ENVIRONMENTAL IMPACT ASSESSMENT FOR THE 66 KV POWER EVACUATION LINE FROM NAMAACHA WIND POWER PROJECT TO BOANE SUBSTATION

ENVIRONMENTAL IMPACT STUDY

FINAL REPORT

VOLUME II – IMPACT ASSESSMENT AND MITIGATION MEASURES

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VOLUME INDEX

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

AEJA	Youth and Adult Literacy and Education (*Alfabetização e Educação de Adultos e Jovens*)
AHP	Analytical Hierarchy Process
AIDS	Acquired Immunodeficiency Syndrome
ANAC	National Administration of Conservation Areas
ANE	National Road Administration (*Administração Nacional de Estradas*)
AP	Administrative Post
AQUA	The National Agency for the Control of Environmental Quality
ARA	Regional Water Authorities
ARENE	Energy Regulatory Agency
ART	Anti-retroviral
CEN	Central Eléctrica da Namaacha
DINAB	National Directorate for Environment
DNA	National Water Directorate
DNE	National Directorate of Energy
DPTADER	Provincial Directorate of Land and, Environment and Rural Development
DUAT	Land use rights
EDM	Electricidade de Moçambique, E.P.
EIA	Environmental Impact Assessment
EIS	Environmental Impact Study
EMP	Environmental Management Plan
EN	National Road
EP	Primary School
EPC	Complete Primary School
EPDA	Environmental Pre-feasibility and Scope Definition Study
ES	Ecosystem Services
ESG	General Secondary School
FIPAG	Investment Fund for Water Supply (*Fundo de Investimento e Património do Abastecimento de Água)*
FUNAE	Mozambique Energy Fund (Fundo de Energia)
GDB	Boane District Government
GDN	Namaacha District Government
GDP	Gross Domestic Product
GoM	Government of Mozambique's

HH	Household
HIV	Human Immunodeficiency Syndrome
HU	Health Unit
HV	High Voltage
IAN	Namaacha Agricultural Institute (*Instituto Agrário de Boane*)
IBA	Important Bird and Biodiversity Areas
IF	Infrastructure
IFC	International Finance Corporation
IFP	Teachers Training Institute (*Instituto de Formação de Professores*)
INE	National Institute of Statistic (*Instituto Nacional de Estatística*)
ISETT	Higher Institute of Education and Technology
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Areas (KBAs)
km/h	Kilometres per hour
kV	Kilovolt
m	Metre
MAE	Ministry of State Administration (*Ministério da Administração Estatal*)
MCDM	Multicriteria Decision-Making
MIMAIP	Ministry of the Sea, Inland Waters and Fisheries (Ministério do Mar, Águas Interiores e Pescas)
MIREME	Ministry of Natural Resources and Energy
MISAU	Ministry of Health (*Ministério da Saúde*)
MTA	Ministry of Land and Environment
OHL	Over Head Line
PA	Administrative Post
PAV	Vaccination Expanded Programme (*Programa Alargado de Vacinação*)
PESOD	District Economic and Social Plan and Budget (*Plano Económico e Social e Orçamento Distrital*)
PESOE	Economic and Social Plan and State Budget
PPP	Public Participation Process
PS	(IFC Environmental and Social) Performance Standards
PSAA	Small Water Supply Systems (*Pequenos Sistemas de Abastecimento de Água*)
PSESR	Physical and Socioeconomic Survey Report
PT	Transformer Stations (*Posto de Transformação*)
RGPH	General Census of Population and Housing (*Recenseamento Geral da População e Habitação)*
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SDAE	Economic Activities District Service (*Serviço Distrital de Actividades Económicas*)
SDEJT	Education, Youth and Technology District Service (*Serviço Distrital de Educação, Juventude e Tecnologia)*

SDPI	Planning and Infrastructure District Service (*Serviço Distrital de Planeamento e Infraestruturas*)
SDSMAS	Health, Women and Social Affairs District Service (*Serviço Distrital de Saúde, Mulher e Acção Social*)
SES	Simplified Environmental Study
SMI	Mother and Child Health (*Saúde Materno-Infantil*)
SNS	National Health System (*Sistema Nacional de Saúde*)
SPA	Provincial Environmental Services
ToR	Terms of Reference
WHO	World Health Organization
WPP	(Namaacha) Wind Power Project

7 Impact Assessment and Mitigation Measures

7.1 General Considerations

This Chapter provides an assessment of the potential biological, physical, and socio-economic impacts, both direct and indirect, positive, and negative, that will result from the implementation of the Project.

Potential impacts of the Project are assessed for each component of the biological, physical, and socio-economic environment, whose baseline is described in Chapter 6 (see **Volume I**), for which relevant impacts were identified. Impact identification was based on the preliminary impact scoping developed in the Environmental Pre-Feasibility and Scope Definition Study (EPDA) and was updated considering the findings of the specialist studies and other more detailed analysis undertaken for this Environmental Impact Study (EIS).

It should be noted that impact assessment is based on the specialists' understanding of the Project to be implemented and their environmental and socio-economic aspects, as per the Project Description provided in Chapter 4 of **Volume I**.

Impact identification and assessment was carried out for the construction[1], and operational[2] phases based on the EIA team's professional judgement and experience, as well as field work, public participation, and desktop analysis.

The significance of potential impacts that may arise from the proposed Project will be determined in order to support decision-making process (typically by a designated authority or state agency, but in some instances, also the proponent).

For each identified impact, an impact description is provided, and its significance is assessed according to a standardized impact assessment methodology, as described in Section 7.2. below. If the impact assessment confirms that impacts are associated with the implementation of the project, mitigation measures and actions to avoid, minimize, compensate for, or offset, potential adverse impacts, or to enhance positive or beneficial impacts will be put in place. As a general principle, for significant environmental and social impacts, a program of actions or measures will apply a mitigation hierarchy which focuses on measures to prevent or avoid these impacts from occurring in the first place, as opposed to minimization, mitigation, or compensation. Where avoidance or prevention is possible, significant impacts will be minimized through environmental and social measures/treatments/design. Acceptable options to minimize or mitigate will vary from abatement, rectification, repair, to restoration of impacts as appropriate. Where avoidance, minimization or mitigation measures are not effective, compensatory, or offset measures for residual impacts will be

[1] The term 'construction' phase covers site preparation, installations, fabrication, site construction, commissioning, and start-up.

[2] In this document, impact assessment for the decommissioning phase is carried out at high level basis. Detailed impact assessment for decommissioning phase will be carried out during the operation phase.

defined. It should be noted that these compensatory or offset measures do not eliminate the need to identify potential residual impacts of the Project.

The significance of each potential impact is also rated after the application of mitigation/enhancement measures, to assess the residual impact significance. The impact assessment for each impact is summarized in table format, including the pre-mitigation assessment, the key proposed mitigation measures, and the residual impact assessment.

Mitigation, enhancement, and monitoring measures resulting from the impact assessment are then organized in thematic programs in Environment Management Plan (EMP) (see **Volume III**).

7.2 Impact Assessment Methodology

This section provides a detailed methodology to be used for the assessment of the significance of potential environmental and social impacts in the EIS. This methodology allows for the identified potential impacts to be analysed in a systematic manner, with significance rating (from *insignificant* to *very high*) assigned to each potential impact, thus helping to minimize the subjectivity inherent to impact assessment.

Impact identification and assessment will be carried out for the construction and operational phases based on the EIA team's professional judgement and experience, as well as field work, public participation, and desktop analysis.

7.2.1 Types of Impacts

An impact is any change, or perceived change, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products, or services (as defined in ISO 14001:2004). Any project can generate a wide range of potential impacts, of different types. The following table lists the different types of impacts that will be identified and assessed.

Table 7-1 – Types of Impacts

Type of Impact	Description
Direct	Impacts that result from the direct interaction between a project activity and the receiving environment (e.g., dust generation which affects air quality).
Indirect	Impacts that result from other (non-project) activities but which are facilitated as a result of the project (e.g., in-migration of jobseekers, which places additional demands on natural resources) or impacts that occur as a result of subsequent interaction of direct project impacts within the environment (e.g., the clearance of the RoW may facilitate the expansion of invasive alien flora species).
Cumulative	Impacts that act together with current or future potential impacts of other activities or proposed activities in the area / region that affect the same resources and / or receptors (e.g., combined effects of vegetation clearance from several power lines in the region).[3]

[3] One project which is expected to have cumulative impacts with the transmission line is, logically, the CEN Project (Namaacha Wind Power Project), from which the 66 kV lines depart. IFC's Cumulative Impact Assessment (CIA) approach will be followed.

7.2.2 Impact Significance Assessment

The purpose of the impact assessment is to inform what kind of mitigation / enhancement is required to reduce the residual effect of a negative impact to acceptable levels or to maximize the benefits of a positive impact.

The significance of an impact is defined as a combination of several impact criteria, which assess the temporal and spatial scale of the impact, the sensitivity, resilience or importance of the affected receptors / resources and the intensity of the imposed changes on those receptors / resources.

The **significance** of an impact is defined as a combination of its **consequence** with the estimated occurrence **probability**. The criteria that will be used to determine impact consequence are presented in the table below. The impact assessment methodology and impact classification were described in the EPDA submitted to MTA in January 2023.

Table 7-2 – Criteria used to determine the Consequence of the Impact

Rating	Definition of Rating	Score
A. *Extent* *– the area over which the impact will be experienced*		
Local	Confined to Project or study area or part thereof (e.g., site)	1
Regional	The region, which may be defined in various ways, e.g., cadastral, catchment, topographic	2
(Inter) national	Nationally or beyond	3
B. *Intensity* *– the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources*		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. *Duration* *– the timeframe over which the impact will be experienced and its reversibility*		
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

Table 7-3 – Method used to determine the Consequence Score

***Combined Score* (A+B+C)**	3 – 4	5	6	7	8 – 9
Consequence Rating	Very low	Low	Medium	High	Very high

Once the consequence is derived, the probability of the impact occurring is considered, using the probability classifications presented in the table below.

Table 7-4 – Probability Classification

Probability *– the likelihood of the impact occurring*	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	70% - 90% chance of occurring
Definite	> 90% chance of occurring

The overall **significance** of impacts is then determined by considering consequence and probability using the rating system prescribed in the table below.

Table 7-5 – Impact significance ratings

		Probability			
		Improbable	Possible	Probable	Definite
Consequence	Very Low	**INSIGNIFICANT**	**INSIGNIFICANT**	**VERY LOW**	**VERY LOW**
	Low	**VERY LOW**	**VERY LOW**	**LOW**	**LOW**
	Medium	**LOW**	**LOW**	**MEDIUM**	**MEDIUM**
	High	**MEDIUM**	**MEDIUM**	**HIGH**	**HIGH**
	Very High	**HIGH**	**HIGH**	**VERY HIGH**	**VERY HIGH**

Finally, the impacts are also considered in terms of their nature (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering the nature of the impacted confidence (in assessment) is laid out in the table below.

Table 7-6 – Impact status and confidence classification

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	(+) - positive – a 'benefit'
	(-) - negative – a 'cost'
Confidence of assessment	
The degree of confidence in predictions based on available information, Consultant's judgment and/or specialist knowledge.	Low
	Medium
	High

There is no statutory definition of 'significance' and its determination is therefore necessarily partially subjective. Criteria for assessing the significance of impacts arise from the following key elements:

- Status of compliance with relevant local legislation, policies and plans, any relevant or industry policies, environmental standards or guidelines and internationally accepted best practice;

- The consequence of the change to the biophysical or socioeconomic environment (e.g., loss of habitats, decrease in water quality) expressed, wherever practicable, in quantitative terms. For socioeconomic impacts, the consequence must be viewed from the perspective of those affected, by taking into account the likely perceived importance of the impact and the ability of people to manage and adapt to the change;
- The nature of the impact receptor (physical, biological, or human). Where the receptor is physical (e.g., a water resource) its quality, sensitivity to change and importance must be considered. Where the receptor is biological, its importance (e.g., its local, regional, national, or international importance) and its sensitivity to the impact must be considered. For a human receptor, the sensitivity of the household, community or wider societal group must be considered along with their ability to adapt to and manage the effects of the impact; and
- The probability that the identified impact will occur. This is estimated based upon experience and / or evidence that such an outcome has previously occurred.

The impact significance rating also reflects the need for mitigation. While low significance impacts may not require specific mitigation measures, high significance negative impacts demand that adequate measures be put in place, to reduce the residual significance (impact significance rating, after mitigation), as described in the following table.

Table 7-7 – Impact Significance and Mitigation Requirements

Significance rating	Description
Insignificant to Low	No specific mitigations measures required, beyond normal environmental good practices and industry standard control measures.
Medium	Specific mitigation measures should be devised, to reduce the impact significance to an acceptable level.
High	Specific mitigation measures should be devised, to reduce the impact significance to an acceptable level. If avoidance or minimization is not possible, compensation measures should be considered.
Very High	Specific mitigation measures should be identified and implemented, to reduce the impact significance to an acceptable level. If such mitigation is not possible, very high negative impacts should be considered in the project's authorisation process.

7.2.3 Mitigation

Mitigation/enhancement is a critical phase of the EIA process: when potential impacts have been identified, the aim of this is to avoid or minimize as much as reasonably practicable of the negative ones, while enhancing those that are positive.

The basic principle of mitigation is to avoid any negative impact in the first place, rather than trying to remedy its negative effect later. Where impacts cannot be avoided, the objective then becomes to reduce them to an acceptable level, such that no major residual impacts are left.

Table 7-8 provides the framework for mitigation options to be considered in the EIS – the mitigation hierarchy.

Table 7-8 – Mitigation Hierarchy

Level of mitigation	Description
Avoid	Re-design the project to remove the potential impact due to the project's feature.
Minimize	Design control systems and implement off-site measures to reduce impacts.
Remedy	Repair any residual damage to natural and human environment by restoration activities or appropriate interventions.
Offset	Compensate for significant residual impacts if other mitigation measures are not feasible or cost-effective, or are already fully implemented

For each impact, mitigation and enhancement measures are recommended, and impacts are rated in the prescribed way for both pre- and post-mitigation / enhancement scenarios.

A summary impact assessment table will be provided for each impact assessment. To visualise the nature (positive/negative) and the significance rating of the assessed environmental and social impacts, the impact summary table is colour-coded as shown in Table 7-9.

Table 7-9 – Colour code of impact nature and significance

Negative Impacts (Significance)	Positive Impacts (Significance)
Insignificant	Insignificant
Very Low	Very Low
Low	Low
Medium	Medium
High	High
Very High	Very High

Section 7.13 provides a summary of all impacts assessed, including pre- and post-mitigation assessments, in tabulated format, in order to facilitate a global perception of the Project's impacts.

Cumulative impacts are specifically assessed in Section 7.14.

7.3 Climate and Climate Change

7.3.1 General Remarks

The objective of this Greenhouse Gas (GHG) assessment is to provide a qualitative greenhouse gas emissions associated with the development of the Project, and to identify actions for mitigating or reducing these emissions. Where sufficient information is available regarding emission sources likely to be significant for this Project, a quantitative assessment has been undertaken.

Pollution prevention and control technologies and practices to reduce and mitigate GHG emissions consistent with international good practice are here proposed such those suggested by IFC Environmental, Health, and Safety (EHS) General Guidelines regarding the reduction and control of GHG.

The IFC General Environmental, Health and Safety (EHS) Guidelines (IFC, 2007a) advise that greenhouse gases emissions should be evaluated for projects where emissions are estimated to be more than 100,000 tonnes CO_2. IFC's EHS Guidelines for electric power transmission and distribution (IFC, 2007b) does not provide any specific guidance on greenhouse gases emissions associated with the construction or operation of transmission and distribution projects, although it does note that the use of sulphur hexafluoride (SF_6) in insulating high-voltage equipment should be minimised where possible as SF_6 is a potent greenhouse gas if it escapes to atmosphere.

The World Bank Energy and Mining sector board discussion paper named "*Impacts of Transmission and Distribution Projects on Greenhouse Gas Emissions. Review of Methodologies and a Proposed Approach in the Context of World Bank Lending Operations*" (Madrigal, 2010) proposes specific methodologies for GHG account from electrical Transmission and Distribution projects, which were adopted as baseline method in this assessment.

GHG emissions resulting from electric transmission line projects are considerably low when compared with other fossil fuel energy-based projects. Transmission lines have emissions in a maximum order of magnitude of tens of kg CO_2/MWh. Given that typical oil and coal power stations would have life-cycle emissions reaching 870–1335 kg CO_2/MWh (DeLuchi, 1991), all the transmission line GHG sources are likely to represent less than 10 percent of typical power generation emissions, although land clearing, is the most representative GHG source. Land clearing emissions are highly variable since they depend on local land conditions (due to the variable amount of vegetation to be cleared) by contributing to an increase in the overall emissions computation.

GHG emissions generated by this project will be associated mainly with the construction phase, although minor -level emissions can also occur during the project's operational phase. The estimation of the Project's GHG emissions will include the emissions from fuel use during construction phase (from internal combustion construction vehicles and machinery operation), but also those resulting from land clearing activities. These emissions are classified as direct non-generation GHG emissions (Madrigal & Spalding-Fecher, 2010).

During the operational phase, Sulphur hexafluoride (SF_6) fugitive emissions may occur, and Nitrous oxide (N_2O) could be potentially released due to Corona effect but is foreseen that both will be of no significancy due to the power rate of this transmission line, as further detailed bellow in dedicated sections of this assessment.

In summary, theoretically, the main GHG emissions sources from transmission projects include:

<u>Construction phase:</u>

- **Energy use during the construction phase of the project** - fuel used in construction machinery and vehicles are the main source of CO_2 emission in this stage of the project's development. These are considered only when there are sufficient project data on fuel usage in the construction phase. Nevertheless, it is expected that this is likely to represent a significant source of GHG emissions.

- **Land clearing emissions -** land clearing can be a significant source of emissions, depending on the vegetation type intercepted by the RoW of the project. The area to be cleared and the carbon density of the biomass to be cleared is assessed based in the flora stratums intercepted by the ROW alignment and converted to CO_2 emissions.

Operational phase:

- **Sulphur hexafluoride (SF_6) fugitive emissions** – SF_6 is used in insulation and current interruption applications in energy transmission systems (IPCC, 2006c). SF_6 may escape as fugitive emissions during the manufacturing, installation, use, maintenance, and disposal of this equipment. These emissions are generally small but could be significant for projects that install new high-voltage equipment. However, these are very lower in lower voltage power lines. Abnormal releases may arise during maintenance of circuit breakers contained within the Boane substation although this are considered of no significance to overall GHG emissions.
- **N_2O emissions resulting from the corona effect** – high-voltage transmission lines can create nitrous oxide (N_2O) from an effect called “corona discharge”. Corona is a phenomenon associated with all energized transmission lines. Under certain conditions, the localized electric field near an energized conductor can be sufficiently concentrated to produce a tiny electric discharge that can ionize the air close to the conductors and promote N_2O releases. The electric discharge is called corona discharge. Production rates of this gas are heavily dependent on weather conditions and transmission line voltage.
- **GHG emissions from maintenance activities** - Emissions associated with routine maintenance of the towers are short-term and intermittent and therefore expected to be negligible.

7.3.2 Methodology and Data Sources

Methodologies and databases consulted for the Project’s GHG evaluation were retrieved from the following data sources:

- World Bank Energy and Mining sector board discussion paper, paper nº 21, 2010. “Impacts of Transmission and Distribution Projects on Greenhouse Gas Emissions. Review of Methodologies and a Proposed Approach in the Context of World Bank Lending Operations”.
- Dones, R., et al, 2007. Life Cycle Inventories of Energy Systems: Results for Current Systems in Switzerland and Other UTCE Countries. Final report EcoInvent data v2.0, No. 5. Dübendorf: EcoInvent Swiss Centre for Life Cycle Inventories. www.ecoinvent.ch
- WRI Greenhouse Gas protocol Tools. Greenhouse Gas Protocol Tools, 2021. https://ghgprotocol.org/calculation-tools.
- U.S. EPA, 2006. (U.S. EPA (Environmental Protection Agency). 2006. *Global Anthropogenic Non-CO2 Greenhouse Gas Emissions: 1990–2020*. Washington.

Other data sources included:

- IFC Carbon Emissions Estimator Tool (IFC 2014), this tool includes a section on land clearing that can be applied for any project type. Land clearing emissions were calculated as the product of the estimated total area to cleared and biomass density (mainly above ground) converted to Carbon. This tool also includes a table of emission factors (aboveground biomass density) for a large variety of vegetation types, sourced from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
- WRI, 2021. Mozambique Total GHG including LUCF, https://www.climatewatchdata.org, accessed February 2022.

These methodologies were applied in the present project with the purpose to calculate GHG emissions (CO_2eq) and to estimate the Project's impact, in the context of Mozambique's total GHG emissions.

