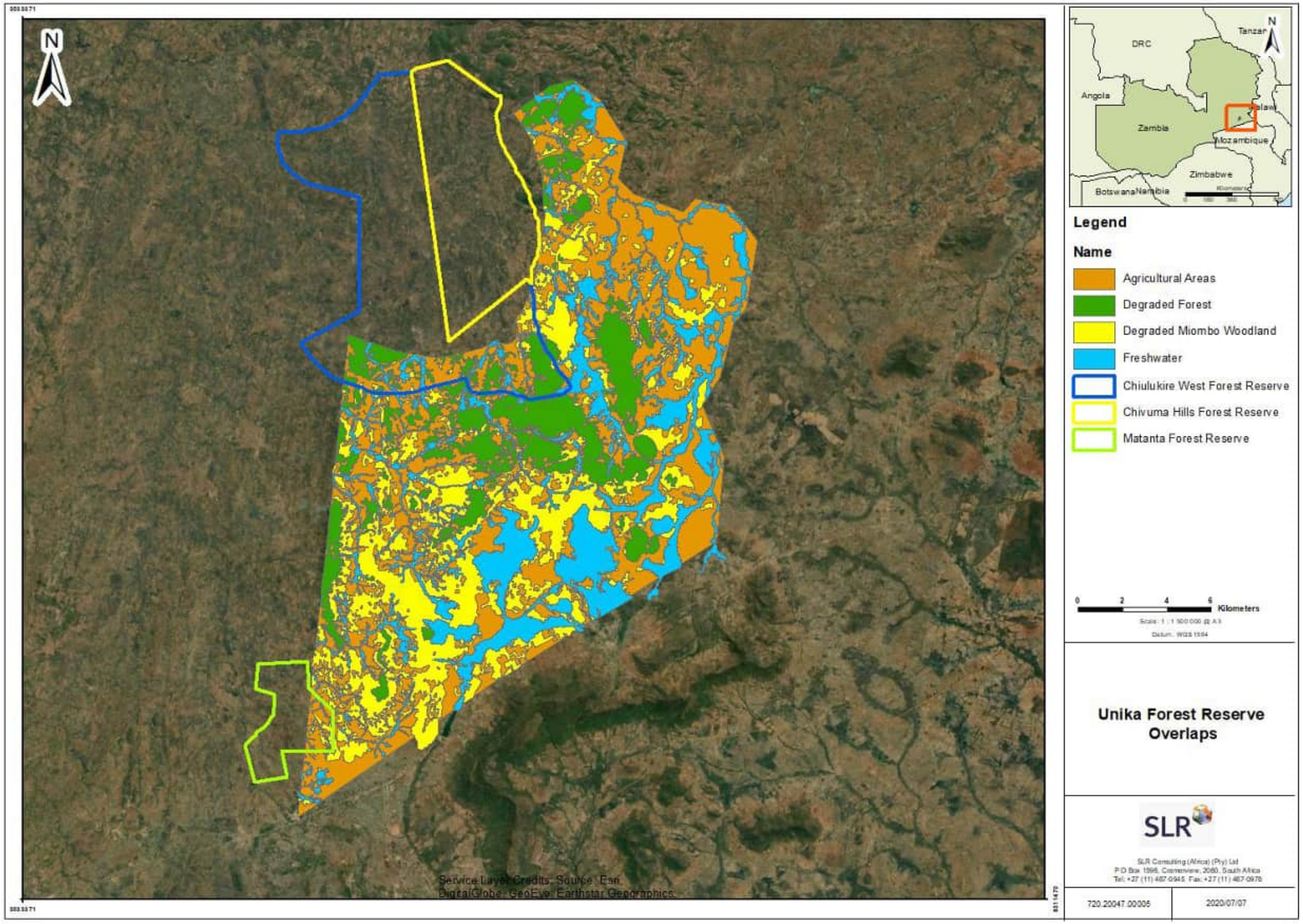


Figure 44: Habitat Units and Forest Reserves

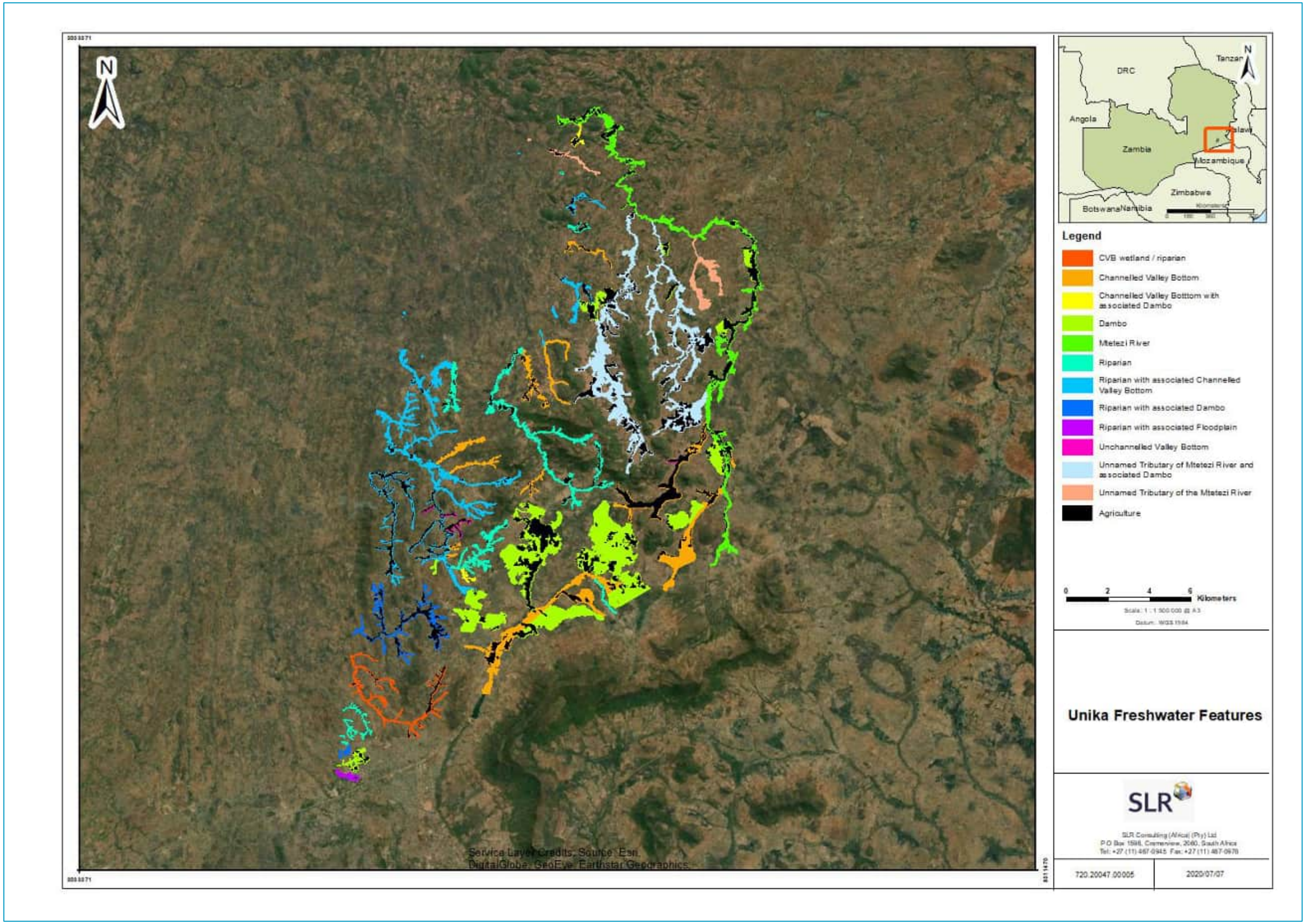


Figure 45: Watercourses and aquatic habitat units within the study area

6.11.4 Natural and Modified Habitats

Habitats of the Unika Project Area were assigned to Natural and Modified Habitat classes as described below.

Natural Habitats:

Degraded Forest: 5,491ha (16%)

Forest habitats occur primarily in the upper reaches of the large inselbergs and central mountainous parts of the study area, along with certain low-lying ridges. In these areas trees exceeded 8 m in height with large predominantly interlinking canopies. Plant species diversity is higher than in the surrounding more low-lying habitats comprising trees such as *Julbernardia globiflora, Brachystegia bussei, Adenia senensis, Lannea discolour, Cassia singueana, Diospyros kirkii, Pericopsis angolensis, Pterocarpus angolensis, Pterocarpus chrysothrix, Dalbergia martini, Dichrostacys cinerea, Brachystegia utilis, Acacia nigrescens, Commiphora africana, Erythrina abbyssinica, Brachystegia boehmi, Diplorhyncus condylocarpon, Pseudolacnostylis maprouneifolia* and *Brachystegia longifolia* amongst others.

The species composition is not consistent with any forest type listed in the Zambian NBSAP[18] as defined by the Zambian Forestry Department[19] and the Potential Vegetation Map for East Africa[20]. Many of the common species are consistent with Miombo Woodland, but the closed canopy forest structure and the balance of the common species are distinct.

Forests provide a wide range of harvestable products and contribute approximately 6.3% of Zambia's GDP[21] primarily in the form of logging and harvesting of timber for charcoal production. This habitat unit in the study area has been impacted mainly by uncontrolled use of timber resources which is leading to the encroachment of miombo woodland species. It still meets the definition of Natural Habitat, but given the impact and fragmentation, it is designated as 'Degraded' Natural Habitat.

[18] Ministry of Lands, Natural Resources and Environmental Protection (currently the Ministry of Green Economy and Environment) (2015) Zambia's Second National Biodiversity Strategy and Action Plan (NBSAP-2) 2015-2025. [Online] Available from: <https://www.cbd.int/doc/world/zm/zm-nbsap-v2-en.pdf>

[19] Food and Agriculture Organisation of the United Nations (2002). Forest Genetic Resources Working Papers. [Online] Available from: <http://www.fao.org/3/ac455e/ac455e02.htm#b1-2.1.%20VEGETATION%20TYPES>

[20] VECEA (2020). Potential Vegetation Map of East Africa. [Online] Available from: <http://vecea.vegetationmap4africa.org/>

[21] Turpie, J., B. Warr, J. Carter Ingram and M. Masozera. 2014. The Economic Value of Zambia's Forest Ecosystems and potential benefits of REDD+ in Green Economy Transformation in Zambia. Report to the United Nations Environment Program on behalf of the Ministry of Lands, Natural Resources and Environmental Protection (currently the Ministry of Green Economy and Environment), Zambia

Despite the higher plant diversity, no IUCN-listed threatened species were confirmed, although two species assessed as globally Least Concern are present and under threat from selective logging; *Pterocarpus angolensis* and *Pterocarpus tinctorius*. Moratoriums on the harvesting of the latter species have been instituted and removed several times since 2014 by the Zambian government[22].

For fauna, the only globally threatened species confirmed to occur in the Project Area was the Martial Eagle (recorded twice in flight). Three Near Threatened bat species, namely *Eidolon helvum* (African Straw-coloured Fruit-bat), *Otomops martiensseni* (Large-eared Giant Mastiff or Free-tailed Bat), and *Hipposideros vittatus* (Striped Leaf-nosed Bat) are predicted to potentially occur in the rocky outcrops of the inselbergs but were not confirmed.

The inselbergs represent the only substantial intact patches of degraded forest habitat which makes up only 16% of the total study area. Since only approximately 60% of the study area is required for the development, and inselbergs have been mapped as sensitive areas to be avoided by the wind turbine layout, impacts on this habitat will be minimised.

Approximately 1,927 ha of this degraded forest type occurs within the IUCN Category VI forest reserve of Chiulukire West.

Freshwater Habitats: Wetlands 3,879 ha (11%)

Wetlands cover approximately 5 642 ha of the study area, which makes up approximately 17% of the total habitat. Wetland types represented on site include channelled and unchanneled valley bottom wetlands, shallow, grassy depression wetlands known locally as 'dambos' and a single small floodplain wetland. Nearly 1,763 ha (31%) of the wetland area is dominated by crop cultivation which falls under 'Modified Habitat' (see below).

The remainder of the wetland habitat (3,879 ha) represents 'degraded' Natural Habitat. All wetland types have been impacted in a variety of ways. Croplands in the catchment and in the Modified Habitat portions of the wetlands tend to have reduced surface roughness and infiltration rates leading to increased runoff within the Natural Habitat portions of the wetlands and minor erosion has been noted in certain dambos. The exposed soil in croplands and heavily grazed areas tends to increase the sediment load in runoff. Cattle grazing and informal roads have disturbed and compacted sediment to a limited degree. Water quality impacts are most likely limited to increased sediment loads from areas of exposed soil and slightly elevated nutrients loads from cattle dung. Encroachment of woody species in the temporary zone was also noted in disturbed areas.

The natural portions of the wetlands, particularly the dambos, provide habitat for unique floral species such as *Habenaria schimperiana* (Orchid), *Drosera* sp. (Sundew), *Boophone disticha* and

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[22] CITES (2019). Consideration of Proposals for Amendment of Appendices II. [Online] Available from: <https://cites.org/sites/default/files/eng/cop/18/prop/020119_d/E-CoP18-Prop_draft-Pterocarpus-tinctorius.pdf>

Hypoxis nyasica, which although not formally protected are often harvested for medicinal purposes or plant collections. Fauna in the wetlands appear to be species poor and only three amphibian species were recorded.

The primary ecosystem services (besides cultivation) include grazing, charcoal production and use of water for domestic and agricultural use (mainly in valley-bottom wetlands), although the latter was not directly observed, but is likely.

Freshwater habitats: rivers, streams and riparian zones: 1,122 ha (3%)

Rivers, streams and associated riparian zones are associated with higher overall biodiversity than the terrestrial areas and are intact over large areas. Agricultural encroachment is extensive and almost 320 ha (29%) has been cleared for crop cultivation. Parts of the riparian zone that are dominated by crop cultivation and these portions are discussed under 'Modified Habitat' below.

The Matetzi River exhibited significant hydrological impact from several small impoundments within the project area. All rivers exhibited increased turbidity from exposed sediments present in cultivated portions of the catchments and riparian zones. Bank incision was present in most rivers and is an indication of increased runoff related to decreased surface roughness and infiltration in the catchment due to crop cultivation. Alien vegetation such as *Ricinus communis* (castor oil) was present in the riparian zone, but nowhere was dominant. The vegetation structure was largely natural in all non-cultivated areas. Geomorphological and hydrological impacts were noted in the form of road crossing of most of the smaller river systems. None were noted within the study area that cross the Matetzi River, although the T4 road crosses nearby (to the south) via a large bridge.

No species of conservation concern (SCCs) were noted within the river, streams and riparian zones, although it is possible that the Near Threatened *Aonyx capensis* (African Clawless Otter) is present. This species is highly mobile and tolerant of terrestrial habitat changes. Only changes in aquatic habitats that impact on their food sources (primarily fish and crabs) or that substantially reduce cover within riparian and wetland corridors are likely to impact this species substantially and no significant impact on theses aquatic habitats is expected from the proposed wind farm.

Several reptile and amphibian species were noted in the riparian zones and indicate the importance of these areas as wildlife corridors.

Modified Habitats

Degraded Miombo Woodland: 8,301 ha (24%)

The miombo woodland occurs on a continuum from seriously degraded to less degraded depending on proximity to settlements and extent of fragmentation for cultivation, timber harvesting and charcoal. Less degraded portions occur adjacent to the inselbergs with degraded forest, and some portions of the degraded miombo has been mapped within the Degraded Forest unit. Large areas near the inselbergs that were historically under forest have been converted to Miombo Woodland through disturbance and thereby represent a departure from natural habitat even in its least disturbed areas.

Areas of higher disturbance are dominated by *Parinari curatellifolia* while areas of less disturbance are dominated by the typical miombo species *Julbernadia paniculata* and *Brachystegia boehmi*. *Boophone disticha* found in the dambos described above was also found in this habitat.

The remaining miombo woodland is under threat from human pressure for grazing, wood resources, cultivation and settlement expansion. Little mammalian fauna remains although birdlife may still be representative of near natural conditions.

Given the extent of disturbance and trajectory of further decline in habitat condition, the degraded miombo woodland has been classed as Modified.

Freshwater Agricultural Areas: 2,083 ha (6%)

Freshwater habitats, including both wetlands and the riparian zones of rivers, have been subjected to significant habitat modification, primarily through crop cultivation. Crops are varied, but cassava and maize are the most common. Wetland species assemblages and vegetation structure has been lost in these areas with modified wetland hydrology, soils and terrain are often the only indications of the underlying wetland nature. These areas can therefore no longer be considered Natural Habitat.

Terrestrial Agricultural Areas: 13,440 ha (39%)	
	Large tracts of the low-lying land, particularly alongside drainage lines and in dambos (discussed above) have been cleared for cultivation, whilst in the western portions of the study area, even the steep hillsides are used for cultivation activities. Agricultural crops are mainly *Zea mays* (Maize), *Glycine max* (Soybean) and *Cucurbita* sp (pumpkin) which are grown throughout the study area. Large indigenous miombo woodland trees are often left along the field boundaries, presumably as a wind break, and include species such as *Uapaca siberiana, Terminalia sericea, Ficus sycamorous, Vangueria infausta, Brachystegia boehmi, Dichrostachys cinerea,* and *Diospiros kirki.* Large mango trees (*Mangifera indica)* are often left in the fields as a fruit source.
Settlements and Infrastructure:	
	The site contains five villages. The largest is Katete, near the southwestern corner of the site. Only a 145 ha portion of Katete falls within the study area, with the majority of the town just outside of the boundary surrounding the junction of the T4 and T6 roads. The dwellings are interspersed with an equal mix of farmland. The remaining four villages (Mbangombe, Kachingwe, Chibela and Gomani) are spread across the site from south to north and consist of a few communal and government buildings such as schools, sparse collections of dwellings and surrounding farmland. The infrastructure in each village is scattered between the cultivated fields such that agriculture dominates that landscape. Infrastructure has not therefore been separated out in terms of total area occupied and has been included in the agricultural area for all mapping. A small portion of the T4 national road falls just within the study area, near Mbangombe. Formalised dirt roads service each village and smaller informal roads and tracks traverse majority of the site. The main access road in the study area leads from the T4 northwards to Msoro.

6.11.5 Critical Habitat Assessment

Each of the criteria for determination of critical habitat were assessed to confirm whether any of the Modified or Natural Habitats described above trigger Critical Habitat. The Unika Project Area does not trigger Critical Habitat.

IFC PS6 Criteria & Thresholds	Rationale	Critical Habitat
Criterion 1: Critically Endangered and Endangered Species[23]		
a) Areas that support globally-important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units[24] of a CR or EN species).	The only globally important species confirmed in the project site was the globally endangered Martial Eagle which was recorded flying over a ridge line on two occasions in 240 hours of vantage point surveys. No nest sites or evidence that it is resident or breeding on the wind farm site or nearby surroundings was obtained. Since it is widely distributed across most of Africa and it is not considered to breed or be resident on the site, it does not meet the CH thresholds under Criterion 1.	No
b) Areas that support globally-important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a).	No VU species were noted not are likely to occur in any of the terrestrial or aquatic habitats of the proposed wind farm area.	No
c) As appropriate, areas containing important concentrations of a nationally or regionally-listed EN or CR species.	No regionally or nationally listed EN or CR species were confirmed present or likely to occur within the site.	No
Criterion 2: Endemic or Restricted Range Species[25]		
a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species	No species are known or likely to occur within the proposed site in numbers that meet the threshold.	No
Criterion 3: Migratory or Congregatory Species[26]		

[23] Where subspecies and sub-populations have been separately assessed for inclusion in the IUCN Red List, they may be considered under Criteria 1, as appropriate (GN68)

[24] The IUCN Biodiversity Areas standard uses the following definition for reproductive unit: "the minimum number and combination of mature individuals necessary to trigger a successful reproductive event at a site Examples of five reproductive units include five pairs, five reproducing females in one harem, and five reproductive individuals of a plant species." Eisenberg, 1977. The Evolution of the Reproductive Unit in the Class Mammalia (footnote GN16 under GN72)

[25] Restricted range species are those with limited Extent of Occurrence (EOO) (GN74):

- For terrestrial vertebrates and plants, a restricted-range species is defined as those species that have an EOO less than 50,000 square kilometers (km^2).
- For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km^2.
- For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart).

[26] Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem) (GN76). Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis (GN77).

IFC PS6 Criteria & Thresholds	Rationale	Critical Habitat
a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle.	Several migratory bird species and congregatory bat species were confirmed to occur on the Project site. However, none of these occur in sufficient numbers to meet the threshold for CH under Criterion 3.	No
b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.		No
Criterion 4: Highly threatened or unique ecosystems		
a) Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN.	Miombo Woodland is a widespread habitat type that does not meet IUCN criteria for CR or EN and has a regional extent of approximately 2.7 million km^2. While the degraded forest patches on the inselbergs are threatened by selective logging and have local biodiversity value they do not qualify as a highly threatened or unique ecosystem. They are not included in the forest reserves for their biodiversity value, but rather for the regulation of harvesting of wood and medicinal products. Similar inselbergs are scattered from beyond Chipata, almost as far as the Luangwa valley. The freshwater ecosystems are of types, species and vegetation assemblages that are common in the region.	No
b) Other areas, not yet assessed by IUCN, but determined to be of high priority for conservation by regional or national systematic conservation planning.	While no national systematic conservation plan exists for Zambia no portions of the Unika area have been identified as a high priority for conservation by either the Zambian government, nor by other conservation entities. The Matanta and Chiulukire Forest Reserves which overlap the Unika project area are not conventional protected areas and have been instituted primarily to regulated harvesting of natural resources with ecosystem conservation a secondary objective. The reserves are listed by the Zambian Wildlife Authority as corresponding to the IUCN level VI.	No
Criterion 5: Key Evolutionary Processes		
a) No thresholds are defined.	No key evolutionary processes in the Unika area are important for sustaining populations of threatened, endemic or migratory/congregatory species or unique ecosystems.	No

6.11.6 Summary of Habitat Status Assessment

No Critical Habitat occurs in the study area as no populations of threatened, restricted range or migratory/congregatory species occur that meet IFC PS6 thresholds, and the habitats are not threatened or unique and do not have key evolutionary processes.

The Project Site includes a combination of Modified and Degraded Natural Habitat covering 69% and 31%, respectively (Table 21). Only 11.5% of the Project Site (33 350 ha) is required for the Unika 1 Wind Farm (3 865 ha) and since the turbine footprint and roads comprise small footprints, it should be possible to microsite the infrastructure to avoid portions of Natural Habitat to a large degree. It will be important to avoid placing infrastructure on the forested ridgelines and in the wetland or stream course habitats.

Table 21: Summary of Modified and Natural Habitat Extents in study area

Habitat Class	Modified Habitat		Natural Habitat		Critical Habitat
	Extent (Ha)	Extent (%)	Extent (Ha)	Extent (%)	
Degraded Forest			5491	16	No
Freshwater Habitats: Wetlands			3879	11	No
Freshwater Habitats: Rivers, streams and riparian zones			1122	3	No
Degraded Miombo Woodland	8301	24			No
Freshwater Agricultural Areas	2083	6			No
Terrestrial Agricultural Areas	13,440	39			No
Total	**23,824**	**69**	**10,492**	**31**	None

From the total 10 492 ha of Natural Habitat it is estimated that approximately 1.85 ha will be impacted by wind turbine laydown/assembly areas (assumed to be 3 680 m^2 each) and approximately 13.5 ha will be impacted by new access roads (assuming total road reserve width of 20 m) based on the current layout. This amounts to approximately 0.15% of the total Natural Habitat present on the Project Site.

6.11.7 Implications for the Project

The IFC performance standards do not place specific biodiversity-related restrictions on projects that fall within modified habitat. Following the criteria for projects within natural habitat (see Figure 46), the implications of the above for the proposed Unika I wind Farm Project are as follows:

- The footprint of the project must be restricted to Modified Habitat as far as possible, including marginal farmland, and degraded miombo.
- Degraded Forest patches on inselbergs and wetland, river and riparian areas should be avoided as far as possible for the siting of turbines or roads. Forest patches have higher importance for biodiversity (protected tree species; birds and bats) while wetland and stream courses have high value for aquatic species and ecosystem services.

Where avoidance of natural habitats is not possible:

- Mitigation measures must be applied that achieve a 'no net loss of biodiversity' across the site. This may be achieved by:
  - Identifying and setting aside areas of Natural Habitat. This should include implementing mechanisms for the improved protection for degraded forest patches on inselbergs;
  - Planning infrastructure layout to avoid fragmentation of remnant forest and woodland patches by maintaining biological corridors;
  - Restoring damaged or degraded areas after construction;

- Implementing Additional Conservation Actions (e.g. tree replanting; riparian rehabilitation) to achieve no net loss of biodiversity within the set-asides (preferably) or through conservation projects outside of the Unika I wind Farm Project area if needed; and
- Minimising reliance on wood resources for fuel or building to help to reduce the pressure on remaining indigenous forest resources.

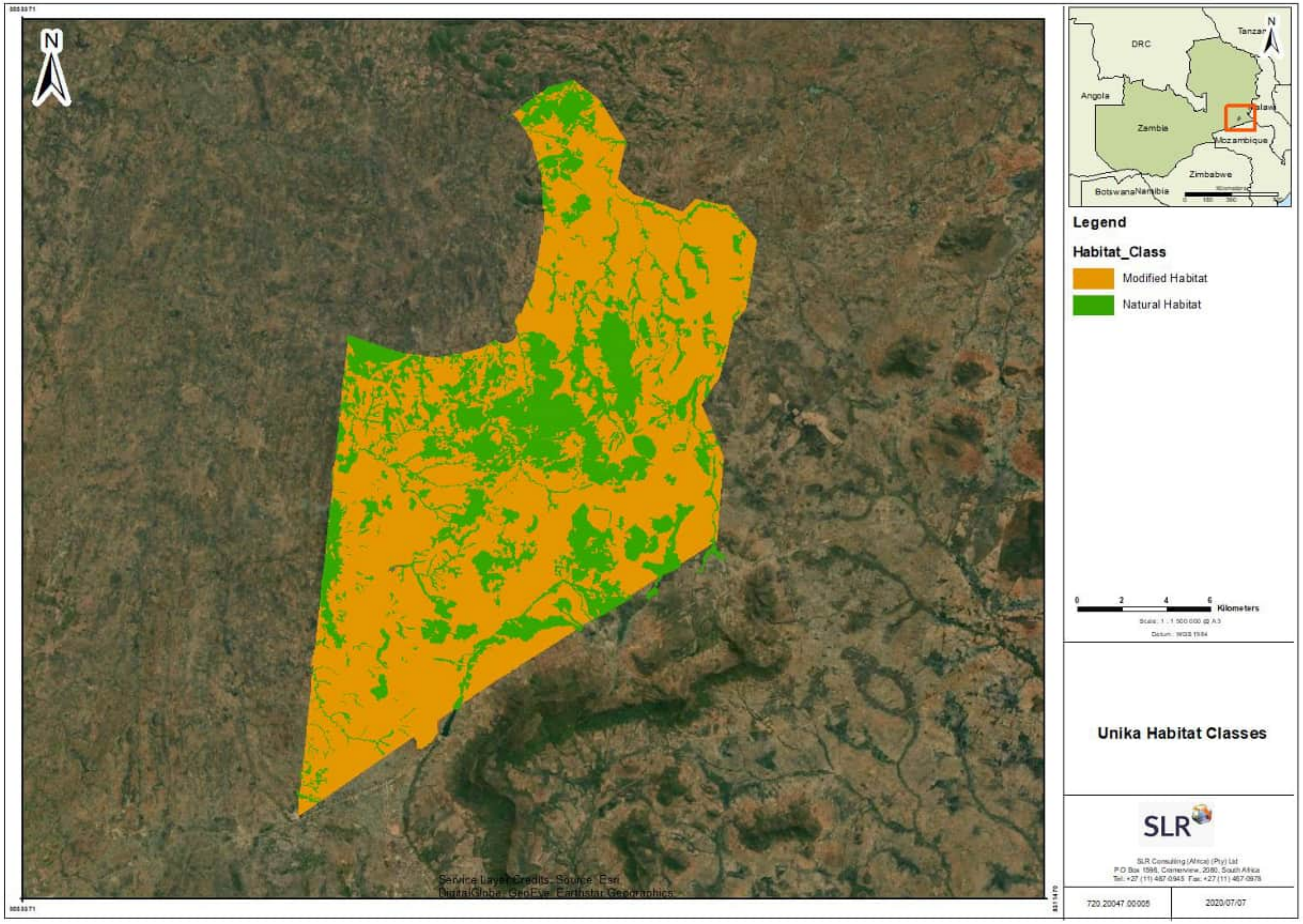

Figure 46: IFC Habitat Classes within the study area

6.12 ARCHAEOLOGICAL AND CULTURAL ENVIRONMENT

A number of villages namely Isibaki, Chimoto Kachngwe, Sumbwi, Pindu, Chamani, Undi, Mchaela Chimbundu and Mbangombe Villages are found on the south western area of the Project Site. Other villages located within the Project Site area include Gomani, Sunku, Mkokeza, Katimba, Malanda, Mlangali, Phindani, Tambala and Sakoba. It is these communities including those that travel from different parts of Zambia, Malawi and Mozambique for the Kulamba Traditional Ceremony, which over time, have shaped the landscape of the Project Site. Just like many other African Societies, these Chewa people have graveyards/cemeteries where they bury their deceased members of the communities. Coincidentally, Gule Wamkulu (believed to be spirits) typically emerge from these graveyards according to their belief.

The culture of the Chewa people is matrilineally driven and therefore focuses on the “mbumba” female members of the community. Their entertainment is centred on dances such as chintali chitele as the apex of their totality. As such, the landscape of Mkaika Royal Village and its immediate surrounding villages is the centre of Gule Wamkulu. The Mkaika Royal Village that houses the “King’s” Palace and that of the Queen Mother Nyangu as well as the Kulamba Cultural Arena known as the Gwalada (the spiritual centre) and the Dzimbabwe entertainment centre, where people converge to celebrate the good things relating to those that have transitioned, are some of the important aspects of the cultural landscape. Gule Wamkulu is the emergence of the re-incarceration in the form of spirits of the departed souls mimicking their deeds, lifestyles or achievements (e.g. deceased of a farmer, a dancer etc.). The emergence of Gule Wamkulu is mainly associated with secrecy and in this case, they appear and disappear into thickets which are mainly associated with pristine forests and graveyards.

Generally, Katete area is occupied by the Chewa people who are part of the Bantu grouping. To date they have continued to venture into agriculture and animal husbandry activities. Paramount Chief Kalonga Gawa Undi presides over the Chewa people not just in Zambia but also the Chewa in Malawi and Mozambique. They have an annual traditional ceremony called “Kulamba” held after harvest in late August, as a way of bringing together different Chewa chiefs from the three countries to present their reports of grievances to paramount chief Kalonga Gawa Undi. The name Kalonga means the one who installs subordinate chiefs. Gawa is the one who gives out land and Undi means the one who protects the subordinates. The Kalonga Gawa Undi is head of all the Chewa chiefdoms and takes care of all the installations of chiefs not only in Zambia but in Malawi and Mozambique as well.

Ancestors and spirits of other living creatures play an important part in present day society by being in constant contact with the living world, predominately through dance of those initiated to "Nyau", or secret societies. "Gule Wamukulu", literally meaning "big dance", have become a sort of title for secret societies of traditional Chewa religious practices. The Gule Wamukulu is one of the only two World Intangible Cultural Heritages recognized by UNESCO.

The Gule Wamukulu ceremonies consist of formally organized dances to admire the remarkable physical abilities of these individuals (considered to be adept at their dance as a result of their spiritual state). Informally, Gule Wamukulu, or "Gule" is a term associated with anyone who participates in the rituals of these secret societies. The peak season for Gule occurs in July, with young men dressed as ancestral animals, trees, or in masks of ancestral spirits. The Gule themselves are initiated through formal ceremony into this society. Gule are considered to be in 'animal state' when they are dressed in such attire, and are not to be approached. If one has the misfortune of passing a Gule on the road, traditional behaviour consists of dropping a few coins for the Gule (never handing them the money directly for fear they will grab you and take you to the cemetery for ritual purposes). Generally, it is best to avoid Gule in informal situations. In their animal or ancestral state, they are unpredictable. In Chewa land, when one notices the red ribbons hanging on the tree, it simply signals that such an area is a “No Go” zone where the Gule practices.

A field assessment of the Project Site was undertaken by Envirodynamics Consulting Limited from during March 2019. Table 23 presents a summary of heritage resources and their conservation significance, and the locations of these resources are presented in Figure 47. The locations of heritage features in relation to wind farm layout is presented in Figure 48.

At this stage there are five sites of national heritage significance that have been identified in the Project Site. These are presented in Table 22 below.

Table 22: Heritage site of national significance

Feature ID	Location	Description	Type
EDK13	-13.83588 South 32.15692 East	Bulawayo village Anoya Zulu (UNIP activist) grave area.	Cultural
EDK18	-13.86988 South 32.1347 East	Decorated potshed near the Kopje	Archaeological
EDK30	-13.98719 South 32.05128 East	Royal Palace, Kulamba Ceremonial Arena	Cultural
EDK31	-13.98759 South 32.05070 East	Mkaika Royal Graveyard	Cultural/ Archaeological
EDK32	-13.90119 South 32.02446 East	Grinding stone	Archaeological

The National Heritage Conservation Commission (NHCC) are reportedly interested in declaring part of the landscape in the area as a National Monument for the role that it plays in attracting and uniting people from three countries based on the Chewa ethnicity and the rich historical background of Mkaika Royal Place.