7.3.3 Greenhouse Gas Accounting Principle

The GHG inventory developed in this assessment was based on the principles outlined in the Greenhouse Gas Protocol (World Business Council for Sustainable Development and the World Resource Institute). Specifically, the GHG Protocol advocates defining a reporting boundary for an inventory, and then segmenting the GHG sources within that boundary, according to their scope. For the present GHG inventory, only emissions from the scope 1 are to be considered, for the project's construction and operation phase. The scopes of these GHG emissions are:

- Scope 1 GHG emissions are those produced directly from construction and operation of the Project such as combustion of fuel, gas venting/flaring and fugitive emission sources.
- Scope 2 GHG emissions arise from purchased electricity, heat or/and steam from external providers. However, these emissions are generated outside of the project boundary.
- Scope 3 GHG emissions are those that result of activities from assets not owned or controlled by the Project or as a result of consumption of products, embodied emissions from construction materials or value of chains of the project. The scope 3 GHG emissions are not assessed in this document.

These project GHG emission sources contribution is detailed in the following sections and subsequently quantified based on the available information.

7.3.4 Construction phase

7.3.4.1 Embodied emissions from construction materials

The construction of power transmission projects consumes mainly considerable quantities of aluminium, steel, concrete and other building materials, but at a minor scale. These materials have embodied emissions resulting from the energy used to produce them, meaning that the implementation of the new transmission line project will create some upstream GHG emissions due to the materials used in the construction phase of the project. Note that Scope 3 GHG emissions are those that result of activities from assets not owned or controlled by the Project or as a result of consumption of products, construction materials or value of chains of the project. As mentioned above the scope 3 GHG emissions are not assessed in this document.

7.3.4.2 Land clearing emissions

The construction of a long-distance transmission line will have an effect over the carbon stored in biomass and soils. Vegetation clearing within the Power Evacuation RoW path will be required for this long-distance transmission line, which would result in a one-time release of the carbon stored in the vegetation that can be converted and translated to annualized CO_2e emissions according with the IPCC Land Use Change & Forestry proposed methodology.

A 50 m corridor (25 m outwards each of the two parallel power lines, plus the 20 m spacing between lines, totalling 70 m) will be established as the transmission line partial protected zone (here considered to be equivalent to the Right-of-Way (RoW), in accordance mostly with the Decree 57/2011, concerning to the security of high-voltage transmission lines (see Volume I Section 4.2.1.3 - Establishment of right-of-way (RoW) and vegetation clearance; and Table 7.10 below). The RoW is required to protect the system from windfall, contact with trees and branches and other potential hazards that may result in damage to the system, power failures or forest fires. The RoW will also be utilized to access, service and inspect the transmission line.

Large trees and other large vegetation may need to be cropped, cut back or removed from the RoW whichever applies best, if it constitutes a risk to the power line. The RoW will also be utilized to access, service and inspect the transmission Line. It is envisaged that all construction works will be undertaken within the area identified for the permanent RoW.

It must be noted that vegetation clearance shall not be done by bulldozing or other mechanical equipment, to minimize soil compaction and erosion. Care shall be taken to avoid unnecessary removal of topsoil.

In terms of vegetation clearance, during the operation phase, the minimum standards to be used for clearance are indicated in Table 7.10 below (as per Volume I Section 4.2.1.3 - Establishment of right-of-way (RoW) and vegetation clearance).

Table 7.10 – Standards for vegetation clearance within the OHL RoW

Item	Construction clearance	Operational maintenance
Centreline (minimum clearance strip)	Clearance of all vegetation in a 5 m corridor (area directly under the line to be cleared). This strip of land shall be completely cleared of all trees, scrub, and undergrowth by felling not more than 150 mm above ground.	Re-growth inside the same 5 m corridor cleared during construction shall be cut within 150 mm of the ground and maintained through manual labour, as necessary.
Vegetation within the RoW (outside the minimum clearance strip)	Selective trimming or cutting down of trees interfering or posing threat to the integrity of the power line. This includes clearing or selective trimming of trees, by ensuring that any tree after falling will not be less than 2.5 m clear of the tower outermost conductor.	Selective trimming to maintain 6 m between the top of trees and the conductor cables (at resting position).
Tower sites	Clear all vegetation within the proposed tower position and within a maximum radius of 6 m around the position.	Re-growth shall be cut within 150 mm of the ground and maintained through manual labour, as necessary.

The impact associated with CO_2 emissions from land clearing becomes more significant when transmission lines cross areas with high forest cover, that is, areas with highly dense carbon stock which is not the case. It is important to notice that some of the biomass will grow back after the construction, although the amount and density would depend on the climate and maintenance procedures for the line (it is anticipated that regrowth vegetation will be cut as necessary), as well as on how high the line is.

According with the Land Cover map intercepting RoW with the existing vegetation cover, it can be observed that the transmission line will cross along its path a total distance of 40 km intercepting roughly 138.93 ha of Natural forest - Tropical scrubland area, 71.33 ha of cropland area and 7.21 ha of grassland.

The IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Table 4.12 (Natural Forest and Plantation Forest) and Table 5.1 (Cropland), indicates an above ground biomass content of 32,9 ton C per hectare for Mozambican natural forest scrubland, a cropland biomass content of 4,7 ton C/ha and 2.48 ton C/ha for grassland.

To estimate the change in the carbon stocks impacted by the land use change, i.e, CO_2 releases from land clearing, emissions are expressed in CO_2 per unit area of land change being the biomass content expressed in units of tonnes of carbon dioxide per hectare (tons CO_2e /ha), according with the following general expression:

$$PELC = A_{def} \times BD \times 44/12$$

Where,

PELC=*Direct non-generation CO_2 emissions from land clearing (tCO_2)*

A_{def}= *Area of land deforested (ha)*

BD= *Biomass density per unit area (aboveground) expressed as (tC/ha)*

Assuming a land clearing width of 70 meters along 40 km of length X 2 Transmission lines side by side, this results in a total intervention area of 232.99 hectares. Considering the specific biomass density per unit of area for each different vegetation stratums converted from carbon-to-carbon dioxide with a (44/12) factor, a total one-time CO_2e emission of **18 054.4 CO_2e tons** is to be expected due to the land clearing operations.

7.3.4.3 Fuel consumption emissions

Greenhouse gases will be emitted mainly during the construction phase of this project. The fuel requirements during the operational phase will be negligible, as they will be limited to the vehicles used for RoW inspections.

The main sources of GHG emissions associated with the construction phase of this project will be originated during construction phase such as operation of heavy machinery, materials and personnel transportation vehicles to and from site and the use of diesel power generators.

The construction phase will include land-based activities such as the site preparation/clearance for installations of temporary construction camp, new access opening, earth moving for tower foundations, crane operations, etc. therefore the main GHG emission sources from the construction phase are associated with:

- Electricity consumptions for general construction activities based in the use of diesel fuel in temporary power generators;
- Transportation activities (diesel fuel consumption associated with transportation of materials to site by Heavy trucks);
- Personnel transportation by bus.
- Diesel fuel consumption on-site heavy machinery operation.

The construction phase will use common civil construction equipment. Table 7.11 presents an estimate of the main construction equipment typologies to be used in the different activities associated with the power evacuation line construction.

Table 7.11 – Expected construction equipment usage

Construction Activities	Construction Equipment	Quantity	Activity Duration
Pioneer works and Camp setup **Transmission Line construction & Associated activities**	Excavators (TLB) (50 tons)	2	10 months
	Dumper/tipper truck (50 tons)	2	10 months
	Excavators (30 tons)	2	10 months
	Dumper/tipper truck (30 tons)	2	10 months
	Roller/Compactor (15 tons)	1	8 months
	Blader/graders	1	6 months
	Diesel generators (8kW)	4	12 months (over 18 months)
	Mobile crane (30/50 tons)	2	10 months
	Access platform (cherry picker)	2	10 months
Mobile transportation	Pick-Up trucks (4X4)	5	12 months
Mobile Transportation (workers)	Transportation Bus (Personnel)	3	12 months
Mobile transportation (Containers)	Heavy Duty Articulated Truck	400 Containers	2 months (estimated)

It was assumed that construction works will be carried out during 6 days per week with a maximum of 10 hours/day. 8 kW diesel generators will work 6 hours/day. 400 containers will be transported from Maputo Port to Boane over a total distance estimated and not exceeding 60 km.

A total consumption 498.1 m^3 of diesel will be required to operate both the construction machinery and mobile vehicles during all the construction phase. Fuel will be sourced from commercial entities in the national market.

The following GHG emission factors were used in the preparation of construction phase GHG emission inventory:

- Scope 1 GHG emissions for the construction phase were estimated using the default GHG emission factors for fuels given by the WRI GHG Emission Factors Compilation and EMEP/EEA Air Pollutant Emission inventory guidebook (2019) - Non-road mobile sources and machinery non-road mobile machinery sources.

The adopted method for GHG emissions quantification from diesel combustion was to multiply its volume (in kilolitres or kL) of by the respective GHG emission factors: 2.676 kg CO_2e/L; 1,11 E-05 $kgCH_4/l$ and 1,16 E-4 kg N_2O/l, as given in EMEP/EEA Air Pollutant Emission inventory guidebook 2019.

Table 7.12 – GHG emissions from Diesel combustion

Activity	Quantity (kL)	GHG Emission Factor (kg CO_2/ L)	GHG Emission Factor (kg CH_4/ L)	GHG Emission Factor (kg N_2O/ L)	TOTAL Emissions (Tons CO_2-e)[1]
Diesel fuel consumption associated with pioneer camp and camp setup	498.1	2.676	1.11 E-5	1.16 E-4	**1,348.2**
Diesel fuel consumption associated with mobile transportation (workers)					
Diesel fuel consumption associated with onsite material transportation (400 containers)					
Diesel fuel consumption associated with Transmission line construction heavy duty machinery operation					
Diesel fuel consumption for temporary power generators within the construction camp					

7.3.4.4 Impact assessment

Impact: Greenhouse gas emissions during construction phase

Impact Assessment

The construction phase of the Project is expected to account for a total emission of 19 402.6 tonnes of CO_2e, as per the assessment provided below. Most of this impact is from land clearing activities with a smaller proportion, accounted as a conservative estimate as direct emissions from fuel combustion associated with construction machinery and transportation activities. Table 7.13 summarizes the total direct and indirect GHG emissions expected from the construction phase of the project.

Table 7.13 – Greenhouse gas emission estimative in the construction phase

Emission Source	GHG Total Emission (CO2e tons)
Land Clearing (based on LULC*)	18 054.4
Fuel Consumption	1 348.2
TOTAL	**19 402.6**

* Map of Land Use and Cover, Maputo province: Magalhães (2018).

The total impact from land clearing can be annualised based on the 35 years expected lifetime of the project leading to a total equivalent impact per year from the land clearing calculated as 515.8 tCO2e/year. Fuel consumption during construction activities will generate total emission of 1348.2 tCO2e in the first year of construction works.

This represents a neglectable fraction of Mozambique's current national emissions (as discussed in the baseline section), and a value very low also if compared to emissions from other energy sources such as those based in fossil fuel power generation which would have emissions an order of magnitude far extent per year.

Given the short term duration of the construction phase, CO_2 emissions arising during the construction phase of this project will have a negligible effect to the Mozambican global climate change at a regional or national level, thus the impact generated from GHG in the construction phase is thus rated as *negative*, *direct*, of *short term* duration, *regional* extent and *low* intensity, resulting in a very *low significance*.

Mitigation measures

As the key impacts on greenhouse gas emissions are mostly confined to the construction phase, potential measures to reduce those impacts are important in improving performance. The mitigation measures presented in this section focus on:

- Sourcing as much as possible materials from sustainable sources such as environmental certified companies;
- Use materials from local sources as much as possible;
- Minimize, as feasible, distance from construction camps to work fronts;
- Adopt measures to minimize fuel consumption such as adopting low velocities and turning off vehicles and equipment's while at idle;
- Promote proper and regular maintenance of vehicles and other internal combustion based equipment;
- Ensuring efficiency in construction and planning including siting of construction camps, laydown and other work areas; and
- Using materials which can be easily reused.

Impact Summary

The impact assessment summary is provided in the table below. The proposed mitigation will reduce the overall GHG impact, but the residual significance is not changed, remaining *very low*.

Impact: GHG emissions during the construction phase					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Promote proper and regular maintenance of vehicles and other motorized equipment per manufacturers' guidance.	Negative	
Type	Direct			Direct	
Extent	Regional	2		Regional	2
Intensity	Low	1		Low	1
Duration	Short-term	1		Short-term	1
Consequence	Very Low	4		Very low	4
Probability	Probable			Probable	
Significance	**Very Low**			**Very Low**	

7.3.5 Operational phase

7.3.5.1 General remarks

Direct impacts of greenhouse gas emissions in the operation phase are anticipated to be negligible. Possible SF6 fugitive emissions may occur, eventual N_2O release due to the Corona discharge and fuel consumption from traffic movements associated with routine maintenance of the lines and substations are the sources of GHG that can be expected but are anticipated to be insignificant. The following subsections analyse in detail each of these potential emissions sources during the operation phase of the project.

7.3.5.2 Nitrous oxide (N_2O) emissions

High-voltage transmission lines may generate nitrous oxide (N_2O) due to an effect called “corona discharge”. In certain meteorological conditions, such as rain or fog, and due to the very high voltage values passing through the transmission line cables, there’s a current leakage to the surrounding air that becomes ionized. In this specific condition, the electric field turns higher, and all the electricity driver appears surrounded by a bluish light halo, which produces noise and releases N_2O gas. This phenomenon is called the corona discharge effect. Dones et al. (2007) suggest that N_2O emissions of the electricity high voltage transmission due to corona effect are about 5 kg N_2O/GWh. Considering that the N_2O GWP is 210, so this is equivalent to 1.05 kg CO2e/MWh.

As 350 GWh is the average annual electricity evacuated through this transmission line, thus this is equivalent to a ‘potential’ annual GHG emissions of 367,5 ton CO_2e/year.

It is important to notice that nitrous oxide emissions are not entirely directly proportional to electricity transmitted. Corona discharge depends on a variety of site-specific factors, from voltage levels to the specific technical characteristics and shape of components so the previous cited emission factor must be faced as an estimate and a conservative maximum value only. High-voltage transmission lines can create nitrous oxide (N_2O) from an effect called “corona discharge”. They are only present on the highest voltage lines, and thus would not be applicable to distribution investments or many transmission lines. Therefore, GHG associated with nitrous oxide emissions arising from a 66 kV Power evacuation can be considered as improbable.

7.3.5.3 Sulphur Hexaflouride (SF_6) emissions

Sulphur hexafluoride is a gas used in insulation and current interruption applications in both T&D systems (IPCC, 2006c). SF_6 is used in gas-insulated switchgear and substations, gas circuit breakers, and can also be used in high-voltage gas-insulated lines. SF_6 may escape as fugitive emissions during the manufacturing, installation, use, maintenance, and disposal of this kind of equipment’s. Transmission equipment often requires periodic refilling and so has higher fugitive emissions during use. The amount of SF_6 emissions during operation and decommissioning is related with the equipment voltage rating, to the number and type of equipment used, as well as to the maintenance and recycling procedures. This source of emissions is dependent on the type of equipment installed, refurbished or maintained. The magnitude of SF_6 emissions depends on what equipment is used, how it is maintained, and operational factors of the transmission line itself.

At a national level, countries report SF_6 emissions from the power sector in their national emissions inventories, so this provides one approach for estimating their magnitude.

U.S. EPA, 2006. Global Anthropogenic Non-CO2 Greenhouse Gas Emissions: 1990–2020. Washington, estimates the total SF_6 emissions from the power sector by country and region throughout the world. This estimate includes all transmission line components, as well as SF_6 from manufacturing and disposal of transmission line equipment's.

Considering that a medium voltage equipment (38-100 kV) accounts for 25 percent of the SF_6 fugitive emissions from T&D, (Madrigal, 2010) the average emissions of SF_6 for power lined in Africa countries is 2.45 $kgCO_2e/MWh$ X 25% ~0.61 $kgCO_2e/MWh$.

As 350 GWh is the average annual electricity flow through the transmission line from Namaacha Wind power to Boane Substation this is equivalent to a potential total GHG emissions of 214,4 tons CO_2e/year.

7.3.5.4 Maintenance activities

Emissions associated with routine maintenance of the towers and RoW may arise from fuel consumption during access and/or to eventual towers repairs activities. The fuel requirements during the operational phase will be negligible, as they will be limited to the use of vehicles used for RoW inspections and the eventual need to use a diesel generator. Emissions arising from these activities are short-term and intermittent in nature and therefore not expected to be significant in what concerns global GHG emissions.

7.3.5.5 Impact assessment

Impact: Greenhouse gas emissions during operation phase

It can then be concluded that the project's operational phase will have no significant direct impacts, in what regards greenhouse gases emissions as these would be less than 600 tons CO_2e /year (581,9 tons) if assuming that Corona Discharge is to be accounted for.

However, this Transmission Line project implementation can enable the development of new power generation in Mozambique. It can be foreseen that this would be a mix of renewable and fossil fuel-based power such as new hydropower and natural gas power projects. In the case of the potential export of electricity to neighbouring countries such as South Africa this project could have a positive contribution to greenhouse gas emissions by potentially supplying renewable energy.

7.4 Air Quality

7.4.1 Construction phase

7.4.1.1 Impact-generating activities

During the construction phase of the transmission line, air emissions will be mainly generated by the operation of construction vehicles and machinery and from the activities carried out in each specific work front. The main construction activities likely to generate the most relevant emissions include:

- Access roads opening – Dust emissions associated with the new access opening and road construction are to be expected. Land preparation and vegetation's clearing (site enabling), machinery operations and transportation activities are due to generate particulate matter emissions.
- Clearance of Right-of-Way (RoW) – vegetation in the RoW will be mowed or cut using adequate equipment like mowers and/or chainsaws.
- Erection of transmission towers – transmission towers are constructed by first using a standard drill rig to bore a hole to the required depth. Concrete trucks carry concrete to the boreholes to construct the tower's foundations. Cranes then erect the towers on the foundations. Finally, the wire is strung between towers using large pulleys.
- Construction camp site – Fugitive dust and air pollutants emissions (combustion gases) are expected to be generated from the construction camp erection since the different land construction activities are to be expected, such as vegetation clearing, land preparation, levelling, fencing. Once in operation machinery parking and vehicle movements to and from the construction may generate temporary dust emissions due to dust entrainment.
- Movement and operation of vehicles and machinery associated with the construction activities – the movement of vehicles and the operation of machinery will be a source of atmospheric pollutants emissions, due to the exhaust gases from the internal combustion engines. Fugitive dusts emission due to vehicle entrainment can be also expected during transportation operations.

It is expected that overhead transmission towers and other materials will be delivered by road by means of heavy truck vehicles. The truck journeys associated with the transmission line installation and other equipment's and materials will result also in temporary exhaust emissions with consequent adverse impacts on local air quality.

Ground works will involve the use of excavators, front-end loaders, rippers, dozers, graders, rollers, water trucks and dump trucks that will operate in the construction sites. The construction activities and equipment operation will both result in temporary dust emissions and combustion gas exhaust releases. However no significant adverse impacts on local air quality are to be expected, in what regards the transmission line construction works, since the operations will take place away from residential areas, for the vast majority of the transmission line alignment.

Air quality impacts are likely to be most relevant near the Boane substation considering that several sensitive receptors are located in close proximity giving way to potential dust annoyance to occur.

Considering the discussed above, the key air pollutants of interest include:

- Particulate matter emissions, arising from construction activities; and
- Combustion gases emissions, including nitrogen oxides (NO_x), carbon monoxide (CO), sulphur dioxide (SO_2) and carbon dioxide (CO_2), associated with the operation of fuel-based equipment, and from the circulation of light and heavy vehicles;

The significance of the Project's air quality impacts is assessed below, taking into consideration the proximity of sensitive receptors to the different construction sites.

7.4.1.2 Impact assessment

Impact: Increase of dust emissions near sensitive receptors

Impact Assessment

The most common impact on air quality resulting from civil works is the emissions of particulate matter (dust) that may result in an increase of the atmospheric concentrations of particulate matter near existing sensitive receptors. Civil construction activities that involve vegetation clearing and earth movements result in this type of emissions, which can be significant during the dry season if no control measures are put in place. The intensity of these emissions is a function of several parameters, such as:

- The nature of the specific construction activity under way (construction methodology, number and type of vehicles and equipment in operation, etc.);
- The duration of the activity.
- The size of the work front.
- Meteorological conditions during the activity (wind speed and direction, rain events);
- The proximity of sensitive receptors to the work site.
- Adequacy of the control measures in place.
- The sensitivity of the receptors to the emitted pollutants.

The magnitude of the impacts of each specific work front will thus be dependent of the parameters listed above.

Dust emissions are expected essentially during site preparation works such as vegetation clearance, soil disturbance for tower foundation works, excavation for buried cable and the movement and transport of soil and other materials by heavy vehicles. These impacts, however, will only be relevant for sensitive receptors located in the immediate vicinity of the RoW, which are scarce along the selected Power Evacuation corridor.

The construction of access roads also has the potential to result in high dust emissions, mainly because of road opening activities, acquisition of material from borrow pits, transportation of materials on unpaved roads and road consolidation works.

Given the expected amounts of particulate emissions over the construction period and the location of the closest sensitive receptors, the global air quality impact associated with dust emissions is rated

as *negative*, *direct*, of *short term* duration, with a *local* extent and with an expected *medium* intensity, resulting in a *very low significance* in the non-mitigated scenario.

Mitigation Measures

Despite the very low significance expected, dust emissions may promote some degree of annoyance to the surrounding communities. As such, mitigation measures are recommended to reduce efficiently the potential nuisance effects caused by dusts on nearby receptors.

In particular, it is recommended that dust control measures are implemented in the construction area throughout the construction phase, namely by good environmental management practices, of standard application to any major civil construction works, should be followed, namely:

- Circulation of construction heavy vehicles (such as trucks used in the transportation of materials) should be adequately planned to minimize limited to pre-approved construction routes.
- Speed limits should be set for construction heavy vehicles (such as trucks used in the transportation of materials) for all construction circuits, since the emission of dusts by vehicle entrainment increases linearly with speed. This speed limit should not exceed 30 km/h in critical segments, such as when near residential areas.
- Heavy trucks transporting granular construction materials (such as sand, soil and gravel, etc.) should not be loaded to full capacity. A free edge of approximately 0.2 m should be kept to avoid spills during transportation;
- Vegetation clearing and earthworks should be minimized as much as possible and limited to the strictly needed areas.
- Trucks carrying dusty materials should have the load conveniently covered, preventing the emission of particulate matter and fugitive dusts.
- All the unpaved surfaces where vehicle movement is to be expected near residential areas, should be kept moist (e.g., through a water sprinkler truck), in particular, during dry and windy conditions, to minimize the dust emitted by vehicle entrainment.
- Stockpiles of granular materials should be regularly sprinkled with water, to minimize windborne dust.

Impact Summary

With the application of the proposed mitigation, the impact's intensity is reduced to *low*, resulting in a *very low* residual significance. The table below summarises impact classification due to the potential increase in dust emissions from construction activities.

Impact: Increase in dust emissions near sensitive receptors					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Vegetation clearing and earthworks should be minimized as much as possible and limited to the strictly needed areas. - All the unpaved surfaces where vehicle movement is to be expected should be kept moist (e.g., through a water sprinkler truck), in particular during dry and windy conditions, to minimize the dust emitted by vehicle entrainment. - Speed limits for construction heavy vehicles should not exceed 30 km/h in critical segments, such as when near residential areas. - Circulation of construction heavy should be limited to pre-approved construction routes. - Heavy trucks transporting construction materials should not be loaded to full capacity. A free edge of approximately 0.2m should be kept avoiding spills during materials transport. - Trucks carrying dusty materials should have the load conveniently covered, preventing the emission of particulate matter and fugitive dust. - Stockpiles of granular materials should be regularly sprinkled with water, to minimize windborne dust.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Low	1
Duration	Short-term	1		Short-term	1
Consequence	Very Low	4		Very Low	3
Probability	Probable			Possible	
Significance	**Very Low**			**Very Low**	

Impact: Increase in atmospheric concentrations of exhaust gases from vehicle and equipment operation

Impact Assessment

The construction works of the transmission line and substations are projected to occur in mainly scarcely inhabited areas. Nevertheless, in the locations where several construction activities may occur at the same time, such as is the case of the future substation location, a slight increase of atmospheric pollutant concentrations may occur.

Greenhouse gases, mainly CO_2 will be also emitted during this phase of the project, due to the fuel consumption, land clearing operations and pollutant gases emissions from the vehicles and machinery involved in the different construction processes. It is estimated, conservatively, that several hundred litres of gasoline and diesel fuel will be required on a monthly basis to operate all the required construction machinery and vehicles. The construction machinery and vehicles associated will then inevitably emit pollutant gases due to the exhaust gases releases from the internal combustion engines operation. These pollutant gases will include CO, NO_x (NO e NO_2), SO_2, VOCs and particulates (TSP), among other residual pollutants, such as heavy metals, aldehydes and other minor organic compounds.

It will be expected a release of combustion gases from construction equipment such as cranes, generators, concrete mixers, and light and heavy vehicles as well. Other important gas emissions source is to be associated with the construction traffic over local roads during material and equipment transport activities. For reference purposes, the Table 7.14 lists typical emission factors of common construction equipment.

Table 7.14 – Average air pollutants emission factors of civil works equipment

Equipment	Equipment Horsepower	Load Factor	CO	VOC	NO_X	SO_X	PM10
	(BHP)	(%)	(g/hr)	(g/hr)	(g/hr)	(g/hr)	(g/hr)
Air Compressor	37	48	88,5	16,3	145,2	16,3	8,2
Backhoe	79	47	249,9	49,9	366,5	33,1	16,8
Compactor	99	58	180,5	51,7	516,7	51,7	25,9
Concrete Mixer	11	56	28,1	5,4	67,1	5,4	2,7
Crane	194	43	340,7	113,4	870,5	75,8	56,7
Dozer	103	59	303	54,9	633,2	54,9	27,7
Front End Loader	147	47	341,1	62,1	713,1	62,1	30,8
Gas Welding Machine	19	51	6501	237,2	8,6	2,7	0,9
Generator	22	74	81,2	15	132,9	15	7,3
Grader	157	58	326,6	122,5	857,8	81,6	40,8
Hand Vibrator Plate	8	43	3183,4	1399,8	0,9	0,9	13,2
Pile Hammer	161	62	905,4	135,6	1086,8	90,7	68
Roller	99	58	180,5	51,7	516,7	51,7	25,9
Rubber Tire Loader	147	54	396	72,1	828,3	72,1	54
Scraper	267	66	878,6	79,8	1517,3	159,7	119,8
Truck Mounted Vertical Drill	209	75	1422	213,2	1706,4	142,4	106,6
Vibrator /compactor	99	58	180,5	51,7	516,7	51,7	25,9
Well Driller	209	75	1422	213,2	1706,4	142,4	106,6

Source: South Coast Air Quality Management District CEQA Air Quality Handbook, November 1993, Tables A9-8-B, A9-8-C and A9-8-D, Adapted.

The pollutant gases emissions generated by the construction equipment will be dependent of several variables, such as the maintenance status of that equipment, their technical specifications, the number of hours of operation and the number of equipment working simultaneous in a specific work front. However, considering that the expected number of machines needed in simultaneous operation will not be very high, it is expected that the emissions of SO_2, NO_x, CO and VOCs will result in a minor increase of the concentration of these pollutants during a limited period. As such, this impact is rated as *negative*, *direct*, of *short term* duration, *local* extent and *low* intensity, probable resulting in a *very low significance.*

Mitigation Measures

Some good environmental practices during construction activities should still be observed, namely:

- All internal combustion machinery and equipment should be kept in good maintenance conditions, in order to minimize combustion gases exhaust emissions. This should include preventive maintenance of machines, equipment and vehicles and operator training, as well as internal monitoring program of proper maintenance of vehicles.
- Select traffic construction routes that minimize the crossing of residential areas and optimize fuel consumption as much as feasible possible.

- Speed limits should be set for construction heavy vehicles. This speed limit should not exceed 30 km/h when near residential areas.
- Internal combustion equipment should be turned off when not in operation. Avoid maintaining equipment in idle when not being used.

Impact Summary

The table below lists the impact classification regarding exhaust gas emissions from vehicle and equipment operations.

Impact: Increase in atmospheric concentrations of exhaust gases from vehicle and equipment operation				
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- All internal combustion machinery and equipment should be kept in good maintenance conditions, in order to minimize combustion gases exhaust emissions. This should include preventive maintenance of machines, equipment and vehicles and operator training, as well as internal monitoring program of proper maintenance of vehicles. - Select traffic construction routes that minimize the crossing of residential areas and optimize fuel consumption as much as feasible possible. - Speed limits should be set for construction heavy vehicles. This speed limit should not exceed 30 km/h when near residential areas. - Internal combustion equipment should be turned off when not in operation. Avoid maintaining equipment in idle when not being used.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Low	1		Low	1
Duration	Short-term	1		Short-term	1
Consequence	Very low	3		Very low	3
Probability	Probable			Possible	
Significance	**Very Low**			**Very Low**	

7.4.2 Operational Phase

During the operational phase of the project, no significant atmospheric emissions are expected. Maintenance activities, and in particular the continued vegetation control along the RoW, will result in some dust emissions and gaseous emissions, due to fuel consumption of the heavy-duty equipment and vehicles used for those maintenance operations.

However, vehicle emissions associated with maintenance activities are expected to be intermittent and of low intensity. As such, atmospheric emissions during the operational phase can be considered to be insignificant, with negligible air quality impacts.

7.5 Noise

7.5.1 Construction phase

7.5.1.1 Impact-generating activities

The construction phase of this project will include a wide range of civil works necessary for the establishment of the projected access roads, substations construction, and overhead towers erection along the Power Evacuation Line route. Key activities involved in the construction phase include:

- **Site preparation -** Site preparations will include vegetation clearance where the line passes over or close to trees which could infringe safe clearances, verification of local utilities and underground services, geotechnical and ecological surveys as necessary. Intrusive works will be undertaken in accordance with archaeological chance find procedures.
- **Site Enabling Works -** Vehicle access to each tower site is required either via direct access road or along the right of way. Where ground conditions prevent normal access, it will be necessary to construct a temporary access road.
- **Civil Works -** Tower foundations are constructed first, either four or one foundations per tower depending on the final tower design. The foundations are mechanically excavated and filled with concrete. Piled foundations may be required in some areas where ground conditions are unstable. The dimensions of the excavation will differ depending on the type of tower to be installed. Concrete would be delivered by ready mixed concrete truck from batching plants strategically located along the route.
- **Steel Erection -** Steelwork sections for the towers will be delivered by road using a 4 x 4 lorry. The assembly of each tower at ground level would proceed as far as possible until the utilisation of a crane becomes necessary to enable the higher sections of the tower to be completed. It is normal practice to use cranes to erect steelwork, subject to good access being available. Where terrain is difficult and to minimise disturbance, steelwork may be delivered by helicopter.
- **Conductor Stringing -** Stringing is undertaken using a winch to pull the conductor along the towers and a 'tensioner' at the other end to keep the conductor above the ground.
- **Testing of Equipment -** Overhead line components including conductors, insulators, towers, joints and fittings are designed and tested to prove compliance with structural, mechanical and electrical requirements.

Other construction activities associated with this phase shall include:

- Setting up of the site camp, namely the temporary workers' accommodation, access roads construction and mobilisation of machines, equipment materials and auxiliary structures;
- Development of right of way (ROW);
- New permanent access/ maintenance roads from existing roads to the line;
- Construction of temporary access roads;
- Permanent trackway underneath the right of way.
- Development or use of borrow pits to provide aggregate and inert materials.

- Temporary storage sites at strategic locations along the route for storage of key plant equipment before delivery to worksite.

7.5.1.2 Impact Assessment

Impact: Increase of noise levels near sensitive receptors during construction

Impact Assessment

During the construction phase of the transmission line, noise will be mainly generated by the operation of heavy machinery (vehicles and machinery) to be deployed in each specific work front as detailed bellow. Typical construction equipment may include bucket trucks, cranes or digger derricks, backhoes, pulling machines, pole trailers, or dumpsters. Ground works should involve the use of excavators, front-end loaders, rippers, dozers, graders, rollers and water trucks. Heavy-duty trucks are expected to be used to haul away material that can't be stockpiled or disposed on-site and to bring in necessary construction materials.

The main construction activities likely to generate relevant noise emissions will include:

- Access roads opening – noise emissions associated with the new access opening and road construction are to be expected. Land preparation and vegetation's clearing (site enabling), machinery operations and transportation activities are due to generate intermittent noise. Sub base works, surface works, are predicted to generate the highest precepted noise levels at a given receptor located as far as 200m from the project site;
- Clearance of Right-of-Way (RoW) – vegetation in the RoW will be mowed or cut using adequate equipment like mowers and/or chainsaws.
- Erection of transmission towers – transmission towers are constructed by first using a standard drill rig to bore a hole to the required depth. Concrete trucks carry concrete to the boreholes to construct the tower's foundations. Cranes then erect the towers on the foundations. Finally, the wire is strung between towers using large pulleys.
- Development or use of borrow pits to provide aggregate for road building - Noise is generated from heavy machinery operation, from blasting, drilling and due to the associated heavy traffic movement to a from the borrow pits. Crushing operations at site are other potential source of significant noise. This noise can be mitigated by limiting the hours of operation, enforcing strict maintenance of equipment and using quieter equipment as further mentioned below.
- Movement and operation of vehicles and machinery – the movement of vehicles and machinery operation will be also an expected temporary noise source. The truck journeys associated with the overhead installation and other equipment's to be deployed may also result in temporary noise emissions.

All these construction activities and equipment operation will result in temporary noise emissions with potential annoyances to community where the construction activities take place in the vicinity human settlements. Of the construction activities with the potential to generate impacts on ambient noise, some are clearly noisier, such as the earthworks. Other activities, such as transportation of materials and the movement of heavy vehicles from the yards to the work fronts and back, will still generate noise, but of lower levels.

It is also worth noting that some activities are very limited in time and space (such as the earth works) while others will be more continuous (such as the movement of machinery and vehicle activity during the construction period). The latter, however, will not generate very high average levels of noise.

The dispersion of the sound energy from the construction activities with distance is done in a spherical geometry. Noisy equipment emits spherical sound waves, for which the decay of sound energy is inversely proportional to the square of the distance, that is to say, it decreases in 6 dB for each doubling of distance, as per the equation presented in the equation represented in **Figure 7.1**. To this attenuation effect with distance, other sound attenuation effects must be added, such as the ground attenuation of the terrain, atmospheric attenuation and the effect of the dominant winds or other effects resulting from temperature variations or atmospheric turbulence.

$$L_{p2} = L_{p1} - 20\log\left(\frac{r_2}{r_1}\right)$$

Figure 7.1 – Noise propagation equation for point sources

It should also be noted that the sound levels generated by the construction activities will depend on several other factors, such as the type and number of equipment mobilized for a construction work, the duration of their operation and the topography of the surrounding terrain. These factors could contribute to an increase or to an attenuation of the noise levels that may be felt at the sensitive receptors closer to a work front.

Given all these changing variables, the noise levels generated by the construction phase are not easily quantified, since they are subject to high variability and randomness. As such, the noise impacts of construction activities are usually assessed in a qualitative way. Nevertheless, Table 7.15 lists the average noise levels perceived at varying distances from typical construction equipment, like the ones required for the transmission line deployment, access roads opening, camp site construction.

Table 7.15 – Typical sound levels at several distances from civil works equipment in dB(A)

Equipment	Distance to noise source					
	15 m	30 m	60 m	120 m	250 m	500 m
Excavators	85	81	75	67	< 58	< 52
Heavy trucks	82	78	72	64	< 55	< 49
Generators	77	73	67	59	< 50	< 44
Compressors	80	76	70	62	< 53	< 47

Source: Geosolve & Certiprojecto (2009).

The table above shows that excavators and heavy trucks generate LAeq sound levels of respectively 81 dB(A) and 78 dBA(A) at a distance of 30 m. These levels decrease to 75 and 72 dB(A) at 60 m, and to 67 and 64 dB(A) at 120 m. Note that these levels refer to sound propagation in free space, i.e., without the consideration of obstacles to sound propagation, and to a continuous operation at full power, in what regards fixed equipment, or to the recorded level when the vehicle passes by at the indicated distance, in what regard mobile machinery. However, as previously noted, normal construction activities do not usually present a continuous operation regime.

It will be expected that the generated noise will be confined to the local surrounding and the impact will be of short-term duration. The potential changes in sound quality over local roads resulting from the increased vehicle traffic during construction are not expected to be significant.

The non-mitigated noise impact is rated as being *negative*, *direct*, of *short term* duration, *local* extent and *medium to high* intensity (depending on the relative proximity of sensitive receptors to the work sites), resulting in a *low significance*.

Mitigation Measures

Despite the expected low significance of the noise impacts, some sensitive receptors may experience annoyance effects, due to the construction noise. Best practice construction measures are therefore recommended, to efficiently reduce the potential nuisance effects caused by noise on nearby receptors. The proposed mitigation is mostly the application of good environmental management practices, of standard application to any major civil construction works such as:

- Vegetation clearing and earthworks should be minimized as much as possible and limited to the strictly needed areas.
- Operate earth moving equipment within specifications and capacity of its manufacturer (e.g., ensure machines are not overloaded).
- Circulation of construction heavy vehicles should be limited to pre-approved construction routes. These will be defined in order to avoid crossing residential areas, schools, hospitals, cultural heritage and religious facilities, whenever feasible.
- Speed limits for construction heavy vehicles should not exceed 30 km/h in critical segments, such as when near residential areas.
- Construction activities, in particular the noisier ones, should whenever possible be limited to the daytime period (between 07:00 and 22:00) during weekdays, avoiding working during the night-time and on weekends.
- The EPC Contractor should avoid, whenever possible, placing fixed equipment (such as cranes or compressors) in proximity to sensitive receptors.
- Perform regular maintenance of all equipment as per manufacturer specifications.
- Inhabitants of local communities nearby the construction locations should be previously informed by The EPC Contractor regarding the upcoming construction activities, including information on the planned start of activities, their nature and duration. This communication

should also include information regarding the project nature and goals as per the Project Stakeholder Engagement Plan.

- Grievance redress mechanisms should be implemented during construction phase.

Impact Summary

Assuming the application of the proper mitigation measures, as stated above, the impact generated by the potential changes in ambient sound pressure levels is expected to be of *very low significance*. The residual noise impact is rated as being *negative*, *direct*, of *short-term* duration, *local* extent and *medium* intensity, resulting in a *very low significance*.

Impact: Increase of noise levels near sensitive receptors during construction					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Vegetation clearing and earthworks should be minimized as much as possible and limited to the strictly needed areas. - Operate earth moving equipment within specifications and capacity of its manufacturer (e.g., ensure machines are not overloaded). - Circulation of construction heavy vehicles should be limited to pre-approved construction routes. These will be defined in order to avoid crossing residential areas, schools, hospitals, cultural heritage and religious facilities, whenever feasible. - Speed limits for construction heavy vehicles should not exceed 30 km/h in critical segments, such as when near residential areas. - Construction activities, in particular the noisier ones, should whenever possible be limited to the daytime period (between 07:00 and 22:00) during weekdays, avoiding working during the night-time and on weekends. - The EPC Contractor should avoid, whenever possible, placing fixed equipment (such as cranes or compressors) in proximity to sensitive receptors. - Perform regular maintenance of all equipment as per manufacturer specifications. - Inhabitants of local communities nearby the construction locations should be previously informed by The EPC Contractor regarding the upcoming construction activities, including information on the planned start of activities, their nature and duration. This communication should also include information regarding the project nature and goals as per the Project Stakeholder Engagement Plan. - Grievance redress mechanisms should be implemented during construction phase.	- Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium/High	3		Medium	2
Duration	Short-term	1		Short-term	1
Consequence	Low	5		Very Low	4
Probability	Probable			Probable	
Significance	**Low**			**Very Low**	

7.5.2 Operational phase

7.5.2.1 Impact-generating activities

During the operational phase of the project different types of noise can be produced, namely by:

1) Wind induced noise due to certain wind conditions acting over the transmission line components.

2) Noise emissions due to the corona effect occurring in the transmission cables under specific meteorological conditions, as further detailed below.
3) Induced traffic and noise during maintenance activities to be performed in the right of way of the Power evacuation Line and finally the noise associated with the substation operation.

7.5.2.2 Impact assessment

Impact: Wind-induced noise

Impact Assessment

Wind-generated noise over an overhead transmission line occurs during certain wind conditions, when wind interacts with certain components of the power transmission line (such as the supports, insulators, conductors or signalization spheres) in such a way that noise is generated. Aerodynamic forces acting on the transmission line, such as turbulent airflow and vortex shedding are one of the main sources of noise as these can create a whistling or humming noise, particularly at high wind speeds. Other common cause is the mechanical vibrations of the transmission line towers and cables, which can create noise as well.

Wind-generated noise does not depend only on the level of tension, but rather on the speed and direction of the wind, in which the different components of the line give rise to different types of noise (conductors, insulators and signalization spheres) (Union of The Electricity Industry, 2003).