Buffer zones have been recommended around the existing residential areas, the royal palace, royal graveyards and community graveyards as these areas are associated with the emergence of the Gule Wamkulu “spirits”.

Preliminary observations from literatures and field surveys revealed no fossil finds and considering that the geology Project Site is not expected to yield any significant palaeontological resources.

Table 23: Summary of heritage features and their conservation significance

Feature ID	Description	Location	Conservation / Preservation Importance	Legally Protected	Permit Required for Removal/ Alteration	Local Importance	National Importance	International Importance (IFC and UNESCO standards)
EDK1	Gomani Village graveyard one (Tombs inside the trees)	-13.97479 South 32.15549 East	High	No	Yes	High	None	High
EDK2	Gomani Village graveyard two	-13.81718 South 32.09721 East	High	No	Yes	High	None	High
EDK3	Gomani village family graveyard three	-13.81849 South 32.09651 East	High	No	Yes	High	None	High
EDK4	Mukokeza village graveyard	-13.82111 South 32.09771 East	High	No	Yes	High	None	High
EDK5	Rare rock Mukokeza village	-13.82368 South 32.09921 East	High	No	No	High	Medium	Medium
EDK6	1964 graveyard	-13.85055 South 32.09334 East	High	No	Yes	High	None	High
EDK7	Chikumba Graveyard	-13.82388 South 32.09913 East	High	No	Yes	High	None	High
EDK8	Matunga Kopje	-13.83987 South 32.10969 East	High	Yes	Yes	Low	Undetermined	Low
EDK9	Gavine Road Kopje	-13.83494 South 32.12402 East	High	No	No	Low	Low	None
EDK10	Chibale Village graveyard	-13.8645 South 32.14563 East	Low	No	Yes	High	None	High
EDK11	Headman Matunga's Graveyard	-13.84102 South 32.15853 East	Low	No	Yes	High	None	High
EDK12	Chiswaswa Graveyard	-13.83594 South 32.15693 East	Low	No	Yes	High	None	High
EDK13	Anoya Zulu's Grave in Bulawayo village (UNIP activist)	-13.83588 South 32.15692 East	High	No	Yes	High	High	High
EDK14	Sizilu village headman graveyard	-13.85551 South 32.15671 East	High	No	Yes	High	None	High
EDK15	Iron Slug (laterite on sight too)	-13.870480 South 32.140490 East	Unknown	Unknown	Unknown	Low	Medium	Low

Feature ID	Description	Location	Conservation / Preservation Importance	Legally Protected	Permit Required for Removal/ Alteration	Local Importance	National Importance	International Importance (IFC and UNESCO standards)
EDK16	Graveyard	-13.86441 South 32.13779 East	High	No	Yes	High	None	High
EDK17	Kopjes in the area one on the far left has a cave underneath	-13.87133 South 32.13427 East	High	Yes	Yes	High	Low	Low
EDK18	Decorated potshed near the Kopje	-13.86988 South 32.1347 East	Low	Yes	Yes	Medium	High	Low
EDK19	Mumba village graveyard (3 villages)	-13.77633 South 32.02008 East	Medium	No	Yes	High	None	High
EDK20	Ntambwa Graveyard 1	-13.86411 South 32.11724 East	Medium	No	Yes	High	None	High
EDK21	Ntambwa graveyard 2	-13.86546 South 32.11538 East	High	No	Yes	High	None	High
EDK22	Ntambwa graveyard 3	-13.86635 South 32.11555 East	High	No	Yes	High	None	High
EDK23	Ngonye village graveyard	-13.84263 South 32.12148 East	High	No	Yes	High	None	High
EDK24	Katimbila village graveyard	-13.83146 South 32.11544 East	High	No	Yes	High	None	High
EDK25	Tinyakula Village graveyard	-13.81818 South 32.05085 East	High	No	Yes	High	None	High
EDK26	Mtonyo village graveyard	-13.83773 South 32.05271 East	High	No	Yes	High	None	High
EDK27	Quarrying area	-13.84806 South 32.06938 East	N/A	N/A	N/A	N/A	N/A	N/A
EDK28	Katandale village graveyard	-13.85157 South 32.07252 East	High	No	Yes	High	None	High
EDK29	Kazembe Hills village Graveyard	-13.88747 South 32.09679 East	High	No	Yes	High	None	High
EDK30	Royal Palace: Kulamba Ceremonial Arena	-13.98719 South 32.05128 East	High	No	Yes	High	High	Critical
EDK31	Mkaika Royal Graveyard	-13.98759 South 32.05070 East	High	No	Yes	High	High	Critical

Feature ID	Description	Location	Conservation / Preservation Importance	Legally Protected	Permit Required for Removal/ Alteration	Local Importance	National Importance	International Importance (IFC and UNESCO standards)
EDK32	Grinding stone	-13.90119 South 32.02446 East	High	Yes	Yes	Medium	High	Medium
EDK33	Mutachi village graveyard	-13.94374 South 32.0486 East	High	No	Yes	High	None	High
EDK34	Royal Palace at Mkaika	-13.987190 South 32.051284 East	High	No	Yes	High	High	Critical

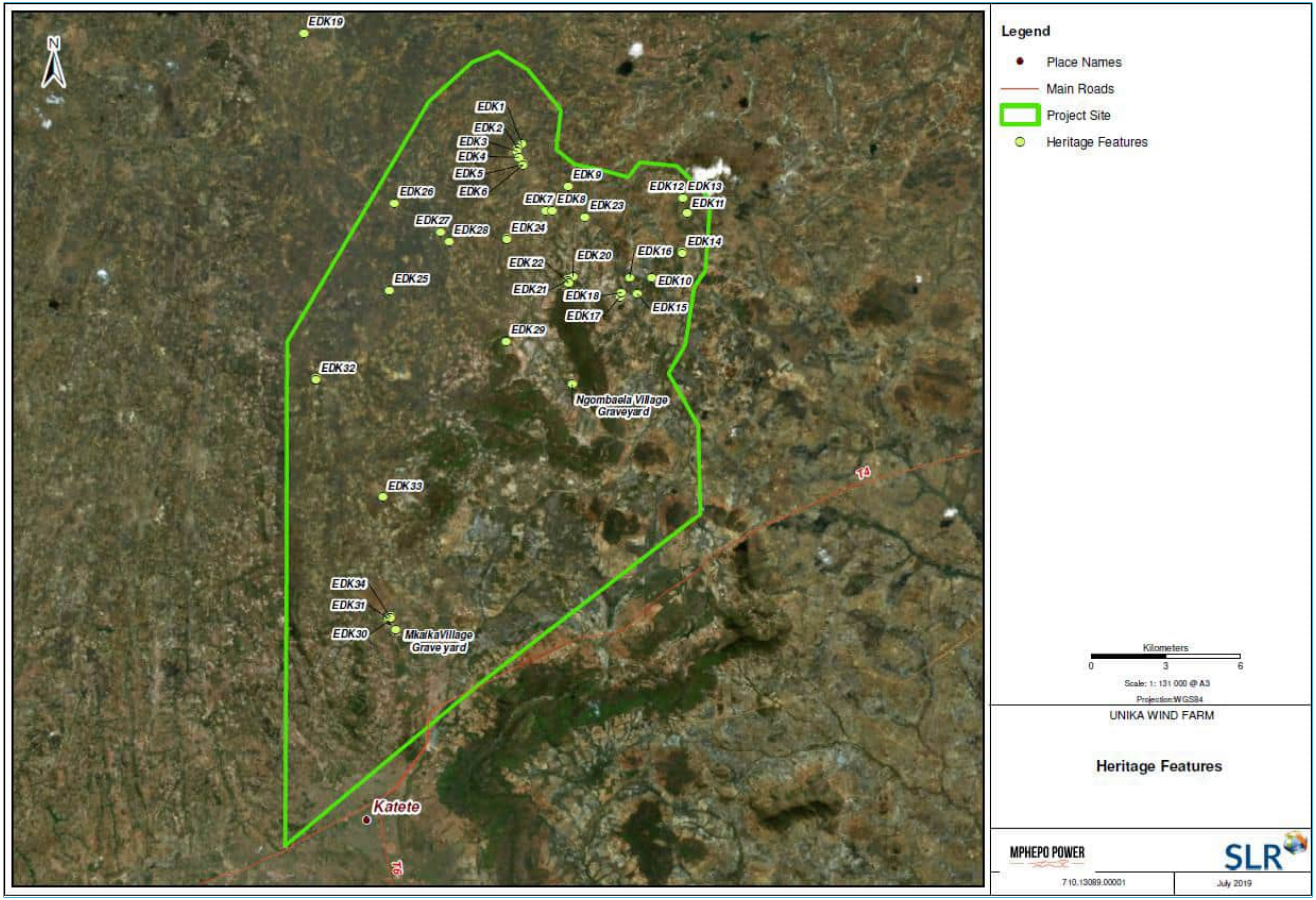

Figure 47: Locations of Heritage Features within the Project Site boundary

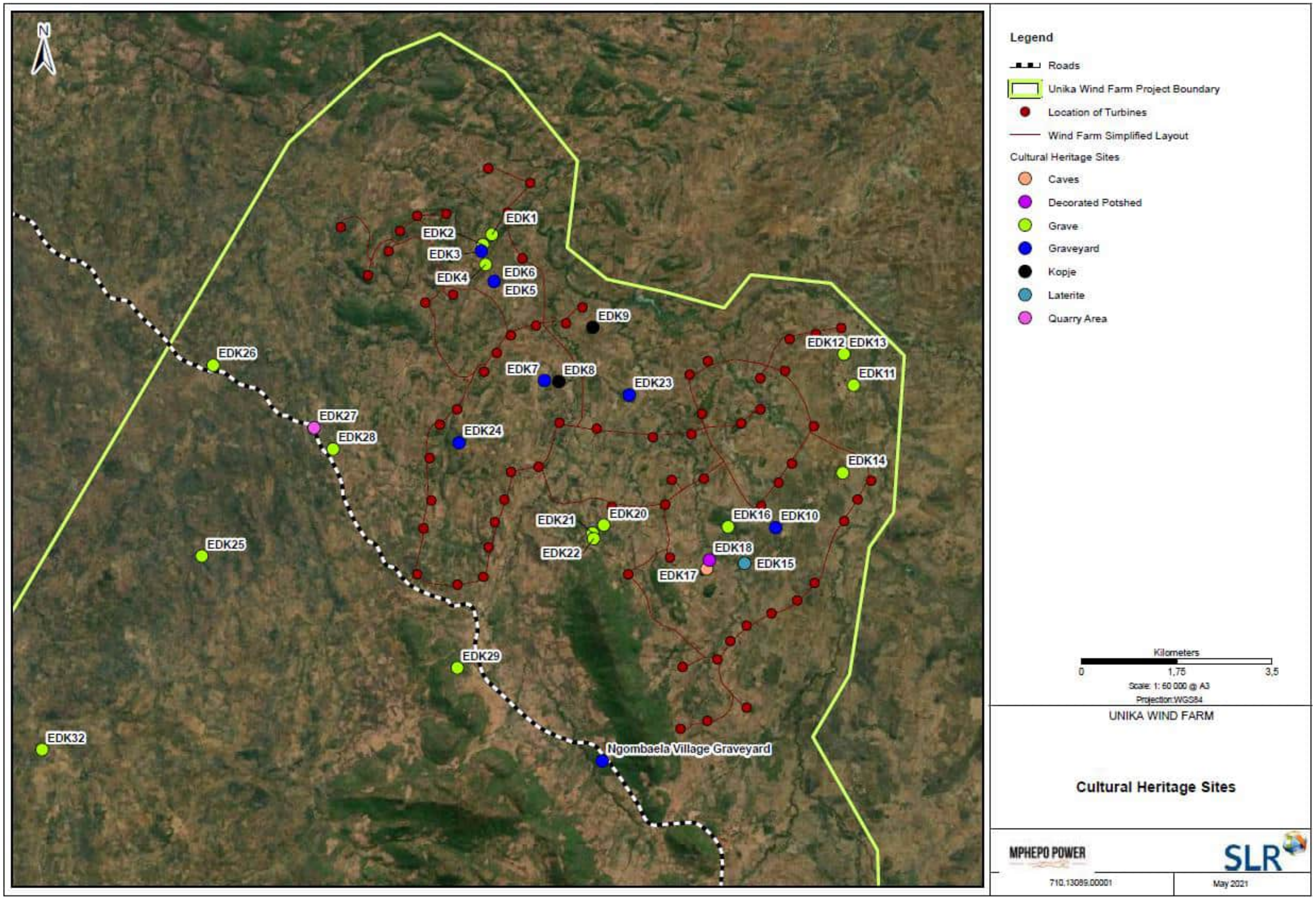

Figure 48: Locations of Heritage Features in relation to wind farm layout.

6.13 SOCIO-ECONOMIC ENVIRONMENT

6.13.1 Administrative Structure

The Project Site is located in the Katete District in the Eastern Province of Zambia. The area also falls directly on Chewa Traditional Establishment land and under one separate Chiefdomship.

The Katete District is formally administered by the District Council located at Katete Town. The town is located on the south-western boundary of the Project Site, and functions as the district administrative centre. The District Council is headed by District Council Chairman and assisted by the District Council Secretary and elected councillors. The mandate of the Council varies, but primarily concerns infrastructure development and management as well as local administration, while also supporting the offices of national government ministries.

Katete District is divided into 18 wards of which the Project Site is located in the Matunga, Mkaika and Mphangwe Wards. The Project Site encompasses major portions of the Matunga and Mkaika Wards, while the Mphangwe only extends into the southern boundaries of the Project Site and includes Katete Town.

Zambia supports a dual administrative structure comprised of formal government departments (i.e. the District Councils) and traditional structures. The traditional structures are founded on the Chewa Royal Establishment, which constitutes the Paramount Chief (or King), his advisors as well as a number of chiefs, indunas and headmen / headwomen.

The traditional administration in the area is a complex and interconnected set of relationships and responsibilities. The Paramount Chief/King is the overall leader of the Chewa Kingdom and is supported by the Chewa Royal Establishment and the Royal Council (including the royal family, chiefs and other functionaries).

The functions, powers and duties of the Paramount Chief are delegated to Chiefs, whom administer broad areas of the Kingdom (i.e. Chiefdoms). The Project is located in a single chiefdom under Chief M'bangombe, while the power transmission line may extend into an area located under Chieftainess Msoro. The chiefs are further supported by headmen/headwomen that administer one or more villages. The Chief and headmen may also be supported by indunas which function as advisors but have no specific powers.

The areas controlled by the different headmen/headwomen is fluid. Headmen/headwomen are often selected based on their ties with major or founding clans of their respective villages. The headmen/headwomen provide direct administrative functions at the village level, and therefore play a direct role in supporting individual households as well as the administration of land.

<u>The land required by the Project falls under customary tenure and is mostly comprised of small-scale farmland held under exclusive rights by an individual. Although not a major land-use by total area, there are also numerous rural settlements within the study area. All land not under settlements or farmland is defined as communal land, which falls under the direct authority of the traditional authorities (the Chewa Royal Establishment). No individual has exclusive rights to communal land, and all resources (including fruit trees, water, grazing land etc.) are shared as a common resource</u>.

6.13.2 Population Demographics

Population Statistics

The Katete District supports a total population of 243 849 persons in 2010 (See Table 24) while the three wards that intersect with the Project Site support 20 % (49 690 persons) of the district population. With a predicted growth rate of 2.6 % per annum (Central Statistics Office of Zambia, 2012), the total district population is expected to be 307 218 in 2019, with similar increase for the three wards.

Table 24: Population Profile

Administrative Division	Census 2010	Projected	Pop. Density

	Males	Females	Total	Population (2019)	(persons/km^2)
Katete District	119 995	123 854	243 849	307 218	61.1
Matunga Ward	3 159	3 270	6 429	8 100	38.7
Mkaika Ward	11 961	12 210	24 171	30 452	61.2
Mphangwe Ward	9 379	9 711	19 090	24 051	136.4

Source: (Central Statistics Office of Zambia, 2012)

The population density for the Katete District is 61.1 persons per km^2. There is however greater variation in population density between the three wards. The Matunga Ward has half of the district population density, which is attributed to the low density and isolated nature of many of the villages in the ward. Mphangwe Ward has a higher population density as Katete Town is located within this ward and supports a much larger resident population.

The district population will be resident in either urban or rural areas, with the greater proportion (87 %) of the district population being resident in rural areas (Table 25). There is however clear differentiation between the three target wards. The Matunga and Mkaika Wards support a near exclusive rural population and are characteristic of the typical population patterns found in the Project Site.

Table 25: Urban / Rural Divide as a Percent of Total Population

Administrative Division	Urban	Rural	Total
Katete District	13	87	100
Matunga Ward	0	100	100
Mkaika Ward	7	93	100
Mphangwe Ward	85	15	100

Source: (Central Statistics Office of Zambia, 2012)

The average household size is 5.2 persons per households for the Katete District, and this is similar in the three wards the cover the Project Site (Table 26). Interviews with local headmen / headwomen confirm that households in their villages have, on average, 5 persons, which matches with district statistics. A typical household in the Project Site is therefore comprised of a typical nuclear family, or the father, mother and 2 to 3 children, while some households will also support grandparents and grand-children.

Table 26: Household Size

Administrative Division	Total Population	Total Households	Household Size
Katete District	243 849	46 852	5.2
Matunga Ward	6 429	1 206	5.3
Mkaika Ward	24 171	4 733	5.1
Mphangwe Ward	19 090	3 785	5.0

Source: (Central Statistics Office of Zambia, 2012)

A single-family retaining use of a single homestead is by far the most common form of household, as confirmed during local interviews. However, there are also some compound homesteads although this is rare. Such households comprise of a large extended family on a single plot. The extended family comprises of a senior male (usually the grandfather) whom retains ownership of the land and his own household assets, while young adult sons and daughters may divide into separate households upon marriage but remain on their father's land.

Age and Gender Composition

The age and gender profile of the District and targeted wards are presented in Table 27. The total population is relatively young with just under half being below the age of 14 years. The only real variation is the slightly higher proportion of persons above 14 years in the Mphangwe Ward. As this ward contains Katete Town, the greater proportion of adults is likely attributed to either improved living conditions or in-migration of young adults into the town.

Table 27: Age and Gender Profile as Percent of Population

Administrative Division	% of Males			% of Females			Total (%)		
	0-14	15-34	> 35	0-14	15-34	> 35	0-14	15-34	> 35
Katete District	48	33	19	47	33	20	48	33	19
Matunga Ward	50	31	20	47	33	20	48	32	20
Mkaika Ward	49	32	19	46	33	20	47	33	20
Mphangwe Ward	43	39	18	42	41	17	43	40	17

Source: (Central Statistics Office of Zambia, 2012)

Literacy & Education

Adult literacy rates are poor with between 44 to 46 % of the adult population (aged between 25 to 54 years of age) having never attended school (Table 28), while illiteracy rates increase significantly for persons above the age of 55. This trend is likely reflective of the limited access to and prioritisation of education in the past, however there is some improvement in education enrolment for younger age groups.

Table 28: Percent of Population (above the age of 5) by School Attendance

Age Group	Currently Attending			Not Currently Attending			Never Attended
	Male	Female	Total	Male	Female	Total	
5 to 9	10	13	22	1	1	1	76
10 to 14	28	33	62	3	3	6	33
15 to 19	28	22	50	8	14	23	27
20 to 24	10	4	14	21	27	48	38
25 to 29	2	1	3	26	27	53	44
30 to 34	1	1	2	30	25	54	44
35 to 39	1	1	2	29	23	52	47
40 to 44	1	1	1	29	23	52	46
45 to 49	1	1	1	31	23	54	45
50 to 54	1	1	1	29	24	53	46
Great than 55	1	1	1	23	15	38	61

Age Group	Currently Attending			Not Currently Attending			Never Attended
	Male	Female	Total	Male	Female	Total	
Total	**12**	**12**	**24**	**15**	**14**	**29**	**47**

Source: (Central Statistics Office of Zambia, 2012)

Enrolments rates of children of schooling going age (between 5 and 18 years of age) indicates that at least a third had not received any form of education in 2010 (Table 29), and this remains a major social challenge in the Project Site. Enrolment in primary school sits around 62% while enrolments in secondary schools are around 50% of the relevant age groups.

Discussion with district authorities and local leadership shows a complex range of issues in terms of gender and education. Young boys and girls are usually enrolled in education, however young boys (aged between 6 - 11 years) may be held back to function as herd-boys with a result of young girls generally receiving a better education. However, once girls enter puberty (aged around 14 years) school drop-out increases significantly largely in response to household care needs as well as a common challenge of child-brides in the region.

The maximum education achievement rates for the district population in 2010 are presented in Table 29 below. There is a noticeable education ceiling reached at Grade 7, with the majority of the district population (75 %) reaching only Grade 7 or below. Grade 7 is the end of primary school level education, with few people continuing on to complete Secondary level education.

Schools noted in the area include Walubwe Primary, Chamalaza Primary, Gaveni Primary, Matunga Primary, Matunga Day Secondary, Kafupa Primary and Chizuzu Primary.

Table 29: Percent of Population (above the age of 5) by Highest Level of Education

Grade	Male	Female	Total
No Grade	2	2	3
1	4	5	9
2	5	6	10
3	5	6	10
4	5	6	11
5	5	5	10
6	5	5	10
7	7	6	12
8	4	3	7
9	4	3	7
10	1	1	2
11	1	0	1
12	2	1	4
Tertiary	2	1	3

Source: (Central Statistics Office of Zambia, 2012)

The low attendance rates at secondary schools are in part to the limited number and costs of attending secondary schools, whereas primary schools are more common and more importantly free. However, there is also a high and consistent drop-out rate of boys and girls throughout the different grades, and interviews attribute drop-outs to child marriages, the need to support household, or lack of interest or perceived value of both parents and children.

Ethno-Linguistic Profile

Zambian supports approximately 72 ethnic groups, with almost 90% of Zambians belonging to the nine main ethno-linguistic groups: the Nyanja-Chewa, Bemba, Tonga, Tumbuka, Lunda, Luvale, Kaonde, Nkoya and Lozi. The population of the Katete District are near exclusively comprised of the Eastern Province (Nyanja speaking) Ethnic Groups and more specifically the Chewa Ethnic Group (Table 30)

Table 30: Percent of Total Population by Ethnic Background

Language Group	Male	Female	Total
Northern and Luapula Province (Bemba Speaking)	0.5	0.5	1.0
Southern and Central Province (Tonga Speaking)	0.2	0.2	0.4
North Western Province Ethnic Groups	0.1	0.1	0.1
Western Province Ethnic Groups	0.2	0.2	0.4
Eastern Province (Nyanja speaking) Groups	47.8	50.2	98.0
Chewa	43.9	46.0	89.9
Nsenga	0.9	1.1	2.0
Ngoni	1.6	1.6	3.2
Nyanja	0.3	0.3	0.6
Kunda	0.5	0.6	1.1
Chikunda	0.1	0.1	0.1
Tumbuka	0.5	0.5	0.9
Senga	0.1	0.1	0.2
Yombe	0.0	0.0	0.0
Northern and Muchinga Province (Mambwe speaking) Groups	0.1	0.1	0.2
Total	**48.8**	**51.2**	**100.0**

Source: (Central Statistics Office of Zambia, 2012)

The Chewa Ethnic Group accounts for 7.5% of the national population, and 40% of the provincial population. As such, the Chewa forms the provincial majority and is not an ethnic minority. The remaining population is comprised of different ethnic groups under the Eastern Province (Nyanja speaking) Ethnic Group, which overall belong to local ethnic majority groups (including Bemba).

Broadly speaking, none of the above groups are considered to be “indigenous peoples” based on the general definitions of such people under the IFC Performance Standard 7. The noted groups are either ethnic majorities in the Eastern Province, or from majority ethnic groups in neighbouring provinces. In general, no indigenous peoples have been identified in broader Zambia that would be relevant to the Project.

Zambia provides protection for minority groups and there is limited systemic discrimination. Interviews with the District Authorities suggest that there are no ethnic or cultural tensions in the District, and in general the relationship between ethnic groups is good. In many cases, ethnic minorities are related to economic migrants from Mozambique and Malawi that provide key skills and basic labour that is generally welcomed by local people. Nevertheless, economic migrants are restricted from obtaining land from the traditional authorities.

6.13.3 Livelihoods

Employment Profile

Of the total district population, 74 % define themselves as falling into the economically active group, or persons that are older than 12 years of age and available for casual of formal work (Table 31). Formal or casual wage employment is only secured by 3 % of the district population, while the majority of economically active people are either self-employed or unpaid family-workers.

These two latter groups do not fall into the traditional interpretation of employment, and in reality, are family members of small-scale farming households. Formal employment from local agriculture is negligible if non-existent, and farm-based employment is largely restricted to households farming their own land, via provision of labour support by both male and female family members, while seasonal casual labour may be used by local households.

Table 31: Percent of Total Population (Above the Age of 12) by Economic Status

Employment Status	Male	Female	Total
Economically Active Group	36	38	74
Employer	0	0	0
Employee	2	1	3
Self-Employed	23	17	40
Unpaid Family Worker	11	20	31
Unemployed (Seeking Work)	1	1	1
Unemployed (Not Seeking Work)	1	1	1
Economically Inactive Group	11	13	23
Total	48	52	100

Source: (Central Statistics Office of Zambia, 2012)

The dominance of small-scale farming in the District is similarly reflected in Table 32. The majority of the total economically active workforce (89 %) falls into the Agriculture, Hunting, Forestry and Fishing industry sector. Forestry and fishing provides minimal contributions, while all other industry sectors in combination contribute only 11 % of the total employment. This includes manufacturing, construction, trade and accommodation and transport, and government functions. These activities will be restricted to trade and services provided in Katete Town.

Table 32: Percent of District Workforce by Industry Sector

Industry Sector	Male	Female	Total
Agriculture, Hunting, Forestry and Fishing	42	47	89
Mining and Quarrying	0	0	0
Manufacturing	1	0	1
Electricity Gas Steam and Air Conditioning Supply	0	0	0
Water Supply	0	0	0

Industry Sector	Male	Female	Total
Construction and Allied Repairs	1	0	1
Wholesale, Retail Trade, Restaurants and Hotel	1	1	2
Transport and Storage	1	0	1
Accommodation and Food Services	0	0	0
Information and Communication	0	0	0
Finance and Insurance	0	0	0
Real Estate	0	0	0
Community, Social and Personal Services	2	1	2
Not Stated	1	2	3
Total	**48**	**52**	**100**

Source: (Central Statistics Office of Zambia, 2012)

Small-Scale Farming

According to Census 2010 data 92% of all households located in the Katete District engaged in some form of agriculture in the 12-months preceding the Census. Such farming tends to be small-scale and informal with the primary aim of securing household food needs and trade in surplus produce. There is no evidence of large to medium commercial farming operations within the Project Site, although farming undertaken by the local Military Units may be treated as quasi-commercial.

Interview with local leaders suggest that the average farmland holdings is 2 hectares per household. Farmland is allocated by major land-holdings clans and headmen/headwomen to individuals, and these holdings are inherited from father to sons. In many cases, any inherited land is granted equally to all sons (but excludes sisters) rather than the eldest. This has resulted in the division of land-holdings into smaller plots through multiple generations.

Interviews with local leaders suggest that the farmland is usually farmed in its entirety, and little land is left fallow or under some form of rotation. Portions of farmland may only be farmed where it is deemed sufficient to support household food needs, while the remaining farmland may be allocated to cash crops or left fallow until the following year. Interviews suggest that fallow land is rare, due to local culture where any fallow land suggests that the landowner is lazy or has been granted too much land. Both such rumours tend to be avoided by local households where possible.

Interviews indicate that staple crops for local households are maize, with sunflower, cotton and groundnuts functioning as important secondary crops. This largely reflects the same crop diversity farmed by households in 2010 in the Katete District (Table 33). The majority (91 %) of households grow maize as their primary crop. Groundnuts, sunflower, cotton, sweet potato is also commonly grown. Other important crops include vegetables, sugar cane and cassava.

Table 33: Percent of District Households by Cultivated Crop Type and Typical Yields

Crop Type	Households	
	No	%
Maize	42 715	91
Groundnuts	31 432	67
Sunflower	23 204	50
Cotton	21 823	47

Crop Type	Households	
	No	%
Sweet Potato	16 555	35
Mixed Vegetables	10 992	23
Mixed Beans	9 014	19
Cow Peas	7 870	17
Sugar Cane	6 439	14
Cassava	4 591	10
Other Crops	3 313	7

Source: (Central Statistics Office of Zambia, 2012)

It is noted that local households also grow a mixed diversity of vegetables (Table 33). This is related to a clear divide between what may be termed dryland farming and vegetable gardens as detailed below in Figure 49.

Figure 49: Images of Dryland Farm plots and Vegetable Gardens

1. **Dryland Farmland:** This type of farmland entails relatively large (interviews suggest average fields holdings of around 2 hectares) farm plots located on slightly elevated land away from local streams and may even extend up into the local hills. These farm plots comprise the major landholdings of local households and are near exclusively comprised of maize, cotton and sunflower with some secondary crops. Interviews suggest that most of the land is farmed and rotation farming / fallow land is largely non-existent, suggesting that land will be under pressure from over-use. Depending on the unique characteristics of each household and their total landholdings, most will farm maize that is just enough to feed their households with some surplus for trade. The remaining land is either not used or is planted with a diversity of other crops (notably sunflower and groundnuts) that protects households from shocks from maize losses as well as permitting some additional trade in produce. Dryland farming, irrespective of the crop, is undertaken at a very specific season (See Table 34). Land preparation and planting is undertaken between October and December and coincides with the seasonal rains. Harvesting is undertaken around May of the following year.

2. **Vegetable Gardens:** Vegetable gardens are restricted to local rivers, streams, drainage lines or dambos (or any drainage feature that sustains water during the dry season). The gardens are normally very small (on average 40 metres squared) relative to the dryland farm plots. The gardens are predominately used to grow high-value and water-hungry vegetables (including tomato, onion, water melon, and other mixed vegetables). The cropping season for vegetables is almost an inverse of the dryland crops (Table 34). The gardens are not farmed during the rainfall seasons as they are usually flooded or water-logged. Land preparation and planting is undertaken in around June, and just after the harvest of the dryland crops. The harvesting of the crops, depending on crop type, extends over July to September.

The two cropping seasons also permit a clear distribution of labour. Preparation for vegetables gardens occurs immediately after the harvesting of the dryland crops and when household labour is readily available. The harvesting of any gardens crops occurs before the need to prepare the dryland farm plots for the next season.

Analysis of latest available crop forecast data covering the staple crop of maize in year 2017/2018 shows that the expected yields for the Katete District, and by extension the households within the Project Site, is only 1.60 tonnes per hectare (Table 35). There are however clear seasonal differences with the 2016/2017 yields predicted at 2.20 tonnes per hectare.

In comparison, the expected yields for Zambia as a whole and the Eastern Province is 2.12 and 2.25 tonnes per hectare respectively for the 2016/2017 season. The Katete District yield is therefore similar to both national and provincial norms, but tends to be lower when compared its immediate neighbouring districts.

Table 34: Cropping Calendar

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dryland / Upland Crops												
Land Preparation												
Planting												
Tending												
Harvesting												
Fallow												
Dambo Crops / Garden Crops												
Land Preparation												
Planting												

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tending												
Harvesting												
Fallow												
Rainfall Seasons												
High / Wet Season												
Medium												
Low / Dry Season												

Table 35: District Estimates on Crop Yields and Utilisation

Crop	Unit	Crop Yield				Use of Crop (2017/2018)	
		2016/17	2017/18	2016/17	2017/18	Home Food	Sale / Trade
		50 kg bags/Ha		Tonnes/Ha		%	
Maize	x 50 Kg	44	32	2.20	1.60	60	40
Groundnuts	x 50 Kg	17	14	0.85	0.70	60	40
Soybeans	x 50 Kg	15	13	0.75	0.65	20	80
Mixed beans	x 50 Kg	5	4	0.25	0.20	30	70
Cotton	MT	0.54	0.5	0.03	0.03	0	100
Sunflower	x 50 Kg	21	18	1.05	0.90	40	60
Cowpea	x 50 Kg	13	9	0.65	0.45	60	40
Irish Potatoes	MT	5	3	0.25	0.15	39	61
Sweet Potatoes	MT	6.5	6.0	0.33	0.30	40	60
Cassava	MT	3.8	3.5	0.19	0.18	40	60
Tobacco	MT	0.8	0.8	0.04	0.04	0	100
Rice	x 50 Kg	4	2	0.20	0.10	60	40

Source: District Agricultural Office, n.d.

Interviews indicate that households farm crops to secure household food needs first, and any surplus is then traded. Trade in surplus is fairly common, however interviews suggest that the net total volumes are low, but this will vary by household. District estimates are that 40% of the district total produce is allocated to trade, but interviews suggest that it is likely to be lower.