Wind noise generation from high-voltage line is unusual, since the conditions under which the noise occurs are very specific, occurring only for relatively high wind speeds. Even under those conditions, the generated noise levels is rated low (that is, barely perceptible to the human ear) and rarely noticeable.

Noise generated from insulators or signalization spheres may be perceptible but will occur only under special conditions of high wind speeds (above 10 m/s), when its direction focuses on certain angles of incidence, and only to some types of insulators applied in high voltage lines.

Location signalization spheres (when installed in on top of the cable lines) for daytime aeronautic signalling may act as a source of noise.

Power transmission line induced wind noise is difficult to predict, occurring very rarely and depending on the speed of the wind. This type of induced noise is also more frequent if the conductor mounting equipment is loosened or has loosened slightly over the years. This is a maintenance issue that can be easily identified and repaired if necessary.

In the project's region the annual frequency of high-speed winds can be considered as uncommon, reason to infer that impacts generated by the wind acting over the transmission line components can be considered as *negative*, *direct*, of long-term duration but of intermittent character, *low intensity*, with a low probability of occurrence leading to an impact with a low significance.

Mitigation Measures

Regular maintenance of the transmission line such as cleaning and replacing damaged components will reduce the probability of wind-generated noise.

Impact Summary

The impact summary is provided in the following table. Regular maintenance should lower the probability of the impact occurring, reducing the residual significance to *very low*.

Impact: Wind-induced noise					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Regular maintenance of the transmission line such as cleaning and replacing damaged components will reduce the probability of wind-generated noise.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Low	1		Low	1
Duration	Long Term	3		Long Term	3
Consequence	Low	5		Low	5
Probability	Probable			Possible	
Significance	**Low**			**Very Low**	

Impact: Corona discharge induced noise

Impact Assessment

When a transmission line is fully operational, an occasional potential disruption of the local sound environment can be caused by a phenomenon called corona discharge. This phenomenon is the main source of noise emissions from transmission lines. Corona discharges are caused by micro electrical discharges around the conductors, depending on the geometrical characteristics of the conductors, the thread tension and of specific weather conditions favourable to the generation of this kind of noise.

High voltage transmission lines use conductors exposed to the atmospheric conditions. In certain conditions, such as rain and fog, when very high voltage values pass through the transmission lines conductors there's some current leakage to the air. The air, which when dry is a perfect insulator but when moist becomes a conductor itself, is then ionized. In this situation, the electric field turns higher, and it begin to appear a bright, effluvia producing a light crackle, where there are sharp edges or protrusions. From a given tension value, and when observed in the darkness, all the driver appears surrounded by a bluish light halo, which produces noise. This phenomenon is called the corona effect or corona discharge.

Specific weather conditions such as rainfall or high relative humidity are likely to lead to significant variations in the intensity of the "corona discharge", but only in high voltage lines (typically as those rated above 220 kV). As the power evacuation line under evaluation is rated as 66kV noise generation due to corona effect is not likely to occur and therefore no annoyance over the populations residing in the vicinity of the transmission line is to be expected.

Impact: Right-of-way maintenance induced noise

Impact Assessment

Operation maintenance activities will comprise the use of 4X4 vehicles and the use of occasional heavy vehicles responsible to perform vegetation control along the corridor. These vehicles will generate noise emissions, but these will be intermittent and sporadic in nature. The associated noise impact can be considered as being insignificant.

7.6 Geology

7.6.1 Construction and operation phases

7.6.1.1 Impact-generating activities

This section discusses potential impacts on Geology during construction and operation of the powerline and associated mitigation measures to be adopted. Following the EIA approach, the assessment is of the impact of the Project on geology rather than vice versa. There are numerous impacts of the geology and seismicity on the Project but typically these are technical constraints to the design and construction methodology which are addressed through the design process.

In terms of geology, the most important impact is the stability condition of slopes. Many aspects of the Project construction have the potential to directly impact the stability of slopes. There are secondary impacts because of the slope instability, for example: river ecology as a result of increased sediment load into the river; property damaged as a result of landslide; and local agriculture through loss of land following landslide.

Activities that can lead to potential geology impacts include excavations and site vegetation clearance (construction camp, along the RoW, towers foundations and clear storage areas) and creation of new access roads, which could lead to a reduction of slope stability and increased erosion on slopes in the project area.

The assessment of the potential impacts of these activities is provided below. There are no known positive impacts relating to the geology environment and the impacts are dominantly related to the construction phase.

7.6.1.2 Impact assessment

Impact: Potential slope instability

Impact Assessment

The stability of a slope is determined by the balance between the forces that tend to destabilize it (such as gravity, erosion, and seismic activity) and the forces that tend to stabilize it (such as the strength and cohesion of the soil or rock). There are several factors that can contribute to instability in slopes and are summarized in the following table. These factors can act alone or in combination to cause instability in slopes.

Table 7-16 – Causes of slope instability

Geology and soil properties	The geology of a slope and the properties of its soil or rock are key factors in slope stability. Some types of rock or soil are inherently unstable and prone to sliding or slumping
Slope angle and height	The steeper the slope and the higher it is, the greater the force of gravity acting on it, making it more susceptible to instability.
Water	Water is a major factor in slope instability. It can saturate the soil and reduce its strength, or it can infiltrate the soil and create hydraulic pressure that can cause landslides
Vegetation	The presence or absence of vegetation can also affect slope stability. Vegetation can help stabilize slopes by holding soil in place and absorbing water, but it can also make slopes more prone to landslides by adding weight and reducing soil strength.
Earthquakes and other seismic activity:	Seismic activity can trigger landslides by causing the soil to liquefy or by shaking the slope, causing it to fail.
Human activity	Human activities such as excavation, construction, and mining can destabilize slopes by altering the slope's geometry or drainage patterns, or by weakening the soil or rock through blasting or other activities.

Rhyolitic ash-flow tuffs and ignimbrites are volcanic rocks (that occur in the initial area of the route with more rigorous relief - steeper slopes) that are typically highly consolidated and have a high strength, which generally makes them less prone to landslides compared to unconsolidated sediments. However, landslides can still occur in these rocks if they are weakened by fractures or faults, or if there is significant alteration or weathering that has reduced their strength.

In addition, the presence of steep slopes or cliffs at the beginning of the route can increase the likelihood of landslides in these types of rocks, particularly if there is a high amount of precipitation or seismic activity in the area. Therefore, it is always important to assess the specific geological and environmental conditions of a particular area before making any conclusions about its susceptibility to landslides, even in rocks that are generally considered to be stable.

Vegetation clearance will take place in all construction affected areas (including the RoW). The removal of vegetation will leave soils exposed to erosion as well as reducing slope stability - vegetation acts to bind soil and reduce pore water pressures.

Excavations will be required at all tower locations and may be required for road cuts (new access roads) as well as for temporary works such as quarrying. Excavation activities may result in two impacts - the first, is the case where excavations involve unloading the toe of natural slopes resulting in the potential for movement/failure of those slopes; the second, are impacts associated with the creation of steep temporary cut slopes associated with various construction activities.

However, the natural slopes in the study area are generally of a shallow gradient and stable. In general, the potential for natural slope instability is very low to low. Note that in terms of natural slope stability, landslides are natural events which may occur independently of the Project construction and operational phases.

Mitigation Measures

- Sufficent geological-geotechnical evaluation will be undertaken such that the structures can be designed for their suitability to the terrain. This will include consideration of soil errosion and landslide.
- Any drainage systems provided for the Project must be sufficient to ensure effective surface water drainage, maintaining the stability of the slopes and not causing erosion.
- Conduct regular inspection and maintenance of any drainage system provided by the Project

Impact Summary

The table below summarizes the impact assessment.

Impact: Potential slope instability					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Sufficent geological-geotechnical evaluation will be undertaken such that the structures can be designed for their suitability to the terrain. This will include consideration of soil errosion and landslide. - Any drainage systems provided for the Project must be sufficient to ensure effective surface water drainage, maintaining the stability of the slopes and not causing erosion. - Conduct regular inspection and maintenance of any drainage system provided by the Project.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Low	1
Duration	Medium-term	2		Short-term	1
Consequence	Low	5		Very low	3
Probability	Possible			Improbable	
Significance	**Very Low**			**Insignificant**	

Impact: Adverse effects on geological heritage or mineral resources

Impact Assessment

No sites of importance relating to **geological heritage or geomorphology** have been identified within the ROW. Impacts on geology and geomorphology are expected to be very limited, as no significant earthmoving activities is currently expected to be necessary during construction of the proposed powerline. However, geology and topography will affect the transmission line in terms of engineering, construction costs, and accessibility. It is assumed that a detailed geotechnical assessment or survey will be required. Also, it will be important to confirm the geological and soil conditions during the detailed design for the towers, particularly on steeper terrain close to rivers and streams.

Regarding the **mineral resources**, Mozambique has a wide range of geological resources which are at various stages of identification and development. While some deposits have been identified and being extracted, others have only recently been discovered and have yet to be developed. Others have yet to be discovered.

In general, powerline routes should seek to avoid sterilising known mineral or aggregate reserves which are currently being exploited (like Boane deposit or bentonite quarries), or could potentially be, at some point in the future. Impacts to mineral resources could be significant if the mineral

resources of economic value to the region and the residents of the district/province are lost or made inaccessible for future use.

As mentioned in the baseline chapter, the transmission line crosses one concession area for Bentonite Prospection and Research and three Mining Concessions (for bentonite and rhyolite extraction). The concessionary companies should be consulted.

Mitigation Measures

- Consult with the mining concession companies which the ROW crosses to determine any concerns that they have and identify any additional mitigation measures required.

Impact Summary

The table below summarizes the impact assessment.

Impact: Adverse effects on geological heritage or mineral resources					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Consult with the mining concession companies which the ROW crosses to determine any concerns that they have and identify any additional mitigation measures required	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	High	3		Low	1
Duration	Long-term	3		Short-term	1
Consequence	High	7		Very low	3
Probability	Probable			Improbable	
Significance	**High**			**Insignificant**	

Impact: Changes in erosion, transport and sedimentation processes

Impact Assessment

The implementation of overhead transmission lines can cause changes in erosion, transport, and sedimentation processes in several ways (See Table 7-17).

Table 7-17 – Causes of changes in erosion, transport, and sedimentation processes

Clearing of vegetation	To construct energy transmission lines, vegetation such as trees and bushes must be cleared. Vegetation plays a crucial role in reducing soil erosion and controlling sedimentation. When it is cleared, the soil is exposed to the elements, increasing the potential for erosion.
Soil compaction	The construction process of energy transmission lines can result in soil compaction. Compacted soils have a lower infiltration rate, which can lead to increased surface runoff and erosion. Additionally, compacted soils may not support vegetation as effectively, further exacerbating erosion and sedimentation issues.
Alteration of drainage patterns	Changes to natural drainage patterns can lead to increased runoff and erosion, especially in areas prone to flash flooding.
Increased runoff	Energy transmission lines often require the construction of access roads and other infrastructure. This can increase the amount of impervious surfaces in the area, leading to increased runoff during precipitation events. Increased runoff can result in erosion and sedimentation issues downstream.

Sedimentation in water bodies	The installation of energy transmission lines may require the crossing of water bodies such as rivers or streams. During construction, sediment may be disturbed and carried downstream, leading to increased sedimentation in the water body. This can harm aquatic habitats and reduce water quality.

Overall, the implementation of energy transmission lines can cause changes in erosion, transport, and sedimentation processes. These changes can negatively impact the environment and surrounding communities.

Mitigation Measures

- Implementation of an Erosion and Sedimentation Management Program – See EMP (Volume III of the EIS).
- Unused soil remaining after backfilling of tower foundation sites shall be disposed near the tower foot, levelled and vegetated.
- All towers will be located at least 30 m from the nearest water source to avoid polluting the waters and to reduce the flow of sediments.

Impact Summary

The table below summarizes the impact assessment.

Impact: Changes in erosion, transport and sedimentation processes					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Implementation of an Erosion and Sedimentation Management Program – See EMP. - Unused soil remaining after backfilling of tower foundation sites shall be disposed near the tower foot, levelled and vegetated. - All towers will be located at least 30 m from the nearest water source to avoid polluting the waters and to reduce the flow of sediments.	Negative	
Type	Direct			Direct	
Extent	Regional	2		Local	1
Intensity	Low	1		Low	1
Duration	Medium-term	2		Short-term	1
Consequence	Low	5		Very low	3
Probability	Probable			Improbable	
Significance	**Low**			**Insignificant**	

7.7 Soils

7.7.1 Construction phase

7.7.1.1 Impact-generating activities

The disturbance of soil and land resources during development or other land use activities has the potential for major impacts on the quality of our environment. Soil erosion, stream sedimentation, mass movement, soil pollution and altered hydrological regimes are just some of the associated environmental problems. Fortunately, there has been an increased awareness of the potential impacts on soil and land resources and a greater commitment to overcome them in recent years. There is, however, still much room for improvement. This section outlines the major environmental impacts and mitigation measures relating to soil.

Electric power transmission lines could have significant impacts on soil resources and land use, namely through the following activities:

- **Vegetation clearance:** Trees and other vegetation may need to be cleared to create space for the transmission line (RoW). This activity can impact the soil's ability to retain moisture, leading to increased erosion;
- **Land modelling / Soil stabilization:** The transmission line's foundation may need to be stabilized with concrete or other materials to prevent erosion and ensure stability. This activity can alter the soil's physical and chemical properties, potentially affecting its ability to support vegetation.
- **Waste generation and handling of hazardous substances:** inadequate management or handling of wastes and hazardous substances could lead to accidental spills or leaks, with potential contamination of soils.
- **Movement and operation of vehicles, machinery, and equipment:** Access roads may need to be constructed to facilitate the transportation of materials and equipment, and excavation required to install the foundations for the towers are the main activities likely cause significant soil disturbance, including soil compaction, loss of topsoil, and changes to soil structure. This can have a significant impact on the soil's ability to support vegetation, leading to changes in land use. Foundations will be dug up to variable depths depending on the tower type and soil characteristics.

The potential effects of these impacts and their significance within the study area are described below.

7.7.1.2 Impact assessment

Impact: Impacts on irrigation lands and on soils with suitability for irrigation

Impact Assessment

The potential impacts are related to the construction activities and the defined location for the placement of the towers (the impact extends to the operation phase). However, at the present stage of the Project, the site of the towers has yet to be defined, so their consideration in irrigated areas or soils suitable for irrigation cannot be assessed in detail. Nevertheless, there is expected to be some destruction of farmland. The Project should repair much of the damage that can occur during construction and provide compensation for damage that cannot be easily fixed.

Overall, the construction of the powerline can have significant impacts on irrigation lands and soils with suitability for irrigation. Proper planning and mitigation measures can help minimize these impacts, but careful consideration should be given to the potential impacts before the definition of the sites for the towers and access roads. Some of the potential impacts include:

- *Soil compaction and erosion*: The construction of transmission lines involves heavy equipment, which can cause soil compaction and erosion, reducing the soil's ability to absorb

and retain water. This can impact the productivity of irrigated lands and affect the suitability of soil for irrigation.

- *Soil contamination*: During the construction process, hazardous materials and chemicals may be released into the soil, contaminating the irrigation lands and soils with suitability for irrigation. This can harm crops and affect soil fertility, leading to decreased yields.
- *Alteration of soil structure*: The installation of transmission towers and associated infrastructure can alter the soil structure, affecting water infiltration and drainage, and reducing soil fertility.
- *Loss of productive land*: The construction of transmission lines may require the permanent occupation of land, resulting in the loss of productive irrigated land. This can impact local agricultural production, food security, and economic development.
- *Interference with irrigation infrastructure*: The installation of transmission lines may require the relocation or modification of existing irrigation infrastructure, such as canals or pipelines, resulting in additional costs and potential impacts on water availability and irrigation efficiency.

The following figure presents the cartography of the significant infrastructure irrigated areas dependent on water from the Limpopo Dam. The powerline ROW does not intercept these irrigated lands.

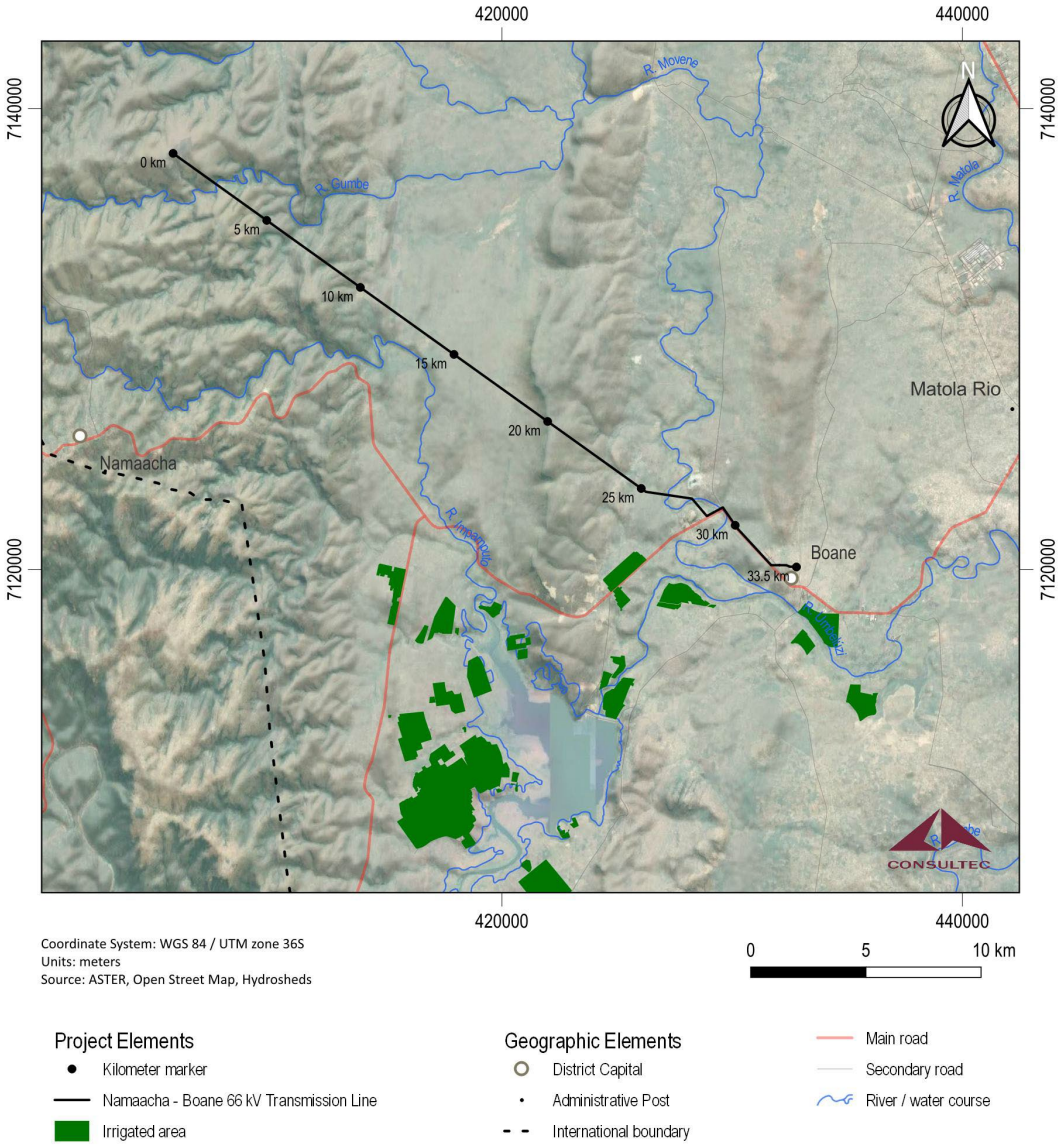


Figure 7-2 – Irrigated and infrastructure areas

Selecting a site for the towers of high-voltage power lines requires a comprehensive assessment of technical, environmental, social, and economic factors to ensure that the site is suitable for the purpose and will provide reliable and safe power transmission. Choosing a site to implement the towers of high-voltage power lines involves several criteria, including:

Table 7-18 – Criteria for choosing the location of the high-voltage line towers

Topography and terrain	The site's topography and terrain must be suitable for constructing the high-voltage power line towers. The land must be stable and level to ensure that the towers can be erected securely.
Accessibility	The site must be easily accessible to enable construction equipment and materials to be transported to the site. The access roads must be adequate to support the heavy equipment that will be required for construction and maintenance.
Availability of resources	The site must have access to the resources required for construction, such as concrete, steel, and electricity. Additionally, the site must have adequate water supply to support construction and operation.

Safety considerations	The site must be evaluated for safety concerns, including risks associated with natural disasters, such as hurricanes, tornadoes, and earthquakes. The towers must be designed to withstand high winds and other severe weather conditions.
Land use	The site's land use must be evaluated, including the potential for conflicts with existing infrastructure, such as roads, railroads, and buildings. Additionally, the site's proximity to residential areas must be evaluated to avoid negative impacts on local communities. The irrigated and infrastructure lands must be avoided.