Interviews suggest that the sale of surplus produce is largely targeted towards local bulk buyers or the government (under the food reserve programme) that visit the villages. In limited cases, households may transport their produce to Katete and Chipata, however this incurs additional travel time.

Interviews indicate that bulk buyers may buy crops, however at heavily discounted prices (half of the market price) while households receive market related prices from both traders in Katete Town and from the Government. The markets rates for the primary staple crops is presented in Table 36. The typical income generated by a household for a 50kg bag of maize will vary from 50 to 100 Kwacha. Assuming that only 40% of total produce is sold and the household excessively farms maize, a typical household would earn between Kwacha 1 200 to 3 520 for a season's surplus produce from 2 hectares of land.

Table 36: Markets Rates in Kwacha (ZMW) for Selected Crops

Crop	Market Rate Per Kilogram			Market Rate Per Typical 50kg Bag		
	2016	2017	2018	2016	2017	2018
Maize	1 -2	1 -2	1 -2	50 - 100	50 - 100	50 - 100
Groundnuts	5 - 10	4 -5	4 -5	250 - 500	200 - 250	200 - 250
Soybeans	5 - 7	4 -5	4 -5	250 - 350	200 - 250	200 - 250
Sunflower	1.5 - 2	1.5 - 2.5	2 - 3	75 – 100	75 - 125	100 - 150

Source: District Agricultural Office, n.d.

The division of labour in farming is shared between the household males and females with some support from children, while there may be the use of casual labour. Males largely contribute in the clearing of trees and vegetation as well as ploughing with oxen. Women focus on hand-ploughing, sowing, tending, irrigating, and harvesting of crops. Casual labour is generally comprised of hiring local young adults during the labour-intensive land clearing and preparation that extends over October to December.

The division of labour tends to be weighted toward women with most of the post-land preparation activities being undertaken by women with some support from males and children. Harvesting of the crops is undertaken by women, with men assisting in the transport of crops to the homestead. Both men and women can be involved in the sale of agricultural produce.

Interviews note that storage of produce is problematic, although this varies by household and the level of care given to storage. Most produce is stored in thatch or reed storage bins or in large bags. Both are however prone to losses from weevils and rats as well as rot. The former two may result in the loss of around 10 to 20 % of produce, while households may lose around 5 % of produce to rot.

Local farming is generally thought to be purely subsistence farming, where crops are used to secure household food needs. However, this is not strictly true as households engage in farming to first secure household food needs, and then engage in some degree of trade in produce.

The proportion of crops that is allocated for consumption and trade varies based on the levels of surplus food available throughout the year, and interviews note that a significant challenge is crop price fluctuations during the year. The lowest prices for crops just after the crop harvests where there is an oversupply in produce in the national and local markets. The highest crop prices occur just prior to the next season's harvest where surplus crops are the lowest in local markets. The latter is normally at the same time as where households are at their lowest in terms of food reserves, and households are rarely are able to benefit from the higher rates.

Livestock Grazing

According to the Census Statistics (Table 37), 77% of all households located in the Katete District engaged in livestock or poultry rearing in the 12-months preceding the 2010 Census. Chicken, pigs, goats and cattle were the main livestock that are reared, and this remains the case within the Project Site.

Table 37: Percent of District Households by Livestock Holding Type

Livestock Type	Households	
	No	%
Cattle	18 965	40
Goats	9 802	21
Pigs	21 997	47
Sheep	320	1
Donkeys	130	0
Chickens	28 362	61
Other Poultry	2 104	4
Other Livestock	1 382	3

Source: (Central Statistics Office of Zambia, 2012)

Interviews indicate that local households rear chicken, pigs and goats mostly to secure household food needs, and would function as a primary source of protein. Cattle are commonly reared for the primary function of accumulating household wealth; however, cattle are also used for ploughing and carting.

Grazing of small livestock is undertaken near the home as chickens, pigs and goats are allowed to range at random. With respect to cattle, there are no communal grazing areas and cattle are grazed at random on community land in and around local villages. Livestock are actively herded by men/boys during the day before returning to the home where the cattle are penned in informal corrals.

Interviews with the District officials indicated that livestock play a primary role for local households, however most livestock numbers of kept low due to a number of diseases, specifically Newcastle disease (chickens), African Swine Flu (pigs) and East Coast Flu (cattle).

6.13.4 Housing and Household Structures

Households within the Katete District are predominately rural with a smaller percentage of urban households. Rural households are generally clustered into small rural villages or as isolated farmsteads, and support between 1 to 3 structures per household, generally comprising of a main house, secondary bedroom and kitchen, however pit latrines and storage sheds are also common (Figure 50).

Of the structures, most (54%) are constructed with traditional materials (including mud or burnt mud bricks, grass or thatch roofing, compacted mud or earth floors) while an additional 31% of structures have a mix of traditional and modern materials (i.e. corrugated iron roof) (Table 38). Only 11% of all structures are constructed of conventional or modern standards, and this is likely limited to Katete Town.

Table 38: Count and Percent of Household Structures by Type

Type of Housing Structure	Household Structures	
	Count	Percent
Traditional Structures	26 642	54
Improved Traditional Structures	15 377	31
Mixed Structures	1 601	3

Type of Housing Structure	Household Structures	
	Count	Percent
Conventional Flat	723	1
Conventional House	4 568	9
Commercial Building	356	1
Improvised / Makeshift Building	19	0
Collective / Institutional Quarters	54	0
Unintended	32	0
Other	24	0
Total	**49 402**	100

Source: (Central Statistics Office of Zambia, 2012)

The profile presented above is reflected in the homesteads present in the Project Site. Households tend to be clustered into villages with homestead blending into the next homestead. Most households have a main residential structure/main home that is primarily used for sleeping, while cooking is either undertaken in the open or in a separate free standing rondavel. Most households also retain at least one poultry coup and grain store, while households with livestock will also establish small corrals.

Figure 50: Typical Examples of Homesteads and Homestead Structures

6.13.5 Basic Services

There was limited electrical infrastructure in the Project Site in 2010, and there has been little further development of infrastructure outside of Katete Town. Candles, paraffin and other fuels sources are primarily used by district households for lighting, while only 3.4 % of households have access to electricity.

The Project Site does support a distribution line established by ZESCO. This link provides connections for some households in village that are in proximity to the line. However, the majority of households in the Project Site do not have power, and are reliant on firewood, charcoal and other fuels for cooking and lighting.

The primary fuels used by District Households for cooking profiled are wood (88.7 %) and charcoal (8.4 %), while only 2.2 % of district households utilise electricity. Firewood remains the primary fuel and is collected from the open bush surrounding communities, while local trees are cut down for charcoal production.

There was a limited diversity of water sources used by District households in 2010, with the majority (85 %) of households securing water from boreholes or wells. A further 11 % of households obtained water from rivers, dam and streams, although this is limited to households that do not have access to private or communal boreholes or wells. Only 2.7 % of district households had access to piped water; however this is limited to Katete Town.

Villages within the Project Site largely reflect the district level patterns in terms of access to water. Water is nearly exclusively obtained from community boreholes that have been established by the Government in the larger or medium sized villages, while the smaller hamlets and isolated farmsteads will likely obtain water from natural sources or hand-dug wells.

Basic sanitation in the Katete District in 2010 was predominately comprised of unimproved pit latrines, which was used by 45 % of the district households. The remaining households (52 % of households) claim to have no formal or informal sanitation, and therefore rely on the local bush.

Interviews with local headmen and ward councillors indicate that there has been improvement in the use of pit latrines over the last 10 years, however most are unimproved pit latrines constructed by local households. The pit latrines constructed by local households are also prone to collapse, and often they are abandoned in favour of using the bush.

There were limited formalised waste management practices in the District in 2010, and there has been limited further development over the last decade. District households are largely dependent on disposal of waste in community or private open pits (46% of households), while burning and street dumping is regularly used by 35% of district households. Only 2.9% have formal waste collection and again this is likely limited to Katete Town.

6.13.6 Social Institutions and NGOs

There is little in the way of public facilities (outside of schools and shops) and services in local villages in the Project Site, and the level of service will vary from village to village. In many cases, households are required to travel to neighbouring villages to access basic facilities, while core services (including formal administrative functions, secondary schooling, hospitals, cemeteries, markets, police stations, and markets) are concentrated in Katete.

For emergencies, local households are required to take a 50-kilometre round trip to the St. Francis hospital in Katete Town.

Tikondane, or Tiko, is a non-profit, non-political, interdenominational, community-based organisation centred in Eastern Province in Zambia. Their mission is to fight poverty in the Katete area of eastern Zambia through better education, health and entrepreneurship. In addition, it is understood that the NGO *Society for Woman and AIDS in Zambia* (SWAAZ) is working with traditional leaders to fight early marriages and teenage pregnancies amounts the youth.

6.13.7 Access and Mobility

The Project Site is located just north (within 1 km along some sections) of the Great East Way (T4), while inside the Project Site there is one District (D-road) and several rural roads (R or U-Roads) as depicted in Figure 51 below. These are gazetted roads maintained by the District Council and the Zambian Road Development Agency.

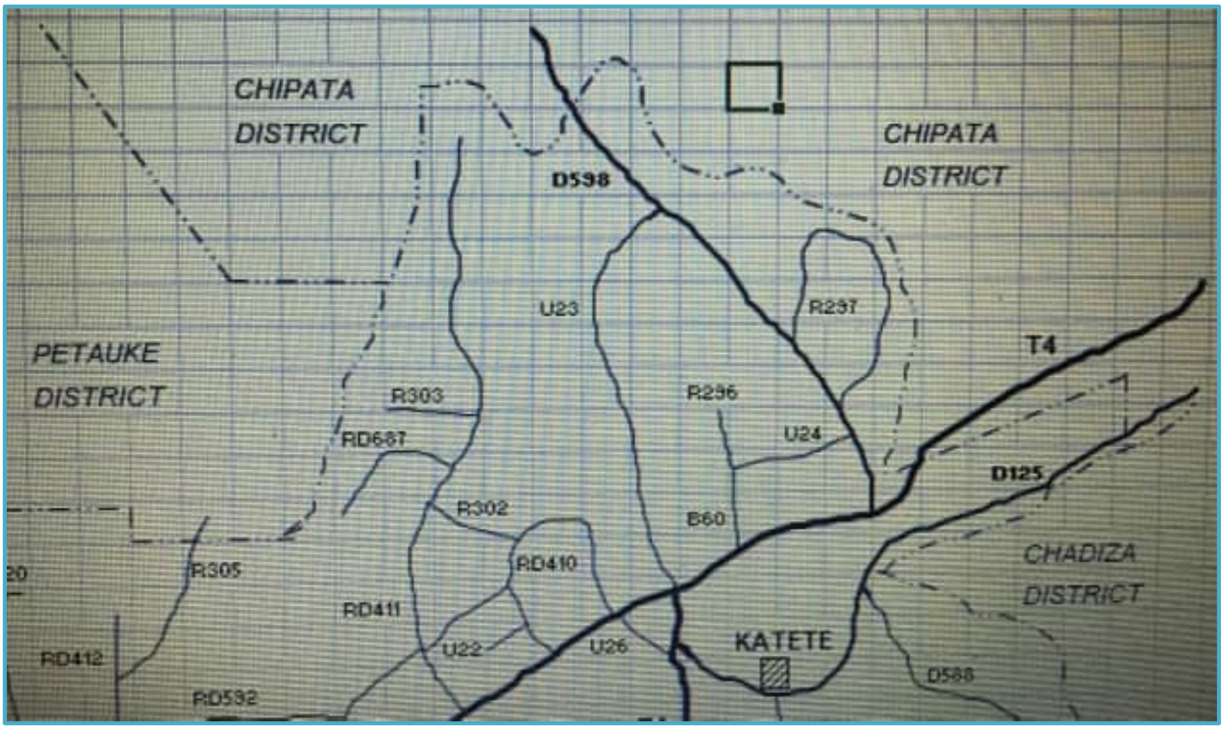

Figure 51: Road Network as provided by the Katete Town Council

The D598 is the primary access road into the Project Site and is in poor condition. This is equally applicable to the rural areas that connect the various villages (see Figure 52). Interviews with local authorities and leadership repeatedly cite the need for repairs and maintenance, and many stakeholders envision this being a key potential benefit of the Project.

In addition to the gazetted roads, there is a network of community roads/tracks. These tracks are central in terms of connecting smaller village to larger villages as well as to existing district and rural roads. These roads are constructed by local communities and have no specific design standard, and will vary in terms of width, quality and condition from good gravel roads to limited cart tracks. A key aspect of these roads is that they extend directly into villages and often cross and wind through individual households.

Interviews indicate that only a few households own their own vehicles. Mobility and movement along the roads are predominantly pedestrians, bicycles or cart-drawn carriages between nearby villages, while local communities utilise taxi's and motorcycle taxis to reach further areas such as Katete Town.

Interviews suggest that transport is expensive therefore most people do not leave their village on a regular basis. Rather transport will be used only when there is a need to reach community services in nearby villages or Katete Town. Some households will also transport goods (such as charcoal or crop produce) to major markets in the area notably Katete Town, as they will obtain better prices.

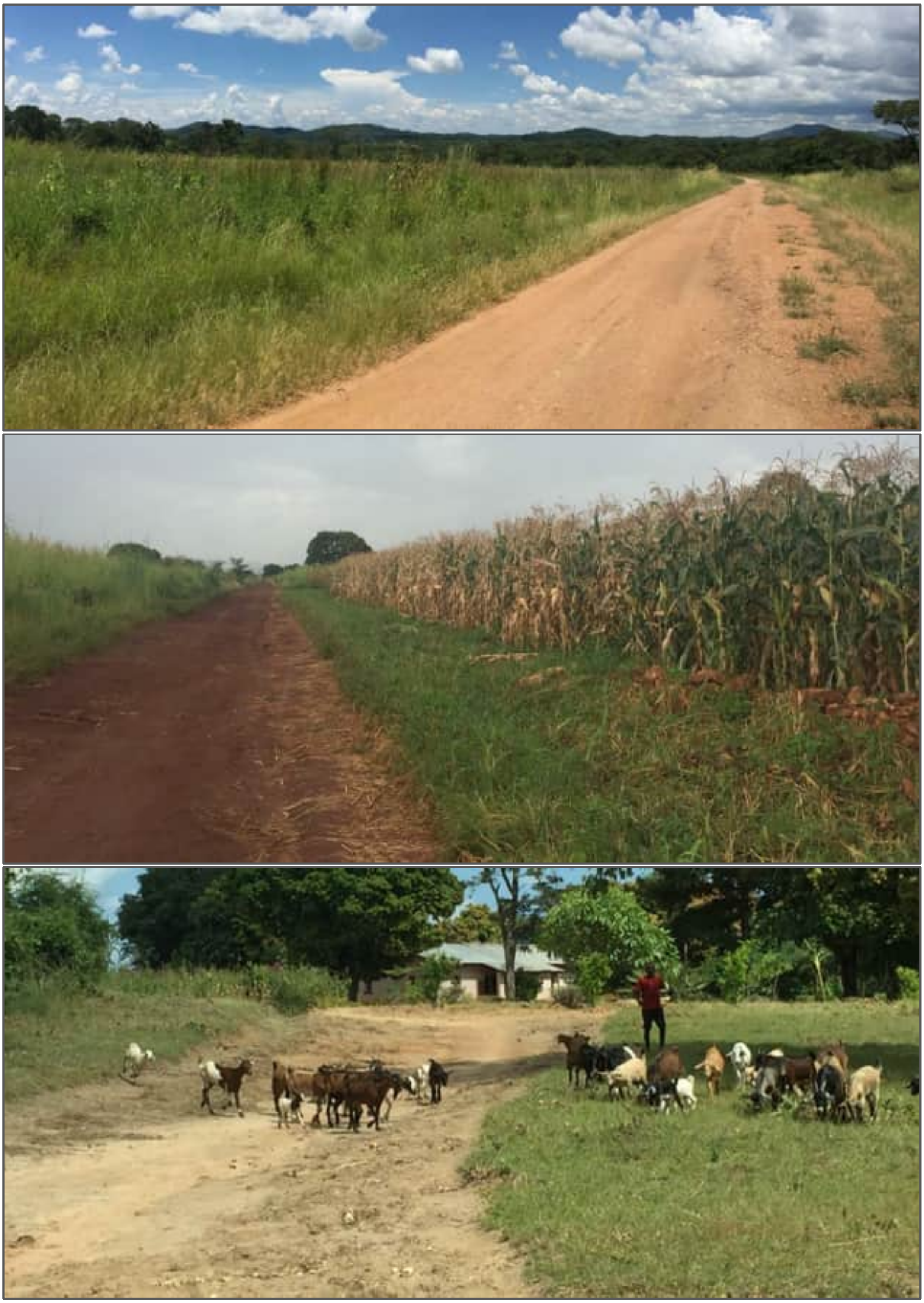

Figure 52: Images of typical Roads Present in the Project Site

6.13.8 Vulnerable People

Vulnerable People is a term given to individuals, households, or groups of people that may be disproportionately affected by a Project based on their gender, ethnicity, age, physical or mental disability, economic disadvantage, or social status within their community. For the purposes of the Social Impact Assessment, vulnerable people have been identified as follows:

1. **Elderly Households with Limited Support:** Elderly headed households (older than 65 years of age) or where the household is comprised of elderly, who have no or marginal support from economically active (able adults) family members. However, some caution is needed, as some households may be headed by an elderly patriarch or matriarch with substantive support of able adult sons and daughters.

2. **Female-headed or Female-Only Households:** While the rights for women are protected under law in Zambia, local customary rights (notably those linked to land) may undermine those rights, while the lack of able adult males often limits household productivity and income. However, some caution is needed, as some households headed by women are not automatically vulnerable as they may be headed by a matriarch with substantive support of able adult sons and daughters. Interviews with the District Social Welfare office indicated that female-headed households are very vulnerable. This stems from a range of issues, but specifically the predominance of child-marriages and high divorce rates. In addition, women's right to land is tenuous and may often be undermined where there is no male head and no clear line of inheritance from father to son. Land ownership is entirely patriarchal, and where the male head as passed females may be evicted from their home or land by the male's clan or extended family.

3. **Child-Headed Households:** The vulnerable group covers cases where the household head is below the age of 18 and has no or marginal support from an economically active (adult) family member.

4. **Persons with Disabilities or Long-Term Illnesses:** Households where one or more household members are defined as disabled (including physical, mental, and long-term illness) are potentially vulnerable.

5. **Landless:** Agriculture is the primary livelihood strategy adopted by local households. Therefore, households without claim to land are potentially vulnerable as their ability to generate food and income is undermined. Interviews suggest that often landless households are headed by females, as their rights to land may be undermined or entirely removed once their husband has passed away or divorced.

6. **Ethnic Minorities:** Local households are near exclusively comprised of the Eastern Province (Nyanja speaking) ethno-linguistic group irrespective of their gender, and this ethnic group is the largest group in the Eastern Province.

Only 2 % of the Census 2010 population are not part of the above group but are linked to other major ethnic groups from surrounding provinces. It can be reasonably assumed that the 2019 population will not be different from the 2010 trends.

Broadly speaking, Zambia provides protection for minority groups and there is no evidence to show that there is local systemic exploitation or pressure on ethnic minorities that may result in these groups being deemed vulnerable.

Interviews with local officials also note that ethnic monitories are generally linked to economic migrants from Mozambique, Malawi and other parts of Zambia. Such migrants are generally welcomed and accommodated by local communities, and the District Authorities noted that here is no evidence of any systemic conflict or tensions. However, any immigrants have limited opportunities to secure land for homes or farming, therefore they tend to be labourers or semi-skilled individuals.

6.13.9 Social Networks

Local households build networks between people, families, village, facilities, and services within and outside of their home village. These networks are often needed to sustain basic household needs and livelihoods, while building resilience in times of stress. However, to access such networks, personal relations as well as more physical forms of accessibility (roads and waterways) and mobility (means of transports) need to be established.

Most family support networks will be within their own homestead (as part of a single or extended clan structure) and within their home village. There is also little evidence of systemic or wide-spread outward migration therefore dependency on non-local families is likely to be limited.

There is little in the way of public facilities (outside of schools and shops) and services in local villages in the Project Site, and the level of service will vary from village to village. In many cases, households are required to travel to neighbouring villages to access basic facilities, while core services (including formal administrative functions, secondary schooling, hospitals, cemeteries, markets, police stations, and markets) are concentrated in Katete.

Interviews suggests that most households concentrate activities within their home village, however they may visit neighbouring villages on a regular basis as it entails, on average, a 1 to 2 km walk. Given the relative isolation of the rural villages within the Project Site, the poor local roads and the need to pay for transport, most households will likely only travel to Katete only a needs basis, and this is undertaken irregularly.

6.13.10 Natural Resource Use by Communities

Natural resource harvesting is common for rural communities within the Project Site, and there is a rich diversity or materials and locations from which such materials are collected. The most common form of natural resource harvesting is firewood collection, which is usually undertaken by women and children and is the most common fuel for cooking. Firewood is generally collected from the open bush/community land in and around the household.

The majority of households (75%) are constructed of traditional or natural materials, or a mix of modern and natural materials (as shown in Figure 50). This includes mud and clays for mud-bricks, cut lumber and poles for the frames of traditional homes, as well as reeds and grasses for thatching. All materials are sourced locally on communal land. Interviews suggest that a key natural resource is the local streams which provide clays, reeds for thatching and fishing.

Charcoal production is also commonly undertaken, mostly by males. Charcoal may be used as household fuel; however, it is more commonly sold along roadsides or to local buyers. Charcoal production is inherently destructive as it requires the cutting of mature trees, and in most cases is deemed an informal and illegal activity. The most visible evidence of charcoal production has been around the base and along the slopes of the local hills. In addition, the collection of wild fruit, vegetables and mushrooms is also common, while local households are also able to harvest fruit from communal fruit trees (including mango). There are no specific areas that are targeted although most of such harvesting is undertaken in the open bush (notably in intact or semi-transformed vegetation around the villages and in the local hills).

Local households may undertake hunting of local animals, while interviews also note that children may often dig out burrowing rodents.

6.13.11 Resettlement Policy Framework

A specific Resettlement Policy Framework for the Unika 1 Wind Farm (and Associated Transmission Line) has been developed (please refer to Annexure I). The Project will need to secure an estimated 440 hectares of land to support the Project infrastructure as well as the associated transmission line. This will include the compensation of all affected persons for the loss of land as well as the losses of any assets or improvement on that land.

As per the Deed of Agreement (Dated 4 October 2018), the Chewa Development Trust will be the primary implementing party on all land acquisition, compensation, and resettlement on behalf of the Project.

Furthermore, any land acquisition, compensation and resettlement undertaken in support of the transmission line (will be the mandate of the Chieftainess Msoro as per established agreement and Memorandum of Understanding with the Project).

The Project however seeks to provide the technical expertise and resourcing required support the Chewa Development Trust and Chieftainess Msoro in undertaking the land acquisition, compensation, and resettlement process. This will likely be undertaken through the establishment of a Land Acquisition Project Management Office (PMO) established under the Zambian registered SPVs for the Project.

The Project is not expected to result in any physical displacement – barring the potential resettlement of 1 household should Route Option 2 of the transmission line be constructed. The Project will however result in economic displacement with respect to the compulsory acquisition of an estimated of 249 hectares of farmland and 364 hectares of communal land.

This Resettlement Policy Framework (RPF) establishes an Eligibility and Entitlement Framework which defines persons that may claim compensation or resettlement assistance for the loss of land and assets, and the types of compensation and resettlement support that will be provided by the Project for these losses. To support the implementation of the land acquisition, compensation and resettlement process, the Proponent will appoint either the (1) government valuation office or (2) private surveyors to undertake an inventory of all affected land and assets that would be affected by the land acquisition process. The surveyor will also prepare a complete valuation report on the affected land and assets, which will form the basis for compensation agreements for the affected households. All surveys and agreements will be supported by, witnessed, and signed-off by the traditional authorities.

The Project will restore and promote the development of affected persons livelihoods. This will be through the provision of cash compensation and replacement assets as contained in the Entitlement Framework. Any replacement land and structures will be provided through infill replacement – or the allocation of unutilised communal land located near the homestead of the affected persons to avoid excessive travel time to any new farmland or dislocation from their home communities.

In addition, the Project (through the Chewa Development Trust or the Msoro Royal Establishment) will invest in livelihoods of affected persons through investigating and implementing programmes that seek to (1) improve market links, (2) improvement in crop storage, (3) diversification of crops and farming practices, and (4) accessing existing government and NGO/CBOs programmes in the district.

The Project will also support further benefits through (1) allowing public use of new access roads, (2) support reasonable local content and procurement of goods (construction supplies, labour etc.) and services, (3) support reasonable preferential local recruitment (with particular focus on women) as part of the recruitment procedures, and (4) targeted support for vulnerable people.

The Project will establish suitable measures to ensure the informed consultation and participation of Affected Persons and other key stakeholders in the land acquisition, compensation and resettlement planning and implementation process. This includes the establishment of a Community Liaison Committee and a Grievance Resolution Mechanism.

The costing related to the land acquisition, compensation, and resettlement process is estimated to be ZMK 24,442,368 (USD 1 364 889). This estimate will need to be updated upon completion of the asset inventories and valuations and provided in an update of this RFP or RAP.

A preliminary schedule required for the development and implementation of the land acquisition, compensation, and resettlement process has been established starting after the approval of this RPF and the ESIA by ZEMA. The overall schedule is expected to be no longer than 12 months for both planning and initial implementation while livelihoods restoration and development will extend for a longer period.

Finally, the Proponent will undertake internal and external monitoring during the implementation of the land acquisition, compensation, and resettlement process. The needed personnel and resources will be established to ensure that the monitoring is effectively performed. Regular feedback and reporting will be provided to ZEMA, any financiers and directly to affected persons.

7. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

The biological, physical and socio-economic impacts of the proposed Unika 1 Wind Farm on the affected environment are assessed in this chapter. The impacts have been assessed according to the impact assessment methodology (Annexure G) approved by ZEMA as part of the ToR. Both positive and negative impacts are assessed for the construction, operation and decommissioning phases of the Project. Mitigation measures for negative impacts and enhancement measures for positive impacts are described.

They key for the main project components associated with the impacts, as presented in the impact assessment tables below, is as follows:

1 - Wind Turbines
2 - Electrical Connections
3 - Transmission Lines
4 - Substation
5 - Access Roads
6 - Borrow Pits
7 - O&M Building
8 - Construction Camp/Offices
9 - Laydown Area
10 - Batching Plant

Mitigation and enhancement measures together with monitoring measures for both construction and operation have been carried over into the Environmental and Social Management Plan (ESMP) included in Annexure A.

A number of environmental and social impacts were screened during the Scoping phase. Based on the understanding of the environmental and social sensitivity of the Project site and the impacts of the construction and operation of a typical wind farm, several impacts were screened out of the impact assessment, and standard mitigation measures for these have been included in the ESMP. In some cases the impacts for the construction and operation phases of the Project are similar and are therefore assessed together. Decommissioning Phase impacts and Cumulative Impacts are assessed separately.

7.1 BIO-PHYSICAL IMPACTS

7.1.1 Impacts on Soil and Groundwater Quality

Background and Baseline Conditions

The characteristics of the local soils underlaying the Project Site are summarized as follows:

- Soils formed from the underlying sedimentary and metamorphic rocks – Leached red brown loams (generally eastern footprint): The soils are non-differentiated ferrisols (highly weathered soils), generally sandy clays with more inert clay;
- Soils formed from the underlying acidic igneous or siliceous sedimentary rock – Sandveldt. These are non-differentiated, coarse-grained sandy soils with a clay content increasing with depth. They are generally yellowish-red to light yellowish-brown were well drained and grey-brown were poorly drained. These soils can be expected at the southeast portion of the general site; and
- Soils of the Luangwa and Lower Zambesi Valleys – Rock and rubble (far western towards northern footprint): Broken, non-differentiated hilly country rock with mainly lithosols/skeletal soils (shallow soils of imperfectly weathered rock fragments), and flatter area with much surface rock or laterite crust.

The Project Site falls within the "Lower Luangwa Aquifer System, Katete Chadiza"[1]. Several 100 boreholes have been drilled around Katete and Chadiza to supply potable water to the rural population. Many boreholes are dry or low yielding, with the success rate depending on the thickness of regolith. The regolith is typically 10 to 15 m thick, but can be up to 30 m thick. Below this, the unweathered bedrock can be fractured to depths of about 60 - 70 m. The static water table is usually 20 to 30 m below surface.

Impact Assessment

During the construction phase the clearing of natural vegetation and the stripping of topsoil could lead to erosion. Soil compaction by use of heavy construction vehicles could result in reduced surface roughness and infiltration.

During the construction phase various activities could impact soil and groundwater quality. These activities include storage and handling of hazardous substances (e.g. fuel, oil, chemicals, etc.), waste water discharge, batching, waste handling and storage, vehicle/equipment repairs, re-fuelling, etc.

Apart from a requirement to store fuel and other hydrocarbons on site for the operational phase, limited hazardous chemicals are expected to be stored and handled, and the risk of pollution from these are minimal if good industry practice is implemented.

For the construction phase and after mitigation the impacts on soil and groundwater quality are of local extent, short-term duration, medium intensity with overall very low consequence, which together with its probable likelihood results in an overall impact significance of ***low***.

For the operational phase and after mitigation the predicted impact on soil and groundwater quality are of local extent, long-term duration, very low intensity with overall very low consequence, which together with its possible likelihood results in an overall impact significance of ***insignificant***.

Table 39: Impact Assessment - Soil and Groundwater Quality

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	Medium	Low	Very low
Geographic Extent	Regional	Local	Local	Local
Duration	Short term	Short term	Long term	Long term
Probability	Definite	Probable	Probable	Possible
Consequence	Medium	Very Low	Low	Very low
Significance	Medium	Low	Low	Insignificant
Project components:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		1, 4, 5, 7	

Recommendations and Mitigation Measures

Construction phase mitigation:

- The placement of soil stockpiles will be identified prior to commencement of construction to minimise soil erosion.
- Site clearing should, where possible, be undertaken in the dry season to minimise the chance of erosion due to run-off.
- Land clearance will only be undertaken just prior to construction of a particular activity and unnecessary land clearance must be avoided. Work areas will be clearly defined to avoid disturbance outside of the footprint.

- Construction vehicles to remain on designated prepared roads.
- Design site drainage and stormwater runoff to minimise risk of erosion.
- Hazardous substances stored on site should be contained in compatible, appropriately-labelled containers to prevent reaction with containers and spillage during handling.
- The relevant MSDS documents should be clearly displayed in the hazardous substance storage area.
- Relevant training should be provided to all employees/contractors on the correct storage and handling procedures and records of this training kept on site.
- Ensure the necessary spill kits are available on site. All hydrocarbons spills on bare ground will be cleared immediately. This will include the lifting of the contaminated soil for bio-remediation or disposal to a hazardous waste facility.
- Hazardous substances stored on site should be within a bunded area and(or) contained in an appropriate, compatible, appropriately labelled containers to prevent reaction with containers and spillage during handling.
- Storage to be located at least 150 m from the seasonal drainage line or other surface depressions or pans.
- Construction vehicles and equipment will be regularly serviced off site. Spills of fuel and lubricants from vehicles and equipment will be contained using a drip tray with plastic sheeting filled with adsorbent material.
- Ensure the use of drip trays and availability of spill kits available during in-field refuelling.
- Concrete to be mixed in designated areas and managed in such a way so that no spillage is allowed to reach the water systems.
- Accidental spillage of potentially contaminating liquids and solids must be immediately contained and cleaned up by trained staff with the correct equipment and disposed of in an appropriate manner.
- Minimise clearing of vegetation to intercept and impede run-off from the site.
- Hazardous wastes must be separated and contained in compatible, appropriately labelled containers to prevent reaction with containers and spillage during handling.
- Waste storage areas to be located at least 150 m from rivers, streams, seasonal drainage lines wetlands, surface depressions, dambos, pans, etc.
- Waste storage areas must have clear signage for the various hazardous waste streams.
- Potentially contaminating fluids and other hazardous wastes must be contained in containers on hard, level surfaces in contained and covered locations, and be clearly marked.
- Develop and implement a site specific Hazardous Waste Management Plan (HWMP) for the management, handling and disposal of hazardous waste streams.
- Hazardous waste will be trucked out and disposed of at a licensed landfill site. A waste manifest must be kept for all hazardous wastes that are disposed of and maintained on site.
- Disposal and potential treatment of sewage and contaminated soil will be included in the HWMP.
- Conduct site inspections to check for oil spills and leaks on soil surface and water bodies and implement remediation as required.
- Maintenance on vehicles/diesel powered equipment will be conducted off-site or within a designated, paved and bunded area.
- Concrete batching activities and/or mixing shall be located within the construction camp in areas of low environmental sensitivity and at least 150 m away from rivers, streams, seasonal drainage lines wetlands, surface depressions, dambos, pans, etc.
- Concrete mixing directly on the ground shall not be allowed and shall only take place on impermeable surfaces.
- No washing out of concrete mixers shall occur on site.
- Washing of excess concrete into the ground or water resources is prohibited.
- All cement-contaminated runoff from mixing areas shall be strictly controlled.