The extent of the impact is local. The impact duration is long term. The intensity can be considered as moderate, which results in a medium consequence. However, the occurrence of this impact is possible, but not probable. The impact is thus rated as of low significance.

Mitigation Measures

Mitigation measures include:

- Prioritize the use of existing tracks to access work sites. Restrict transportation to the identified access by clearly marking out the limit of the RoW and access roads.
- Limit the clearing of vegetation to strictly required areas.
- Conducting regular meetings or workshops with farmers to discuss their upcoming field activities and understand their specific needs regarding powerline construction. This will allow for proactive planning and coordination between the powerline project team and farmers, minimizing disruptions.

Impact Summary

The impact summary is provided in the table below. The application of the proposed mitigation measures limits the intensity of the impact to low and keeps he duration globally of short-term. Furthermore, it becomes improbable, thus post-mitigation assessment is insignificant.

Impact: Impacts on irrigation lands and on soils with suitability for irrigation					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Prioritize the use of existing tracks to access work sites. Restrict transportation to the identified access by clearly marking out the limit of the RoW and access roads. - Limit the clearing of vegetation to strictly required areas. - Conducting regular meetings or workshops with farmers to discuss their upcoming field activities and understand their specific needs regarding powerline construction. This will allow for proactive planning and coordination between the powerline project team and farmers, minimizing disruptions.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Low	1
Duration	Long term	3		Short-term	1
Consequence	Medium	6		Very Low	3
Probability	Possible			Improbable	
Significance	**Low**			**Insignificant**	

Impact: Increased soil erosion and compaction

Impact Assessment

Soil erosion and the consequent sediment transport are caused by the action of water, wind or gravity on exposed soil. The process involves the detachment of particles from the soil surface due to the force of raindrop impact, flowing water or wind and its subsequent transportation away from the site. These impacts are more likely to occur at the beginning of the route, where the soils have an erosion risk of category 6, with slope being the major contributing factor to erosion hazard. The impacts resulting from soil erosion manifest themselves in various ways:

- **Impacts at the site of erosion**

The most serious impacts are generally the loss of valuable soil, particularly topsoil, which provides the medium for plant growth. This soil loss results in less potential for agriculture, site rehabilitation, re-establishment of native ecosystems. Note that soil erosion can also occur on adjacent lands away from the RoW as a result of increased water runoff. Some of the common characteristics of an area from which soil has been eroded include:

- *Loss of topsoil*: Erosion can strip away the top layer of fertile soil, leaving behind a thin layer of less productive soil.
- *Exposed rocks and subsoil*: As the topsoil is removed, rocks and subsoil may become exposed, creating a rocky and barren landscape. This effect may be magnified in the area where lithic rhyolitic soils occur.
- *Changes in the landscape*: Erosion can alter the landscape, creating gullies, ravines, and other erosion features.
- *Reduced plant growth*: Without topsoil, plants may struggle to grow and thrive, leading to a reduction in plant cover and biodiversity.
- *Increased runoff*: With less soil to absorb water, rainfall and runoff may increase, leading to flooding and further erosion.
- *Nutrient depletion*: As the topsoil is lost, nutrients may be depleted, leading to reduced soil fertility.

- **Impacts in the transporting waters and air**

A serious impact is the reduction in water quality arising from high turbidity; sediment has been described as the world's greatest pollutant of surface waters. Also, depending of the soil quality, contamination of the waters can occur when the eroded soil contains high nutrient levels or hazardous chemicals. These problems result in degradation of the natural aquatic ecosystem and decline in quality of water for human use.

In the case of wind erosion, fine dust can be carried over great distances through the air, resulting in lowered air quality.

- **Impacts at the site of sediment deposition**

The build-up of sediment in sites of deposition is often associated with serious problems. Waterways such as river channels, lakes, estuaries and wetlands may become filled with sediment leading to:

- a smothering of natural aquatic and riparian habitat, eg, sea grass beds or riverbank vegetation.
- increased streambank erosion and channel width, resulting in potential loss of riparian habitat or agricultural land.
- increased flooding due to decreased carrying capacity of waterways; and/or
- damage and a loss in utility assets such as water storage facilities and stormwater channels.

As mentioned in the baseline chapter, the soils present along the ROW are fundamentally (around 90%) clayed and sandy clay loam soils, varying depth with variable presence of silt and clay. Generally, the finer the non-clay fraction, the more erodible the soil, e.g., sand particles are less erodible than silt particles; high clay contents usually mean greater soil cohesion and less erodibility.

Soil mixing, rutting, and compaction are interrelated impacts commonly associated with transmission construction and can greatly affect future crop yields and vegetation regeneration. Soils may be mixed during the excavation of pole foundations or during the undergrounding of electrical lines (the excavation depth for transmission structure foundations can vary greatly).

Excavated parent material or subsoils should not be mixed with topsoil and spread on the surface of the RoW. Significant rutting can occur when soil becomes saturated or in areas of sensitive, which may impact agricultural lands. The degree to which soil is compacted by heavy construction equipment again depends on the type of soil and its saturation level. Ineffective erosion controls may wash valuable topsoil downhill and impact wetlands and waterways. Agricultural soils that have been improperly protected or mitigated may suffer decreased yields for several years after the construction of the transmission line is completed.

Resulting impacts are *very low* even in the pre-mitigation scenario.

Mitigation Measures

Site clearing and topsoil handling - the clearing and disturbance to existing vegetation should be kept to a minimum. In addition to the immediate benefits in erosion and sediment control, it also provides a source of seed for future regeneration. For parts of the site undergoing greatest disturbance, the stripping and appropriate stockpiling of topsoil should be undertaken; this ensures its preservation for later use. It generally involves separate storage of organic and inorganic soil layers, preferably in low flat mounds. Stockpiles must be adequately protected from wind and water erosion by using of a cover crop or other protection measures where the storage period is significant (normally over 14 days).

To minimize soil compaction during construction in low-lying areas, saturated soils, and/or suitable irrigation soils, low-impact machinery with wide tracks can be used. When construction of the line is complete, the soil in the RoW in fields that were accessed by heavy construction traffic should be checked for compaction with a soil penetrometer and compared to penetrometer readings on soils outside of the RoW, especially in irrigated areas. If compaction within the RoW is detected, appropriate equipment should be used to restore the soil tilth. A soil with good tilth has large pore spaces for adequate air infiltration and water movement. Application of the mitigation measures outlined below such as the decompaction of soils following construction as well as the postponing of construction activities during times when soils are saturated will help reduce associated adverse effects.

Impact Summary

The table below summarizes the impact assessment.

Impact: Increased soil erosion and compaction					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Implementation of an Erosion and Sedimentation Management Program – See EMP. - Prioritize the use of existing tracks to access work sites. Restrict transportation to the identified access by clearly marking out the limit of the RoW and access roads; - Control the movement of heavy vehicles and equipment over the soil, including restricting movement over non-essential areas; - Stockpile topsoil into low, broad mounds and replacing as soon as possible to prevent excessive compaction and help with the retention of soil fauna; - Protect temporarily stored soils with a waterproof cover and adequate height to ensure stability; - Ensure that all cleared and impacted land is rehabilitated and re-vegetated, as appropriate; - Soils excavated for pylon foundations should be used for backfilling excavations and not be left exposed to wind or water for long periods; - Implementation, if necessary, of appropriate structural erosion and sediment control measures, e.g., water diversion banks, contour banks, sediment traps and sediment dams.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Low	1
Duration	Medium-term	2		Short-term	1
Consequence	Low	5		Very low	3
Probability	Possible			Improbable	
Significance	**Very Low**			**Insignificant**	

Impact: Potential soil contamination

Impact Assessment

Soil contamination may result from unsound waste management practices. Hazardous waste can be easily ignited, corrosive, reactive, or toxic. They can also have other physical, chemical, or biological characteristics that pose a potential risk to human health or the environment, if improperly managed.

The contamination can result in several problems including:

- human health problems such as poisoning by toxic substances when contact is made with the soil, and the spread of disease by bacteria, viruses and other organisms that have developed in wastewater.

- degradation or prevention of re-establishment of native ecosystems.
- pollution of surface and groundwaters either through the leaching of contaminants by permeating waters or through the erosion and transportation of contaminated soil affecting plant and animal life in the area.
- decline or even a complete loss in agricultural potential, making it more difficult for crops to grow, which can affect food security and the economy.
- decrease in public amenity due to unpleasant odors and increased insect numbers.
- Legal and financial implications: property owners may be liable for the cost of cleaning up contaminated soil on their land, which can be a significant financial burden.

Prevention of soil contamination requires careful control, collection and disposal of all potentially contaminating materials on a development or operational site. Contractors and sub-contractors will be required to develop and implement waste management plans that comply with relevant waste management guidelines to ensure that various types of waste produced during the construction phase (sanitary, non-hazardous and hazardous) are adequately recovered, stored and disposed of.

Inadequate handling or management of hazardous substances, or bad maintenance of vehicles and machinery, can also lead to spills or leaks of contaminants, with potential soil contamination.

This impact is pre-mitigation assessed as *negative,* of *local extent*, *medium intensity* (in particular if soils of good agricultural quality are affected) and *medium-term* duration. It is, however, an impact with a low probability of occurrence (*possible*), as it will only manifest in the event of accidental spills or if inadequate management of wastes and hazardous substances is verified. Thus, the significance is rated as *very low*. With the application of the mitigation measures it is possible to reduce the impact with regard to its intensity and duration, also reducing its consequence, resulting in a residual impact rated as insignificant.

Mitigation Measures

- Maintain vehicles and equipment to ensure no oil or fuel leakages. If a spill occurs, a spill kit must be used to immediately reduce the potential spread of the spill.
- Prohibit the discharge of any type of non-treated residual water in the soil and/or water resources (rivers, streams, springs, lagoons, aquifers, etc.).
- Develop a Waste Management Plan (WMP) that is fully aligned with IFC Performance Standard 3 (see EMP – Volume III of the EIA). The WMP will define how wastes will be reduced, re-used, collected, managed, recycled and disposed of in an appropriate manner and in accordance with good international practice. The WMP will provide the basis for all the waste management arrangements and act as a central point of reference for how wastes will be managed by the Project. Appropriate disposal routes have already been identified for the whole range of wastes that are likely to be generated by the Project. The WMP will include:
    - clear objectives and targets with respect to waste management;
    - an analysis of types/quantities of waste that will be produced by the drilling operation and support activities;

- an analysis of potential opportunities to reduce, reuse or recycle waste in accordance with the waste hierarchy (reduction, re-use, recycling, disposal) and a description of how this will be achieved at the Project sites;
- a description of roles, responsibilities and resources to ensure that the objectives and targets are achieved;
- procedures governing the handling, treatment and disposal of all wastes;
- verification procedures for appropriate assessment of contractors and third-party facilities used for waste transport, management and disposal; and
- a comprehensive waste inventory will be prepared detailing information about the types and quantities of each type of waste generated by the Project.

Impact Summary

The table below summarizes the impact assessment.

Impact: Potential soil contamination					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Maintain vehicles and equipment to ensure no oil or fuel leakages. If a spill occurs, a spill kit must be used to immediately reduce the potential spread of the spill. - Prohibit the discharge of any type of non-treated residual water in the soil and/or water resources. - Develop a Waste Management Plan that is fully aligned with the requirements set out in IFC Performance Standard 3 (see EMP).	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Low	1
Duration	Medium-term	2		Short-term	1
Consequence	Low	5		Very low	3
Probability	Possible			Improbable	
Significance	**Very Low**			**Insignificant**	

7.7.2 Operational phase

During the operation phase, no relevant impacts on soils are expected. As during the construction phase, the risk of soil contamination from accidental oil spills from maintenance vehicles and machinery cannot be completely discarded. Oil spills could result from equipment breakdown and lead to soil contamination in proportion with the magnitude of these accidental events. The application of general mitigation measures and of the waste management plan will help reduce this risk significantly.

7.8 Water Resources

Sustainable management and development of water resources is the foundation of a green economy and essential for inclusive growth. Water resources management underpins and interacts with all the pillars of the economy, including environmental protection, food and energy. An activity associated with a development can impact any of the resource ecosystem drivers (flow regime, water quality, geomorphological) or responses (habitat, biota) and this will have a knock-on effect on potentially all the other drivers and or responses.

The preservation of freshwater ecosystems is fundamental to the concept of sustainable development as they provide services that are crucial for human survival. As well as providing clean water for household use, agriculture and industry, they support fisheries, recycle nutrients, remove waste, replenish groundwater, help prevent soil erosion, and protect against floods. This is particularly the case in Mozambique, as they often depend directly on water and other ecosystem services provided by rivers, lakes and wetlands for their livelihoods.

7.8.1 Construction phase

7.8.1.1 Impact-generating activities

The construction of the powerline can have several impacts on hydrology, both on surface water and underground water systems:

- *Surface water runoff*: During the construction of a transmission line, vegetation and soil are disturbed, which can increase surface water runoff. This can lead to erosion, sedimentation, and changes in the flow and quality of nearby water bodies.
- *Alteration of streams and rivers*: Transmission line construction may require stream or river crossings, which can alter the course, depth, and flow of these water bodies. This can affect the habitats of aquatic organisms and cause changes to the water quality.
- *Changes in groundwater recharge*: Transmission line construction can result in changes to the amount of water that infiltrates the soil and recharges groundwater. This can lead to changes in the groundwater table and potentially affect the availability of groundwater for wells and other uses.
- *Soil compaction*: The construction of transmission line towers and access roads can result in soil compaction, which can reduce soil permeability and increase surface water runoff. This can also affect the infiltration of water into the ground.
- *Contamination:* Transmission line construction activities may involve the use of chemicals and fuels, which can potentially contaminate surface and groundwater systems if they are not properly handled and disposed of.

The following table summarizes the activities that can generate the impacts summarized above.

Table 7-19 – Sources of impact to hydrology

Construction Phase	
Construction of access roads and tower foundations	→ Clearance of vegetation → Soil compaction and erosion → Increased runoff (volume and capacity) → Alteration of local hydrological regime (e.g., creation of preferential flow paths)
Construction camp/ equipment laydown areas.	→ Decreased roughness → Increased runoff (volume and velocity) → Soil compaction and erosion → Hydrocarbon contamination
Creating servitudes (RoW)	→ Clearing of vegetation → Decreased roughness. → Increased runoff (volume and velocity) → Change in vegetation community (i.e. species composition) of catchments
Use of machinery to construct the foundations; for the placement of towers and stringing of the transmission lines	→ Hydrocarbon leaks/spills entering the systems through surface flow, groundwater/ subsurface pathways → Soil compaction and erosion
Waste Management	→ Potential for material packaging and general wastes (plastic wrapping and bottles) entering the freshwater systems → Potential sewage contamination to the systems from portable toilets

7.8.1.2 Impact assessment

Impact: Changes to natural run-off patterns and water bodies

Impact Assessment

Stream corridors are dynamic and complex systems that support aquatic (within the stream), riparian (adjacent to the stream), and terrestrial (land-based) ecosystems. Stream corridor refers to the stream and adjacent lands within a stream valley and active floodplain.

Streams continually change at rates related to their position within a watershed or the erodibility of their bed and banks. Confined canyon streams change little and very slowly, while unconfined alluvial valley streams may change more rapidly. Alluvial refers to streams whose bed and banks are composed of mobile material and are able to modify their channel via erosion and deposition of sediment. In the Movene River valley area and the Umbeluzi River mouth area, these rivers behave as alluvial rivers.

Episodic events like floods or landslides can cause rapid changes such as channel widening, realignment, and even the creation of new flow paths within the floodplain, potentially impacting riverine infrastructure. Disturbance can be beneficial from an ecological perspective. Floods create and maintain complex and diverse aquatic, riverine, and terrestrial habitats, sustaining crucial ecosystems.

Connectivity, defined as the movement of flow, materials, and organisms, is a fundamental concept in contemporary stream research and management. For example, longitudinal connectivity refers to pathways of flow, sediment, organic matter, and organisms through stream corridors. Lateral connectivity is the exchange of this material between the stream channel(s) and adjacent floodplains and riparian areas.

It should be highlighted that during heavy rainfall events the Umbeluzi and Movene River catchments can produce flooding. Flooding is a result of flow exceeding the capacity of the stream channels and overspilling the natural banks. In the case of Umbeluzi River this situation can further occur or be aggravated when the storage capacity of the Pequenos Limpopos dam is exceeded, and it is necessary to proceed to the discharges that increase the average and maximum flow, to which the communities and environment are adapted. In the low-lying coastal areas of the catchment (estuaries area) flooding can be also increased by high-tide conditions, storm-surge conditions or large freshwater flood flows moving down an estuary.

Construction activities can increase surface water runoff in several ways, such as removing vegetation, compacting soil, and altering drainage patterns. This increased runoff can have several impacts on the environment, including:

- *Soil Erosion*: With increased runoff, there is a high possibility of soil erosion, leading to sedimentation in waterways. Soil erosion can also expose the underlying rocks, making the area prone to landslides.
- *Flooding*: High levels of runoff can overwhelm natural drainage systems, leading to flooding in nearby areas. This can result in property damage and pose a risk to human life.
- *Water Quality Degradation*: Increased runoff can pick up pollutants from construction sites, such as sediments, oils, and chemicals. These pollutants can then flow into nearby waterways, causing water quality degradation and harm to aquatic life.
- *Habitat Destruction*: High volumes of runoff can cause significant damage to the ecosystem by eroding the soil and destroying vegetation, which can have adverse effects on the habitat of wildlife.
- *Increased Costs:* Construction activities that lead to increased runoff may require additional resources to manage and mitigate the impacts on the environment. This can lead to increased project costs and timelines.

The Project would not substantially alter the existing drainage pattern of the site area, including through the alteration of a course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in on site or off-site flooding. Also, the Project would not result in additional impermeable surfaces and would not significantly alter the existing topography or drainage characteristics.

The overall water management approach is to design drainage of the site to replicate natural conditions (engineering with nature). Designing landforms that mimic pre-development or natural conditions in the watersheds helps stabilize soil, prevent erosion, and prevent introduction of sediment to the aquatic environment.

Mitigation Measures

- Do not block or constrain river flow in the construction of access roads, even if temporary. Ensure that suitable transversal drainage (culverts, viaducts, etc.) are in place.

- Only areas already disturbed (outside any watercourse) or within the construction area limits should be used for setup of laydown areas. The following sites must be avoided:
  - Sites susceptible to seasonal flooding.
  - Steep terrain which, in periods of high rainfall, may drag sediments downstream and into waterways.
  - Places that are less than 50 m from surface water and any identified wells and boreholes
- Watercourses, including wetlands should be clearly marked. These areas should be avoided by contractors and site personnel.
- Riverbeds will not be modified beyond the strictly necessary to complete a particular work. The affected areas will be rehabilitated to the original profile and native vegetation.

Impact Summary

The table below summarizes the impact assessment.

Impact: Potential changes to natural run-off patterns and water bodies					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Do not block or constrain river flow in the construction of access roads, even if temporary. Ensure that suitable transversal drainage (culverts, viaducts, etc.) are in place. - Only areas already disturbed (outside any watercourse) or within the construction area limits should be used for setup of laydown areas. The following sites must be avoided: o Sites susceptible to seasonal flooding. o Steep terrain which, in periods of high rainfall, may drag sediments downstream and into waterways. o Places that are less than 50 m from surface water and any identified wells and boreholes - Watercourses, including wetlands should be clearly marked. These areas should be avoided by contractors and site personnel. - Riverbeds will not be modified beyond the strictly necessary to complete a particular work. The affected areas will be rehabilitated to the original profile and native vegetation.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Low	1
Duration	Long-term	3		Short-term	1
Consequence	Medium	6		Very low	3
Probability	Possible			Improbable	
Significance	**Low**			**Insignificant**	

Impact: Accidental contamination of surface and/or ground waters

Impact Assessment

Water pollution is any physical, chemical, or biological change in water quality that renders it unfit for its intended purpose or causes damage to living organisms.

The removal of vegetation and excavations in riverbanks, floodplains or wetland areas can increase soil erosion and sediment run-off into the water resources, especially during rainy events. Eventually, this could lead to the deterioration of water quality, through the increase of Suspended Solids and associated Turbidity. High turbidity can affect water colour. High concentration of suspended solids decreases the passage of light through water, limiting photosynthesis of aquatic plants and the production of Dissolved Oxygen. Additionally, water temperature increases, since suspended particles absorb more heat. Thus, Suspended Solids increase can also affect aquatic life. Suspended materials can clog fish gills, reduce fish resistance to disease, lower growth rates, and affect roe and larval development. As the particles settle on riverbeds, especially in calm waters, they can suffocate fish eggs and benthic macro-invertebrates.