- At the end of the contract, any ponds used for contaminated water collection shall be dried out and the solids disposed of appropriately.
- Unused (full) cement bags shall be stored out of the rain and where runoff will not affect them;
- Used cement bags shall not be used for any other purpose and shall be disposed of on a regular basis.
- All excess concrete and rubble shall be removed from site on completion of concrete works and disposed of appropriately.

Operation phase mitigation:

- Conduct monthly inspections to identify areas of erosion. If areas are identified then develop and implement an action plan to avoid further erosion and to rehabilitate the areas as identified.
- Hazardous substances stored on site should be within a bunded area and(or) contained in an appropriate, compatible, appropriately labelled containers to prevent reaction with containers and spillage during handling.
- Storage to be located at least 150 m from rivers, streams, seasonal drainage lines wetlands, surface depressions, dambos, pans, etc.
- The relevant MSDS sheets should be clearly displayed in the hazardous substance storage area.
- Relevant training should be provided to all employees/contractors on the correct storage and handling procedures and records of this training kept on site.
- Conduct monthly site inspections to check for oil spills and leaks on soil surface and water bodies and implement remediation as required.
- Maintenance on vehicles/diesel powered equipment will be conducted off-site or within a designated, paved and bunded area. Spills of fuel and lubricants from vehicles and equipment will be contained using a drip tray with plastic sheeting filled with adsorbent material.
- Accidental spillage of potentially contaminating liquids and solids must be immediately contained and cleaned up by trained staff with the correct equipment and disposed of in an appropriate manner.
- See Construction phase waste related mitigation measures above.

7.1.2 Impacts as a result of Water Supply for the Project

Background and Baseline Conditions

Aurecon conducted a desk top based water resource assessment during August 2020 to identify, assess and evaluate the possible water sources to supply the water demand needs during the construction, operation and maintenance of the Unika I Wind Farm. Groundwater, surface water and municipal water was identified as potential sources, and potential surface water abstraction points as well as potential boreholes sites were identified. The assessment consisted of desktop investigations and did not include any field investigations.

Majority of the Project Site falls within the BL-02 quaternary catchment of the Luangwa catchment. A small part the south eastern corner of the Project Site falls within the BZ-10 quaternary catchment of the Zambezi catchment. The Project Site area is underlain by as aquifers of limited potential or regions without significant groundwater. The stratum has intermediate characteristics with borehole yields typically 0.1 – 2 litres per second as a result of low yielding formations (e.g. basement gneiss).

Attempts to source site-specific borehole data from the “Geodin Database” managed by the Water Resources Management Authority (WARMA) in Zambia did not reveal any results. The static water table is usually 20 to 30 m below surface. Generally, boreholes are drilled between 50 to 60 m deep.

Based on the data acquired during the desk study, it was concluded that groundwater can be considered as a feasible option to supply the Project with construction and operational water, either as the only source or in conjunction with surface water.

Some potential surface water abstraction points were identified and streamflow has provisionally been shown to represent a feasible source for the purposes of water supply. However, it should be noted that flows during the dry periods periodically might be very low, or even zero.

Katete was identified as the closest developed town that could potentially have a municipal water supply. Katete is approximately 30 km from the Project Area.

Impact Assessment

The raw water demand varies, based on the phase of the project, between an estimated 1 122 kl/month to a maximum of 6 480 kl/month. The potable water requirements range from 132 kl/month to 440 kl/month depending on the phase of construction. Surface water abstraction points as well as potential boreholes sites were identified. The total water demand for construction (raw and potable) ranges between 1 254 kl/month to 6 832 kl/month and the selected water sources (surface and/or groundwater) need to either singularly or in combination satisfy this demand. Abstraction of large volumes of surface, especially during the dry periods could result in impacts on downstream users and downstream freshwater ecology. Abstraction of groundwater could impact on surrounding groundwater users and impacts on springs, dambos, streams, rivers, etc, as a result of decreased recharge rates. The extent of these impacts will need to be verified once the water supply sources have been identified and secured.

Because the wind turbines would be air-cooled, there would be no water requirement for operation and maintenance. However, the O&M Building would require potable water and water for sanitary purposes. It is expected that the operation and maintenance demand is negligible compared to the construction phase.

For the construction phase and after mitigation the impacts related to water supply for the Project are of local extent, short-term duration, medium intensity with overall very low consequence, which together with its probable likelihood results in an overall impact significance of ***very low***. The reversibility of the impact is high because the affected environment may be able to recover from the impact. Moreover, the level of residual risk / impact is low because mitigation exists and will considerably reduce the significance of impacts.

For the operational phase and after mitigation the impacts related to water supply for the Project are of local extent, long-term duration, very low intensity with overall very low consequence, which together with its possible likelihood results in an overall impact significance of ***insignificant***.

Table 40: Impact Assessment – Water Supply for the Project

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	Medium	Low	Very low
Geographic Extent	Regional	Local	Local	Local
Duration	Short term	Short term	Long term	Long term
Probability	Definite	Probable	Probable	Possible
Consequence	Medium	Very low	Low	Very low
Significance	Medium	Very Low	Low	Insignificant
Project components:	1, 2, 3, 4, 5, 7, 8, 10		1, 5, 7	

Recommendations and Mitigation Measures

Construction phase mitigation:

- More in-depth investigations and analysis must be conducted prior to construction. A field inspection and gathering of information from official sources and inhabitants of the Project Site would be required to firm up on various uncertainties and assumptions that underlie the provisional desktop study. The field assessment needs to confirm whether these settlements do indeed rely on the streams or boreholes for water supply and to quantify their water requirements.
- Feasibility of municipal water supply (for potable water) must be investigated during the field assessment and discussions with the local municipal water authorities.
- Surface and groundwater abstraction rates must not significantly impact other users or ecology aspects. Depending on the volumes to be abstracted and the locations of abstraction points, an ecological flow study (for surface water) and/or groundwater impact study (for groundwater) relating to the construction phase may be required.
- Potable water supply (excluding municipal supply) will be subject sampling and analyses (compared to the national drinking water quality standards). The water treatment requirements may need to be assessed once water samples have been collected and analysed.
- After the field assessment and confirmation of usable sources, the relevant authorities would then need to be contacted to obtain the relevant licences for water supply.
- Due to the fact that the major water demand is only required for the construction period, it is recommended that a nominal storage facility be provided at each potential abstraction site with enough capacity to satisfy a periodic demand.
- It is recommended that water tankers be utilised to transport the water from the abstraction points to the point of use in order to avoid the need for additional infrastructure (e.g. pipelines, pumphouses, etc.) and further environmental impacts.
- Develop and implement a Water Management Plan

Operation phase mitigation:

- Implement water use efficiency measures and procedures for the operational phase.

7.1.3 Changes to Hydrological Function and Sediment Balance

Background and Baseline Conditions

Impacts on hydraulic and geomorphological regimes may result in altered extents (hydroperiod) of wetlands, as well as changes to floral assemblages. For example, increased surface water inputs arising from stormwater runoff from hard surfaces (e.g. the hardstand areas associated with the wind turbines) may lead to the extent of a wetland increasing, and as a result, altered species composition of adjacent areas as plants adapted to saturated soil establish and become dominant, thus having an effect on faunal assemblages and ecological service provisioning. Increased water inputs may also lead to changes in aquatic biota assemblages, as increased flow may allow for the establishment of populations of rheophilic species. Conversely, decreased or impeded flow, either as a result of instream man-made structures such as bridge crossings or increased sediment deposition may lead to losses of populations of flow-dependent macroinvertebrates impede fish migration, smothering of biota (fauna and flora) and changed floral assemblages. The four wind turbines situated within dambo wetlands may have a relatively insignificant impact in this regard due to the small footprints associated with each as well as the seasonal nature of the dambos, however, bridge crossings, particularly over the larger river systems (especially the Mtetezi River) may have more significant impacts on hydraulic and sediment regimes. Bridge crossings in particular have the potential to cause turbulent flows, upstream ponding and downstream scouring, and this must be considered during planning and design to ensure that any bridge crossings retain hydraulic connectivity and do not cause significant instream disturbances.

Impact Assessment

During the construction phase disturbance to the freshwater systems, most impacts on the hydraulic and geomorphological regimes within unchanneled systems (i.e. unchanneled valley bottom wetlands and dambos) are expected to be ***very low*** provided that a high level of mitigation takes place. Construction activities within channelled systems (channelled valley bottom wetlands and streams) are expected to be of potentially medium to high severity depending on the degree to which mitigation takes place, however, the overall impact significance is reduced to ***very low*** with mitigation. Construction of infrastructure located outside of freshwater systems and associated buffers is not considered likely to have any significant impact on the freshwater habitat although some indirect impacts such as runoff from hardened surfaces may occur.

The wind turbines and associated hardstand areas, whilst “permanent” fixtures, are either situated outside freshwater systems or those that are within the dambos, are unlikely to have any significant latent impacts since the dambos are likely only saturated seasonally. Therefore, perceived impact significance of the wind turbines on hydraulic and geomorphological regimes ranges from ***very low***. Similarly, the latent impacts of road crossings through unchanneled valley bottom wetlands and dambos will be limited in extent and severity, with mitigation, and impact significance is likely to be ***very low***. However, the latent impacts of bridge support structures within those systems with active channels, particularly the Mtetezi River, may potentially be of medium intensity will be permanent in duration. Ensuring that minimal instream infrastructure is placed within active channels, and that where it cannot be avoided appropriate designs to minimise creation of turbulent flows and other disturbances are implemented, will assist in reducing the impact significance to ***medium***.

Table 41: Impact Assessment - Hydrological functioning and sediment balance (infrastructure outside of setback zones)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Very low	Very low	Very low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Short term	Short term
Probability	Improbable	Improbable	Improbable	Improbable
Consequence	Very low	Very low	Very low	Very low
Significance	Insignificant	Insignificant	Insignificant	Insignificant
Project components:	1, 2, 3, 5, 6, 9, 10		1, 2, 5	

Table 42: Impact Assessment - Hydrological functioning and sediment balance (turbines located within delineated dambos)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**

Type of Impact	Negative Impact			
Intensity/Severity	Medium	Low	Low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Medium term	Short term
Probability	Definite	Definite	Definite	Possible
Consequence	Very low	Very low	Very low	Very low
Significance	Very low	Very low	Very low	Very low
Project components:	1, 2, 5		1, 2, 5	

Table 43: Impact Assessment - Hydrological functioning and sediment balance (road crossings through unchanneled valley bottom wetlands and dambos)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	Low	Medium	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Medium term	Medium term
Probability	Definite	Definite	Definite	Possible
Consequence	Low	Very low	Low	Very low
Significance	Low	Very low	Low	Very low
Project components:	2, 5		2, 5	

Table 44: Impact Assessment - Hydrological functioning and sediment balance (road crossings through channelled valley bottom wetlands and rivers)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	Medium	Medium	Medium
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Permanent term	Long term

Type of Impact	Negative Impact			
Probability	Definite	Definite	Definite	Definite
Consequence	Low	Very low	High	Medium
Significance	Low	Very low	High	Medium
Project components:	2, 5		2, 5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- Where feasible, undertake all construction work in or near Freshwater Habitats during the drier months when the flow is low in the freshwater systems.
- Excavation of pits for the wind turbine foundation must not be in close proximity to a freshwater system.
- Soil must be stockpiled upgradient of the excavations. Mixture of the lower and upper layers of the excavated soil should be kept to a minimum. This soil must be used to either infill the pits or in rehabilitation processes.
- The bedding layers (such as clean gravel) should be spread evenly and compacted uniformly to the required density in order to minimise the post-construction use of large machinery within or within close proximity to the freshwater systems.

Operation phase mitigation:

- Routine maintenance of the roads must be undertaken. Such maintenance activities must specifically be undertaken after high rainfall events.
- Stormwater runoff areas at the road crossings should be monitored (by the Operation and Maintenance (O&M) Manager) for erosion. Should erosion be observed, caused by the road crossings/instream infrastructure, the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation. Use can also be made of rocks collected from the surrounding area to infill any area prone to erosion, as a natural dispersal mechanism.
- Stormwater should be allowed to diffusely spread across the landscape where possible. Where it is not possible to allow diffuse spread of flows, provision must be made for the controlled release of stormwater into the landscape to prevent the formation of preferential flow paths which may lead to incision and erosion.
- Vehicles must make use of dedicated access roads and no indiscriminate movement in the freshwater systems may be permitted.

7.1.4 Impacts on Surface Water Quality

Background and Baseline Conditions

Particularly during the construction phase, increased vehicular activity and increased human presence carries the potential for direct and indirect impacts on surface water quality. Spills of hazardous substances, disturbances to soils and uncontrolled sanitary activities of construction personnel are amongst the potential impacts which may adversely affect water quality.

Impact Assessment

Impacts on surface water quality within freshwater systems is unlikely during construction of infrastructure located outside the freshwater systems or their associated buffer zones, although latent impacts, such as sediment-laden runoff, may occur at sites situated upgradient of watercourses.

Nevertheless, the impact significance of construction activities not located within wetlands or rivers on water quality is deemed ***insignificant***. Activities relating to the construction of the 4 wind turbines located within dambos may have a ***very low*** impact on water quality, since the related disturbances are limited in duration. Activities relating to the construction of road crossings through freshwater systems have the potential for impacts on water quality to occur, particularly vehicular spills which, if they occur within a freshwater system have the potential to be of high severity but if suitable mitigation is implemented throughout the construction phase, severity can be reduced to 'low' and the overall impact significance will therefore be ***very low***.

Few latent impacts on water quality are anticipated in the operational phase. Exceptions include increased presence of hydrocarbons in the footprint area due to increased road traffic, which may enter the various watercourses in stormwater runoff. However, whilst the roads may see increased vehicular traffic this is still likely to remain minimal given the rural setting and socio-economic status of residents. Therefore, the anticipated impacts are considered to be of ***very low*** significance.

Table 45: Impact Assessment – Water Quality (infrastructure outside of setback zones)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Very low	Very low	Very low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Short term	Short term
Probability	Improbable	Improbable	Improbable	Improbable
Consequence	Very low	Very low	Very low	Very low
Significance	Insignificant	Insignificant	Insignificant	Insignificant
Project components:	1, 2, 3, 5, 6, 9, 10		1, 2, 5	

Table 46: Impact Assessment – Water Quality (turbines located within delineated dambos)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Medium	Low	Low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Medium term	Short term
Probability	Definite	Definite	Definite	Possible
Consequence	Very low	Very low	Very low	Very low

Type of Impact	Negative Impact			
Significance	Very low	Very low	Very low	Very low
Project components:	1, 2, 5		1, 2, 5	

Table 47: Impact Assessment – Water Quality (road crossings)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	Low	Low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Medium term	Short term
Probability	Definite	Definite	Definite	Possible
Consequence	Low	Very low	Very low	Very low
Significance	Low	Very low	Very low	Very low
Project components:	2, 5		2, 5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- See mitigation measures prescribed under Changes to Hydrological Function and Sediment Balance.
- Excavated materials should not be contaminated, and it should be ensured that the minimum surface area is taken up by any stockpiled materials.
- All exposed soil must be protected from wind using a suitable geo-textile or vegetation for the duration of the construction phase.
- If re-seeding with graminoid species is undertaken, the soil must be protected until vegetation is re-established.
- Develop and implement a stormwater management plan (with input from a freshwater ecologists).
- Ensure that no concentrated runoff from the surface infrastructure construction areas enter the freshwater systems by installing silt traps or placing haybales down gradient of the construction footprint (until suitable basal vegetation cover has been restored).
- Ensure that no mixed concrete is deposited outside of the designated construction footprint; and that concrete spills outside of the demarcated areas be promptly removed and appropriately disposed of.

Operation phase mitigation:

- See operational phase mitigation measures prescribed under the Changes to Hydrological Function and Sediment Balance section above.

- Unnecessary disturbances surrounding the perimeter of the surface infrastructure must be avoided.
- Ensure that routine inspections and monitoring of any instream infrastructure are undertaken to monitor any build-up of debris that will impact on structure integrity or lead to erosion and sedimentation. Furthermore, monitoring to determine the establishment of indigenous vegetation and the presence of any alien or invasive plant species.
- The surface infrastructure areas must be inspected to ensure that no concentrated runoff from these areas form erosion. Should these impacts be noted, these gullies/preferential flow paths must be infilled with in situ material and appropriately stabilised and/or revegetated.
- Develop and implement an Alien Invasive Species Management Plan.

7.2 TERRESTRIAL ECOLOGICAL IMPACTS

7.2.1 Impact of Noise on Fauna

Background and Baseline Conditions

The Project Site is largely undeveloped with a rural character, though there are a significant number of communities dispersed in the area. Ambient sound levels are typical of a rural noise district with no industry or other significant noise sources. Ambient sound measurements indicate that the area is defined as naturally quiet. Outside the established community areas (i.e. villages), sound levels are low with wind-induced noises and faunal sounds, dominating.

Impact Assessment

Noise from construction activities generally do not influence faunal species, because they would be more affected by people and equipment moving in and around construction sites. Sensitive faunal species may move, and birds could abandon nests containing eggs or fledglings, although this is most likely related to increased activities in the area.

While there are claims about the potential impacts of wind farms on animals, this is mainly in the form of bird and bat strikes to the moving blades. To date, there is little evidence that noise from wind turbines significantly affects animals. Studies undertaken to date indicate that:

- There may be a possible impact on the health of animals caged very close to an operating WTG (within 500 m);
- Songbirds may change the spectral character of songs and calls used for communication and defence in areas very close to the wind turbines. This is similar to the effects of other anthropogenic noise sources such as traffic, which can disrupt bird 'chatter' to the point of being detrimental to reproductive success; and
- Aquatic species will leave an area during the construction phase, but will return during the operational phase as they appear not to be affected by operational noises.

There is not yet a clear consensus on the potential risks or impacts from noise on other fauna.

Table 48: Impact Assessment - Noise impacts on Fauna

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	High	High	Moderate	Moderate
Geographic Extent	Local	Local	Local	Local
Duration	Short Term	Short Term	Short Term	Short Term
Probability	Possible	Possible	Possible	Improbable
Consequence	Low	Low	Medium	Medium
Significance	Very Low	Very Low	Low	Low
Project components:	1, 2, 3, 4, 5, 6, 7, 8, 10		1, 5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- The developer should implement an environmental awareness programme, providing induction to employees, contractors and subcontractors about their potential impact on the surrounding environment.
- The developer should minimise the areas that will be impacted and disturbed by construction activities. This includes limiting employees, contractors and subcontractors to the construction areas and demarcating No-Go areas where faunal species may be located.
- If feasible, the developer should select a wind turbine model fitted with serrated trailing edges on the blades which will reduce noise emission levels from the wind turbines.

Operation phase mitigation:

- The developer should implement environmental awareness programmes, providing training to the local communities about the potential risks to animals kept in cages very close to wind turbines.

7.2.2 Loss of Faunal Habitat and Species Diversity in the Degraded Miombo Woodland

Background and Baseline Conditions

The Degraded Miombo Woodland remaining within the footprint area of the wind farm has and still is being impacted upon by local community activities. These impacts arise because of land clearing for agricultural lands, wood harvesting for general firewood, charcoal production and general construction activities within the villages. The remaining areas of intact habitat are becoming more isolated, creating "island" effects in terms of habitat provision for faunal species. This has resulted in fragmented faunal populations and lower species diversity and abundance in the proposed turbine areas.

Impact Assessment

The construction phase will result in the clearing of vegetation for access roads and turbine footprint/ laydown areas. This will lead to the loss of habitat and faunal species in these areas, whilst also leading to additional habitat fragmentation. With mitigation the consequence and significance of the impacts for this phase can be reduced from a low to very low. This will largely be dependent on the ability to mitigate edge effects stemming from the development footprint areas and roads.

The wind farm will have a notably decreased impact significance on the receiving environment once operational. This is due to no further vegetation clearing or road construction taking place. As such, the impact significance both prior to and post mitigation is expected to be low. Post mitigation, there is likely to be ancillary community-related impacts such as increased wood harvesting due to the development of roads and newly gained access to areas.

Impacts on faunal habitat and species diversity in the Degraded Miombo Woodlands is considered to be local in extent and of ***very low*** significance post mitigation for the construction and operational phases.

Table 49: Impact Assessment - Faunal habitat and species diversity in the Degraded Miombo Woodlands

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Medium	Low	Low	Low
Geographic Extent	Regional	Local	Local	Local
Duration	Short-Term	Short-Term	Long-Term	Short-Term

Type of Impact	Negative Impact			
Probability	Definite	Definite	Definite	Definite
Consequence	Low	Very Low	Low	Very Low
Significance	Low	Very Low	Low	Very Low
Project components:	1, 2, 3, 5, 6		1, 5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- Access control measures should be investigated, especially where turbine footprints are located within or adjacent to the Degraded Forest Habitat. Although such measures will not stop wood harvesting from taking place, they will serve to slow the rate down as donkey carts and/ or vehicles will not be able to access these areas.
- Removal of vegetation must be restricted to what is absolutely necessary and should remain within the approved development footprint. These areas are to be clearly demarcated and no vegetation clearance or vehicle movement outside of these demarcated areas are to occur;
- Clearing of vegetation should take place in a phased manner. This will allow for faunal species within the footprints to relocate naturally and avoid harm.
- Restrict on site fires by construction personnel to designated areas only, and no uncontrolled fires whatsoever should be allowed.
- Under no circumstance are fires to be used as a vegetation clearance tool.
- Rip, profile and revegetate with indigenous species all compacted areas that will not be used during the operational phase;
- Only indigenous species to be used to revegetate the disturbed areas.
- No collection or hunting of any fauna must be allowed by construction personnel.
- Should the presence of any faunal SCC (see Table 14) be noted, or their breeding sites be located within the development footprint a suitably qualified faunal specialist should be consulted on the best way to proceed.
- If any spills of hazardous substances such as fuels occurs, they should be immediately cleaned up. Spill kits should be kept on-site within workshops and on any refuelling vehicles/fuel bowsers. In the event of a breakdown, maintenance of vehicles must take place with care, and the recollection of spillage should be practised, preventing the ingress of hydrocarbons into the topsoil.
- Smaller species such as scorpions and reptiles will be less mobile during rainfall events and cold days (winter) and as such will not readily able to move out of an area ahead of ground clearing activities. As such, should any be observed in the construction site during clearing and construction activities, they are to be carefully and safely moved to an area of similar habitat outside of the disturbance footprint. Construction personnel are to be educated about these species and instructed not to kill them. Smaller scorpion species and harmless reptiles should be carefully relocated by a suitably nominated and trained construction person. For larger venomous snakes, a suitably trained specialist, or on-site personnel, should be contacted to carry out the relocation of the species, should it not move off on its own.
- Vehicle movement should be limited to designated roadways. Additional road construction should be limited to what is absolutely necessary, and the footprint thereof kept to a minimal.
- Existing access roads to be used as far as practically possible.

Operation phase mitigation:

- Maintain a suitable herbaceous layer in the areas immediately around the wind turbine footprint so as to ensure that no erosion occurs.
- Access control measures should be investigated for the shorter roads branching off from main access roads, particularly where turbine footprints are located within or adjacent to areas of Degraded Forest so as to limit the incidence and magnitude of wood harvesting.
- Implement an effective monitoring programme of operational activities and infrastructure areas associated with the turbine footprints and access roads to ensure edge effects are being controlled and any impacts such as erosion and vegetation loss are timeously discovered and rectified.
- Ensure that no unnecessary clearing of habitat occurs during the operational phase.
- No hunting/trapping of faunal species or collecting of plants is allowed.
- Monitor the success of rehabilitation efforts of disturbed areas seasonally until fully recovered.

7.2.3 Loss of Faunal Habitat and Species Diversity in the Degraded Forest

Background and Baseline Conditions

A small area of Degraded Forest will be impacted upon in the north of the proposed wind farm. These degraded forest patches are fairly small and are surrounded by existing agricultural activities, with increased levels of wood harvesting for charcoal manufacturing evident on some of the slopes. Although these forest patches are small, they do still provide habitat for smaller faunal species whilst providing a semblance of habitat connectivity (movement corridor) between the larger forest patch to the south and north of the windfarm footprint. Currently there are 5 wind turbines located within Degraded Forest areas (T05, T06, T07, T08 and T10) as shown in Figure 26.

Impact Assessment

The construction phase will result in the clearing of vegetation for the access roads and turbine footprint/ laydown areas. This will lead to the loss of habitat and faunal species in these areas, whilst also leading to additional habitat fragmentation. With mitigation the consequence and significance of the impacts for this phase can be reduced from a low to very low. This will largely be dependent on the ability to mitigate edge effects stemming from the footprint areas and roads.

The wind farm will have a notably decreased significance of impact once operational. This is largely as a result of no further vegetation clearing or construction taking place. The significance both prior to and post mitigation is expected to be low. Post mitigation is not expected to be very low as the newly built roads will allow for greater access to the surrounding areas, leading to further wood harvesting and habitat loss.

Impacts on faunal habitat and species diversity in the Degraded Forests is considered to be local in extent and of ***very low*** significance post mitigation for the construction phase and of ***low*** significance post mitigation for the operational phase.

Table 50: Impact Assessment - Faunal habitat and species diversity in the Degraded Forests

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Medium	Low	Low	Low
Geographic Extent	Regional	Local	Local	Local
Duration	Short-Term	Short-Term	Long-Term	Long-Term

Type of Impact	Negative Impact			
Probability	Definite	Definite	Definite	Probable
Consequence	Low	Very Low	Low	Low
Significance	Low	Very Low	Low	Low
Project components:	1, 2, 3, 5		1, 2, 3, 5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- It is recommended that the following wind turbines be relocated in order to avoid impacts on the remining Degraded Forests habitat:
    - T10 –Shift the turbine into the agricultural fields;
    - T07 – Shift the turbine into the cleared areas;
    - T05 – Shift the turbine to avoid the Degraded Forest. Additionally, the indicated disturbance footprint for this tower falls over a hill with a steep incline to the north of the turbine. This will result in increased vegetation loss and a loss of habitat connectivity along the vegetated hillside;
    - T06 – shift the turbine out of the Degraded Forest area to the agricultural areas surrounding the turbine; and
    - T08 – Shift the turbine into the nearby agricultural lands.
- See mitigation measures for Degraded Miombo Woodland above.

Operation phase mitigation:

- See mitigation measures for Degraded Miombo Woodland above.
- Continually monitor the operational activities and infrastructure areas associated with the turbine footprints and the access roads to ensure edge effects are being controlled and any impacts such as erosion and vegetation loss are timeously discovered and rectified.

7.2.4 Loss of Faunal Habitat and Species Diversity in the Freshwater Habitat

Background and Baseline Conditions

The wind farm will impact several freshwater habitats, most notably due to the construction of road crossings and the placement of four wind turbines (T39, T44, T51 and T53) footprints within freshwater systems (dambos) (see Figure 26). The freshwater habitat is one of the most extensive and important habitats within the area as it provides niche habitat for water dependant species, serves as a prominent source of water and connects several disjunct habitat units throughout the larger area.

Impact Assessment

The construction phase will result in the clearing of vegetation for access roads and the turbine footprint / laydown areas. This will lead to the loss of riparian vegetation and habitat within the affected dambos. Consequently, this will lead to a significant decrease of abundance and diversity of faunal species within the project footprint areas, whilst also contributing to additional habitat fragmentation within the larger landscape. With mitigation, the consequence and significance of the impacts for this phase can be reduced from low to very low. This will largely depend on the designs of the freshwater crossings and the degree to which they hamper hydrology of the system, potentially causing upstream ponding and downstream desiccation and the extent of the vegetation clearance.

The severity and intensity of impact from the wind farm on freshwater ecology will decrease notably once in the operation phase, provided no further vegetation clearance occurs and that all freshwater crossings are properly maintained. The freshwater habitat is considered to be an important and sensitive habitat system. As such, any activities without sound mitigation may likely result in a high impact significance. However, with the implementation of mitigation measures, impact significance can be adequately reduced to very low.

Impacts on faunal habitat and species diversity in the Freshwater Habitats is considered to be local in extent and of ***very low*** significance post mitigation for the construction and operational phases.

Table 51: Impact Assessment – Faunal habitat and species diversity in the Freshwater Habitats

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	Medium	Medium	Low
Geographic Extent	Regional	Local	Local	Local
Duration	Medium-Term	Medium-Term	Medium-Term	Medium-Term
Probability	Definite	Definite	Definite	Probable
Consequence	High	Very Low	Low	Very Low
Significance	High	Very Low	Low	Very Low
Project components:	2, 3, 5, 10		5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- Four turbines (T39, T44, T51 and T53), including associated hardstand areas, are currently located within the Freshwater habitat. It is recommended that these wind turbine footprints be re-investigated and shifted so that they fall outside of the freshwater habitat and that of the 32 m buffer insofar as possible;
- Where possible use existing roads to access the turbine footprints, in order to minimise the need to clear vegetation for new roads;
- Where turbines can be accessed from other turbine sites negating the need for additional freshwater habitat crossings, this must be done;
- The design should consider excluding the proposed road between T01 and T02; T56 and T65; T36 and T46; T18 and T11; and T38 and T49 as these sites can be accessed without the need for these additional roads, thereby minimising crossings of freshwater habitats.

Operation phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Miombo Woodland and Degraded Forest above.

7.2.5 Loss of Faunal Habitat and Species Diversity in the Agricultural Areas

Background and Baseline Conditions

Agriculture is the dominant land form / use within the project footprint. These areas have already been cleared of vegetation and are currently being used for crop cultivation or lying fallow. These habitats are of low sensitivity and provide limited habitat for faunal species.

Impact Assessment

Construction activities will lead to surface hardening techniques being used as part of the installation of the wind farm. Impacts expected from the construction will likely result from edge effects and footprint creep. Such impacts will be of increased severity where the footprint areas are nearby adjacent Freshwater habitats.

The operational phase of the turbines and roads within the agricultural areas should have a minimal impact to the receiving environment provided that all mitigation measures are in place and that edge effects are suitably managed.

The table below presents the perceived impact on the Agricultural Areas associated with the wind farm construction and operation in terms of habitat and faunal species loss, both prior to and post mitigation measures.

Impacts on faunal habitat and species diversity in the Agricultural Areas is considered to be local in extent and of ***very low*** significance post mitigation for the construction phase and of ***insignificant*** significance post mitigation for the operational phase.

Table 52: Impact Assessment - Faunal habitat and species diversity in the Agricultural Areas

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Low	Very low	Low	Low
Geographic Extent	Localised	Localised	Localised	Localised
Duration	Short-Term	Short-Term	Short-Term	Short-Term
Probability	Definite	Definite	Definite	Possible
Consequence	Very Low	Very Low	Very Low	Very Low
Significance	Very Low	Very Low	Very Low	Insignificant
Project components:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		1, 2, 3, 4, 5, 7	

Recommendations and Mitigation Measures

Construction phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Degraded Woodland above.

Operation phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Degraded Woodland above.

7.2.6 Loss of Sensitive Faunal Species

Background and Baseline Conditions

Due to large scale habitat transformation associated with the clearance of vegetation from Forest and Miombo Woodland to agricultural areas as well an ever increasing hunting by local community members, there are limited opportunities remaining for faunal Species of Conservation Concern (SCC) within the areas surrounding that of the proposed wind farm. The turbine footprints have been predominantly located within already disturbed areas and as such decreases the risk of impact to SCC. The numerous freshwater crossings may pose a threat to the Near Threatened Aonyx capensis (African Clawless Otter); however, this species is more likely to occur within the larger river systems to the east of the current proposed wind farm layout.

Impact Assessment

The construction phase will result in the clearing of vegetation for the access roads and turbine footprint/ laydown areas. This will lead to the loss of habitat and potential disturbance to faunal species, notably the disturbance of potential foraging grounds. Impacts expected from the construction will likely result from edge effects and footprint creep.

The operational phase of the turbines and roads should have a minimal impact to the receiving environment for SCC provided that all mitigation measures are in place and that edge effects are suitably managed.

Loss of faunal SCC is considered to be ***local*** in extent and of ***very low*** significance post mitigation for the construction and operational phases.

Table 53: Impact Assessment - Loss of Faunal Species of Conservation Concern

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Low	Very low	Low	Low
Geographic Extent	Local	Local	Local	Local
Duration	Short-Term	Short-Term	Long-Term	Long-Term
Probability	Definite	Definite	Definite	Possible
Consequence	Very Low	Very Low	Low	Low
Significance	Very Low	Very Low	Low	Very Low
Project components:	1, 2, 3, 5, 6		2, 5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity Degraded Forest above.

Operation phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Degraded Forest above.

7.2.7 Loss of Floral Habitat and Species Diversity in the Degraded Miombo Woodland

Background and Baseline Conditions

The Degraded Miombo Woodland remaining within the footprint area of the wind farm has, and still is, being impacted upon as a result of local community activities, notably clearing for agricultural lands and wood harvesting for general firewood, charcoal production and general construction activities within the various villages. The remaining areas of habitat are becoming ever more isolated, creating "island" of none cleared vegetation amongst the agricultural fields. This has resulted in fragmented habitat units which may also impact on potential seed dispersal patterns, pollination of floral species and the loss of potential unique floral species.

Impact Assessment

The construction phase will result in the clearing of vegetation for the access roads and turbine footprint/ laydown areas. This will lead to the loss of floral species in these areas whilst also leading to additional habitat fragmentation. With mitigation the consequence and significance of the impacts for this phase can be reduced from a low to very low. This will largely be dependent on the ability to mitigate edge effects stemming from the footprint areas and roads.

The wind farm will have a notably decreased nature of impact once operational. This is largely as a result of no further vegetation clearing or road construction taking place. The significance both prior to and post mitigation is expected to be low. Post mitigation, there is likely to be ancillary community related impacts such as increased wood harvesting as a result of the newly gained access to areas due to the development of roads. Access control measures such as booms / locked gate structures across the roads, should be investigated, especially where turbine footprints are located within or adjacent to the Degraded Forest Habitat. Although such measures will not stop wood harvesting from taking place, they will serve to slow the rate down as donkey carts and/ or vehicles will not be able to access these areas.

Impacts on floral habitat and species diversity in the Degraded Miombo Woodland is considered to be ***local*** in extent and of ***very low*** significance post mitigation for the construction phase and of ***low*** significance post mitigation for the operational phase.

Table 54: Impact Assessment - Floral habitat and species diversity in the Degraded Miombo Woodland

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Medium	Low	Low	Low
Geographic Extent	Regional	Local	Local	Local
Duration	Short-Term	Short-Term	Long-Term	Long-Term
Probability	Definite	Definite	Definite	Probable
Consequence	Low	Very Low	Low	Low
Significance	Low	Very Low	Low	Low

Type of Impact	Negative Impact	
Project components:	1, 2, 3, 5, 6	1, 5

Recommendations and Mitigation Measures

Construction phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Miombo Woodland above.

Operation phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Miombo Woodland above.

7.2.8 Loss of Floral Habitat and Species Diversity in the Degraded Forest

Background and Baseline Conditions

The proposed layout will impact upon small areas of Degraded Forest in the north of the proposed wind farm. These degraded forest patches are surrounded by existing agricultural activities, with increased levels of wood harvesting for charcoal manufacturing evident on some of the slopes. Although these forest patches are small, they are still considered important in terms of habitat provision for floral species, notably species adapted to living in the forest understory. In addition, these forest patches have the capacity to serve as a source for seed dispersal through seed production and distribution (wind, surface water flow and animal dispersal) into the surrounding areas where wood harvesting has ceased or old agricultural lands have been abandoned. As such, these remaining patches of forest are of increased intrinsic value to the ecosystem and future conservation and will help facilitate natural vegetation.

Impact Assessment

The construction phase will result in the clearing of vegetation for the access roads and turbine footprint/ laydown areas. This will lead to the loss of floral species in these areas, whilst also leading to additional habitat fragmentation. With mitigation the consequence and significance of the impacts for this phase can be reduced from a low to very low. This will largely be dependent on the ability to mitigate edge effects stemming from the footprint areas and roads as well as taking into considerations the recommendations made regarding the moving of certain turbine footprints and access roads.

The wind farm will have a notably decreased nature of impact once operational. This is largely as a result of no further vegetation clearing or road construction taking place. The significance both prior to and post mitigation is expected to be low. Post mitigation is not expected to be very low as the newly built roads will allow for greater access to the surrounding areas, leading to further wood harvesting and habitat loss. Where possible gates and / or booms that can be locked must be installed across the smaller access roads that deviate from the main roads. This will limit the quantity of wood being removed as the access for donkey carts and vehicles will be restricted.

Impacts on floral habitat and species diversity in the Degraded Forests is considered to be ***local*** in extent and of ***very low*** significance post mitigation for the construction phase and of ***low*** significance post mitigation for the operational phase.

Table 55: Impact Assessment - Floral habitat and species diversity in the Degraded Forest

Type of Impact	Negative Impact	
Impact Criteria	**Construction**	**Operations**

Type of Impact	Negative Impact			
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Medium	Low	Low	Low
Geographic Extent	Regional	Local	Local	Local
Duration	Short-Term	Short-Term	Long-Term	Long-Term
Probability	Definite	Definite	Definite	Probable
Consequence	Low	Very Low	Low	Low
Significance	Low	Very Low	Low	Low
Project components:	1, 2, 3, 5		1, 2, 3, 5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Degraded Forest habitat above.
- It is recommended that prior to vegetation clearance activities within the proposed infrastructure footprints, these areas be searched for any floral species of concern, and where found, these species be recorded and marked using a GPS. In the case where plant species can be suitably rescued and relocated, this is to be carried out by a suitably qualified specialist. Where large trees that cannot be relocated are found and will have to be destroyed, consideration should be given to planting of new trees of the same species in areas demarcated for rehabilitation or potentially along the roadsides leading up to the turbines. For every SCC tree removed it is recommended that at least 2 new ones are planted.

Operation phase mitigation:

- See mitigation measures for loss of Degraded Forest habitat above.

7.2.9 Loss of Floral Habitat and Species Diversity in the Freshwater Habitat

Background and Baseline Conditions

The wind farm will impact upon several freshwater habitats, most notably as a result of the many road crossings associated with this habitat, but also due to the current placement of four wind turbine footprints within freshwater systems (see freshwater report for details on the various freshwater system types). The freshwater habitat is one of the most extensive and important habitats within the area as it provides niche habitat for floral species associated with freshwater areas, notably species adapted to areas of increased / permanent water-logged soils. The freshwater habitat also functions as an important floral seed dispersal corridor due to its extent throughout the study area. Seeds are distributed through water as well as faunal species that frequent this habitat.

Impact Assessment

The construction phase will result in the clearing of vegetation for the access roads and turbine footprint/ laydown areas. This will lead to the loss of riparian vegetation and habitat within the affected dambos within these footprint areas. Consequently, the floral species abundance and diversity within the footprint areas will be negatively impacted upon, whilst also contributing to additional habitat fragmentation. With mitigation the consequence and significance of the impacts for this phase can be reduced from a low to very low. This will largely be dependent on the freshwater crossing designs and the degree to which they hamper water flow and the extent of the vegetation clearance. Should there be extensive downstream impacts, then the significance of the impact will increase.

The wind farm will have a notably decreased nature of impact once operational provided no further vegetation clearance occurs and that all freshwater crossings are properly maintained and do not contribute to further habitat degradation. The freshwater habitat is considered to be an important and sensitive habitat system, as such any activities herein, without sound mitigation, will likely result in a high impact. With mitigation measures, impacts can be adequately reduced. Provided the river crossings are well managed and no additional impacts to the receiving environment occur, the post mitigation impacts for this phase are likely to be low.

Impacts on floral habitat and species diversity in the Freshwater Habitats is considered to be ***local*** in extent and of ***low*** significance post mitigation for the construction and the operational phases.

Table 56: Impact Assessment - Floral habitat and species diversity in the Freshwater Habitats

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Medium	Medium	Medium	Low
Geographic Extent	Regional	Local	Local	Local
Duration	Medium-Term	Medium-Term	Long-Term	Long-Term
Probability	Definite	Definite	Definite	Probable
Consequence	Medium	Low	Medium	Low
Significance	Medium	Low	Medium	Low
Project components:	2, 3, 5, 10		5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Freshwater habitat above.

Operation phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Freshwater habitat above.

7.2.10 Loss of Floral Habitat and Species Diversity in the Agricultural Areas

Background and Baseline Conditions

The agricultural areas are the dominant landform / use within the current wind farm layout. These areas have already been cleared of vegetation and are currently being used for crop cultivation or are lying fallow. These habitats are of low sensitivity and provide limited habitat to floral species, other than early pioneer grass and forb species and alien plant species which readily colonise disturbed ground.

Impact Assessment

Construction activities will lead to surface hardening techniques being used as part of the installation of the wind farm. Impacts expected from the construction will likely result from edge effects and footprint creep.

The operational phase of the turbines and roads within the agricultural areas should have a minimal to insignificant impact to the receiving environment provided that all mitigation measures are in place and that edge effects are suitably managed.

Impacts on floral habitat and species diversity in the Agricultural Areas is considered to be ***local*** in extent and of ***very low*** significance post mitigation for the construction phase and of ***insignificant*** significance post mitigation for the operational phase.

Table 57: Impact Assessment - Floral habitat and species diversity in the Agricultural Areas

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Low	Very low	Low	Low
Geographic Extent	Local	Local	Local	Local
Duration	Short-Term	Short-Term	Medium-Term	Medium-Term
Probability	Definite	Definite	Possible	Possible
Consequence	Very Low	Very Low	Very Low	Very Low
Significance	Very Low	Very Low	Insignificant	Insignificant
Project components:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		1, 2, 3, 4, 5, 7	

Recommendations and Mitigation Measures

Construction phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Agricultural Areas above.

Operation phase mitigation:

- See mitigation measures for loss Faunal habitat and species diversity in Agricultural Areas above.

7.2.11 Loss of Sensitive Floral Species

Background and Baseline Conditions

The region has seen extensive transformation through clearance of vegetation from Forest and Miombo Woodland to agricultural areas as well as for charcoal production. No floral SCC were observed at the time of assessment, however species such as Pterocarpus tinctorius (chrysothrix), Pterocarpus angolensis, Boophone disticha and Habenaria schimperiana are of concern due to increased harvesting in the region.

The turbine footprints have been predominantly located within already disturbed areas and as such decreases the risk of impact to SCC. Where the access roads and footprints impact upon Freshwater and Degraded Forest habitats, these species may be placed at increased risk.

Impact Assessment

The construction phase will result in the clearing of vegetation for the access roads and turbine footprint/ laydown areas. This will lead to the loss of habitat and potential disturbance to floral species. Provided all mitigation measures are followed the overall impact to floral SCC is likely to be Very Low.

The operational phase of the turbines and roads should have a minimal impact to the receiving environment for SCC provided that all mitigation measures are in place and that edge effects are suitably managed. Provided all mitigation measures are implemented the overall impact significance is likely to be Very Low.

Loss of floral SCC is considered to be ***local*** in extent and of ***very low*** significance post mitigation for the construction and the operational phases.

Table 58: Impact Assessment - Loss of Floral Species of Conservation Concern

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Low	Low	Low	Low
Geographic Extent	Local	Local	Local	Local
Duration	Short-Term	Short-Term	Long-Term	Long-Term
Probability	Probable	Probable	Possible	Possible
Consequence	Very Low	Very Low	Low	Low
Significance	Very Low	Very Low	Very Low	Very Low
Project components:	1, 2, 3, 5, 6		2, 5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- Survey final project footprint to confirm presence of any floral SCC.
- No collection or harvesting of floral SCC should be allowed by construction personnel.
- Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC resulting from construction activities outside that of the proposed development footprint area, notably where disturbance footprints are near areas of increased sensitivity.
- It is recommended that prior to vegetation clearance activities within the proposed infrastructure footprints, these areas be searched for any floral species of concern, and where found, these species be recorded and marked using a GPS. In the case where plant species can be suitably rescued and relocated, this is to be carried out by a suitably qualified specialist. Where large trees that cannot be relocated are found and will have to be destroyed, consideration should be given to planting of new trees of the same species in areas demarcated for rehabilitation or potentially along the roadsides leading up to the turbines. For every SCC tree removed it is recommended that at least 2 new ones are planted.

Operation phase mitigation:

- Disturbed areas are to be rehabilitated to a similar state as that of pre-disturbance conditions. Where this is not possible due to operational and maintenance requirements, it is recommended that at a minimum a suitable herbaceous layer is maintained within the footprint of the wind farm turbine so as to ensure that no erosion occurs.
- Continually monitor the operational activities and infrastructure areas associated with the turbine footprints and the access roads to ensure edge effects are being controlled and any impacts such as erosion are timeously discovered and rectified.
- Ensure that no unnecessary clearing of habitat occurs during the operational phase.
- Monitor the success of rehabilitation efforts of disturbed areas seasonally.

7.3 AQUATIC ECOLOGY IMPACTS

7.3.1 Loss of Freshwater Habitat and Ecological Structure

Background and Baseline Conditions

Some loss or degradation of freshwater habitat has occurred as a result of subsistence agriculture, particularly in the shallow dambo areas which are commonly utilised for cultivation of crops by local communities. However, the construction of turbines and road crossings in or across freshwater systems may lead to further alterations to habitat and ecological structure, primarily through vegetation loss necessitated during pre-construction preparation, but also potentially by impeding or altering the movement of water through the landscape. Since the footprints of both the turbines and road crossings are anticipated to be relatively small in comparison to the full extent of the affected freshwater systems, the impact significance of these activities will likely be limited.

Impact Assessment

Pre-construction activities such as clearing of vegetation and establishment of contractor laydown areas may result in some or all of the impacts described above. Where these activities occur outside of the delineated boundaries of the freshwater resources, and their associated buffer zones (see Figure 26), impacts are likely to have an insignificant effect on the freshwater systems with mitigation. Thus, the impact significance of the construction and subsequent operation of wind turbines and access roads which are located outside of freshwater systems and their buffer zones will be ***insignificant***.

The four wind turbines located within two dambos will result in unavoidable impacts, which can only be completely avoided by relocating the infrastructure outside of the freshwater systems. Nevertheless, the small footprint of each turbine and associated hardstand area, will assist in reducing the extent, and therefore significance, of impacts particularly if appropriate mitigation measures are implemented, such as construction during the dry season. The construction of wind turbines within the dambos is likely to be of ***very low*** impact significance.

Construction of road crossings through wetlands and rivers will necessitate unavoidable encroachment into delineated boundaries. However, the duration of this encroachment can and should be minimised, thus a **very low** impact significance can be achieved with the implementation of appropriate mitigation measures.

Once operational, the wind turbines are not expected to have any significant impact on freshwater habitat or ecological structure, since little anthropogenic activity is expected around the turbines, with the exception of occasional monitoring and maintenance activities. Similarly, although the access roads are expected to see increased traffic as they will be utilised by local communities, impacts to habitat and ecological structure as a result are likely to be minimal. Impact significance during the operational phase is expected to be of ***very low***.

Table 59: Impact Assessment – Freshwater habitat and ecological structure (infrastructure outside of setback zones)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Very low	Very low	Very low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Short term	Short term

Type of Impact	Negative Impact			
Probability	Improbable	Improbable	Improbable	Improbable
Consequence	Very low	Very low	Very low	Very low
Significance	Insignificant	Insignificant	Insignificant	Insignificant
Project components:	1, 2, 3, 5, 6, 9, 10		1, 2, 5	

Table 60: Impact Assessment – Freshwater habitat and ecological structure (turbines located within delineated dambos)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Medium	Low	Low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Short term	Short term
Probability	Definite	Definite	Definite	Possible
Consequence	Very low	Very low	Very low	Very low
Significance	Very low	Very low	Very low	Very low
Project components:	1, 2, 5		1, 2, 5	

Table 61: Impact Assessment – Freshwater habitat and ecological structure (road crossings)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Medium	Low	Low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Medium term	Short term
Probability	Definite	Definite	Definite	Possible
Consequence	Very low	Very low	Very low	Very low
Significance	Very low	Very low	Very low	Very low

Type of Impact	Negative Impact	
Project components:	2, 5	2, 5

Recommendations and Mitigation Measures

Construction phase mitigation:

- Ensure that all non-linear components of the Project (wind turbines, substation, O&M buildings, etc.) and any linear components running parallel to the freshwater systems (e.g. roads, powerlines, communication cables, culverts, etc.) occur outside of the delineated boundaries of the freshwater resources, and their associated buffer zones (see Figure 26). This also applies to vegetation clearance.
- Ensure existing roads and road crossings are used as far as practically possible. It was noted that several proposed access roads are located within 100 m to 200 m of existing roads. Where feasible, it is strongly recommended that these existing roads be upgraded, rather than constructing new roads, to minimise the degree of disturbance to and loss of freshwater habitat and to minimise impacts on hydrological and geomorphological processes and balances.
- Also refer to mitigation measures prescribed under Sections 7.1.3 and 7.1.4 above.
- All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential.
- Retain as much indigenous vegetation as possible.
- All vegetation removed as part of the site clearing activities (specifically where large areas need to be cleared) should be transported from the construction site and disposed of in a safe and appropriate manner. Vegetation which is suitable for use in reinstatement may be temporarily stockpiled, outside of delineated freshwater systems, in stockpiles not exceeding 2m in height. Plant material suitable for use as firewood or which would normally be harvested by communities may be given to the community. No Alien or Invasive Plants (AIPs) may be donated.
- Freshwater systems, particularly in the vicinity of road crossings, must be regularly inspected and monitored for incision and erosion, especially after rainfall events. Any erosion noted must be proactively managed to prevent further degradation.
- Ensure freshwater systems are protected by means of construction of a silt trap, erected along the boundary of the freshwater system. Silt traps must be monitored closely and accumulated sediment removed as regularly as required. Ensure no indiscriminate movement of machinery within freshwater systems during removal of silt.
- Ensure dust suppression is implemented (either by using water or other biodegradable agents) .
- Ensure that freshwater systems outside the construction footprint with approved road crossings are demarcated as no-go areas. At the access road crossings these no-go areas can be marked at a maximum distance of 5 m upstream and downstream of the proposed road upgrade crossing. This 5 m buffer area would allow for construction personal, vehicles (if applicable) to enter the freshwater system crossing where the road is proposed to be upgraded or constructed.
- Ensure contractor laydown areas, accommodation camps, material storage facilities and batching plants are located at least 150 m from freshwater systems.
- The reaches of the freshwater systems where no activities are planned to occur must be considered no-go areas.
- Topsoil removed in preparation for construction of new road crossings must be stored separately and may not be contaminated. This must be used for rehabilitation post

construction. Furthermore, the soil layers should be replaced in the same order and the topsoil returned last.

Operation phase mitigation:

- Refer to operational phase mitigation measures prescribed under Sections 7.1.3 and 7.1.4 above.

7.3.2 Changes to Aquatic Ecological and Sociocultural Service Provision

Background and Baseline Conditions

The loss or alteration of freshwater habitat and ecological structure as a result of the various activities discussed above, particularly during pre-construction and construction phases will inevitably lead to changes in the ability or capacity of the rivers and wetlands to provision certain ecological services, such as sediment trapping, flood attenuation and assimilation of excess nutrients. Changes in socio-cultural service provision are less likely to occur, although a reduction in available arable land within the dambos may arise due to the construction of the wind turbines and associated hardstand areas.

Impact Assessment

Potential alteration of habitat, for example through the clearing of vegetation, is likely to lead to a reduction in the capability and capacity of freshwater systems to provide certain ecological services, such as sediment trapping or assimilation of excess nutrients. The perceived impacts on socio-cultural (goods and direct benefits) services are considered minimal except where very localised impacts may occur, for example where wind turbines and hardstand areas are placed within cultivated fields situated within the dambos. Nevertheless, with appropriate mitigation and post-construction rehabilitation, the possible losses can be reinstated to allow recovery of the system and for the goods provided to the local community. The perceived impact significance on ecological and socio-cultural service provision ranges from **insignificant** (all infrastructure placed outside the freshwater systems and associated buffers) to **very low** (the four wind turbines placed in the dambos, and the road crossings).

Provided that minimal disturbances occur during the operational phase as expected and the disturbed areas are allowed to recover, it is unlikely that the proposed wind turbines and access roads will have direct impacts on the freshwater systems. Latent impacts such as reduced faunal use (and therefore reduced biodiversity maintenance) due to altered habitat and reduction in available harvestable goods (e.g. reeds) may persist due to the permanence of the infrastructure. Nevertheless, the perceived impact significance on ecological and socio-cultural service delivery during the operational phase is expected to be of **insignificant to very low levels**.

Table 62: Impact Assessment – Ecological and Sociocultural service provision (infrastructure outside of setback zones)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Very low	Very low	Very low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Short term	Short term
Probability	Improbable	Improbable	Improbable	Improbable
Consequence	Very low	Very low	Very low	Very low
Significance	Insignificant	Insignificant	Insignificant	Insignificant

Type of Impact	Negative Impact	
Project components:	1, 2, 3, 5, 6, 9, 10	1, 2, 5

Table 63: Impact Assessment – Ecological and Sociocultural service provision (turbines located within delineated dambos)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Medium	Low	Low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Medium term	Short term
Probability	Definite	Definite	Definite	Possible
Consequence	Very low	Very low	Very low	Very low
Significance	Very low	Very low	Very low	Very low
Project components:	1, 2, 5		1, 2, 5	

Table 64: Impact Assessment – Ecological and Sociocultural service provision (road crossings)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Medium	Low	Low	Very low
Geographic Extent	Local	Local	Local	Local
Duration	Short term	Short term	Medium term	Short term
Probability	Definite	Definite	Definite	Possible
Consequence	Very low	Very low	Very low	Very low
Significance	Very low	Very low	Very low	Very low
Project components:	2, 5		2, 5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- Refer to construction phase mitigation measures in section 7.3.2 above..

Operation phase mitigation:

- Refer to operational phase mitigation measures in section 7.3.2 above.

7.4 AVIFAUNA (BIRDS) IMPACTS

On site features which have been considered in the development of an avifaunal sensitivity map are presented in Table 65. Avifaunal features used to map avifaunal sensitivity on site include: local forest reserves; major hills; water courses; and dams. Local forest reserves are provided protection since they are believed to hold more pristine woodland and forest vegetation and be less subject to anthropogenic impacts. It follows that avifaunal diversity and abundance may be greater in these areas. The larger hills on site were seen to house less impacted woodland and also attract raptors in flight (favourable air currents), meaning that turbines placed on these hills would pose a higher collision risk to birds. These areas were delineated on site manually by the specialist, using Google Earth imagery. Water courses and associated riparian vegetation attract a different suite of bird species to the surrounding habitats. They also serve as flights paths for larger birds through the landscape, although the bird flight data collected on site did not provide strong evidence for this, and a very low abundance and diversity of water fowl was recorded in the broader area. Dams theoretically attract large water-fowl species which are particularly susceptible to collision with wind turbines, although once again a surprisingly low abundance of such species on the two large dams on site was recorded. Dams were delineated manually.

The above features are sensitive for wind turbines only, the placement of roads, substations, offices, underground cables may proceed in these areas.

Table 65: Avifaunal features used to map avifaunal sensitivity

No-Go No wind turbines permitted	High Sensitivity Only currently proposed infrastructure permitted. No additional infrastructure to be moved into High sensitivity areas.
• Local forest reserves • Major Hills/Inselbergs • Watercourses – 32m buffer • Mtetezi & Katete Dams – 500m buffer	• Mtetezi River - 200m buffer • Watercourses – 100m buffer

The No-Go and High sensitivity areas are shown in Figure 53.

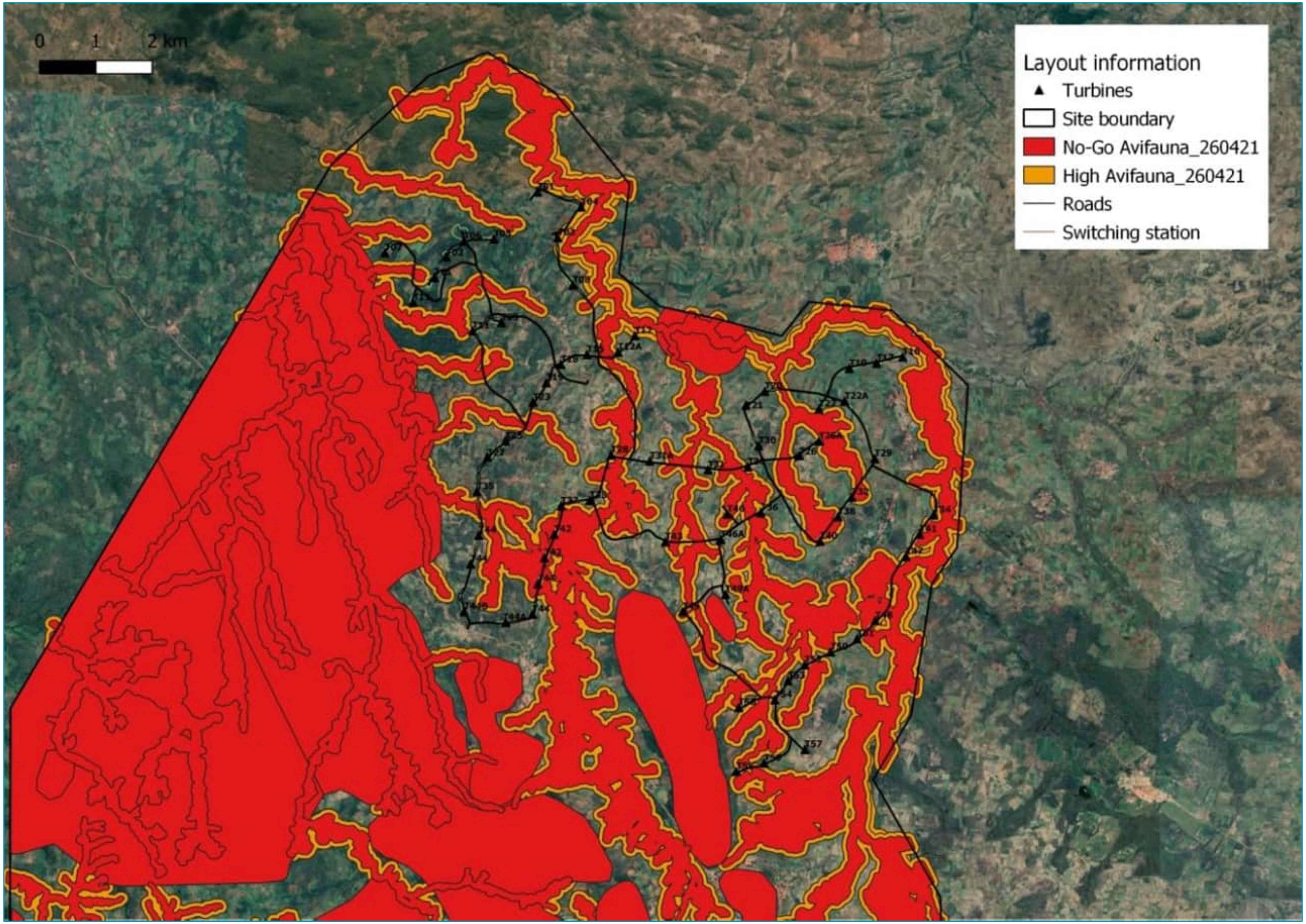

Figure 53: Avifaunal sensitivity map

7.4.1 Collision of Birds with Blades (Operational Phase)

Because of the large size of turbine blades the tips of the blades move at very high speeds (>200km/h). Birds are used to flying in empty skies, often at the height of many wind turbines. Causes of death include collision and barotrauma (the internal injuries caused by exposure to rapid pressure changes near the trailing edges of moving blades). Raptors usually look down at the ground for prey, which places them at high risk to wind turbine collisions.

Migratory bird species are often of particular interest with respect to wind farms as migration can concentrate large numbers of birds in both space and time, thereby presenting a high risk of turbine collision. Overall it was concluded that one raptor species (Common or Steppe Buzzard) and at least 6 passerines (European Bee-eater, Southern Carmine Bee-eater, Barn Swallow, House Martin, Brown-throated Martin, African Palm Swift) showed signs of migrating over the Project Site. The Steppe Buzzard presents an increased turbine collision risk, but not to the extent typically associated with migration events. For the small passerines migration definitely placed the species at risk of collision with turbines. During non-migration these species would not be at significant risk of turbine collision.

A wide diversity of raptors were recorded flying on site, some of which flew frequently. Only one Globally Red Listed species was recorded flying on site, flying only twice: Martial Eagle (Endangered – 2 records of single birds). This is a very low flight activity level for Red Listed species and it can therefore be concluded that Red Listed species will be at low risk of collision with turbines. More common non-Red Listed species will be at higher risk of collision.

The species recorded flying more frequently are all common non-Red Listed species both globally and within Zambia. Although many migrant raptor species were recorded flying on site, a significant 'migration event' whereby hundreds of birds pass over the site in a short space of time was not recorded. This may mean that the Unika1 site is safely located relative to migration corridors, although these routes could change over time so this risk cannot be entirely ruled out this. Large numbers of European Bee-eater and several other small passerines were observer flying over site, providing an indication that these birds may be at risk of collision with turbines in spring and autumn. None of these species are Red Listed.

At a landscape level the proposed Unika1 site does not fall in or close to any sensitive features such as protected areas or Important Bird Areas. At this landscape level then the site would appear to be in a low sensitivity area of Zambia with respect to avifauna.

The current proposed layout includes four turbines within the avifaunal No-Go areas (T42, T42, T44, & T46).

Taking the above into account the sensitivity of the collision prone avifauna in this regard is assessed to be low, and the severity to be medium. The overall significance of this impact before mitigation is ***high*** (predominantly due to the risk during spring and autumn), and it is reduced to ***medium*** after mitigation.

Table 66: Impact Assessment - Avifaunal impacts (Collision with turbines)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	-	-	Medium	Low
Geographic Extent	-	-	International	International
Duration	-	-	Long-Term	Long-Term
Probability	-	-	Probable	Probable

Type of Impact	Negative Impact			
Consequence	-	-	Medium	Medium
Significance	-	-	High	Medium
Project components:	-		1	

Recommendations and Mitigation Measures

- The proposed layout should avoid the sensitive areas identified in Figure 53 as far as possible.
- Consider moving wind turbines T42, T42, T44, & T46) out of the avifaunal no-go areas in the final micro-siting.
- Currently the lowest possible turbine blade tip height above ground would be 41m, if the lowest hub height of 120m and the largest rotor diameter of 158m is used. No changes to turbine models should be made which lower this blade tip any lower than 41m above the ground, and where possible this blade tip should be raised by using a higher hub height or a smaller rotor diameter. The higher the lower blade tip is above ground the better for bird collision as much of bird flight takes place relatively low over the ground. Raising this lower blade tip could partially mitigate bird collision risk.
- Given that bird collisions with turbines could occur once the wind farm is operational, and if significant, could require additional mitigation (such as curtailment, stopping certain wind turbines during certain periods, etc.). As a result, an appropriate mitigation/adaptive management budget should be provided for by Unika 1. At this stage it is not possible to determine what mitigation may be appropriate, and in the time between writing this report and the mitigation need arising (likely several years) new mitigation methods may be developed. However, if such a need arises and suitable mitigation is identified Unika 1 will have a contingency budget to account for this. Mitigation could cost the operator either in the form of additional costs or lost productivity as a result of changes to turbine operations. The most likely mitigation options are technology or observer led shutdown on demand, or blade painting.
- Post construction bird monitoring of the wind farm must be conducted by a suitably qualified avifaunal specialist for at least the first two years of operation of the facility. If any significant impacts are detected this monitoring may need to continue longer. In particular, bird fatality estimates should include searches under turbines once a week, and twice a week during spring and autumn.

7.4.2 Destruction of Bird Habitat (Construction Phase)

Background and Baseline Conditions

Most of the proposed project components are situated in degraded woodland or arable land. No particularly sensitive micro habitats have been identified on site in the areas where infrastructure will be located.

These two factors diminish the sensitivity of the avifaunal receptor for this impact. The significance of this impact is assessed to be ***low*** both pre and post mitigation.

Table 67: Impact Assessment - Avifaunal impacts (Habitat destruction)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Low	Low	-	-
Geographic Extent	Local	Local	-	-
Duration	Permanent	Permanent	-	-
Probability	Definite	Definite	-	-
Consequence	Low	Low	-	-
Significance	Low	Low	-	-
Project components:	1, 2, 3, 5, 6		-	

Recommendations and Mitigation Measures

- All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment. No unnecessary access by staff vehicles and machinery should be allowed into the dambo, stream and wetland areas in particular.
- Particular care must be taken not to remove or alter any more of the Miombo woodland than absolutely necessary. Where areas are cleared for construction which will not be needed again during operations, these areas must be rehabilitated back to woodland as soon as possible. This requirement is to reduce the amount of habitat destruction, and to reduce the presence of open areas which may attract foraging raptors close to turbines.

7.4.3 Disturbance of Birds (Construction & Operational phase)

No breeding sites of sensitive species on or near site were identified during the field visits, or any other sensitive spatial feature such as communal roosts which may be particularly sensitive to disturbance during construction or operation of the Project. The Project Site does provide almost unlimited nesting substrate for tree nesting raptors and it was not possible to survey thoroughly for these. However, no behaviour by raptors suggestive of breeding was observed.

On this basis the significance of this impact is assessed to be ***Low*** for both the construction and operations phase pre and post mitigation.

Table 68: Impact Assessment - Avifaunal impacts (Disturbance)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Low	Low	Low	Low

Type of Impact	Negative Impact			
Geographic Extent	Local	Local	Local	Local
Duration	Short-Term	Short-Term	Long-Term	Long-Term
Probability	Probable	Probable	Probable	Probable
Consequence	Low	Low	Low	Low
Significance	Low	Low	Low	Low
Project components:	1, 2, 3, 5, 6		1, 5	

Recommendations and Mitigation Measures

Construction phase mitigation:

- All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment. No unnecessary access by staff vehicles and machinery should be allowed into the dambo, stream and wetland areas in particular.
- Particular care must be taken not to remove or alter any more of the Miombo woodland than absolutely necessary. Where areas are cleared for construction which will not be needed again during operations, these areas must be rehabilitated back to woodland as soon as possible. This requirement is to reduce the amount of habitat destruction, and to reduce the presence of open areas which may attract foraging raptors close to turbines.

7.4.4 Displacement of Birds & Barrier Effects (Operational Phase)

These effects are typically most pronounced when dealing with a sensitive species nest or a communal roost or some other feature which sensitive bird species visit daily (and which may be disrupted by the project). No such aspects were identified on site.