Wastewater produced at refuelling, maintenance and equipment washing areas are rich in oil and greases (oils, fuel, and lubricants) and detergents. These organic chemicals can affect human health and damage aquatic life.

Domestic wastewater from camps is rich in organic matter and suspended solids. It can also contain relevant concentrations of nitrogen (nitrates, ammonia) and phosphates. The increase of organic matter in water reduces the concentration of dissolved oxygen, due to its decomposition by aerobic bacteria, and can affect aquatic communities. The presence of nutrients such as nitrites, phosphates, and ammonia, promote excessive growth of algae and aquatic plants, potentially leading to imbalances in aquatic ecosystems and, in extreme cases, to the eutrophication of water bodies. Domestic wastewater contains human faeces and as such is rich in bacteria, and can also contain pathogenic micro-organisms (Virus, Salmonella, Vibrio cholera). Infectious agents are the major concern associated with domestic wastewater pollution.

Moreover, the excavation of pits for the towers' foundations could expose groundwater. This groundwater will be consequently more exposed to contamination by spills or leaks of contaminants. Thus, any contaminated groundwater observed during excavation should be pumped out of the pits.

If not adequately managed, construction activities can lead to the contamination of surface water that, in turn, can have adverse indirect impacts in the aquatic communities and affect the health of the population that uses the water.

Mitigation Measures

- The disposal and/or storage of construction materials and construction waste shall be protected from wind and rain and should be located as far away as possible from sensitive areas, including water lines (minimum 50 m).
- No soil, vegetation, waste or construction materials will be knowingly discharged into any water courses.
- Natural water resources (rivers, lakes, etc.) will not be used for equipment or vehicle washing. This activity will only be conducted in designated authorized washing areas, inside the construction sites.
- Refuelling and maintenance of equipment will only be done only in designated areas, adequately delimitated, with impermeable pavement and adequate drainage infrastructure,

including a water-oil separation system. The waste generated from these activities must be properly managed to ensure safe disposal (storing and transporting).

- Whenever necessary, install portable toilets in the construction sites, with watertight septic tank for storage. Toilet should not be more than 250 meters from the working area.
- Any spill of chemicals or hydrocarbons on the soil surface will be cleaned up using control/spill kits. Contaminated soils will be collected and managed and disposed appropriately as hazardous waste.

Impact Summary

The table below summarizes the impact assessment.

Impact: Accidental contamination of surface and/or ground waters					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- The disposal and/or storage of construction materials and construction waste shall be protected from wind and rain and should be located as far away as possible from sensitive areas, including water lines (minimum 50 m). - No soil, vegetation, waste or construction materials will be discharged into any water courses. - Natural water resources (rivers, lakes, etc.) will not be used for equipment or vehicle washing. This activity will only be conducted in designated authorized washing areas. - Refuelling and maintenance of equipment will only be done only in designated areas, adequately delimitated, with impermeable pavement and adequate drainage infrastructure, including a water-oil separation system. The waste generated from these activities must be properly managed to ensure safe disposal (storing and transporting). - Whenever necessary, install portable toilets in the construction sites, with watertight septic tank for storage. - Any spill of chemicals or hydrocarbons on the soil surface will be cleaned up using control/spill kits. Contaminated soils will be collected and managed and disposed appropriately as hazardous waste.	Negative	
Type	Direct			Direct	
Extent	Regional	2		Regional	2
Intensity	Medium	2		Low	1
Duration	Short-term	1		Short-term	1
Consequence	Low	5		Very Low	4
Probability	Probable			Probable	
Significance	**Low**			**Very Low**	

Impact: Increase of suspended sediments in water bodies

Impact Assessment

The removal of vegetation and excavations in riverbeds and riverbanks areas can increase soil exposure and erosion and the dragging of sediments into the water resources, especially during rain events. Eventually, this could lead to the deterioration of water quality, through the increase of Suspended Solids and associated Turbidity. This aspect is particularly important at the beginning of the route, between pk 0+000 and 7+500 and at the end between pk 25+000 – 30+000.

Turbidity, or the cloudiness of water, is a measure of the concentration of suspended sediment in water. Suspended sediment is undissolved matter ranging from clay-size particles to fine pebbles (2 to 4mm). Most of this material is made up of soil particles released by erosion of the banks of a watercourse or disturbed upland areas.

Increased water turbidity in rivers can have a range of impacts, including:

- *Reduced sunlight penetration*: High levels of turbidity can reduce the amount of sunlight that penetrates the water, which can affect the growth of aquatic plants and algae. This, in turn, can affect the food chain, as many organisms rely on these plants and algae for their survival.
- *Reduced dissolved oxygen*: Suspended particles can also reduce the amount of dissolved oxygen in the water, making it difficult for fish and other aquatic organisms to breathe. This can lead to fish kills and other negative impacts on the aquatic ecosystem.
- *Increased water temperature*: Turbid water can absorb more solar radiation, leading to an increase in water temperature. This can be harmful to fish and other aquatic organisms that are sensitive to changes in water temperature.
- *Altered nutrient cycles*: Suspended particles can carry nutrients, such as nitrogen and phosphorus, which can promote the growth of algae and other aquatic plants. This can lead to eutrophication, which can have negative impacts on water quality and aquatic biodiversity.
- *Reduced water clarity*: High turbidity can reduce water clarity, making it more difficult for aquatic organisms to find food and avoid predators. This can also affect recreational activities, such as swimming and fishing.

Mitigation Measures

- Limit the clearing of vegetation to the strictly required areas, i.e. within the ROW; construction site areas and accesses created.
- In areas with high erosion risk (i.e. from pk 0+000 to 2+500), ensure that sediment control measures are in place prior to disturbance.
- Rehabilitate disturbed areas as soon as practicable after they are vacated, and no longer than 2 months after vacated; Rehabilitation should be phased to ensure that no soil is left bare for long. Revegetate disturbed areas along riverbanks.
- Silt-laden water must not be pumped directly into a watercourse. It must be pumped into a settling pond, behind a silt-filtering medium, or onto an adjacent vegetated area sufficient in size to filter any water returning to the watercourse, such that the concentration of suspended solids in the watercourse does not increase more than 25 mg/l above background level.
- Restore the transversal and longitudinal profile of the river to its original geometry. In areas with high erosion risk (i.e. from pk 0+000 to 2+500), construct the necessary protection works of riverbanks.

Impact Summary

The table below summarizes the impact assessment.

Impact: Increase of suspended sediments in water bodies					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Limit the clearing of vegetation to the strictly required areas, i.e. within the ROW; construction site areas and accesses created. - In areas with high erosion risk (i.e. from pk 0+000 to 2+500), ensure that sediment control measures are in place prior to disturbance. - Rehabilitate disturbed areas as soon as practicable after they are vacated, and no longer than 2 months after vacated; Rehabilitation should be phased to ensure that no soil is left bare for long. Revegetate disturbed areas along riverbanks. - Silt-laden water must not be pumped directly into a watercourse. It must be pumped into a settling pond, behind a silt-filtering medium, or onto an adjacent vegetated area sufficient in size to filter any water returning to the watercourse, such that the concentration of suspended solids in the watercourse does not increase more than 25 mg/l above background level. - Restore the transversal and longitudinal profile of the river to its original geometry. In areas with high erosion risk (i.e. from pk 0+000 to 2+500), construct the necessary protection works of riverbanks.	Negative	
Type	Direct			Direct	
Extent	Regional	2		Local	1
Intensity	Medium	2		Low	1
Duration	Short-term	1		Short-term	1
Consequence	Low	5		Very Low	3
Probability	Probable			Probable	
Significance	**Low**			**Very Low**	

Impact: Changes in groundwater recharge

Impact Assessment

The construction of a power transmission line can impact groundwater recharge in several ways. During the construction of a transmission line, heavy equipment is used to perform soil clearance, excavations for tower foundations, installation of towers, and stringing of cables. This can result in soil compaction, which reduces the amount of pore space in the soil where water can infiltrate and recharge the groundwater.

Transmission lines are typically constructed in open areas, which may require the removal of vegetation. Vegetation plays an important role in regulating the water cycle by intercepting rainfall and allowing it to slowly infiltrate the soil. Removing vegetation can increase the amount of water that runs off the surface and reduces the amount of water that can recharge the groundwater.

Also, powerlines have to cross streams or other water bodies. Altering the flow of surface water can also impact groundwater recharge by changing the way water is distributed across the landscape.

Excavating foundations for tower installation can disturb the soil and alter its permeability, which can lead to changes in the way water moves through the soil and impacts groundwater recharge.

These actions, often in combination, lead to changes in aquifer recharge, which in turn, groundwater recharge can have several impacts on the environment, human health, and socio-economic activities. Some of the significant effects resulting from altered groundwater recharge include:

- ***Lowered water tables***: If groundwater recharge is reduced, the water table may drop, which can lead to a reduction in the amount of available water for human and environmental needs.
- ***Reduced stream flows***: Groundwater is often a significant source of baseflow for streams and rivers. If groundwater recharge is reduced, stream flows can also decrease, which can impact aquatic ecosystems and limit the availability of water for agriculture, industry, and human consumption.
- ***Land subsidence***: In areas where groundwater is a significant source of subsurface support, reduced groundwater recharge can lead to land subsidence, which can cause infrastructure damage and impact local economies.
- ***Contamination***: Groundwater recharge can help dilute and remove contaminants from the subsurface. Reduced groundwater recharge can result in higher concentrations of contaminants in the groundwater, which can pose a risk to human health and the environment.
- ***Reduced water quality***: Lowered water tables can cause surface water to become more saline, which can impact water quality and make it unsuitable for certain uses, such as irrigation.

Mitigation Measures

- During the construction of the powerline minimize the disturbance to the ground and avoid damaging the aquifer recharge zone (alluvial zones). This may include using low-impact construction techniques, minimizing the amount of excavation, and avoiding the use of heavy equipment in sensitive areas;
- If possible, use permeable materials to construct access roads to maintain the natural recharge.

Impact Summary

The table below summarizes the impact assessment.

Impact: Changes in groundwater recharge					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- During the construction of the powerline minimize the disturbance to the ground and avoid damaging the aquifer recharge zone (alluvial zones). This may include using low-impact construction techniques, minimizing the amount of excavation, and avoiding the use of heavy equipment in sensitive areas; - If possible, use permeable materials to construct access roads to maintain the natural recharge.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Low	1		Low	1
Duration	Short-term	1		Short-term	1
Consequence	Very Low	3		Very Low	3
Probability	Possible			Improbable	
Significance	**Insignificant**			**Insignificant**	

7.8.2 Operational phase

The impacts during the operational phase will largely be related to the maintenance requirements of tower and transmission lines and are likely to be infrequent and largely confined to individual tower positions or sections of line that require periodic repair or maintenance. It is assumed that such activities would center mainly on repairs to the lines and their support or insulation structures on the towers, and the need for replacement of the towers themselves would be highly infrequent, although possible.

7.9 Landscape

7.9.1 Construction phase

7.9.1.1 Impact-generating activities

For assessing landscape and visual impacts in tropical habitats no formal methodology exists. Therefore, a combination of the World Bank Group EHS Guidelines 2007 and the Landscape Institute Guidelines for Landscape and Visual Impact Assessment, 2002 has been used as the basis for this impact assessment and definitions.

The significance of the impacts on the landscape depends on the quality and the capacity of the landscape to integrate the changes that the infrastructure causes in the spatial organization of the area under study. The highest quality landscape spaces are those that suffer the greatest impacts, while the lower quality landscapes with heterogeneous spatial organization and high human influence have less significant impacts.

In general terms, the construction of the project will involve several activities that will potentially affect the landscape of the area of influence of the project. The activities that are expected to have greater influence on the visual component will be:

- Clearance of trees in the line's RoW;
- Temporary construction camps and presence of associated equipment;
- Presence of infrastructures (towers, power line, buildings);
- Presence of permanent RoW under the overhead lines.

These actions will result in visual impacts for observers who circulate in the surrounding areas. This is a temporary effect that will impact only in the short time span of the construction.

7.9.1.2 Impact assessment

Impact: Temporary degradation of landscape at worksites

Impact Assessment

The more significant impacts on landscape will occur during the construction phase as a result of vegetation clearance in the RoW, presence of temporary construction camps and associated equipment, construction traffic, machinery movement, earthworks, infrastructures assembly and installation. All these activities will generate negative, localized, mostly temporary, impacts limited to the construction phase, which can overall be described as a temporary degradation of the landscape at worksites. This impact is a combined effect of several aspects, including:

- Reduction of Landscape Quality;
- Reduction of Visual Absorption Capacity / Greater Visual Accessibility (due to vegetation clearance);
- Temporary degradation of scenic value in woodland and forested areas;
- Change in tranquillity of the surrounding landscape;
- Visual impact of moving machines;
- Localized light pollution;
- Changing wilderness character and creating dominant visual elements; and
- Spatial disorganization.

The reduction of landscape quality, visual absorption capacity, and spatial disorganization generate relevant impacts that will remain in the operation phase. In places with potential for visualization, identified in the reference situation, the perception of alterations in the landscape resulting from the infrastructure will be higher and the visual impacts may become more significant.

The extent of the impact is local, as the impact will only be felt along the RoW and access roads, and directly adjacent areas. The impact duration is short to medium (2 to 5 years), as it will be felt continuously over a period of time equivalent to the construction phase. The intensity is assessed as moderate. The probability of the occurrence of this impact is definite because the landscape will certainly be disrupted at the work sites and potentially at scenic areas. The impact is thus rated as of low significance.

Mitigation Measures

The described landscape degradation can be minimized, through the application of adequate mitigation. Such mitigation includes:

- Vegetation clearing, topsoil removal, and earthmoving activities should be minimized as much as practicable and limited to the strictly needed areas.
- All temporary construction sites, such as borrow pits and landing areas, and any other areas disturbed by construction, will be revegetated as soon as practicable following the completion of the construction activities. The use of native species will be prioritized for the rehabilitation works.

- Priority will be given to areas that are already highly disturbed for the establishment of construction site camps and/or laydown areas.
- Laydown areas and machinery parks should be located as far as possible (minimum distance of 300 m) from any areas of sensitive use (residential areas, schools, and health units).
- Limit the movement of machines and vehicles to work areas.

Impact Summary

The impact summary is provided in the table below. The application of the proposed mitigation measures limits the intensity of the impact on the landscape during the construction phases. With the implementation of the mitigation measure this impact is expected to see its residual significance reduced to very low.

Impact: Temporary degradation of landscape at worksites					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Vegetation clearing, topsoil removal, and earthmoving activities should be minimized as much as practicable and limited to the strictly needed areas. - All temporary construction sites, such as borrow pits and landing areas, and any other areas disturbed by construction, will be revegetated as soon as practicable following the completion of the construction activities. The use of native species will be prioritized for the rehabilitation works. - Priority will be given to areas that are already highly disturbed for the establishment of construction site camps and/or laydown areas. - Laydown areas and machinery parks should be located as far as possible (minimum distance of 300 m) from any areas of sensitive use (residential areas, schools, and health units). - Limit the movement of machines and vehicles to work areas.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Low	1
Duration	Short to medium-term	2		Short-term	1
Consequence	Low	5		Very Low	3
Probability	Definite			Definite	
Significance	**Low**			**Very Low**	

7.9.2 Operational phase

7.9.2.1 Impact-generating activities

During the operation phase, the main impacts will be the presence of a permanent RoW under the overhead lines and the presence of infrastructure (towers, power line, buildings), elements that will reduce landscape quality and visual intrusions, giving artificiality and complexity to the rural character of the landscape in the study area.

Throughout the alignment occupied by the infrastructure, the organization of the space will be permanently altered, creating a spatial discontinuity due to the presence of the line and towers, and constant visual intrusion in a landscape of natural and rural characteristics.

The identified impact is assessed in the following section.

7.9.2.2 Impact assessment

Impact: Permanent alteration to the landscape

Impact Assessment

The overall aesthetic effect of a transmission line is likely to be negative to most people, especially where proposed lines would cross natural landscapes. The tall steel structures may seem out of proportion and not compatible with agricultural landscapes, vast plains, or hills. This impact can be described as a permanent alteration to the landscape, resulting from several aspects including:

- Landscaping Quality Reduction;
- Visual Intrusion;
- Change in tranquillity of the surrounding landscape;
- Changing wilderness character and creating dominant visual elements.

Research and experience show that reaction to aesthetic of transmission lines vary. Some residents do not notice them or find them objectionable from an aesthetic perspective. To some, the power transmission lines or other utilities may be viewed as part of the infrastructure necessary to sustain everyday lives and activities and are therefore acceptable. To others, new transmission lines may be viewed in a positive way as they are associated with economic development.

The extent of the impact is local as the impact will be felt along the entire length of the transmission line. The impact duration is long as it will be felt continuously for the lifetime of the transmission line. The intensity of the impact on the landscape during the operation phase is considered moderate. The impact's significance is assessed as medium.

Mitigation Measures

The described landscape alteration results directly from the presence of the project infrastructure, so it is not avoidable. However, it can be minimized through the application of the following mitigation:

- Limit vegetation removal/maintenance activities exclusively to the transmission line corridor;
- During maintenance activities, existing access roads will be used as much as possible to avoid new landscape disturbance;
- Allow tree and shrub species whose height is limited to 4 m to grow within the RoW.

Impact Summary

The impact summary is provided in the table below. The application of the proposed mitigation measures lowers the magnitude of the impact, but the residual significance remains medium.

Impact: Permanent alteration to the landscape					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Limit vegetation removal/maintenance activities exclusively to the transmission line corridor; - During maintenance activities, existing access roads will be used as much as possible to avoid new landscape disturbance; - Allow tree and shrub species whose height is limited to 4 m to grow within the RoW.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Low	1
Duration	Long-term	3		Long-term	3
Consequence	Medium	6		Low	5
Probability	Definite			Definite	
Significance	**Medium**			**Low**	

7.10 Biodiversity

7.10.1 Construction phase

7.10.1.1 Impact-generating activities

During the construction phase, the main actions that could generate potential impacts on biodiversity include the following:

- Construction of access roads.
- Foundations.
- Opening and exploration of borrow pits to provide aggregates and inert materials.
- Establishment of construction camps, including temporary workers' accommodation and temporary storage sites for equipment and materials.
- Establishment of right-of-way (RoW) and vegetation clearance.
- Potential inadequate management of wastes and hazardous materials, leading to soil and water contamination, and subsequent impacts on biodiversity.
- Movement of machinery and equipment and other construction activities – noise emissions and increased human presence.

The identified impacts are assessed in the following section.

7.10.1.2 Impact assessment

Impact: Wetlands and riverine areas degradation

Impact Assessment

The construction activities will generate wastewater and solid wastes and will require the handling and use of oils and other pollutants. Inadequate management of these can lead to water quality degradation on rivers and waterbodies, as previously discussed in Section 7.8.

Accidental spills can lead to local degradation of water quality, and dispersion of those pollutants downstream, affecting directly both aquatic flora and fauna, as well as indirectly terrestrial fauna that feed and roost close by, like aquatic birds and bats.

The construction of towers in riverbeds or banks must be avoided, to avoid changes on water turbidity and degradation of water quality, causing impacts in fishes and other fauna. Soil movement would also affect invertebrates' habitat, causing injuries and death, especially to sediment invertebrates. As distance between towers (span length) may reach 1000 m to facilitate single span river crossings, it may be possible to avoid affecting river banks and river beds.

Considering the above, this impact is assessed as negative, regional (considering the impact can extend to a significant part of the rivers basin), of Medium magnitude and of medium-term duration (since pollutants, and particularly oil can accumulate or remain in sediments for several years), resulting in a medium significance.

Mitigation Measures

The described wetlands and riverine areas degradation can be minimized, through the application of the mitigation already proposed above to minimize water quality impacts. Additionally, the following mitigation is proposed:

- Adopt good housekeeping to prevent spillages and contamination.
- Prioritize locating the towers outside riverbanks, wetlands, and floodplains.
- Forbid movement of heavy machinery in wetlands, riverbanks, riverbeds, and waterbodies as far as practically possible. Where it can't be avoided, the project HSE manager must provide case by case guidance to the EPC on how best to avoid damage, record any damage caused and ensure it is rehabilitated completely before construction is completed.
- All vehicles and equipment should be well-maintained per manufacturers' guidance.
- All refuelling and servicing of equipment should take place in demarcated areas, away from rivers, wetlands, and waterbodies. Refuelling and servicing of equipment must take place on an impermeable surface, and a spill kit must be available where the servicing or refuelling takes place.
- Limit the movement of machines and vehicles to work areas. Forbid any disturbance outside site boundaries.
- Implement an Emergency Response Plan, to respond to any accidental spills.
- Implement a Waste Management Plan.

Impact Summary

The impact summary is provided in the following table. The proposed mitigation lowers the impact's magnitude and probability, resulting in a very low residual significance.