The significance of this impact is assessed to be of ***Low***.

Table 69: Impact Assessment - Avifaunal impacts (Displacement)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	-	-	Low	Low
Geographic Extent	-	-	Local	Local
Duration	-	-	Long-Term	Long-Term
Probability	-	-	Possible	Possible
Consequence	-	-	Low	Low
Significance	-	-	Low	Low

Type of Impact	Negative Impact	
Project components:	-	1, 3, 5

Recommendations and Mitigation Measures

- Refer to mitigation measures under section 7.4.2 above.

7.4.5 Collision and electrocution: Internal 33kV transmission lines

Background and Baseline Conditions

Transmission lines pose collision and electrocution risks to birds, particularly larger birds with a long wing span (such as cranes) which are less manoeuvrable and cannot change direction quickly or birds which may perch or nest on the transmission line cross bars (typically raptors).

A total of seven priority species were identified. This includes the Steppe Buzzard, Augur Buzzard, Brown Snake-Eagle, Black-chested (breasted) Snake-Eagle, Wahlberg's Eagle, African Harrier-Hawk and Martial Eagle. All these species present a medium risk of transmission line collision. None of these species, except the Martial Eagle, holds any particular conservation concern, being classified as Least Concern Globally and not listed in Zambia. The Martial Eagle is not Red Listed in Zambia, but it is Globally listed as Endangered. No signs of any Martial Eagle roosts/nests were identified, and it was recorded only twice on site in autumn. This species is considered to be at low risk of transmission line collision, however the consequence of any fatalities will be high.

Impact Assessment

Although all of the raptors recorded flying on site could be at some risk of collision with overhead transmission lines during operational phase, raptors are not the group of species typically most at risk of this impact. Large terrestrial species such as cranes, bustards, storks, and waterfowl are most at risk. These species were not recorded to be in any abundance on site. The more open areas (either dambos or cleared for cultivation) do provide suitable habitat for some of these species which may visit occasionally.

Many of the larger raptors recorded on site would be at risk of electrocution if perched on overhead transmission lines with an incorrect design. This is particularly the case for lower voltage power lines, where phase-phase and phase-earth clearances are smaller and the risk of birds bridging these clearances is greater. This is the case for some of the 33kV connector transmission lines located near the proposed substation to be located on the Unika I Wind Farm site. At this stage there is a short distance (<5km) of overhead connector transmission lines planned.

For collision with the 33 kV connector lines the pre-mitigation operational impact on birds is likely to be of international extent; Long-term and of Medium intensity with overall high consequence. Given that the likelihood is Probable, the overall significance is rated high**.** With implementation of bird mitigation in transmission line design, the significance is reduced to ***medium***.

For electrocution of birds from the 33 kV connector overhead transmission lines the pre-mitigation operational is likely to be of international extent; Long-term and of Medium intensity with overall high consequence. Given that the likelihood is Probable, the overall significance is rated high**.** With implementation of bird mitigation in transmission line design, the significance is reduced to ***medium***.

Table 70: Collision of birds with 33 kV connector overhead transmission lines

Type of Impact	Negative Impact	
Impact Criteria	Construction	Operations

Type of Impact	Negative Impact			
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	-	-	Medium	Low
Geographic Extent	-	-	International	International
Duration	-	-	Long-Term	Long-Term
Probability	-	-	Probable	Possible
Consequence	-	-	High	High
Significance	-	-	High	Medium
Project components:	-		3	

Table 71: Electrocution of birds from 33 kV connector overhead transmission lines

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	-	-	Medium	Low
Geographic Extent	-	-	International	International
Duration	-	-	Long-Term	Long-Term
Probability	-	-	Probable	Possible
Consequence	-	-	High	High
Significance	-	-	High	Medium
Project components:	-		3	

Recommendations and Mitigation Measures

Construction phase mitigation:

- It is essential that as much as possible of the 33 kV connector transmission lines be placed underground to ensure that the impact of bird electrocution on these power lines is reduced to acceptable levels (and no more than the current 5km section must be overhead). In addition, all poles/pylons for the of the overhead connector transmission lines must be designed bird friendly to ensure that large birds such as raptors can perch safely on the poles without being able to bridge the critical clearances and be electrocuted (and cause an outage). The pole design should be approved by an ornithologist when it is available.
- The aboveground sections of the 33 kV overhead connector transmission lines will need to be fitted with suitable anti bird collision line marking devices as described above. Where multiple lines run close to each other in a corridor, the two outer lines should be marked.

Operation phase mitigation:

- Post construction bird monitoring of the overhead transmission lines (main TL and overhead connector lines) must be conducted by a suitably qualified avifaunal specialist for at least the first two years of operation. The transmission lines must be patrolled at least four times a year to search for any bird collision or electrocution fatalities. Monitoring programs to be revised/updated based on results.
- An suitably qualified avifaunal specialist shall be consulted if roosts/nests are noted on poles/pylons.

7.5 BATS IMPACTS

Background and Baseline Conditions

Wind farms have the potential to impact bats directly through collisions (with spinning turbine blades) and barotrauma resulting in mortality, and indirectly through the modification of habitats. Modification of habitat includes roost destruction, roosts disturbance, and displacement from foraging areas and/or commuting routes. In the context of the project, direct impacts pose the greatest risk to bats but, due to the high roost potential in the area and availability of high value foraging areas, habitat modification could also be a significant risk.

Direct impacts to bats posed by the turbines at the proposed Unika 1 Wind Farm will be limited to species that make use of the airspace in the rotor-swept zone of the wind turbines. At least seven species or species complexes recorded on site exhibit behaviour that could bring them into contact with turbine blades, including fruit bats, plain-faced bats (various complexes and Banana bats), the Midas free-tailed bat, and all other free-tailed bats. The complexes include all species that could potentially occur on site, many of which are high risk.

Curtailment and deterrents can significantly reduce fatalities and should be considered as a management action. Hayes et al. (2009) estimated that in their study, curtailment reduced power generation and estimated annual revenue by ≤ 3.2% for turbines that were curtailed relative to turbines that were not.

A sensitivity map has been developed and is presented in Figure 54 below.

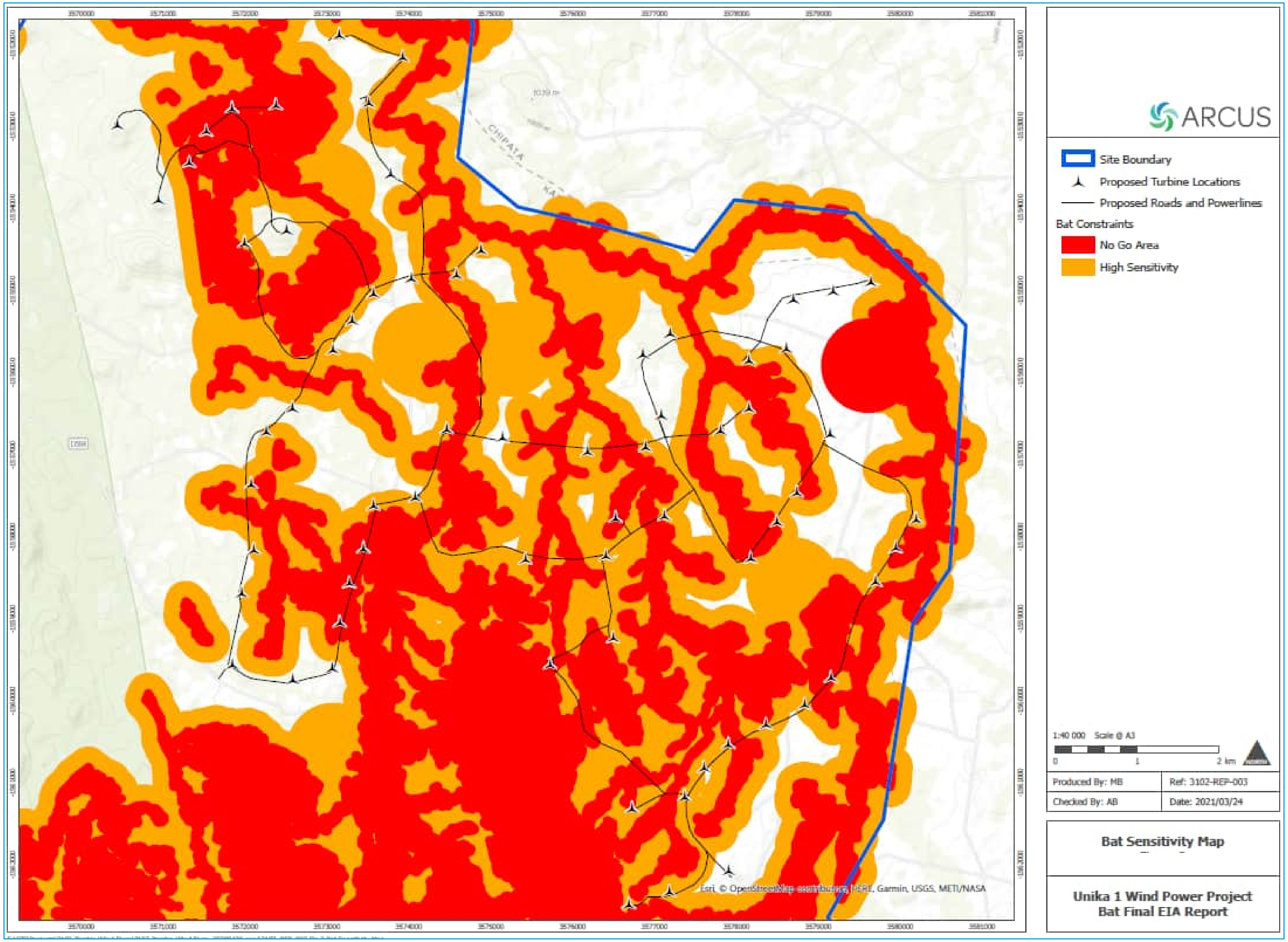

Figure 54: Bat sensitivity map

7.5.1 Disturbance of Bat Roosts (Construction Phase)

Wind farm projects have the potential to impact bats directly through the disturbance of roosts during construction. Relevant activities include the construction of roads, Operation and Maintenance (O&M) buildings, sub-station(s), internal transmission lines and installation of wind turbines. Excessive noise and dust during the construction phase could result in bats abandoning their roosts, depending on the proximity of construction activities to roosts. This impact will vary depending on the species involved; species that may roost in trees are likely to be impacted more because tree roosts are less buffered against noise and dust compared to roosts in buildings and rocky crevices. Roosts are limiting factors in the distribution of bats and their availability is a major determinant in whether bats would be present in a particular location. Reducing roosting opportunities for bats is likely to have negative impacts. Two roosts have been confirmed in buildings in the nearby villages while the site also has a high potential for roosting opportunities in woodlands and inselbergs. Though it is probable that disturbance will occur (even with mitigation measures), the impact on bats is predicted to be ***very low*** as the duration is short-term.

Table 72: Impact Assessment - Impacts on Bats (Disturbance of Bat Roost)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Medium	Low	-	-
Geographic Extent	Localised	Localised	-	-
Duration	Short-Term	Short-Term	-	-
Probability	Probable	Possible	-	-
Consequence	Very Low	Very Low	-	-
Significance	Very Low	Insignificant	-	-
Project components:	1, 2, 3, 5, 6		-	

Recommendations and Mitigation Measures

- Avoid construction activities near roosts and limit construction to agricultural areas as far as possible. Two roosts have been confirmed in nearby local villages and there is high potential for roosts in large trees, rocky crevices, woodlands, forest, inselbergs, and buildings.
- Maintain a 50m no-go buffers around water bodies inselbergs and degraded forests (which all provide potential roosting spaces), inside which no construction activities may take place. These buffers have been mapped (Figure 54). Confirmed roosts in buildings and the villages themselves (as it is assumed that other buildings may be housing bats and that the villages will be buffered anyway for other development constraints) have been buffered by 500 m. No construction activities may take place within these 500 m buffers (Figure 54).
- Removal of larger older trees must be limited as much as possible. Should these trees be removed, bat boxes must be provided, away from turbines should be undertaken to replace these roosting spaces.

7.5.2 Destruction of Bat Roosts (Construction Phase)

Wind farm projects have the potential to impact bats directly through the physical destruction of roosts during construction. Relevant activities include the construction of roads, O&M buildings, sub-station(s), grid connection transmission lines and installation of wind turbines. Potential roosts that may be impacted by construction activities include trees, crevices in rocky outcrops and buildings. Roost destruction can impact bats either by removing potential roosting spaces which reduces available roosting sites or, if a roost is destroyed while bats are occupying the roost, this could result in bat mortality. Reducing roosting opportunities for bats or killing bats during the process of destroying roosts will have negative impacts. With the high amount of activity, potential for roosts on and confirmed roosts in the villages, mitigation will be essential in minimising impact to bats and bringing the significance down to ***very low***.

Table 73: Impact Assessment - Impacts on Bats (Destruction of Bat Roosts)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	Low	-	-
Geographic Extent	Localised	Localised	-	-
Duration	Long-Term	Long-Term	-	-
Probability	Probable	Possible	-	-
Consequence	Medium	Low	-	-
Significance	Medium	Very Low	-	-
Project components:	1, 2, 3, 5, 6		-	

Recommendations and Mitigation Measures

- The Wind farm must be designed and constructed in such a way as to avoid the destruction of potential and actual roosts, particularly large mature trees, rocky crevices (if blasting is required), inselbergs, and buildings as well as limit construction as much as possible to agricultural land (see Figure 54).
- Removal of larger older trees must be limited as much as possible. Should these trees be removed, bat boxes must be provided, away from turbines should be undertaken to replace these roosting spaces.

7.5.3 Modification of Bat Habitat (Construction Phase)

Bats can be impacted indirectly through the modification or removal of habitats and can also be displaced from foraging habitat by wind turbines. The removal of vegetation during the construction phase can impact bats by removing vegetation cover and linear features that some bats use for foraging and commuting as well as roosting. The modification of habitat could create linear edges which some bats use to commute or forage along. This modification could also create favourable conditions for insects upon which bats feed which would in turn attract bats. Since the Miombo woodland is shown to have a higher abundance and diversity of bat species and taking into account the already degraded woodland on site, further removal of the habitat could be detrimental to bat populations. This impact can be reduced by limiting the removal of vegetation as far as possible and bringing the significance down to ***very low***.

Table 74: Impact Assessment - Impacts on Bats (Modification of Bat Habitat)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	Low	-	-
Geographic Extent	Localised	Localised	-	-
Duration	Long-Term	Long-Term	-	-
Probability	Probable	Possible	-	-
Consequence	Medium	Low	-	-
Significance	Medium	Very Low	-	-
Project components:	1, 2, 3, 5, 6			

Recommendations and Mitigation Measures

- Laydown areas and temporary access roads should be kept to a minimum in order to limit direct vegetation loss and habitat fragmentation.
- Limit the removal of vegetation (particularly Miombo woodland and associated large mature trees) as far as possible.
- Rehabilitation of all disturbed areas (e.g. temporary access tracks and laydown areas) must be undertaken after construction.
- Removal of larger older trees must be limited as much as possible. Should trees be removed, bat boxes must be provided, away from turbines should be undertaken to replace these roosting spaces.

7.5.4 Creation of Bat Habitat in High-Risk Locations (Operational Phase)

The construction of a wind farm and associated building infrastructure may provide new roosts for bats, attracting them to the area and indirectly increasing the risk of negative mortality impacts. Bats may investigate wind turbines for potential roosting spaces increasing the chance of wind turbine induced mortality. New buildings may also provide roosting opportunities while lights at the wind farm provide potential foraging areas. The probability of bats forming roosts in the new infrastructure is possible due to the high activity on site and because bats do use man-made structures at the site for roosting already. If any bats do manage to do so, they would be at greater risk of mortality due to proximity to wind turbines. With mitigation, significance will be brought down to ***very low***.

Table 75: Impact Assessment - Impacts on Bats (Habitat creation in high-risk locations)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**

Type of Impact	Negative Impact			
Intensity/Severity	-	-	Low	Low
Geographic Extent	-	-	Localised	Localised
Duration	-	-	Long-Term	Long-Term
Probability	-	-	Possible	Improbable
Consequence	-	-	Low	Low
Significance	-	-	Very Low	Very Low
Project components:	-		1, 4, 7	

Recommendations and Mitigation Measures

- Bats should be prevented from entering any possible artificial roost structures (e.g. roofs of buildings, road culverts and wind turbines) by ensuring that they are sealed in such a way as to prevent bats from entering.
- If bats colonise Project infrastructure, a suitably qualified bat specialist should be consulted before any work is undertaken on that infrastructure or attempting to remove bats.
- Ongoing maintenance and inspections of buildings must be carried out to ensure no access to bats or actively roosting bats.

7.5.5 Mortality of Bats during Commuting and/or Foraging (Operational Phase)

The major potential impact of wind turbines on bats is direct mortality resulting from collisions with turbine blades and/or barotrauma. These impacts will be limited to species that make use of the airspace in the rotor-swept zone of the wind turbines. The high activity of species that exhibit behaviour that bring them into contact with wind turbine blades (particularly free-tailed bats and fruit bats) could result in major negative impacts to the overall bat population. Without mitigation, significance would be very high but with mitigation measure significance would be brought down to ***medium***.

Table 76: Impact Assessment - Impacts on Bats (Mortality during commuting and/or foraging)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	-	-	High	Medium
Geographic Extent	-	-	Regional	Regional
Duration	-	-	Long-Term	Long-Term
Probability	-	-	Definite	Possible
Consequence	-	-	Very High	High
Significance	-	-	Very High	Medium

Type of Impact	Negative Impact	
Project components:	-	1

Recommendations and Mitigation Measures

Layout and design specific mitigation:

- The following should be taken into consideration during the design of the Unika 1 Wind Farm, noting that all buffers are to blade tip:
    - Establish No-Go areas 50 m around water bodies, inselbergs and degraded forests;
    - Establish a 200 m high sensitivity buffer around water, inselberg (turbines are allowed, though more stringent mitigation and management actions are required);
    - Ensure a minimum 50 m blade tip clearance from the ground;
    - Rotor swept area must be minimized as much as practicable;
    - Establish no go buffer of 500 m around the confirmed bat roost locations;
    - Establish a 500 m high sensitivity around villages;
    - Ensure blade feathering is implemented from the start of operations;
    - Install ultrasonic deterrents on turbines in the 200 m high sensitivity buffer from the start of operations; and
    - Raise the cut-in speeds of turbines (4 ms^{-1}), and turbine blade feathering (up to 4 ms^{-1}) from the start of operations.
- The layout of the wind farm must be updated to include the above mitigation measures. There are 11 turbines in the No-Go areas (that need to be moved).
- The 37 turbines that are located within the 200 m high sensitivity buffer areas will need to be moved where possible, and if not possible, must be subject to more frequent monitoring than the other wind turbines.
- Should the above still result in unacceptable high bat fatalities (based on international best practice and results of the operational monitoring), additional mitigation measures must be considered and may include shutting down certain turbines during defined times.

Operation phase mitigation:

- Blade feathering must be applied to all turbines from the start of operations.
- The height of the lower blade swept area must be maximised. As such, the turbine design favoured by the specialist would not sweep down below 50 m.
- Operational acoustic monitoring and carcass searches for bats must be performed, based on South African best practice (or other international standard if none exist for Zambia), to monitor mortality and bat activity levels. Acoustic monitoring should include monitoring at height (from more than one location i.e. such as on turbines) and at ground level.
- Carcass searching of all turbines must be done from the start of operational and continue for two years. The appointed bat specialists should, based on the results of the carcass searching and the effectiveness of mitigation measures, determine if this should continue and for how long.
- Raising the cut in speed to 4 m/s on all turbines from the start of operations. Operational monitoring of the wind farm will determine the effectiveness of this and apply adaptive management to reduce bat fatalities. These measures will include raising the cut in speed and shutting down turbines that cause the greatest number of fatalities. The appointed operational bat specialist must determine this based on applicable local, regional and international guidelines.

7.5.6 Mortality of Bats during Migration (Operational Phase)

High numbers of migratory species suffer mortality at wind farms in North America and Europe. Therefore, the direct impact of bat mortality may be higher when they migrate compared to when they are commuting or foraging. This is therefore considered here as a separate impact of the wind farm, potentially for the African straw-coloured fruit bat, which exhibits long-distance migratory behaviour from across a significant portion of the African continent including South Africa, Kenya and Ethiopia. This species has not been confirmed on site but due to it being recorded within 60 km around the southern area of Katete (well within the travelling abilities of this species) and its near-threatened status, consequence and significance without mitigation would be high to very high. With appropriate mitigation, significance would be brought down to ***Low***. Little is known about bat migration locally and in the region and other migratory species may also be present.

Table 77: Impact Assessment - Impacts on Bats (Mortality during migration)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	-	-	High	Low
Geographic Extent	-	-	National	Regional
Duration	-	-	Long-Term	Long-Term
Probability	-	-	Possible	Possible
Consequence	-	-	Very High	Medium
Significance	-	-	High	Low
Project components:	-		1	

Recommendations and Mitigation Measures

- Blade feathering must be applied to all turbines from the start of operations.
- Raising the cut in speed to 4 m/s on all turbines from the start of operations. Operational monitoring of the WPP will determine the effectiveness of this and apply adaptive management to reduce bat fatalities. These measures may include raising the cut in speed and shutting down turbines that cause the greatest number of fatalities. The appointed operational bat specialist must determine this based on applicable local, regional and international guidelines.
- Operational acoustic monitoring and carcass searches for bats must be performed, based on South African best practice (or other international standard if none exist for Zambia), to monitor mortality and bat activity levels. Acoustic monitoring should include monitoring at height (from more than one location i.e. such as on turbines) and at ground level.
- Carcass searching of all turbines must be done from the start of operational and continue for two years. The appointed bat specialists, based on the results of the carcass searching and the effectiveness of mitigation measures, determine if this should continue and for how long.

7.5.7 Impact of Light Pollution on Bats (Operational Phase)

The construction of a wind farm will marginally increase light pollution. This excludes turbine aviation lights which do not appear to impact bats. During the operation of the Wind Farm, it is assumed that the only light sources would be motion sensor security lighting for short periods and lighting associated with the substation and O&M building.

This artificial lighting would impact bats indirectly via the mortality of their insect prey thereby reducing foraging opportunities for certain bat species. Lighting attracts and can cause direct mortality of insects. These local reductions in insect prey may reduce foraging opportunities for bats, particularly for species that avoid illuminated areas. This impact is likely to be ***Insignificant*** after mitigation because, relative to the large area in the region that would not be developed that likely supports large numbers of insects, the prey resource for bats is likely to be sufficient.

Other bat species actively forage around artificial lights due to the higher numbers of insects which are attracted to these lights. This may bring these species into the vicinity of the project and indirectly increase the risk of collision/barotrauma particularly for species that are known to forage around lights.

Table 78: Impact Assessment - Impacts on Bats (Light Pollution)

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	-	-	Low	Very Low
Geographic Extent	-	-	Localised	Localised
Duration	-	-	Long-Term	Long-Term
Probability	-	-	Probable	Possible
Consequence	-	-	Low	Very Low
Significance	-	-	Low	Insignificant
Project components:	-		4, 7	

Recommendations and Mitigation Measures

- This impact can be mitigated by using as little lighting as possible, and only where essential for operation of the facility.
- Where lights need to be used such as at the substation and switching station and elsewhere, these should have low attractiveness for insects such as low pressure sodium and warm white LED lights. High pressure sodium and white mercury lighting is attractive to insects and should not be used as far as possible.
- Lighting should be fitted with movement sensors to limit illumination and light spill, and the overall lit time. In addition, the spread of light should be restricted and directed downward (i.e. near to and below the horizontal plane) to minimise light trespass and sky glow.
- Increasing the spacing between lights, and the height of light units can reduce the intensity and volume of the light to minimise the area illuminated and give bats an opportunity to fly in relatively dark areas between and over lights.

7.6 SOCIO-ECONOMIC IMPACTS

7.6.1 Physical and Economics Displacement

Background and Baseline Conditions

The Project will need to secure communal land required for the establishment of the Project infrastructure – including the wind turbines, offices, sub-stations, as well as wayleaves for the access roads and underground interconnectors.

The land required by the Project falls under customary tenure and is mostly comprised of small-scale farmland held under exclusive rights by an individual. Although not a major land-use by total area, there are also numerous rural settlements within the study area. All land not under settlements or farmland is defined as communal land, which falls under the direct authority of the traditional authorities (the Chewa Royal Establishment). No individual has exclusive rights to communal land, and all resources (including fruit trees, water, grazing land etc.) are shared as a common resource.

Under the current design iteration, all communities, community facilities and homesteads have been avoided. As such, it is very unlikely that the Project will lead to physical displacement. The Project will however lead to economic displacement – or the loss or restriction of access to private and communal land (but not the loss of any homes) that supports the livelihoods of local communities and households.

The economic displacement will be both the loss of small-scale farmland owned by local households, as well as communal land held by the Chewa Royal Establishment. All land is communal, and no formal titled private land is expected to be affected.

Impact Assessment

The impact associated with physical and economic displacement will occur prior the construction phase, however without mitigation the impacts are deemed to be permanent in nature. While the Project may likely avoid physical displacement, it cannot be fully discounted at this point. Economic displacement with respect to the loss of land; however, cannot be reasonably avoided given the land requirements of the Project.

As small-scale farming is the economic foundation for local households, the loss of farmland would be deemed to be a substantial social impact. Without the adoption of effective mitigation measures (in the form of compensation and resettlement support) the impact of displacement would be permanent and of high negative significance. By adopting accepted national and international measures to address displacement (via a Resettlement Policy Framework for the environmental authorisation (see Annexure I), and later a Resettlement Action Plan for the financiers) the impact may be reduced to a ***Low*** negative significance.

Table 79: Impact Assessment - Physical and Economic Displacement

Type of Impact	Direct Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	Low	-	-
Geographic Extent	Local	Local	-	-
Duration	Permanent	Permanent	-	-
Probability	Definite	Definite	-	-
Consequence	High	Low	-	-

Significance	High	Low	-	-
Project components:	1, 2, 3, 4, 7		-	

Recommendations and Mitigation Measures

- Ensure the placement of any Project infrastructure will avoid the need to relocate households to the maximum extent possible. To ensure avoidance the following recommendations will apply:
  - All Project infrastructure (including all linear infrastructure and wayleaves) will be sited to avoid all villages, hamlets, and isolated households, to the maximum practical extent possible.
  - Suitable set-back limits will be established from each turbine and the turbines will be placed so that all villages, hamlets, and isolated households are located outside of the set-back limit.
  - Where the Project requires the rerouting, upgrading, clearing or increase of width of community roads, the Project will avoid the need to relocate households.
- Ensure the placement of any Project infrastructure will avoid the acquisition of land to the maximum extent possible. The following recommendations apply:
  - All Project infrastructure (including all linear infrastructure and wayleaves) should be sited on communal land before acquiring small-scale farmland, but only where this does not conflict with any ecologically sensitive sites or habitats.
  - All Project infrastructure (including all linear infrastructure and wayleaves) should avoid garden plots located on local rivers, streams, drainage lines or dambos, to the maximum extent possible.
- Adhere to the Resettlement Policy Framework (Annexure I) to address any physical or economic displacement. Further detail on the provision of compensation, resettlement and livelihoods restoration will be defined in the framework.
- Once environmental authorisation is granted, the required asset inventories and valuations will be undertaken, and the Resettlement Policy Framework will be upgraded to a full Resettlement Action Plan.

7.6.2 Impacts on Natural Resource Harvesting

Background and Baseline Conditions

Natural resource harvesting is common for rural communities within the Project area, and there is a rich diversity of materials and habitats from which such materials are collected. Firewood, wood for charcoal production, hunting, collection of wild fruit, communal fruit trees, vegetables and mushrooms are common and are generally sourced from communal bush around local villages, as well as along the slopes of the local hills.

In addition, local rivers, streams and dambos are important sources of traditional building materials – including mud and clays for mudbricks, cut lumber and poles for the frames of traditional homes, as well as reeds and grasses for thatching. Similarly, these natural resources are sourced from communal areas.

The establishment of the Project will require the siting of infrastructure on communal land. However, as the infrastructure is distributed across a large area, it is unlikely to result in the complete destruction of entire habitats or systemic losses of natural resources. Rather, the Project will require the clearing of sections or linear strips of communal land / natural habitats, that will likely result in the localised loss or degradation of communal land or natural habitats on which local communities rely.

Impact Assessment

Given the distributed nature of the project infrastructure over a large area, the impact on communal land and natural resources is expected to be of **medium negative significance**, assuming no mitigation measures are established. This is largely related to any indiscriminate clearing of communal land, notably sensitive habitats such as streams, rivers, dambos and local hills, which have been avoided as much as possible in the layout. However, such impacts can readily be mitigated, and the impact can be reduced to a ***Low*** negative significance.

Table 80: Impact Assessment - Communal Land and Natural Resources

Type of Impact	Direct Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Medium	Low	-	-
Geographic Extent	Local	Local	-	-
Duration	Permanent	Permanent	-	-
Probability	Definite	Definite	-	-
Consequence	Medium	Low	-	-
Significance	Medium	Low	-	-
Project components:	1, 2, 3, 4, 5, 6, 7		-	

Recommendations and Mitigation Measures

- Any recommendations made in the ecological specialist studies apply with respect to the conservation of sensitive habitats in the area. The Project shall avoid the construction of any infrastructure along existing rivers, streams, marches and dambos, as well as on local hills. Where required suitable crossing / culverts are permitted;
- Local small-scale farmland is considered to be more valuable, therefore project infrastructure should be constructed on communal land as much as possible, but only where the local habitats are already degraded;
- Communal land shall be leased from the Chewa Royal Establishment consistent with established Deed of Agreement and the Resettlement Policy Framework / Resettlement Action Plan. All funds provided as compensation for the use or lease of communal land shall be placed into a community trust for the use for the benefit of local communities.
- The Project shall not make any payments of compensation for communal land, to any individual, body, or organisation as a private payment, or which is inconsistent with the provisions of the previous requirement.

7.6.3 Labour, Working Conditions, and Work-Seeker Influx

Background and Baseline Conditions

The Project is expected to employ 500-700 people during the construction phase, which will extend over approximately 24 months. The operational phase will require a relatively small workforce of 10-15 skilled and 5-10 unskilled people that are expected to be resident in Katete Town or surrounding villages. At this stage it is not anticipated to accommodate worker onsite.

Such employment opportunities will be a significant benefit given the very low level of formal employment in the district (estimated to be only 3% of the total population), as well as in communities immediately surrounding the Project site. However, given the very low employment rates the project will need to manage labour-related risks including:

1. Managing elevated and unreasonable community expectation on employment benefits;
2. Ensure fair and preferential recruitment practices in local communities;
3. Reducing the potential of work-seeker influx;
4. Ensuring safe and appropriate working conditions for the Project workforce; and
5. Managing economic *boom and bust* related to workforce demobilisation.

In general, the above-mentioned risks do not offset the positive benefits in terms of local employment opportunities if the risks are actively managed as part of the project human resources management policies and procedures.

Impact Assessment

Without mitigation/enhancement the provision of employment (including fair and safe working conditions) will be of low positive benefit for the short-term during the construction phase, as well as during the operational phase. Assuming effective labour management systems are put in place to (1) promote local employment (2) provide safe and fair working conditions, and (3) manage the risks of worker influx, the benefits are expected to increase to ***Medium*** positive.

Table 81: Impact Assessment - Labour, Working Conditions, and Work-Seeker Influx

Type of Impact	Direct Positive Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Medium	High	Low	Medium
Geographic Extent	Regional	Regional	Local	Local
Duration	Short-Term	Short-Term	Long-Term	Long-Term
Probability	Definite	Definite	Definite	Definite
Consequence	Low	Medium	Low	Medium
Significance	Low Positive	Medium Positive	Low Positive	Medium Positive
Project components:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		1, 4, 5, 7	

Recommendations and Mitigation Measures

- The Proponent/Project Developer will establish suitable Human Resources and Recruitment Procedures that establish rules for local recruitment and preferential employment consistent with national labour laws and relevant ILO conventions to which Zambia is a signatory. These procedures will be issued to the Construction Contractor for adoption with the own internal recruitment procedures during the construction phase. The procedures will also apply to the operational workforce.
- The Proponent/Project Developer, and where relevant the appointed Construction Contractor, will provide fair and safe working conditions consistent with (1) Zambian national labour law, (2) ILO conventions applicable to Zambia, (3) IFC Performance Standards, and (4) any additional labour standards established by financiers.
- The Proponent/Project Developer, and where relevant the appointed Construction Contractor, will establish measures to reduce the potential for work-seeker influx during the construction phase. This will include:

- Establishment of a formal recruitment system and no "*at-the-gate*" casual employment will be permitted.
- Monitoring of settlement growth and the formation of informal housing or settlements around the Project.

- Promote the investment in community facilities and self-employment programmes as part of the Community Development Plan.
- The Proponent/Project Developer, as well as any third-party contractors, will ensure the occupational health and safety of all workers with (1) Zambian National health and safety laws, (2) ILO conventions applicable to Zambia, (3) IFC Performance Standards, and (4) any additional labour standards established by financiers.

7.6.4 Community Health and Safety

Background and Baseline Conditions

The communities that will be located close to the Project infrastructure are rural and will have minimal exposure to large-scale development and the associated health and safety risks. Interviews indicate that the current major community health and safety risks primarily relate to:

1. Household diseases, notably malaria, flu/influenza, and Cholera.
2. General poor nutrition, which is dominated by staple starches.
3. Poor water quality and poor sanitation practices, that results in elevated cases of Cholera.
4. Poor roads quality which results in accidents for pedestrians and commuter traffic.

In addition, there is limited public health infrastructure available within the study area. For emergencies, local households are required to take a 50-kilometre round trip to the St. Francis hospital in Katete Town.

The Project will pose some limited risks to community health and safety – including potential risks during the construction phase related to (1) construction traffic and movement of abnormal load materials and equipment, (2) transport of hazardous materials and waste, (3) soil and water contamination, (4) security control at work-sites, and (5) incidents and emergency events.

The operational phase will present a different profile of community health and safety risks – including (1) operational traffic, (2) transport of hazardous materials, (3) soil and water contamination, (4) wind turbine structure failure and (5) blade throw. Community health may also be affected by blade flicker, noise, and infrasound, which have been addressed by the visual and noise impact specialist studies.

Impact Assessment

The introduction of the Project into local communities will pose some health and safety risks. However, risks are deemed to be highly manageable under standard Health and Safety (H&S) Plans. Without the adoption of such measures, the impact or risks to local community health and safety would be deemed to be medium negative for both the construction and operational phases. However, the establishment of a functional Project H&S system would result in a risk of ***Low*** significance.

Table 82: Impact Assessment - Community Health, Safety and Security

Type of Impact	Direct Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	High	Medium	Medium	Low
Geographic Extent	Regional	Regional	Regional	Regional

Duration	Short-Term	Short-Term	Long-Term	Long-Term
Probability	Probable	Probable	Probable	Probable
Consequence	Medium	Low	Low	Low
Significance	Medium	Low	Medium	Low
Project components:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		1, 4, 5, 7	

Recommendations and Mitigation Measures

The following mitigation measures and recommendations apply to the construction phase:

- The Project will establish suitable H&S and Emergency Response Plans that respond to both occupational incidents as well as incidents between the Project (including all third-party contactors) and local communities. The plans must make provision for:
    - Restricting access to secure sites (including construction camps, laydown areas, working areas etc.) and ensure safety measures are in place.
    - Standard traffic safety measures to ensure the safety of both pedestrian and vehicle traffic on public and project access roads.
    - Reduce soil and water contamination, notably to local farmland and surface water sources, during the construction of infrastructure along or through rivers, streams and dambos.
- Any upgrades to existing roads or new access roads will include standard traffic safety measures to ensure the safety of both pedestrian and vehicle traffic. This will include specific procedures to be adopted by the construction contractor, as well as long-term safety measures during the operational phase.
- Project turbines must be sited at an acceptable distance ("setback") between wind turbines and adjacent sensitive receptors to maintain public safety, based on international good practice on recommended setback distances (i.e. the Public Safety Zone).
- Once the equipment transport routes have been identified, ensure that a Community H&S risk assessment is conducted and that a Traffic Safety Management Plan is developed (prior to construction).

The following mitigation measures and recommendations apply to the operational phase:

- The Project will establish suitable Emergency Response Plans that respond to both occupational incidents as well as incidents between the Project (including all third-party contactors) and local communities. The plans must make provision for:
    - Restricting access to all operational sites, where possible, and ensure safety measures are in place to address accidental and active trespassing, theft, and vandalism,
    - Safety of project vehicles, as well as commuter and pedestrian traffic on public and project roads,
    - Accidental damage or sabotage of underground interconnectors, including provision of suitable warning signage, maintenance of the operational ROW of way and suitable monitoring and surveillance.
- Community health aspects related to blade throw, blade-flicker, noise, and infrasound are detailed further in other studies, and mitigation measures in those studies apply with respect to the management of community health and safety risks.
- Collaborate with the Chewa Development Trust in terms of allocating community funds towards assisting in community development (e.g. health, education, sanitation, etc).

7.6.5 Disruption of Access and Mobility (pathways, roads)

Background and Baseline Conditions

The Project is located north the Great East Way (T4) which connected to the D538 District Road into the Project Site. Both the T4 and the D538 will act as the primary truck road to and from the Project Site. Roads within the study area are largely limited to four major types – gazetted, district roads (D-roads), rural roads (R-roads), and informal community tracks. The first three are state roads administrated by the Roads Authority or the District Authorities, while the informal community tracks have no formal designation and are owned by the local community and customary authorities.

It is the intent of the Proponent to upgrade existing public and community roads, as well as construct new access roads to support the construction and operations of the Project. The typical design of the road will be a 4,5-metre-wide gravel access road in a 20-metre-wide road reserve. The road reserve will support drainage and cabling.

The Project will require an estimated 22 different access roads with a total length of 59 kilometres. Assuming that a 20-metre-wide road reserve is established or enforced on existing roads, the total land-take is estimated to be approximately 118 hectares.

Local communities are very isolated and rely on both public roads and community tracks to connect to neighbouring villages and the T4 highway. Vehicle, cart, and foot traffic is commonly found on all existing roads. The poor state of the local roads limits the mobility of local communities. Travel to Katete Town or further afield takes a long time and comes at a cost, and therefore is only undertaken on a need's basis.

Impact Assessment

The Project will likely result in changes in access and mobility of local households, mostly from the need to use existing public roads or by constructing new access roads. This will result in a combination of positive benefits (improved road conditions and mobility) and negative impacts (temporary closure of existing roads, public traffic safety).

Assuming that no mitigation measures are in place to manage traffic safety, as well as the temporary closure or degradation of existing public and community roads, the impact is deemed to be of high severity during the construction phase if no mitigation measures are established. The overall impact is however of low negative significance as the impacts would be of short-term duration. However, the same impacts would be of high negative significance as they would extend over the operational life of the Project. Assuming the Project allows (1) continued public access on all exiting public and community roads, (2) provides for ongoing maintenance and upgrades, and (3) public use of new access roads, then the balance of impact is considered to be ***High*** positive significance.

Table 83: Impact Assessment - Disruption of Accessibility and Mobility

Type of Impact	Direct Positive and Negative Impacts			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	High	High	High
Geographic Extent	Local	Local	Local	Local
Duration	Short-Term	Short-Term	Permanent	Long-Term
Probability	Definite	Definite	Definite	Probable
Consequence	Low	Low	High	High Positive
Significance	Low	Low	High	High Positive
Project components:	2, 5		5	

Recommendations and Mitigation Measures

The following recommendations, mitigation and benefit enhancement measures apply:

- The Project will upgrade and use existing public roads as well as community tracks in preference to the construction of new roads. Any upgrades to district and rural roads will be authorised by the road and district authorities or local communities.
- In cases where district or rural tracks are upgraded, the Project will attempt to avoid the increase in width of the road reserve, where it results in the destruction of homes, loss of property or loss of farmland. Where this cannot be avoided, compensation will be provided consistent with the Resettlement Policy Framework/ Resettlement Action Plan.
- No existing public roads or community tracks will be converted into private roads, nor will the Project seek to restrict public use of existing roads or tracks.
- The Project will explore options of allocating community development funds to the ongoing repairs and maintenance of local roads with the Community Development Trust.
- The Project will ensure effective traffic safety management (via policies, plans, procedures, and occupational training) during the construction and operational phases. This will include specific safety measures when transporting turbine parts and other heavy equipment through or near local communities.

7.6.6 Local Economic Development

Background and Baseline Conditions

The Project will be the first major industrial development in the study area and as well as within Katete District. It therefore has the potential to support local economic development directly via (1) local employment and (2) local content (defined as use of local goods and services), and (3) via community development programmes.

The Project is expected to employ 500-700 persons during the construction phase, which will extend over 24 months. The operational phase will require a relatively small workforce of 10-15 skilled and 5-10 unskilled persons that are expected to be resident in Katete Town or surrounding villages.

In addition, the Project is expected to invest approximately USD 300 - 450 million into the Zambian economy. It is expected that the Project will drive demand for local goods and services, notably from Katete Town and surrounding major urban areas. The benefits will be most apparent during the construction phase. However, the short-term nature of construction often leads to an economic *boom-and-bust*, while operational expenditure will be lower but will be an ongoing benefit over the operational life of the Project.

To ensure long-term economic development, the Project and the Chewa Royal Establishment have established a community development trust (the Chewa Development Trust). This is a legally constituted trust that will function as the primary development vehicle and will be funded by the Project via a share of dividends. All funds granted to the trust will be allocated to community development projects determined by the trustees.

Impact Assessment

The direct Project investment in Zambia as well at the local region, including local employment and community investment, will be a project benefit during both the construction and operational phases. However, local benefits may not be realised unless local procurement, local employment and local community development measures are established. Should such measures be adopted the benefit may be increased from very low benefits to ***Medium*** benefits specifically for local communities.

Table 84: Impact Assessment - Local Economic and Community Development

Type of Impact	Positive Direct and Indirect Benefit

Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	Low	High	Very Low	Medium
Geographic Extent	Regional	Regional	Regional	Regional
Duration	Short-Term	Short-Term	Long-Term	Long-Term
Probability	Definite	Definite	Probable	Probable
Consequence	Very Low	Medium	Medium	Medium
Significance	Very Low Benefits	Medium Benefits	Very Low Benefits	Medium Benefits
Project components:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		1, 4, 5, 7	

Recommendations and Mitigation Measures

The following mitigation measures and recommendations apply to the construction phase:

- The Project and third-party contractors will promote local recruitment as much as possible under its human resources and recruitment systems. Preferential employment will be, *where feasible*, granted to residents of Katete District and Project area before recruiting other Zambian nationals or expatriates.
- The Project and third-party contractors should promote local content under its procurement systems, where practically feasible. It should prioritise existing small, medium enterprises present in Katete Town and local communities as potential suppliers, notably in terms of accommodation, food, basic services etc.

The following mitigation measures and recommendations apply to the operational phase:

- The Project will promote local recruitment of persons from villages within the Project area and nearby Katete Town during its operational life.
- The Project will support reasonable local content and procurement of goods (construction supplies, labour etc.) and services (accommodation, food) from villages within the Project area and/or Katete Town.
- The Project will support developmental programmes via its proposed Community Development Plan developed in collaboration with the Community Development Trust, and where possible collaboration with existing government development programmes in the District.

7.6.7 Cultural Heritage

Background and Baseline Conditions

During the Heritage Impact Assessment a total of 34 heritage features were identified within the Project Site which includes grave sites (individual and village graveyards, rocks, kopjes (hills), potshed, royal palace and ceremonial arena.

Five of these heritage features were considered of national importance and include the following:

- Bulawayo village Anoya Zulu (UNIP activist) grave area
- Decorated potshed near the Kopje
- Royal Palace, Kulamba Ceremonial Arena
- Mkaika Royal Graveyard

- A Grinding stone

Impact Assessment

Based on the current layout of the Unika 1 Wind Farm none of the heritage features identified will be impacted upon (see Figure 48). As such Project is unlikely to impact on any cultural heritage features. The impact, for both construction and operation phases, is therefore considered to be ***Insignificant.*** There is however a chance that cultural heritage features could be exposed during construction and a Chance Find Procedure would therefore be required.

Table 85: Impact Assessment - Cultural Heritage

Type of Impact	Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	Very Low	Very Low	Very Low	Very Low
Geographic Extent	Local	Local	Local	Local
Duration	Short-Term	Short-Term	Long-Term	Long-Term
Probability	Improbable	Improbable	Improbable	Improbable
Consequence	Very Low	Very Low	Very Low	Very Low
Significance	Insignificant	Insignificant	Insignificant	Insignificant
Project components:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		1, 4, 5, 7	

Recommendations and Mitigation Measures

- Ensure a Chance Find Procedure is developed and implemented during the construction phase to address any potential chance finds of cultural heritage aspects during site clearance and preparation. The EPC and O&M Contractor staff and sub-contractors shall be trained on the Chance Find Procedure.
- Ensure that EPC and O&M Contractors are made aware of the natura and location of heritage features identified, and these will be treated as No-Go areas for staff and sub-contractors.
- The Mkaika Village Cultural Landscape should be protected by avoiding infrastructure borrow pits near or within the highly culturally sensitive areas such as Royal Palace, Graveyards, and Community Graveyards.
- Buffers need to be established between the wind turbines and existing residential areas, the Royal Palace, Graveyards, and Community Graveyards. This is applicable to places which are associated with the emergence of the Gule wamkulu “spirits”.
- The Grave of Anoya Zulu should be demarcated as a No-Go Area.
- Any impacts on the community graves should not occur without the consent of the community members and the National Heritage Conservation Commission (NHCC). In case of any exhumation, the owners and the local council should be informed for authorization as guided by The Inquests Act Chapter 36 of the Laws of Zambia.

7.6.8 Noise Impacts on Surrounding Communities

Background and Baseline Conditions

Ambient sound levels were measured at eight locations over a period of at least 1 hour at each location. The data indicated that ambient sound levels are generally low with no measurements collected during times when the average wind speeds exceeded 3 m/s (as measured at 1.5 m height). The results indicate a quiet environment where natural noises, mostly wind-induced as well as faunal noises, dominate.

Anthropogenic noises will increase ambient sound levels, especially closer to the communities and local towns. The data is similar to sound level measurements measured at other, similarly natural locations.

Available data indicates that wind-induced noises will start to increase at wind speeds 3 – 4 m/s, becoming significant (and frequently the dominant noise source in rural areas) at wind speeds higher than 10 – 12 m/s. Most wind turbines reach their maximum noise emission level at a wind speed of 8 – 10 m/s. At these wind speeds, increased wind-induced noises (wind howling around buildings, rustling of leaves in trees, rattling noises, etc.) could start to drown other noises, including those being generated by wind turbines.

An aerial mage showing the wind turbine locations and the identified Noise Sensitive Receptors (NSRs) is presented in Figure 55.

The potential maximum noise levels associated with the operational phase is illustrated in Figure 56 when considering a wind turbine generator with a sound power emission level of 107.5 dBA. The calculated noise rating level contours are presented in Figure 57 for a quieter wind turbine generator (such as the Vestas V150 with serrated trailing edge with a sound power emission level of 104.9 dBA).

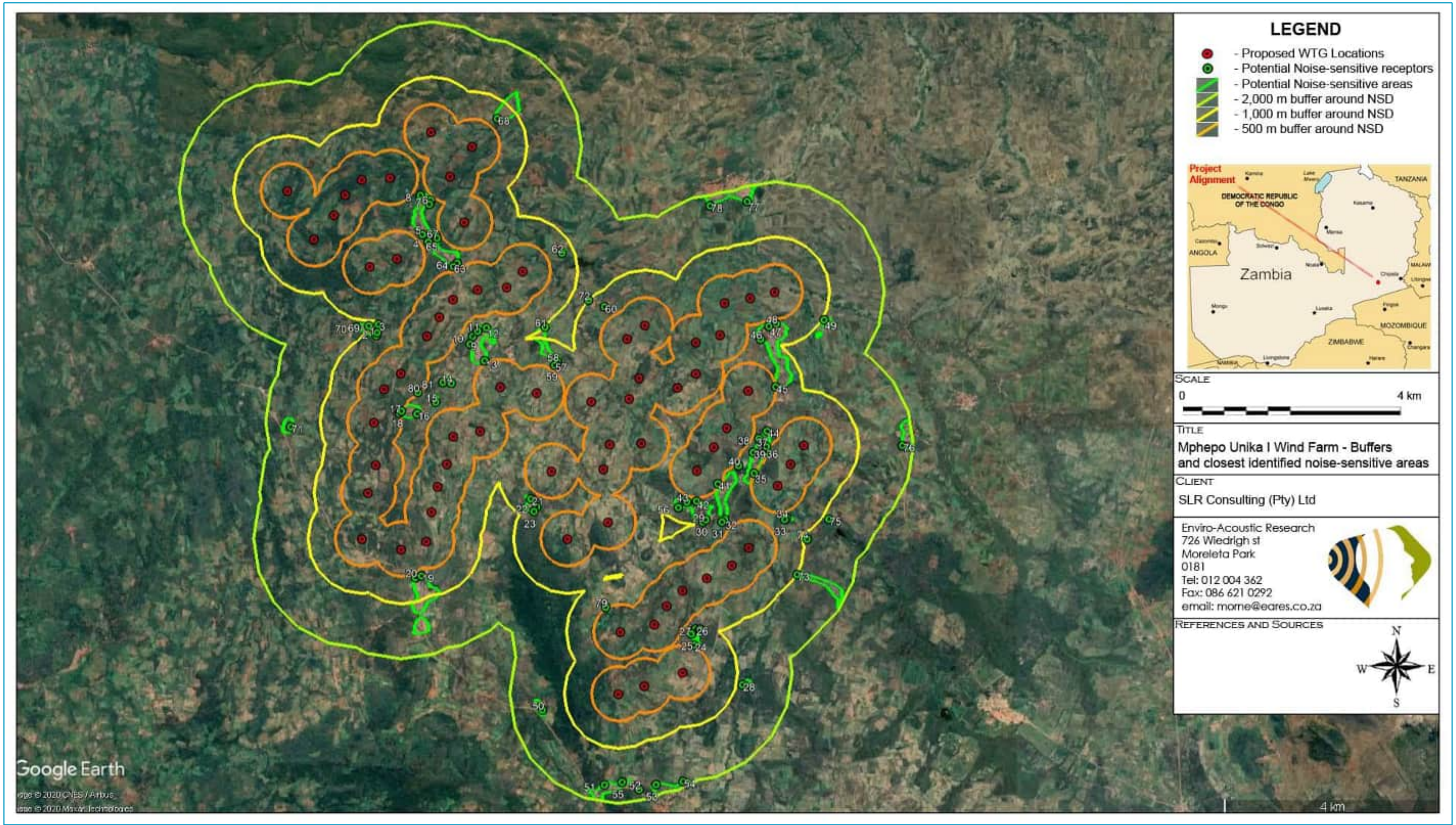

Figure 55: Noise sensitivity map and NSRs

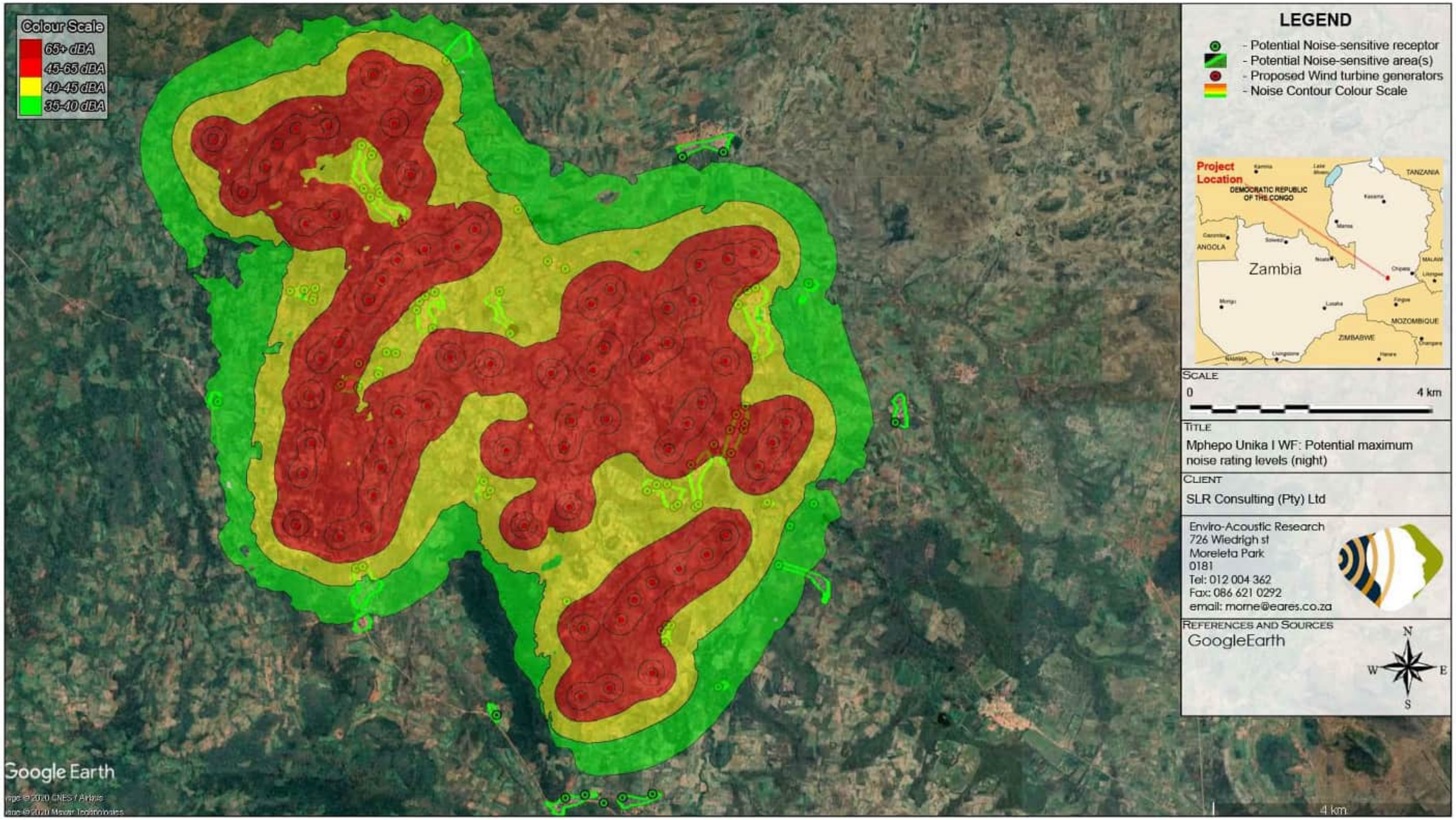

Figure 56: Projected maximum night-time operational noise rating levels using a wind turbine generator with a 107.5 dBA sound power emission level

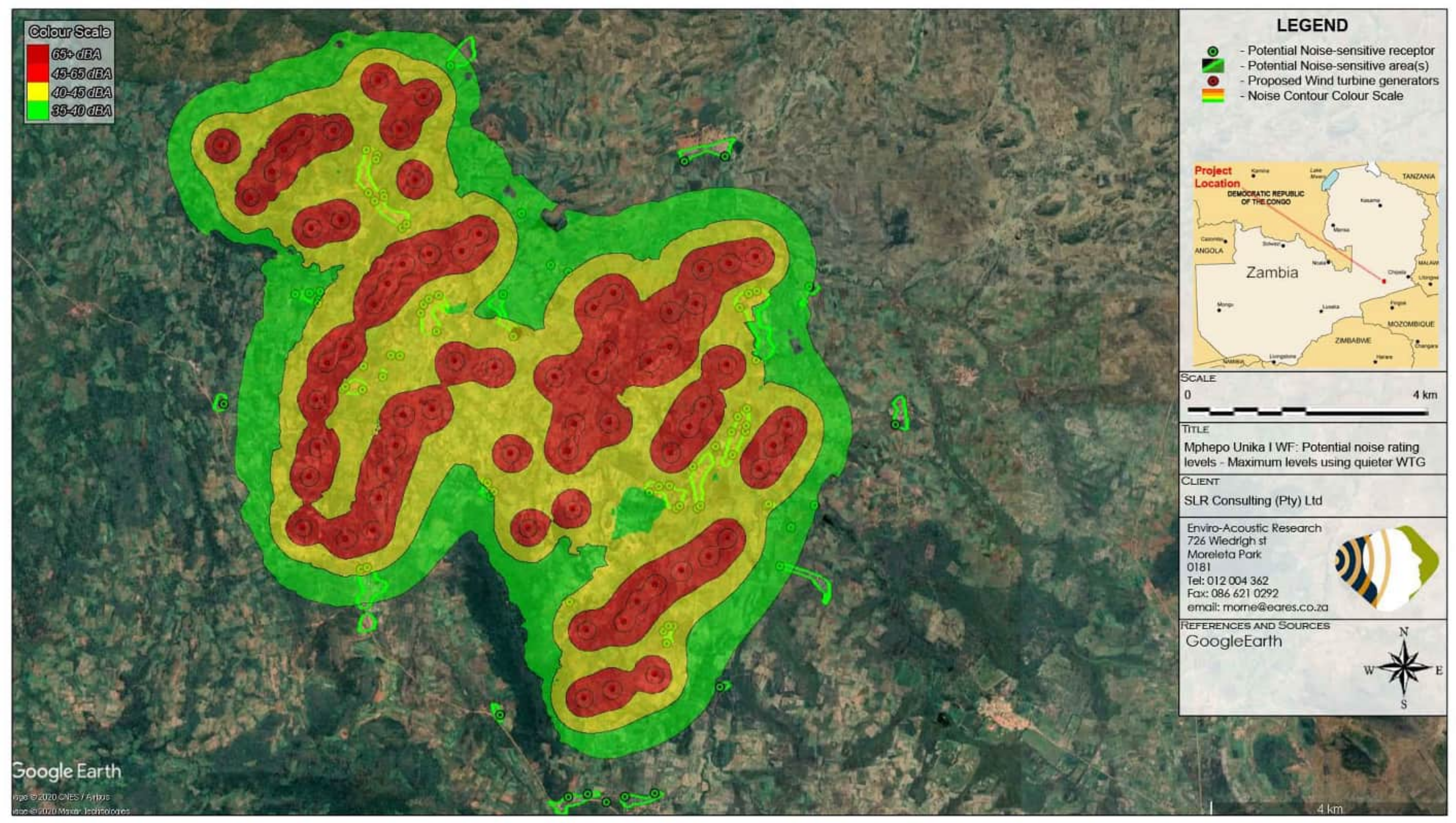

Figure 57: Projected mitigated night-time operational noise rating levels using a wind turbine generator with a 104.9 dBA sound power emission level

Impact Assessment

There are numerous activities and equipment at a construction site that generate a variety of noises. Each activity (including equipment used for the construction activity) can generate a sound with a different spectral character, at a different level and phase with a different modulation. While the human ear may be able to detect the specific equipment or activity, the result is that it increases the acoustic energy in the area which a receptor will perceive as noise. However, because most construction activities will take place during daylight hours quite far from potential noise-sensitive receptors, the probability of a noise impact occurring is low (improbable) and the impact post mitigation assessed to be ***Insignificant***.

Noise emitted by wind turbines can be associated with two types of noise sources. These are aerodynamic sources due to the passage of air over the wind turbine blades and mechanical sources which are associated with components of the power train within the turbine, such as the gearbox and generator and control equipment for yaw, blade pitch, etc. This assessment considers a potential worst-case scenario, using the sound power emission levels of the Vestas V150-4.0 MW wind turbine, with the noise levels at the closest receptors defined as high as 46.6 dBA. The impact is assessed to be on ***Low*** significance post-mitigation.

Table 86: Impact Assessment - Noise Impact on Surrounding Communities

Type of Impact	Direct Negative Impact			
Impact Criteria	**Construction**		**Operations**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity/Severity	High	High	High	Moderate
Geographic Extent	Local	Local	Local	Local
Duration	Short Term	Short Term	Short Term	Short Term
Probability	Improbable	Improbable	Possible	Improbable
Consequence	Low	Low	Medium	Low
Significance	Very Low	Insignificant	Medium	Low
Project components:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10		1	

Recommendations and Mitigation Measures

Construction phase mitigation:

- Avoid simultaneous construction activities at numerous locations close to Noise-Sensitive Receptors (NSRs).
- Where possible night-time activities should be minimized.
- New access roads should not be constructed closer than 40 m from identified NSRs and should not pass through the local communities.

Operation phase mitigation:

- The developer must select a wind turbines having a sound power emission level less than 105.8 dBA; or
- The developer must develop and implement a noise abatement program that operates certain wind turbines in a reduced noise mode (to generate less than 105.8 dBA); or
- The developer must move certain wind turbines further from identified noise-sensitive receptors.

- Ensure that Grievance Mechanism is in place to deal with noise related issues (a noise specialist may be required to assist).

7.6.9 Visual Impact

Background and Baseline Conditions

In general the Project Site is comprised of a landscape of tall forested hills, elevated ridges and low-undulating hills, with broad, flat valleys extending between the hills. The valleys in-turn supports a number of ephemeral streams and well as seasonally flooded wetlands.

Although the hilly terrain does add value to the surrounding landscape, the form and scale of the hills do not create significant topographic features that are unique to the region. Larger and more interesting hill features are located to the south of the proposed Project Site, which do add to the landscape character. However, there are numerous ridgelines, peaks on the hills, as well as conical shaped, steep sided hills.

Impact Assessment

Construction of some components like the new access roads and wind turbine foundations may have some localised impacts on the topography of the Project Site, but this is not expected to be significant.

The viewshed analysis is undertaken in order to determine the extent to which the proposed landscape change would be visible to the surrounding areas.

Receptors are a general term used to define those persons, or places, that make use of the visual resources in the area where the proposed landscape modification will be visible. During the site visit and landscape survey, four different types of receptors were identified: rural village settlement; rural isolated homestead; urban settlement (Katete) and the T4 National Road.

The views of the turbines will result in a dominating feature in the regional landscape. Located within the Foreground Areas, with Very High (up to 2 km) and High Exposure area (2 km to 4 km), are many small villages, where receptors would have clear views of the surrounding turbines. It is likely that the turbines will dominate the local sense of place, and care would need to be taken to ensure that flicker effects do not negatively affect the villages. In this regard, a Shadow Flicker Assessment would need to be undertaken prior to construction.

The T4 National Road should also be considered as a Key Observation Point (KOP) as this road is an important regional route. Due to the predominantly agricultural vistas as seen from the road, as well as trees on the verge of the road offering visual screening, so clear viewpoints of the Wind Turbines along this road are likely to be few. Carefully planned placements of the Wind Turbines could add value to this route, but care should be taken to ensure that massing effects are limited. However, the most important aspect defining this cultural landscape, are the many small villages within the project area.

In conclusion, due to the woodlands vegetation of the region, as well as the small hills that characterise the topography, the wind farm zone of visual influence is rated as **Medium** to **High**.

The wind farm's visual impacts mainly relate to the presence of wind turbines in the landscape and aircraft warning lights at night. The visual impacts relating to the presence of wind turbines in the landscape will be applicable to the construction and operational phases, while the impacts related to aircraft warning lights will only be applicable during the operational phase.

Table 87: Impact Assessment - Visual impacts (Presence of wind turbines in the landscape)

Type of Impact	Negative Impact	
Impact Criteria	Construction	Operations

Type of Impact	Negative Impact			
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity/Severity	High	Medium	High	Medium
Geographic Extent	Regional	Regional	Regional	Regional
Duration	Short-Term	Short-Term	Long Term	Long Term
Probability	Probable	Possible	Probable	Possible
Consequence	High	Medium	Very High	High
Significance	Medium	Low	Very High	Medium
Project components:	1		1	

Recommendations and Mitigation Measures (Presence of wind turbines in the landscape)

Construction phase mitigation:

- Undertake a Shadow Flicker Impact assessment prior to construction.
- Where possible, ensure that wind turbines remain beyond a 1 km buffer area around villages.
- The substation and O&M buildings should be located in visually unobtrusive positions, or alternatively screened with earth berms and/or vegetation screens.
- The construction camp, batching plant and related storage/stockpile should be located in areas in unobtrusive positions in the landscape.
- Restrict size of construction camps to a limited essential, utilising diamond shaped fencing or similar to catch any wind-blown litter.
- Ensure dust suppression and litter control measures are implemented.
- Areas that are disturbed during construction and that will not be used during the operational phase must be rehabilitate.
- Signage for the Project should be minimised as far as practically possible, with limited logos or branding on the turbine hubs.
- Do not use any up-lighting of structures or turbines.
- Security lighting needs to be inward and downward facing to reduce light spillage.
- The walls of buildings should be painted with natural colours of a mid-grey hue to blend into the landscape better.

Operation phase mitigation:

- Ensure on-going maintenance of the roads to ensure erosion is managed.
- Ensure rehabilitation and restoration of portions of the wider construction roads that are no longer required for maintenance purposes.

Table 88: Impact Assessment - Visual impacts (Aircraft warning lights at night)

Type of Impact	Negative Impact			
Impact Criteria	Construction		Operations	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation

Type of Impact	Negative Impact			
Intensity/Severity	-	-	High	Medium
Geographic Extent	-	-	Regional	Regional
Duration	-	-	Long Term	Long Term
Probability	-	-	Probable	Possible
Consequence	-	-	Very High	High
Significance	-	-	Very High	Medium
Project components:	-		1	

Recommendations and Mitigation Measures

- Pulsed, red coloured aircraft warning lights at night have the potential to radically dominate the current dark sky sense of place of this deep-rural cultural landscape. To assist in reducing the intensity of the aircraft warning lights, aviation detection lighting systems (ADLS) need to be implemented. If allowed by the Zambian Civil Aviation Authority, locating aircraft warning lights on turbines along the edge of the wind farm only needs to be incorporated.
- If feasible, use physical screening cones to direct the aircraft warning lights out and up, as opposed to down to the ground to limited light spillage below the turbine hub height (*pending Zambian Civil Aviation Authority regulations*).