Impact: Wetlands and riverine areas degradation					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Adopt good housekeeping to prevent spillages and contamination. - Prioritize locating the towers outside riverbanks, wetlands, and floodplains. - Forbid movement of heavy machinery in wetlands, riverbanks, riverbeds, and waterbodies as far as practically possible. Where it can't be avoided, the project HSE manager must provide case by case guidance to the EPC on how best to avoid damage, record any damage caused and ensure it is rehabilitated completely before construction is completed. All vehicles and equipment should be well-maintained per manufacturers' guidance. - All refuelling and servicing of equipment should take place in demarcated areas, away from rivers, wetlands, and waterbodies. Refuelling and servicing of equipment must take place on an impermeable surface, and a spill kit must be available where the servicing or refuelling takes place. - Limit the movement of machines and vehicles to work areas. Forbid any disturbance outside site boundaries.	Negative	
Type	Indirect			Indirect	
Extent	Regional	2		Regional	2
Magnitude	Medium	2		Low	1
Duration	Medium-term	2		Medium-term	2
Consequence	Medium	6		Low	5
Probability	Probable			Improbable	
Significance	**Medium**			**Very Low**	

Impact: Direct loss of vegetation units and habitats

Impact Assessment

The construction of roads and line will require the clearing of vegetation in the RoW. According to the project description, the requirements for vegetation clearance within the RoW include the clearance of all vegetation in a 5 m corridor (area directly under the line to be cleared) and selective trimming or cutting down of trees interfering or posing threat to the power line.

However, the clearance of a wider construction corridor will be required, to allow for the movement and operation of machinery, and to allow access to each tower location. This will create a maintenance road that will be kept during operation.

As such, and to account for the needs above, vegetation clearance will be undertaken in a 30 m corridor (15 m to each side of each line) along the full length.

Vegetation clearance constitutes a direct loss of the vegetation units affected, as well as a loss of habitat for the fauna communities that depend on these habitats.

As expected, the percentages of the affected units are very similar to the percentages of these units cover at the study area, which means that these will be affected nearly in the proportion they occur.

Undifferentiated woodland, the most representative vegetation unit in the study area, will be the more affected unit by the project corridor.

The loss of vegetation units corresponds to a direct loss of habitats for fauna, including foraging, roosting, and breeding/nesting habitat. This impact is especially relevant for threatened species, like leopards (although their presence in the study area is unlikely) and woodland species.

It is important to note that the described losses of natural habitats are not avoidable by exploring alternative alignments. The natural habitats that will be impacted (African lineage acacia and undifferentiated woodlands) are widely distributed and abundant throughout the region crossed by the proposed power lines. In fact, undifferentiated woodlands are the dominant habitat in all districts crossed by the alignment, with vast areas occupied by this type of vegetation.

Considering the start and end points of the power line (Namaacha Wind Farm to the connection point at the Boane Substation), there are no possible alternative alignments that would avoid losses of undifferentiated woodlands.

Considering the above, this impact is assessed as negative, local, of medium magnitude (considering the total extension of natural areas that will be lost) and of long-term duration (as these areas will be kept cleared until project decommission, after which they will naturally regenerate within 2 to 15 years, depending on the habitat), resulting in a medium significance.

Mitigation Measures

The described loss of vegetation and habitats results directly from the construction of the project infrastructure and are not avoidable. The following mitigation is proposed:

- Strictly limit the clearing of vegetation to the required areas, with particular emphasis of this in areas of natural habitat (see Figure 6-69, Volume I of the EIA).
- Prioritise siting of construction lay-down areas and borrow pits outside of areas of natural habitat (See Figure 6-69, Volume I of the EIA).
- Avoid locating towers and access roads in wetlands and riverbeds and on banks.
- Areas to be cleared within the right-of-way will be marked by a surveyor and searched by a suitably trained professional for threatened species, before the vegetation is cleared. Any identified threatened species will be relocated in similar habitats outside the area to be disturbed. If any animal or nesting sites with eggs or chicks/juveniles are identified, they will be removed and relocated, unless the species is identified as threatened, upon which the breeding will be allowed to reach completion. The surveys will be done during the flowering season of the majority of threatened plant species that may be present. Search and rescue reports will be maintained, which will include the names and coordinates of relocated specimens. Vegetation in the remainder of the transmission line servitude will remain untouched, except where required for access, construction, or height clearance it will be cropped no lower than knee height. Rehabilitate temporary work areas as soon as practical (i.e., once work is concluded in each segment), to reduce the duration of the impact.
- Whenever possible new and temporary accesses should be created based in existent accesses.

Impact Summary

The implementation of the mitigation proposed above will reduce the impact's magnitude to low and lower its probability from definite to probable. This results in a residual very low significance impact on natural habitats. The impact summary is provided in the table below.

Impact: Direct loss of vegetation units and habitats					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Strictly limit the clearing of vegetation to the required areas, with particular emphasis of this in areas of natural habitat. - Prioritise siting of construction lay-down areas and borrow pits outside of areas of natural habitat. - Avoid locating towers and access roads in wetlands and riverbeds and on banks. - Areas to be cleared within the right-of-way will be marked by a surveyor and searched by a suitably trained professional for threatened species, before the vegetation is cleared. Any identified threatened species will be relocated in similar habitats outside the area to be disturbed. If any animal or nesting sites with eggs or chicks/juveniles are identified, they will be removed and relocated, unless the species is identified as threatened, upon which the breeding will be allowed to reach completion. The surveys will be done during the flowering season of the majority of threatened plant species that may be present. Search and rescue reports will be maintained, which will include the names and coordinates of relocated specimens. Vegetation in the remainder of the transmission line servitude will remain untouched, except where required for access, construction, or height clearance it will be cropped no lower than knee height. - Rehabilitate temporary work areas as soon as practical (ie, once work is concluded in each segment). - Whenever possible new and temporary accesses should be created based in existent accesses.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Magnitude	Medium	2		Low	1
Duration	Long-term	3		Long-term	3
Consequence	Medium	6		Very Low	4
Probability	Definite			Probable	
Significance	**Medium**			**Very Low**	

As discussed above, after the implementation of all feasible mitigation measures, a very low significance residual impact on natural habitats remains.

Impact: Degradation of nearby vegetation units

Impact Assessment

Construction activities that implicate soil and machinery movements will contribute for the expansion of ruderal and invasive flora species through the construction areas, thus degrading habitats quality in nearby areas of the study area, especially in the north were vegetation is less disturbed by human activities.

The opening of new access roads can potentially increase natural resources exploration by local people, both of flora (wood and charcoal) and others (quarries). This can lead to vegetation degradation though unmanaged cutting and litter.

High rate of movement of machinery and vehicles associated with vegetation clearance and soil movements will lead to dust emission and dispersion that can affect plants evapotranspiration and photosynthesis rate, generally affecting vegetation health.

Considering the above, this impact is assessed as negative, local, of low magnitude (considering that only vegetation units very close to the construction area would be affected) and of medium-term duration (as most of these habitats will naturally regenerate within 5 to 15 years, depending on the habitat), resulting in a very low significance.

Mitigation Measures

The following mitigation is proposed:

- Limit the movement of machines and vehicles to work areas. Forbid disturbance outside site boundaries. Where disturbance outside site boundaries can't be avoided, the HSE Manager needs to record the instance and an environmental incident and ensure that the area is rehabilitated.
- Limit non-Project vehicles entrance in the construction area to avoid invasive and ruderal species dispersion and entrance of people that can illegally exploit natural resources.
- Strictly limit the clearing of vegetation to the required areas, with particular emphasis of this in areas of natural habitat (See Figure 6-69, Volume I of the EIA).
- Whenever possible, new and temporary accesses should be created based in existent accesses.

Impact Summary

The impact summary is provided in the table below.

Impact: Degradation of nearby vegetation units					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Limit the movement of machines and vehicles to work areas. Forbid disturbance outside site boundaries. Where disturbance outside site boundaries can't be avoided, the HSE Manager needs to record the instance and an environmental incident and ensure that the area is rehabilitated. - Limit non-Project vehicles entrance in the construction area to avoid invasive and ruderal species dispersion and entrance of people that can illegally exploit natural resources. - Strictly limit the clearing of vegetation to the required areas, with particular emphasis of this in areas of natural habitat. - Whenever possible, new and temporary accesses should be created based in existent accesses.	Negative	
Type	Indirect			Indirect	
Extent	Local	1		Local	1
Magnitude	Low	1		Low	1
Duration	Medium-term	2		Medium-term	2
Consequence	Very Low	4		Very Low	4
Probability	Possible			Improbable	
Significance	**Insignificant**			**Insignificant**	

Impact: Reduction of feeding, breeding and roosting areas

Impact Assessment

Clearance of vegetation will destroy feeding, breeding and roosting areas for fauna species, especially for birds and mammals. Since most of the area affected is woodland, species that depend on trees will be especially affected, such as tree frogs, reptiles, rodents, and bats that use the inside

of trees as roosts, but also several tree nesting birds species (most of the small birds, nocturnal birds, and raptors, among others), and even bigger mammals that roost in trees, like monkeys and leopard (although the presence of this last species is unlikely in the study area).

Feeding areas will be lost by vegetation clearance along much of the route, although since the vegetation clearance strip is narrow, animals should be able to feed in similar nearby areas.

Considering the above, this impact is assessed as negative, local, of medium magnitude (considering the extension amount of feeding, roosting and breeding areas that will be lost) and of long-term duration (as these areas will be kept cleared until project decommission, after which they will naturally regenerate within 2 to 15 years, depending on the habitat, regenerating into new feeding, roosting and breeding areas, that may however provide lower quality habitats), resulting in a high significance.

Mitigation Measures

The described reduction of feeding, breeding and roosting areas results directly from the construction of the project infrastructure, so it is not avoidable. The following mitigation is proposed:

- Vegetation clearing, topsoil removal, and earthmoving activities should be minimized as much as practical and limited to the strictly needed areas.
- Avoid locating towers and access roads in wetlands and river beds and on banks.
- Areas to be cleared within the right-of-way will be marked by a surveyor and searched by a suitably trained professional for threatened species, before the vegetation is cleared. Any identified threatened species will be relocated in similar habitats outside the area to be disturbed. If any animal or nesting sites with eggs or chicks/juveniles are identified, they will be removed and relocated, unless the species is identified as threatened, upon which the breeding will be allowed to reach completion. The surveys will be done during the flowering season of the majority of threatened plant species that may be present. Search and rescue reports will be maintained, which will include the names and coordinates of relocated specimens. Vegetation in the remainder of the transmission line servitude will remain untouched, except where required for access, construction, or height clearance it will be cropped no lower than knee height.
- Whenever possible new and temporary accesses should be created based in existent accesses.
- The Project will conduct training on biodiversity management program.

Impact Summary

The impact summary is provided in the table below. The implementation of the proposed mitigation will reduce the residual significance to low.

Impact: Reduction of feeding, breeding and roosting areas					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Vegetation clearing, topsoil removal, and earthmoving activities should be minimized as much as practical and limited to the strictly needed areas.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1

Impact: Reduction of feeding, breeding and roosting areas					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Magnitude	Medium	2	- Avoid locating towers and access roads in wetlands and river beds and on banks. - Areas to be cleared within the right-of-way will be marked by a surveyor and searched by a suitably trained professional for threatened species, before the vegetation is cleared. Any identified threatened species will be relocated in similar habitats outside the area to be disturbed. If any animal or nesting sites with eggs or chicks/juveniles are identified, they will be removed and relocated, unless the species is identified as threatened, upon which the breeding will be allowed to reach completion. The surveys will be done during the flowering season of the majority of threatened plant species that may be present. Search and rescue reports will be maintained, which will include the names and coordinates of relocated specimens. Vegetation in the remainder of the transmission line servitude will remain untouched, except where required for access, construction, or height clearance it will be cropped no lower than knee height. - Whenever possible new and temporary accesses should be created based in existent accesses. - The Project will conduct training on biodiversity management program.	Low	1
Duration	Long-term	3		Long-term	3
Consequence	Medium	6		Low	5
Probability	Definite			Probable	
Significance	**Medium**			**Low**	

Impact: Increased fauna mortality and decreased species diversity

Impact Assessment

Vegetation clearance will lead to death of some animals, potential decreasing species diversity in the study area. Organisms that are sessile during the day and roost in trees, such as bats, tree frogs and reptiles, will most likely be affected, since these animals typically don't leave roosting sites during the day. As such, these will likely not escape and therefore die during vegetation removal activities. Birds that nest in trees (including eggs and chicks), especially nocturnal ones, can also die during these activities.

An increase in machinery and vehicles movements will also lead to a high risk of run over. Animals that move slower, like reptiles and amphibians, are typically the most affected by this impact, because they have difficulties in moving away rapidly and are also difficult to detect by drivers.

Considering the above, this impact is assessed as negative, local, of medium magnitude (considering that most of the area is woodland and therefore a large number of trees and animals can be affected) and of medium-term duration (as for several species successful reproductive cycles take several years), resulting in a medium significance.

Mitigation Measures

The described direct loss of species and decreased species diversity results directly from the construction of the project infrastructure, so it is not avoidable. However, the application of the following mitigation measures is very important to avoid impacts in threatened species, enabling a relevant decrease in the impact significance. The following mitigation is then proposed:

- Vegetation clearing, topsoil removal, and earthmoving activities should be minimized as much as practical and limited to the strictly needed areas.
- Limit machinery and vehicles speed limit to 30km/h to reduce risk of animal run over.
- Place signs along access roads informing speed limits and possible animal presence.
- During induction sessions inform workers about the importance of biodiversity and commitment of the project to it, in order to avoid running over animals on purpose.
- In instances where animals and birds have not vacated a specific construction area and the construction can't be postponed, the project will use an air horn to frighten animals from the area in order to avoid injury or fatalities during vegetation clearance.
- Areas to be cleared within the right-of-way will be marked by a surveyor and searched by a suitably trained professional for threatened species, before the vegetation is cleared. Any identified threatened species will be relocated in similar habitats outside the area to be disturbed. If any animal or nesting sites with eggs or chicks/juveniles are identified, they will be removed and relocated, unless the species is identified as threatened, upon which the breeding will be allowed to reach completion. The surveys will be done during the flowering season of the majority of threatened plant species that may be present. Search and rescue reports will be maintained, which will include the names and coordinates of relocated specimens. Vegetation in the remainder of the transmission line servitude will remain untouched, except where required for access, construction, or height clearance it will be cropped no lower than knee height. Avoid locating towers and access roads in wetlands, river beds, and on river banks.
- Whenever possible, new and temporary accesses should be created based in existent accesses.

Impact Summary

The impact summary is provided in the table below.

<table>
<tr><th colspan="5">Impact: Increased fauna mortality and decreased species diversity</th></tr>
<tr><th>Criteria</th><th colspan="2">Pre-mitigation assessment</th><th>Key Mitigation Measures</th><th colspan="2">Post-mitigation assessment</th></tr>
<tr><td>Nature</td><td colspan="2">Negative</td><td rowspan="9">- Vegetation clearing, topsoil removal, and earthmoving activities should be minimized as much as practical and limited to the strictly needed areas.
- Limit machinery and vehicles speed limit to 30km/h to reduce risk of animal run over.
- Place signs along access roads informing speed limits and possible animal presence.
- During induction sessions inform workers about the importance of biodiversity and commitment of the project to it, in order to avoid running over animals on purpose.
- In instances where animals and birds have not vacated a specific construction area and the construction can't be postponed, the project will use an air horn to frighten animals from the area in order to avoid injury or fatalities during vegetation clearance.
- Areas to be cleared within the right-of-way will be marked by a surveyor and searched by a suitably trained professional for threatened species, before the vegetation is cleared. Any</td><td colspan="2">Negative</td></tr>
<tr><td>Type</td><td colspan="2">Direct</td><td colspan="2">Direct</td></tr>
<tr><td>Extent</td><td>Local</td><td>1</td><td>Local</td><td>1</td></tr>
<tr><td>Magnitude</td><td>Medium</td><td>2</td><td>Low</td><td>1</td></tr>
<tr><td>Duration</td><td>Medium-term</td><td>2</td><td>Medium-term</td><td>2</td></tr>
<tr><td>Consequence</td><td>Low</td><td>5</td><td>Very Low</td><td>4</td></tr>
<tr><td>Probability</td><td colspan="2">Probable</td><td colspan="2">Probable</td></tr>
<tr><td>Significance</td><td colspan="2">Low</td><td colspan="2">Very Low</td></tr>
</table>

Impact: Increased fauna mortality and decreased species diversity			
Criteria	**Pre-mitigation assessment**	**Key Mitigation Measures**	**Post-mitigation assessment**
		identified threatened species will be relocated in similar habitats outside the area to be disturbed. If any animal or nesting sites with eggs or chicks/juveniles are identified, they will be removed and relocated, unless the species is identified as threatened, upon which the breeding will be allowed to reach completion. The surveys will be done during the flowering season of the majority of threatened plant species that may be present. Search and rescue reports will be maintained, which will include the names and coordinates of relocated specimens. Vegetation in the remainder of the transmission line servitude will remain untouched, except where required for access, construction, or height clearance it will be cropped no lower than knee height.. - Avoid locating towers and access roads in wetlands, river beds, and on river banks. - Whenever possible, new and temporary accesses should be created based in existent accesses.	

Impact: Possible introduction or spread of invasive species in the Project area

Impact Assessment

Construction activities such as new access road opening, soil movements, and movement of machinery will contribute to the expansion of ruderal and invasive flora species along the lines corridors, especially in the north, were vegetation is less disturbed by human activities. This impact is even more likely since there is already at least one invasive species present in the study area (e.g., *Ricinus communis*) although its distribution does not seem to be wide.

Since access roads come from more urban areas, potentially with a higher number of invasive species, it is possible that the number of invasive species in the study area will increase, increasing also the risk of their expansion to non-affected areas.

Considering the above, this impact is assessed as negative, regional, of low magnitude and of medium-term duration, resulting in a low significance.

Mitigation Measures

The following mitigation is proposed to minimize the introduction and spread of flora invasive species:

- Forbid vegetation disturbance outside the set boundaries for each construction site.
- Limit vegetation clearance to the construction footprint. Avoid clearing any further vegetation in the project boundary as far as possible.
- Restrict people and vehicle movements outside project accesses, especially in natural habitat areas (see Figure 6-69, Volume I of the EIA).
- Whenever possible, new and temporary accesses should be created based in existent accesses.

Impact Summary

The impact summary is provided in the table below.

Impact: Possible introduction or spread of invasive species in the Project area					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Forbid vegetation disturbance outside the set boundaries for each construction site. - Limit vegetation clearance to the construction footprint. Avoid clearing any further vegetation in the project boundary as far as possible. - Restrict people and vehicle movements outside project accesses, especially in natural habitat. - Whenever possible, new and temporary accesses should be created based in existent accesses.	Negative	
Type	Indirect			Indirect	
Extent	Local	1		Local	1
Magnitude	Low	1		Low	1
Duration	Medium-term	2		Medium-term	2
Consequence	Very Low	4		Very Low	4
Probability	Probable			Improbable	
Significance	**Very Low**			**Insignificant**	

Impact: Exclusion of fauna species due to increase of disturbance

Impact Assessment

All construction activities will result in increasing noise, light, movement, and disturbance in general. This will result in disturbance of fauna species and consequent exclusion of fauna around the study area.

This impact is especially relevant to more sensitive species, like shy forest bird species in undisturbed, or less disturbed, woodland areas, and during breeding period. This can also lead to abandonment of nests, breeding, roosting and/or congregation sites. This is particularly relevant for water birds, that present a high number of congregatory and migratory species in the study area and are very sensitive to human presence, especially in more undisturbed wetland areas.

Considering the above, this impact is assessed as negative, local, of medium magnitude (considering the area extension and the species potentially present) and of short-term duration (as disturbance will finish after construction and at least several fauna species may then return to the previously abandoned areas), resulting in a very low significance.

Mitigation Measures

The application of the following mitigation measures will help avoid impacts in threatened species, enabling a relevant decrease in the impact significance. The following mitigation is proposed:

- Strictly limit the clearing of vegetation to the required construction footprint, particularly in areas of natural habitats (See Figure 6-69 Volume I of the EIA).
- Whenever possible new and temporary accesses should be created based in existent accesses.
- Areas to be cleared within the right-of-way will be marked by a surveyor and searched by a suitably trained professional for threatened species, before the vegetation is cleared. Any identified threatened species will be relocated in similar habitats outside the area to be disturbed. If any animal or nesting sites with eggs or chicks/juveniles are identified, they will

be removed and relocated, unless the species is identified as threatened, upon which the breeding will be allowed to reach completion. The surveys will be done during the flowering season of the majority of threatened plant species that may be present. Search and rescue reports will be maintained, which will include the names and coordinates of relocated specimens. Vegetation in the remainder of the transmission line servitude will remain untouched, except where required for access, construction, or height clearance it will be cropped no lower than knee height..