7.7 DECOMMISSIONING PHASE IMPACTS

The impacts during the decommissioning phase for the Unika 1 Wind Farm will be similar as during the construction phase where none are considered to result in impacts of high significance. A detailed ESMP will be compiled for the decommissioning phase prior to decommissioning the Wind Farm, and more details are included in the ESMP (Appendix A). The framework for a decommissioning plan is outlined in Section 09.

Once the Wind Farm reaches its end of life, there are two options. The first includes refurbishing or replacing the wind turbines and other components to allow the Project to continue generating electricity. The second option is to decommission the Wind Farm. The latter options will involve all components of the Wind Farm being removed and the impacted areas being rehabilitated. Where possible materials will be recycled, alternatively they will be disposed of according to both local and international waste management practices.

7.8 CUMULATIVE IMPACTS

From a cumulative impact perspective, there is some uncertainty about specific future developments in and around the Unika 1 Wind Farm Project Site. Except for the proposed Unika I Wind Farm development the only other projects identified within Katete itself (e.g. a fruit processing plant) and road upgrade projects along the T4 (Great East Road).

The Unika 1 Wind Farm site is rural in nature and no other existing industries or developments were noted within in the broader Project Site boundary.

There is a possibility of future expansion of the Unika Wind Farm (i.e. Unika 2 and Unika 3) within in the broader Project Site boundary which could lead to significant additional negative cumulative impacts. However, as the details are not known at this stage the cumulative impacts cannot be accurately assessed. This will be subject to a separate ESIAs at a later stage.

Negative cumulative impacts as a result of future wind farm or industrial development are likely to include increased air and noise emissions, impacts on bats and avifauna, waste management, traffic and various social issues arising from immigration of job seekers to an area of high growth.

If not properly managed, alien invasive plant species will out-compete indigenous flora and reduce overall indigenous biodiversity in the area. Not attempting to control or preventing the worsening of alien invasive infestation will cause a decline in indigenous species. Altered population dynamics, such as displacement of natural indigenous species by alien invasive species, can impact on natural community structures, impacting further on ecological interactions, ecological services and natural food-chains.

Similarly, cumulative impacts on bats were not considered as there are presently no current or potential future developments of wind farms within a 50 km of the proposed Unika 1 Wind Farm. However, should any future developments come to fruition the cumulative impacts would need to be considered in subsequent ESIA reports. It will be important to consider cumulative impacts across the entire scale potentially affected animals are likely to move, especially mobile animals like bats. Impacts at a local scale could have negative consequences at larger scales if the movement between distant populations is impacted. The cumulative impacts could be lower for species that do not migrate over such large distances or resident species that are not known to migrate. The sphere of the cumulative impact would then likely be restricted to the home ranges and foraging distances of different species, which can range from 1 km to at least 15 km for some insectivorous bats and up to at least 24 km for some fruit bats. Cumulative impacts could result in declines in populations of even those species of bats currently listed as Least Concern, if they happen to be more susceptible to mortality from wind turbines.

As no other wind farms or similar projects of this nature in the broader surrounding landscape have been identify the cumulative impacts on birds in this area is considered to be of low significance.

In order to minimise the cumulative impacts on the freshwater systems it has been recommended that some of the proposed access roads be realigned along existing roads.

According to the Noise impact assessment the proposed Unika I Wind Farm will be the first renewable project in the area and there are no other sources of noise in the area that would cumulatively increase noise levels.

Cumulative Visual Impacts pertain to the intervisibility between multiple wind farms, the loss of potential economic income generating opportunities and eco-tourism from degradation of natural resources, as well as loss of vegetation from increased access to previously remote areas due to increased road access. Cumulative visual impacts can also arise from visual massing effects where turbines and power line infrastructure viewed seen together, changing the local sense of place. The cumulative visual impacts are considered to be of Low significance as there are currently no other wind farms located in the vicinity However, there is a possibility that other wind farms could be attracted to the vicinity should this project become a successful venture. Future wind farming would be subject to an ESIA which would have to take intervisibility into consideration. The existing woodlands vegetation located on an undulating terrain, is likely to localise the ground level landscape changes effectively. The open spacing of the turbine placement also assists in reducing landscape cluttering.

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

A detailed Environmental and Social Management Plan (ESMP) is included in Appendix A.

The ESMP provides a framework for the implementation of environmental and social management measures identified in the ESIA and is based on best practice principles which require that every reasonable effort is made to reduce, and prevent negative impacts while enhancing the benefits.

The project will be implemented in line with the ESMP. As the Project Owners, Mphepo will have overall responsibility, authority and accountability for environmental and social issues associated with the project. The ESMP outlines the key steps to be taken by all project personnel and their contractors, to effectively manage the environmental and social impacts and risks associated with the construction and operation of the project. All personnel engaged on the project are required to fully comply with the requirements of the ESMP in order to limit the potential for unacceptable environmental and/or social impacts or regulatory non-compliance.

8.1 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

Monitoring will be conducted during construction and operational activities to verify compliance and to evaluate the effectiveness of the mitigation measures. Monitoring requirements have been set out in the monitoring plans as contained in the ESMP.

9. DECOMMISSIONING AND REHABILITATION PLAN

The key objective of the Decommissioning and Closure Plan is to return the disturbed areas on the Project Site back to an acceptable state. In general, the Unika 1 Wind Farm development area includes areas of disturbed agricultural land, Miombo Woodlands, Degraded Forests and Freshwater areas (including rivers, streams, valley bottom wetlands, dambos and floodplain wetlands). The rehabilitation programme will attempt to restore these areas to an acceptable standard.

The overall closure objectives are:

- Ensure that the area is safe for the intended end land use with the removal of the project infrastructure.
- Minimise the visual impact of the Project and rehabilitate areas by using indigenous vegetation from the area for rehabilitation.
- Ensure that the plant communities which establish within the rehabilitated areas comprise of indigenous vegetation only.
- Ensure that all areas are stable and rehabilitated to prevent erosion or dust creation.

At the end of the life of the Project, the following decommissioning and rehabilitation activities will take place:

- Disconnect inter connections;
- Disconnect all services;
- Dismantle all wind turbine components;
- Concreate foundations will be ripped;
- Rubble will be removed and disposed of at a suitably licensed facility;
- Removal of fencing;
- Compacted and disturbed areas on the Project footprint will be ripped, sloped and shaped;
- Disturbed areas will be sloped to enhance natural run-off patterns;
- Seeding of the Project footprint will be undertaken using indigenous seed mix (and/or by planting using indigenous plants);
- Monitoring and ongoing management of the vegetation establishment at site for a period of time to be determined after rehabilitation.

The need for a Decommissioning and Closure Plan is included in the ESMP.

10. ACTION PLAN FOR INCIDENTS AND ACCIDENTS

This section deals with potential incidents and accidents related to the construction and operation of the proposed Unika I Wind Farm. The purpose of this section is to briefly identify what measures need to be in place prior to commencement of the proposed construction phase to prevent and manage incidents and accidents. The plans, programmes, mechanisms, assessments and measures highlighted in this section have been included in the ESMP and the responsibility for implementation have been assigned to specific individuals or entities for implementation.

10.1 IDENTIFICATION OF POTENTIAL ACCIDENTS AND INCIDENTS

Accidents and incident relate to the employees (construction personnel, workers) appointed by the Project Company and/or contractors and the public (community, visitors, commuters). The materials, technologies and processes associated with wind farm expose workers to occupational risks as well as the public which live and work around the proposed Project Site and may use the same public infrastructure or land near the development. Potential accidents and incidents and accident include (but are not limited to):

- Employees:
  - Health (e.g. malaria, HIV/Aids);
  - Safety (e.g. fall from height, exposure to welding fumes, toxic chemicals);
  - Environmental (e.g. fire, spills of oil or chemicals);
  - Worker demonstrations;
  - Traffic accidents or incidents;
  - Trespassing, theft, and vandalism; and
  - Other non-compliances.

- Public:
  - Commuter and pedestrian traffic on public roads used by the project and project roads;
  - Accidental damage or sabotage of infrastructure;
  - Trespassing, theft, and vandalism;
  - Accidents/incidents involving livestock;
  - Accidents/incidents involving construction personnel;
  - General complaints (e.g. related to noise); and
  - Civil conflict and demonstrations.

10.2 PREVENTION AND MANAGEMENT OF POTENTIAL ACCIDENTS AND INCIDENTS

The consequences of incidents/accidents whether they relate to reoccurring complaints or emergency events can be far reaching. Developing effective plans, programmes, mechanisms, assessments and measures to prevent incidents/accidents from occurring and where they do occur, reducing their severity through effective response and management will underpin the success of the project. Listed below are the necessary documents integrated into the ESMP which is set to deal with incidents/accidents prevention and management:

- A Community H&S risk assessment will be conducted prior to construction to assess health and safety issues in the community and where employees and contractors of the Project Company will work and stay. This assessment will inform the Emergency Preparedness and Response Plan (EPRP)
- H&S and Emergency Response Plans that respond to both occupational incidents as well as incidents between the Project (including all third-party contactors) and local communities will be established. An EPRP will be required for the project. All emergency scenarios must be considered, including those for health (e.g. Malaria), Safety (e.g. fall from height), Environment (e.g. a spill), social and local economic development (e.g. fire), labour (e.g. worker demonstrations) and

security (e.g. a civil conflict). Collaboration with the potentially affected communities and the local government agencies will be required preparing to respond effectively to emergency situations, especially when their participation and collaboration are necessary to ensure effective response (e.g. fires spreading off-site, emergency ambulance services, community unrest, police, etc.). The EPRP shall be aligned with the IFC's General EHS Guidelines to include the following:

  - Identification of the emergency events that may arise;
  - Emergency procedure for each type of emergency event;
  - Indication of the emergency equipment required on site, including fire-fighting equipment, first-aid kits, spill kits, and incorporate checklists to be used to ensure that the emergency equipment is in place, good condition, accessible and correctly stocked;
  - Identification of key emergency-related appointments, roles and responsibilities (including fire-fighters and first aid personnel);
  - Clear direction on required responses to operational or environmental emergencies;
  - Evacuation Procedures;
  - Emergency contact details for Project staff and external emergency services;
  - Requirements for periodic tests and drills to ensure that necessary response actions are understood by EPC/&OM Contractor designated emergency response personnel, other Project staff, sub-contractors, and, as appropriate for the given location, community emergency response representatives from all affected each villages;
  - Organization of emergency areas (coordination centres, fire-fighting equipment, medical stations, etc.);
  - Emergency training requirements and procedures;
  - Deactivation and recovery plan;
  - Worker and community notification and communication; and
  - Business Continuity and Contingency (such as Identifying replacement supplies or facilities to allow business continuity following an emergency and maintaining back-ups of critical information in a secure location).

- A Traffic Safety Management Plan will be developed prior to construction once the equipment transport routes have been identified and final project designs have been concluded.

- A Grievance Mechanism will be established to manage community complaints (typically dust and noise) during construction and operation phase. It will be easily accessible to the local community, through which complaints related to contractor or employee behaviour can be lodged and responded to.

- A Code of Conduct will be established as part of the Labour Management Plan for all workers directly related to the project. A copy of the Code of Conduct is to be presented to all workers and signed by each person. It will contain clear rules to be adopted by the Project Company, EPC Contractor or third-party non-local employees with respect to working or interacting in local communities including engagement procedures, obtaining permissions, grievance redress etc.

- A Worker Health Programme will be implemented during the construction that specifically targets risky behaviours, training and voluntary screening of HIV and other sexually transmitted diseases

  - An HIV/AIDS Policy and Information document for all workers directly related to the Project. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS.
  - Workers to be referred to medical professional for early treatment and monitoring of opportunistic infections such as coughs, colds and pneumonia.

- Education and awareness programmes for local schools and communities will be implemented.

  - A Public Safety Zone radius around each wind turbine will be based on the blade tip hight plus 10% (based on the current design this amounts to a 242-metre radius).
  - Security fencing and other control measures to restrict or control public access to construction camp and laydown area.

- Waste Management Plan (WMP) to ensure no accidents or incidents associated with poor waste management practices occur. Specifically emphasising the safeguarding, handling, storage, transport and disposal of hazardous waste.
- Stormwater Management Plan with due consideration of potential incidents or accidents related to stormwater events, specifically new and upgraded road infrastructure and trenching which may occur during rain events.

11. CONCLUSIONS AND RECOMMENDATIONS

The aim of the ESIA process is to provide sufficient information to allow ZEMA to make an informed decision with regards to allowing the proposed Unika 1 Wind Fam to proceed. The ESIA provides this information and has been compiled in alignment with national legislation and the IFC Performance Standards.

The impacts of the construction and operation of the Unika 1 Wind Farm are summarised in Table 89.

Some impacts to soil and groundwater quality could be expected from construction activities, including storage and handling of hazardous substances (e.g. fuel, oil, chemicals, etc.), waste water discharge, batching, waste handling and storage, vehicle/equipment repairs, re-fuelling, etc. Apart from a requirement to store fuel and other hydrocarbons on site for the operational phase, limited hazardous chemicals are expected to be stored and handled, and the risk of pollution from these are minimal if good industry practice is implemented.

Groundwater, surface water and municipal water was identified as potential sources, and potential surface water abstraction points as well as potential boreholes sites were identified. water sources (surface and/or groundwater) need to either singularly or in combination satisfy this demand. Abstraction of large volumes of surface, especially during the dry periods could result in impacts on downstream users and downstream freshwater ecology. Abstraction of groundwater could impact on surrounding groundwater users and impacts on springs, dambos, streams, rivers, etc, as a result of decreased recharge rates. The extent of these impacts will need to be verified once the water supply sources have been identified and secured.

In general, the Project Site includes areas of disturbed agricultural land, Miombo Woodland, Degraded Forest and Freshwater habitats. Complete vegetation clearance will not be required. The initial layout contained wind turbines and access roads along the southern and eastern portions of the Project Site. The current layout of the infrastructure (wind turbines, access roads, interconnectors, substation, etc.) is based on the areas with best available wind resources and the environmental and social constraints identified during the baseline and specialist investigations. The Unika 1 Wind Farm will be located in the north eastern part of the Project site. All sensitive areas have been avoided as far as practical. Micro-siting of the wind turbines will still be required, which may require minor adjustments to the current positions of the wind turbines. A few (less than 20) of the wind turbines would also have to be moved slightly during final placement in order to avoid sensitive areas in relation to ecology, bats, birds and noise.

The construction of the turbines and road crossings in or across freshwater systems may lead to further alterations to habitat and ecological structure, primarily through vegetation loss necessitated during pre-construction preparation, but also potentially by impeding or altering the movement of water through the landscape. Since the footprints of both the turbines and road crossings are anticipated to be relatively small in comparison to the full extent of the affected freshwater systems, the impact significance of these activities will likely be limited. The four wind turbines located within two dambos will result in unavoidable impacts, which can only be completely avoided by relocating the infrastructure outside of the freshwater systems.

Potential alteration of habitat, for example through the clearing of vegetation, is likely to lead to a reduction in the capability and capacity of freshwater systems to provide certain ecological services, such as sediment trapping or assimilation of excess nutrients. The perceived impacts on socio-cultural (goods and direct benefits) services are considered minimal except where very localised impacts may occur, for example where wind turbines and hardstand areas are placed within cultivated fields situated within the dambos.

No Critical Habitat occurs in the study area as no populations of threatened, restricted range or migratory/congregatory species occur that meet IFC PS6 thresholds, and the habitats are not threatened or unique and do not have key evolutionary processes. The Project Site includes a combination of Modified and Degraded Natural Habitat covering 69% and 31%, respectively. Only 11.5% of the Project Site (33 350 ha) is required for the Unika 1 Wind Farm (3 865 ha) and since the turbine footprint and roads comprise small footprints, it should be possible to microsite the infrastructure to avoid portions of Natural

Habitat to a large degree. No infrastructure has been placed on the forested ridgelines and or stream course habitats.

The Project Site is not in or near an Important Bird Area, Protected Area, or any other sensitive feature for avifauna. A total of 248 bird species were recorded. None of these are Red Listed in Zambia. One species is Globally Red Listed (IUCN, 2021): Martial Eagle (Endangered); although only one individual as noted. No active nest sites of priority bird species were identified. Slightly higher flight frequency of some raptor species was recorded during the spring migration period, although nowhere near the concentrations of birds that can occur elsewhere in Zambia during this period. Elevated numbers of several small passerine species migrating during spring and autumn were also recorded. Impacts are expected to range from Insignificant to Medium post mitigation. Post construction bird monitoring of the wind farm must be conducted by a suitably qualified avifaunal specialist for at least the first two years of operation of the facility. If any significant impacts are detected this monitoring may need to continue longer. In particular, bird fatality estimates should include searches under turbines once a week, and twice a week during spring and autumn.

Bat activity at the proposed Project Site is mostly medium to high (particularly high in August, September, March and April). Numerous high-risk species, in terms of coming into contact with turbine blades, including across the free-tailed, fruit bat and plain-faced families, are present on site. This includes the potential (not confirmed) presence of two Near Threatened bat species; African straw-coloured fruit bat and Large-eared giant mastiff bat (whose broad scale geographic distribution overlaps with the site) and the confirmed presence of the Near Threatened Striped leaf-nosed bat. Therefore, the significance ratings for the majority of the impacts to bats posed by the development are predicted to be low to high before mitigation. After mitigation, all impacts are predicted to be very low to low apart from collision risk which might reduce to medium significance. The mitigation measures required relate to the design and avoiding the placement of turbines in areas that bats are most active (based on the pre-construction monitoring data), the use of ultrasonic deterrents, raising the cut in speed and blade feathering. The current turbine layout does not adhere to the bat sensitivity map and needs to be adjusted. Additional mitigation measures that must be considered are the choice of turbine model. The minimum distance between the blades and the ground must be maximised, the specialist recommends using a turbine model with ground clearance of minimally 50 m and that the rotor swept area be minimized. Due to the high amount of bat activity an initial operational minimization strategy will need to be implemented, alongside monitoring of bat activity and bat fatality using carcass searching. This includes the use of deterrents installed on turbines within the 200 m high sensitivity buffer, raising the cut in speed and blade feathering. It is crucial that the mitigation measures be tested in a controlled manner to determine their effectiveness. Adaptive management must be used based on the results of such testing. Monitoring of bat activity and bat fatality during the operational phase of the Project must be undertaken for two years, and must commence from the start of operations. Attention must be given to bat fatality levels during operation of the facility which should be assessed by a bat specialist on at least a quarterly basis but preferably monthly. An updated curtailment strategy taking into account updated seasonal activity and time periods for specific turbines that coincide with periods of increased bat activity and fatality, must be produced by a bat specialist, pending the results of the mitigation testing mentioned above. It is likely that residual impacts to bats will be greater in August, September, March and April as this is when bat activity is highest. The bat monitoring data collected and analysed suggest that the development of the Unika 1 Wind Farm can be achieved without unacceptable risks to bats provided the turbine layout adheres to all bat sensitivity and no-go areas and initial mitigation measures are followed. However, because of the significant number of turbines in bat buffers and limited amount of space available for development outside of sensitive areas, considerable effort and careful design, including active mitigation using curtailment and deterrents, will be needed to achieve these goals.

The land required by the Project falls under customary tenure and is mostly comprised of small-scale farmland held under exclusive rights by an individual. Although not a major land-use by total area, there are also numerous rural settlements within the study area. All land not under settlements or farmland is defined as communal land, which falls under the direct authority of the traditional authorities (the Chewa Royal Establishment). No individual has exclusive rights to communal land, and all resources (including fruit trees, water, grazing land etc.) are shared as a common resource. Under the current design iteration, all communities, community facilities and homesteads have been avoided. As such, it is very unlikely that the Project will lead to physical displacement. The Project will however lead to economic displacement – or the loss or restriction of access to private and communal land (but not the loss of any homes) that supports the livelihoods of local communities and households. The economic displacement will be both the loss of small-scale farmland owned by local households, as well as communal land held by the Chewa Royal Establishment. All land is communal, and no formal titled private land is expected to be affected.

The Project will pose some limited risks to community health and safety – including potential risks during the construction phase related to (1) construction traffic and movement of abnormal load materials and equipment, (2) transport of hazardous materials and waste, (3) soil and water contamination, (4) security control at work-sites, and (5) incidents and emergency events. Occupational health and safety issues for the workforce during both the construction and operational phases of the project are of concern due to the potential unfamiliarity of the local workforce with international good practice procedures. However, this can easily be mitigation through appropriate training and implementation of a health and safety management system throughout the construction and operational phase of the project. The operational phase will present a different profile of community health and safety risks – including (1) operational traffic, (2) transport of hazardous materials, (3) soil and water contamination, as well as (4) blade throw. Community health may also be affected by blade flicker, noise, and infrasound.

The benefits of job creation and opportunities for local suppliers should be noted. The Project is expected to employ 500-700 persons during the construction phase, which will extend over 24 months. The operational phase will require a relatively small workforce of 10-15 skilled persons that are expected to be resident in Katete Town or surrounding villages. In addition, the Project is expected to invest approximately USD 300 - 450 million into the Zambian economy. It is expected that the Project will drive demand for local goods and services, notably from Katete Town and surrounding major urban areas. The benefits will be most apparent during the construction phase. However, the short-term nature of construction often leads to an economic boom-and-bust, while operational expenditure will be lower but will be an ongoing benefit over the operational life of the Project.

Based on the current layout of the Unika 1 Wind Farm none of the heritage features identified will be impacted upon. As such Project is unlikely to impact on any cultural heritage features. The impact, for both construction and operation phases, is therefore considered to be Insignificant.

The potential noise impact of the Project was evaluated using a sound propagation model. Conceptual scenarios were developed for the construction and operational phases. With the modelled input data as used, this assessment indicated that a potential noise impact of a very low significance during the day for the construction phase and no additional mitigation is required, and a potential noise impact of (up to) medium significance before mitigation for night-time operational activities, with proposed mitigation available to allow the reduction of the potential noise impact to a low significance.

According to the Visual Impacted Assessment the Project, with mitigation, does not present a potential fatal flaw in visual terms. Mitigations have been provided and would need to be implemented. The rural and tribal setting and settlement pattern of the landscape has aesthetic value as a cultural landscape, and care should be taken to ensure that the proposed wind farm adds to the value of this cultural landscape, without resulting in landscape modifications that are visually intrusive. Wind farms have the potential to complement a rural settlement landscape, and with mitigation and the effective control of the aircraft warning lights at night, and the effective set-back of the turbines from the villages, it is likely that the village essence of this deep rural cultural landscape will be retained, albeit in a slightly modified form.

The assessment of the construction and operation of the Unika 1 Wind Farm shows there are no impacts that are assessed to higher than medium significance after mitigation. The rest of the impacts associated with the Project range from low to insignificant. The impacts of medium significance after mitigation include:

- Hydrological functioning and sediment balance (road crossings through channelled valley bottom wetlands and rivers);

- Avifauna (birds) Impacts: Collision of Birds with Blades (Operational Phase);
- Bats Impacts: Mortality of Bats during Commuting and/or Foraging (Operational Phase);
- Visual impacts (Presence of wind turbines in the landscape); and
- Visual impacts (Aircraft warning lights at night).

Impacts of medium to high **positive** benefits after mitigation include:

- Labour, Working Conditions, and Work-Seeker Influx;
- Disruption of Access and Mobility (pathways, roads); and
- Local Economic Development.

It is concluded that, if mitigation and monitoring measures contained in the Environmental and Social Management Plan (ESMP) (Appendix A) are implemented and the developer commits to enhancing community benefits through creation of local jobs and use of local suppliers, the benefits of the Unika I Wind Farm should outweigh the negative impacts.

Table 89: Summary of Environmental and Social impacts

Environmental component	Impact during construction & operation phase of the **Unika 1 Wind Farm**	CONSTRUCTION PHASE			OPERATIONAL PHASE		
		Project Components*	Significance without mitigation		Project Components*	Significance with mitigation	
			Without mitigation	With mitigation		Without mitigation	With mitigation
Biophysical Impacts	Impacts on Soil and Groundwater Quality	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Medium	Low	1, 4, 5, 7	Low	Insignificant
	Impacts as a result of Water Supply for the Project	1, 2, 3, 4, 5, 7, 8, 10	Medium	Very Low	1, 5, 7	Low	Insignificant
	Hydrological functioning and sediment balance (infrastructure outside of setback zones)	1, 2, 3, 5, 6, 9, 10	Insignificant	Insignificant	1, 2, 5	Insignificant	Insignificant
	Hydrological functioning and sediment balance (turbines located within delineated dambos)	1, 2, 5	Very low	Very low	1, 2, 5	Very low	Very low
	Hydrological functioning and sediment balance (road crossings through unchanneled valley bottom wetlands and dambos)	2, 5	Low	Very low	2, 5	Low	Very low
	Hydrological functioning and sediment balance (road crossings through channelled valley bottom wetlands and rivers)	2, 5	Low	Very low	2, 5	High	Medium
	Water Quality (infrastructure outside of setback zones)	1, 2, 3, 5, 6, 9, 10	Insignificant	Insignificant	1, 2, 5	Insignificant	Insignificant
	Water Quality (turbines located within delineated dambos)	1, 2, 5	Very low	Very low	1, 2, 5	Very low	Very low
	Water Quality (road crossings)	2, 5	Low	Very low	2, 5	Very low	Very low
Ecological Impacts	Impact of Noise on Fauna	1, 2, 3, 4, 5, 6, 7, 8, 10	Very Low	Very Low	1, 5	Low	Low
	Loss of Faunal Habitat and Species Diversity in the Degraded Miombo Woodland	1, 2, 3, 5, 6	Low	Very Low	1, 5	Low	Very Low
	Loss of Faunal Habitat and Species Diversity in the Degraded Forest	1, 2, 3, 5	Low	Very Low	1, 2, 3, 5	Low	Low
	Loss of Faunal Habitat and Species Diversity in the Freshwater Habitat	2, 3, 5, 10	High	Very Low	5	Low	Very Low
	Loss of Faunal Habitat and Species Diversity in the Agricultural Areas	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Very Low	Very Low	1, 2, 3, 4, 5, 7	Very Low	Insignificant
	Loss of Sensitive Faunal Species	1, 2, 3, 5, 6	Very Low	Very Low	2, 5	Low	Very Low
	Loss of Floral Habitat and Species Diversity in the Degraded Miombo Woodland.	1, 2, 3, 5, 6	Low	Very Low	1, 5	Low	Low
	Loss of Floral Habitat and Species Diversity in the Degraded Forest	1, 2, 3, 5	Low	Very Low	1, 2, 3, 5	Low	Low
	Loss of Floral Habitat and Species Diversity in the Freshwater Habitat	2, 3, 5, 10	Medium	Low	5	Medium	Low
	Loss of Floral Habitat and Species Diversity in the Agricultural Areas	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Very Low	Very Low	1, 2, 3, 4, 5, 7	Insignificant	Insignificant
	Loss of Sensitive Floral Species	1, 2, 3, 5, 6	Very Low	Very Low	2, 5	Very Low	Very Low
	Freshwater habitat and ecological structure (infrastructure outside of setback zones)	1, 2, 3, 5, 6, 9, 10	Insignificant	Insignificant	1, 2, 5	Insignificant	Insignificant
	Freshwater habitat and ecological structure (turbines located within delineated dambos)	1, 2, 5	Very low	Very low	1, 2, 5	Very low	Very low
	Freshwater habitat and ecological structure (road crossings)	2, 5	Very low	Very low	2, 5	Very low	Very low
	Ecological and Sociocultural service provision (infrastructure outside of setback zones)	1, 2, 3, 5, 6, 9, 10	Insignificant	Insignificant	1, 2, 5	Insignificant	Insignificant
	Ecological and Sociocultural service provision (turbines located within delineated dambos)	1, 2, 5	Very low	Very low	1, 2, 5	Very low	Very low
	Ecological and Sociocultural service provision (road crossings)	2, 5	Very low	Very low	2, 5	Very low	Very low
	Avifauna (birds) Impacts: Collision of Birds with Blades (Operational Phase)	-	-	-	1	High	Medium
	Avifauna (birds) Impacts: Destruction of Bird Habitat (Construction Phase)	1, 2, 3, 5, 6	Low	Low	-	-	-
	Avifauna (birds) Impacts: Disturbance of Birds (Construction & Operational phase)	1, 2, 3, 5, 6	Low	Low	1, 5	Low	Low
	Avifauna (birds) Impacts: Displacement of Birds & Barrier Effects (Operational Phase)	-	-	-	1, 3, 5	Low	Low
	Avifauna (birds) Impacts: Collision of birds with 33 kV connector overhead transmission lines	-	-	-	3	High	Medium
	Avifauna (birds) Impacts: Electrocution of birds from 33 kV connector overhead transmission lines	-	-	-	3	High	Medium
	Bats Impacts: Disturbance of Bat Roosts (Construction Phase)	1, 2, 3, 5, 6	Very Low	Insignificant	-	-	-
	Bats Impacts: Destruction of Bat Roosts (Construction Phase)	1, 2, 3, 5, 6	Medium	Very Low	-	-	-
	Bats Impacts: Modification of Bat Habitat (Construction Phase)	1, 2, 3, 5, 6	Medium	Very Low	-	-	-
	Bats Impacts: Creation of Bat Habitat in High-Risk Locations (Operational Phase)	-	-	-	1, 4, 7	Very Low	Very Low

Environmental component	Impact during construction & operation phase of the **Unika 1 Wind Farm**	CONSTRUCTION PHASE			OPERATIONAL PHASE		
		Project Components*	Significance without mitigation		Project Components*	Significance with mitigation	
			Without mitigation	With mitigation		Without mitigation	With mitigation
	Bats Impacts: Mortality of Bats during Commuting and/or Foraging (Operational Phase)	-	-	-	1	Very High	Medium
	Bats Impacts: Mortality of Bats during Migration (Operational Phase)	-	-	-	1	High	Low
	Bats Impacts: Impact of Light Pollution on Bats (Operational Phase)	-	-	-	4, 7	Low	Insignificant
Socio-economic Impacts	Physical and Economics Displacement	1, 2, 3, 4, 7	High	Low	-	-	-
	Communal Land and Natural Resources	1, 2, 3, 4, 5, 6, 7	Medium	Low	-	-	-
	Labour, Working Conditions, and Work-Seeker Influx	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Low Positive	Medium Positive	1, 4, 5, 7	Low Positive	Medium Positive
	Community Health and Safety	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Medium	Low	1, 4, 5, 7	Medium	Low
	Disruption of Access and Mobility (pathways, roads)	2, 5	Low	Low	5	High	High Positive
	Local Economic Development	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Very Low Benefits	Medium Benefits	1, 4, 5, 7	Very Low Benefits	Medium Benefits
	Cultural Heritage	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Insignificant	Insignificant	1, 4, 5, 7	Insignificant	Insignificant
	Noise Impacts on Surrounding Communities	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Very Low	Insignificant	1	Medium	Low
	Visual impacts (Presence of wind turbines in the landscape)	1	Medium	Low	1	Very High	Medium
	Visual impacts (Aircraft warning lights at night)	-	-	-	1	Very High	Medium

***Key for project components**: 1 - Wind Turbines, 2 - Electrical Connections, 3 - Transmission Lines, 4 – Substation, 5 - Access Roads, 6 - Borrow Pits, 7 - O&M Building, 8 - Construction Camp/Offices, 9 - Laydown Area, 10 - Batching Plant

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Additional lists of bibliography are included in the various specialist reports.

13. DECLARATION OF AUTHENTICITY OF REPORT CONTENTS

I, __**Stuart Heather-Clark**___ (full name), in my capacity as__ **Africa Power Sector Lead**_ (position)

within __ **SLR Consulting (Africa) Pty Ltd**__ (company), declare that the contents of this report is

authentic.

Signature:

Date: 10 March 2022

ANNEXURE A: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

ANNEXURE B: ZEMA LETTER OF APPROVAL FOR THE TERMS OF REFERENCE

ANNEXURE C: APPROVED SCOPING REPORT AND TERMS OF REFERENCE

ANNEXURE D: ESIA PHASE PUBLIC DISCLOURE MEETINGS

ANNEXURE E: SPECIALIST STUDIES

Annexure E 1: Social Impact Assessment

Annexure E 2: Ecology (Terrestrial and Aquatic) Impact Assessments

Annexure E 3: Avifaunal Impact Assessment

Annexure E 4: Bat Impact Assessment

Annexure E 5: Noise Impact Assessment

Annexure E 6: Visual Impact Assessment

Annexure E 7: Cultural Heritage Impact Assessment

Annexure E 8: Water Resource Assessment

Annexure E 9: Construction Materials Sourcing Report

ANNEXURE F: DEED OF AGREEMENT WITH LANDOWNER

ANNEXURE G: METHOD OF ASSESSING IMPACT SIGNIFICANCE

ANNEXURE H: DESIGN DRAWINGS

509415-UNIK-DRG-CC-0003[0A]-Key Plan

509415-UNIK-DRG-CC-0004[0A]-Layout1

509415-UNIK-DRG-CC-0005[0A]-Layout2

509415-UNIK-DRG-CC-0006[0A]-Layout3

509415-UNIK-DRG-CC-0007[0A]-TD-Drainage

509415-UNIK-DRG-CC-0008[0A]-TD-Interface

509415-UNIK-DRG-SS-0001 - Turbine Foundation General Arrangement

509415-UNIK-DRG-CC-0002[0A]-Hardstand and Turn-Arounds

ANNEXURE I: RESETTLEMENT POLICY FRAMEWORK

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