- Restrict construction works to the daytime hours, limiting illumination in the construction areas as much as practical.
- All garbage should be secured in sealed containers overnight to avoid attracting nocturnal carnivores and other opportunistic species to site.
- Avoid vegetation clearance activities in natural habitats and near large water masses between October and March, as much as practical, to minimize impacts on migratory birds.
- Start construction from south to north (between April to September) to avoid disturbing the larger natural areas during the period when more birds are breeding.

Impact Summary

The impact summary is provided in the table below.

Impact: Exclusion of fauna species due to increase of disturbance					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Strictly limit the clearing of vegetation to the required construction footprint, particularly in areas of natural habitats (See Figure 6-69 Volume I of the EIA). - Whenever possible new and temporary accesses should be created based in existent accesses. - Areas to be cleared within the right-of-way will be marked by a surveyor and searched by a suitably trained professional for threatened species, before the vegetation is cleared. Any identified threatened species will be relocated in similar habitats outside the area to be disturbed. If any animal or nesting sites with eggs or chicks/juveniles are identified, they will be removed and relocated, unless the species is identified as threatened, upon which the breeding will be allowed to reach completion. The surveys will be done during the flowering season of the majority of threatened plant species that may be present. Search and rescue reports will be maintained, which will include the names and coordinates of relocated specimens. Vegetation in the remainder of the transmission line servitude will remain untouched, except where required for access, construction, or height clearance it will be cropped no lower than knee height.. - Restrict construction works to the daytime hours, limiting illumination in the construction areas as much as practical. - All garbage should be secured in sealed containers overnight to avoid attracting nocturnal carnivores and other opportunistic species to site. - Avoid vegetation clearance activities in natural habitats and near large water masses between October and March, as much as practical, to minimize impacts on migratory birds.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Magnitude	Medium	2		Low	1
Duration	Short-term	1		Short-term	1
Consequence	Very Low	4		Very Low	3
Probability	Definite			Probable	
Significance	**Very Low**			**Insignificant**	

Impact: Exclusion of fauna species due to increase of disturbance			
Criteria	**Pre-mitigation assessment**	**Key Mitigation Measures**	**Post-mitigation assessment**
		- Start construction from south to north (between April to September) to avoid disturbing the larger natural areas during the period when more birds are breeding.	

7.10.2 Operational phase

7.10.2.1 Impact-generating activities

During the operational phase, the main actions that could generate potential impacts on biodiversity comprise the following:

- Transmission line operation – the presence of the transmission, and associated permanent RoW, will result in habitat fragmentation. The conductor cables and towers will also introduce a risk of collisions and electrocution, leading to increased bird mortality.
- Transmission line maintenance activities and presence of access roads – the presence of access roads and the project maintenance activities could facilitate the spread of invasive flora species and could increase human exploitation of previously inaccessible areas, resulting in further degradation of the habitats along the RoW.

The identified impacts are assessed in the following section.

7.10.2.2 Impact assessment

Impact: Indirect degradation of vegetation units and habitats along the RoW

Impact Assessment

Maintenance operations include vegetation control in the RoW, which will limit the recovery of vegetation recovery within this corridor. Frequent maintenance operations will also contribute to expansion of ruderal and invasive flora species.

Access roads to the corridor and towers can also increase natural resources exploration by local people, both of flora (wood and charcoal) and others (quarries). This can lead to vegetation degradation though unmanaged vegetation clearance of new areas.

Considering the above, this impact is assessed as negative, local, of low magnitude (although the length of the area is considerable, the impact will only be relevant for vegetations units with low representativity – essentially Acacia woodland) and of long-term duration (as vegetation will only be able to fully regenerate after project decommission), resulting in a very low significance.

Mitigation Measures

The impact of the RoW maintenance on the adjacent habitats can be managed through the application of the following mitigation:

- Forbid vegetation control outside the designated maintenance boundary.

- Limit non-Project vehicle entrance and circulation along the RoW, as much as possible, through the placement of signage.
- Incorporate in the normal maintenance procedures of the RoW the monitoring of creation of new settlements or cutting or burning of woodland areas in adjacent areas along the RoW and report these occurrences to the local authorities.

Impact Summary

The impact summary is provided in the table below.

Impact: Indirect degradation of vegetation units and habitats along the RoW					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Forbid vegetation control outside the designated maintenance boundary. - Limit non-Project vehicle entrance and circulation along the RoW, as much as possible, through the placement of signage. - Incorporate in the normal maintenance procedures of the RoW the monitoring of creation of new settlements or cutting or burning of woodland areas in adjacent areas along the RoW and report these occurrences to the local authorities.	Negative	
Type	Indirect			Indirect	
Extent	Local	1		Local	1
Magnitude	Low	1		Low	1
Duration	Long-term	3		Long-term	3
Consequence	Very Low	4		Very Low	4
Probability	Possible			Improbable	
Significance	**Very Low**			**Insignificant**	

Impact: Increased mortality of bird and bat species due to collisions and electrocution with high voltage power line

Impact Assessment

Bird collision occurs in all kinds of suspension lines (power, communications, railways, etc.) because birds do not see the cables. The risk of collision is higher with reduced visibility (like at night and with fog) or with small diameter cables.

In high voltage lines there are two types of cables: conduction cables and ground cables. Ground cables cause most of bird mortality since they are located higher than conduction cables and have smaller diameter. The risk of collision is also related with the number of horizontal plans in which cables are stretched, being higher as the number of horizontal plans increase. Mortality risk is also higher in vertical track frames than in horizontal track frames.

Several factors may increase a bird risk of collision with lines concerning species-specific factors, including sensory perception (like avian vision), morphological features (that include manoeuvre capacity based on wing loading and wing aspect ratio), flight behaviour (gregarious species showing higher susceptibility), phenology and circadian habits, age, sex, and health (Bernardino *et al.*, 2018). In general, congregatory, nocturnal, migratory, juveniles, and both slow (like vultures) and very fast (like swallows, swifts and martins) fliers, diving birds, poor fliers (such as Otididae) and water birds have higher risk of collision with lines (Bevanger, 1998).

Collisions may occur mostly when birds cross power lines in their local, daily movements, as migrants are referred as generally flying well above the height of power lines (Newton, 2010), although there may be exceptions. nocturnal migrants, like rails, thrushes, starlings, and other passerines seem to be more susceptible (Drewitt & Langston, 2008). Also, birds that spend a large part of their day flying between breeding/nesting or roosting sites and foraging areas (or between foraging areas, such as several waterbird species), which often fly during crepuscular periods with low light levels, can have a higher collision risk, especially if the areas are relatively close together and birds tend to fly between them at lower altitudes (Bevanger, 1994. Drewitt and Langston, 2008). Concerning raptors, although infrequently reported as collision victims, power lines intersecting the home range of some eagle species can be problematic (Rollan *et al*., 2010. Watts *et al*., 2015). The exact location is important though. power line spans placed close to the nest may never be crossed by individuals, whereas spans more distant may pose a higher collision risk if located directly along flight paths between the nest and foraging areas (Rollan *et al*., 2010).

Despite their nocturnal habits, owls and nighthawks seem to collide with power lines in relatively small numbers, especially compared to other anthropogenic sources of mortality (e.g., Alonso *et al*., 1994. Schaub *et al*., 2010).

This impact is considered relevant for several bird threatened species (Ferrer, 2012). The groups of birds that are considered among the more susceptible to collision risk include: waterbirds (in particular large ducks, geese and swans, pelicans, flamingos, large herons, and waders), grebes, gamebirds and rails, and cranes and bustards. Smaller species may be also susceptible, like pigeons, various passerines and solitary, high-speed predators such as falcons (Jenkins *et al*. 2010. Bernardino *et al*., 2018).

Vultures are a particularly important group in the study area, since three Critically endangered vultures are potential for the area. however, their presence in the study area is unlikely, with at most infrequent and occasional occurrences. and as such, impacts are improbable.

There are few records of bat mortality due to collision with power lines, since echolocating bats can easily avoid them, but not non-echolocating fruit bats (*Pteropodidae* family), for which the risk exists, being even higher for migratory species, such as the African straw-coloured fruit-bat (*Eidolon helvum*) (Kipeto Energy Limited, 2013).

A bird's death though electrocution occurs when the bird touches two conducting elements, allowing energy current to circulate in the bird's body. Electrocution occurs close to the towers and not in the suspended lines (once there the distance between cables is too large) (ICNF, 2019). As such, electrocution happens mainly when birds rest in towers, and when they try to hunt another bird that is sitting in a tower. This risk is higher in tension towers, since the pole and the conductor are closer. electrocution risk is also high in substations due to the presence of transformer towers (ICNF, 2019). Electrocution occurrence is restricted to power lines carrying tensions of 130 kV and below and to transformer and substations (Bevanger, 1994), as the highest is the tension, the larger are the distances of isolation and hence lower the electrocution risk. As such, if the distance between cables is larger than wingspan, the risk should be residual (Kipeto Energy Limited, 2013). Considering the

tension of the transmission lines of the present project (66 kV), electrocution is considered a negligible impact.

Considering the above, this impact (particularly due to collision) is assessed as negative, local, of potential high magnitude (considering the length of the corridor, the number of species present and the susceptibility of endangered species) and of long-term duration (as the impact will occur during all operation phase), resulting in a medium significance.

Mitigation Measures

The described increased mortality of bird and bat species due to collisions with high voltage power line results directly from the operation of the project infrastructure, so it is not avoidable. The inherent design of the towers has been selected to minimise collision risk. Additionally, the application of the following mitigation measures will also reduce the impact significance:

- Signalling devices must be installed in the whole extension of earth cables. Signals must be placed with 20 m spacing, alternating in each earth cable, resulting in an apparent 10 to 10 m distancing between signals considering both earth cables. Use this signalling scheme with rotative fireflies or tapes as signal devices in areas where the line cross or goes closer to riparian vegetation and any large, undisturbed woodland areas along the route (i.e., those in the northern part of the route). In other woodland areas use double spirals as signal devices with the same distancing. Note that signalling lines are the most effective ways to minimize mortality though collision, although these measures still do not completely avoid the impact.
- Implement design measures aligned with those set out in the IUCN's "*Wildlife and power lines: Guidelines for preventing and mitigating wildlife mortality associated with electricity distribution networks"*, i.e.:
    - Install elements that increase the gap between the conductors on the crossarm;
    - Cover the conductors and other live elements (surge arresters, fuses, disconnectors) with insulating materials, to ensure minimum safety distances; and
    - Install elements that discourage or prevent birds from perching on dangerous parts (anti-perching devices).

Impact Summary

The impact summary is provided in the table below.

<table>
<tr><th colspan="6">Impact: Increased mortality of bird and bat species due to collisions and electrocution</th></tr>
<tr><th>Criteria</th><th colspan="2">Pre-mitigation assessment</th><th>Key Mitigation Measures</th><th colspan="2">Post-mitigation assessment</th></tr>
<tr><td>Nature</td><td colspan="2">Negative</td><td rowspan="7">- Signalling devices must be installed in the whole extension of earth cables. Signals must be placed with 20 m spacing, alternating in each earth cable, resulting in an apparent 10 to 10 m distancing between signals considering both earth cables. Use this signalling scheme with rotative fireflies or tapes as signal devices in areas where the line cross or goes closer to riparian vegetation and any large, undisturbed woodland areas along the route (i.e., those in the northern part of the route). In other woodland areas use double spirals as signal devices with the same distancing.</td><td colspan="2">Negative</td></tr>
<tr><td>Type</td><td colspan="2">Direct</td><td colspan="2">Direct</td></tr>
<tr><td>Extent</td><td>Local</td><td>1</td><td>Local</td><td>1</td></tr>
<tr><td>Magnitude</td><td>Medium</td><td>2</td><td>Medium</td><td>2</td></tr>
<tr><td>Duration</td><td>Long-term</td><td>3</td><td>Long-term</td><td>3</td></tr>
<tr><td>Consequence</td><td>Medium</td><td>6</td><td>Medium</td><td>6</td></tr>
<tr><td>Probability</td><td colspan="2">Probable</td><td colspan="2">Improbable</td></tr>
</table>

Impact: Increased mortality of bird and bat species due to collisions and electrocution			
Criteria	**Pre-mitigation assessment**	**Key Mitigation Measures**	**Post-mitigation assessment**
Significance	**Medium**	- Install elements that increase the gap between the conductors on the crossarm. - Cover the conductors and other live elements (surge arresters, fuses, disconnectors) with insulating materials, to ensure minimum safety distances. - Install elements that discourage or prevent birds from perching on dangerous parts (anti-perching devices).	**Low**

Impact: Habitat fragmentation due to the presence of the RoW

Impact Assessment

The establishment and maintenance of the RoW will imply the creation of a linear long corridor with modified vegetation, which will likely be composed of secondary shrub (as the growth of larger trees will be controlled through maintenance activities). Where this corridor crosses large areas of unfragmented habitats, such as in the northern part of the alignment, which crosses large extents of woodland habitats, the RoW could induce an effect of habitat fragmentation, i.e., animals, in particular the more sensitive species, might avoid crossing this corridor, thereby sub-dividing animal populations. This effect can lead to a reduction of biodiversity, if the fragmentation is so severe that animal populations are rendered unviable. This effect, however, is not expected to be critical in the study area, as large extents of continuous non-fragmented woodlands, able to support local fauna populations, are relatively abundant in the northern region of the study area.

Considering the above, this impact is assessed as negative, regional, of medium magnitude (considering the length of the corridor) and of medium-term duration (as with time vegetation may recover – but the complete recover is only possible after project decommissioning - and some animals species may get used to the line and to crossing the area in the absence of natural vegetation), resulting in a medium significance.

Mitigation Measures

The described habitat fragmentation in the study area and surroundings results indirectly from the construction of the project infrastructure, so it is not avoidable. The following mitigation is proposed:

- Limit vegetation clearance to within the designated maintenance boundary.
- Ensure tree and shrub species, whose height is limited to 4 m, are allowed to re-establish in the RoW, by providing a list of such species to vegetation clearing/ control contractors and ensuring they are trained on the identification of such species.

Impact Summary

The impact summary is provided in the table below.

Impact: Habitat fragmentation due to the presence of the RoW			
Criteria	**Pre-mitigation assessment**	**Key Mitigation Measures**	**Post-mitigation assessment**
Nature	Negative		Negative

Impact: Habitat fragmentation due to the presence of the RoW					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Type	Direct		- Limit vegetation clearance to within the designated maintenance boundary. - Ensure tree and shrub species, whose height is limited to 4 m, are allowed to re-establish in the RoW, by providing a list of such species to vegetation clearing/ control contractors and ensuring they are trained on the identification of such species.	Direct	
Extent	Regional	2		Regional	2
Magnitude	Medium	2		Medium	2
Duration	Medium-term	2		Medium-term	2
Consequence	Medium	6		Medium	6
Probability	Probable			Improbable	
Significance	**Medium**			**Low**	

7.11 Socioeconomic Environment

Following the establishment of the socioeconomic baseline, this chapter presents the assessment of the potential socioeconomic impacts resulting from the construction and operation of the future Namaacha – Boane 66 kV Power Evacuation Line.

As per legal framework the Project adopts a general 50 m wide corridor (25 m to either side of the transmission line) for compensation and resettlement purposes. As the project includes two 66 kV lines running parallel to each other, at a distance of approximately 20 m, in most of its extension (first ~29 km of the total 33.5 km) the full protection zone in this section will result in a 70 m wide corridor, accounting for both lines (25 m outward from line 1, 20 m between line 1 and line 2 and 25 m outward from line 2) (refer to Section 4 of Volume I, for details on land take requirements).

In the final 310 meters (approximately), where the transmission line reaches the Boane substation, the cable will be buried to minimize impacts to the surrounding residential area and existent infrastructures. For the buried cable section, the required construction corridor – mostly along an existing street - will have a width of 2 meters (1 meter for each side of the cable trench centreline). The construction corridor will be reinstated after the completion of the works, thus the impacts will be mostly temporary. However, as these options were still being discussed during field survey phase, the 70 meters corridor was adopted for the entire line's length, to allow for the identification of all potential Project Affected People (PAPs) within this wider corridor.

7.11.1 Construction phase

7.11.1.1 Impact-generating activities

The construction phase of the Namaacha – Boane Project will include all construction works necessary for the establishment of the powerline and associated infrastructure, thus encompassing a wide range of construction activities, such as vegetation and soil clearing, earthworks, construction of temporary roads and setting up temporary construction camps and laydown areas, and the operation of construction machinery as well as the movement of heavy vehicles, among other activities. Borrow pits to provide aggregates and inert materials may be required, as well as spoil areas for disposal of excavated soils that may be unsuitable for reuse, but these would typically be licensed sites operated by third-party suppliers, so their core impacts would have been safeguarded within their own licensing processes.

The clearing of the construction area and the line's protection zone and the setup of the temporary construction support areas and road access will result in permanent changes to land use rights, and in some sort of involuntary resettlement[4] of individuals and households along the route (PAP Project Affected People[5]).

The construction activities will also require the mobilization of workforce. This will result in direct positive impacts, due to the creation of employment opportunities, but could also result in indirect negative impacts, associated with the potential influx of migrants from other districts, provinces or even countries.

The construction phase will thus include a wide range of activities with several potential social and economic impacts, of which the expectedly more relevant ones are the following:

- Land clearing – the required clearance of the Project's footprint, as well as the OHL protection zone, the access roads, etc. can lead to loss of houses and or other built structures, farmland and cultural heritage, hence causing physical and/or economic displacement, either temporary or permanent.
    - In this regard, land parcels subject to temporary resettlement refers to land within the protection zone that will be cleared of vegetation and usage prohibited during construction but where usage – albeit restricted – will be permitted during the Projects operational phase. Such PAPs will, therefore, be subject to the temporary loss of their *machamba*s and land plots during construction and subsequently, once the *machamba*s/land plots have been returned, they will be subject to conditional usage (no tall trees or structures). Land plots subject to permanent loss refers to land parcels and typically vacant land, where a meaningful section (over 10%) is within the protection zone and can no longer be utilised by owner as intended, or

[4] Involuntary resettlement is herein referred to as displacement and/or impacts of land use rights changes – as a result of the Project related land acquisition, for which affected individuals or households do not have the right to refuse such land acquisition or rights changes and which may result in physical displacement (relocation, loss of residential land or loss of shelter), economic displacement (loss of land, assets or access to assets, leading to loss of income sources or other means of livelihoods), or both.

[5] individuals, households and communities directly affected by the Projects land acquisition processes.

where the protection zone runs through the land parcel, effectively creating an incontiguous land parcel.

- Workforce mobilization – the hiring of temporary construction workers will result in some employment opportunities, with potential positive impacts associated with training, experience and/or short to medium-term income generation amongst the local population. The total required labour force is estimated to be no less than 200 workers for the power line itself (ascending to around 330, when combined with the wind farm construction, to be deployed in parallel). It is a Project objective to maximize the number of national workers, with a smaller number of expatriate workers to provide specialised knowledge and/or supervision. It should be noted that whilst the construction phase of the Project may be considered to be a relatively large endeavour, it is not expected that the construction will result in a massive influx of prospective workers to the surrounding areas, as most workers will probably come from Boane and Namaacha districts and eventually other neighbouring areas (such as Matola), where the construction and industry sectors are very well represented. This means that skilled workers are likely available, thus the contractors expect to recruit locally and, if needed, utilize local accommodations for the staff rather than having an independent accommodation unit. A bus transportation service shall also be provided. Also, local individuals are aware of the social conventions of the existing communities, and they are unlikely to generate social conflicts. As such, the Project is not expected to have the potentially significant associated impacts on social infrastructure or local communities, which are common for large scale projects in more remote locations.
- Operation of vehicles and machinery and constructions activities in general – the construction activities, such as clearing, excavations, erection of poles/towers, cable installation, as well as setting and operation of construction camps, along with associated road traffic and machinery operation, will generate noise, dust and other air emissions, as well as possibly some disturbance to traffic, along with temporary access restrictions. These combined effects are mainly a nuisance factor for the surrounding communities but can also result in possible health and safety issues.

The relevant potential social impacts generated by these Project activities are discussed and assessed in the following sections, divided into:

- Socioeconomic impacts, i.e., impacts that affect the daily life practices or the economic livelihood of families and communities.
- Cultural heritage impacts, i.e., impacts affecting cultural heritage sites, resources and values. and
- Community health and safety impacts, i.e., impacts affecting community health (such as from noise or environmental quality degradation) or safety (such as increased safety and security risks).

7.11.1.2 Impact assessment – Socioeconomic impacts

Impact: Involuntary resettlement as a result of the establishment of the transmission line's Protection Zone

Impact Assessment

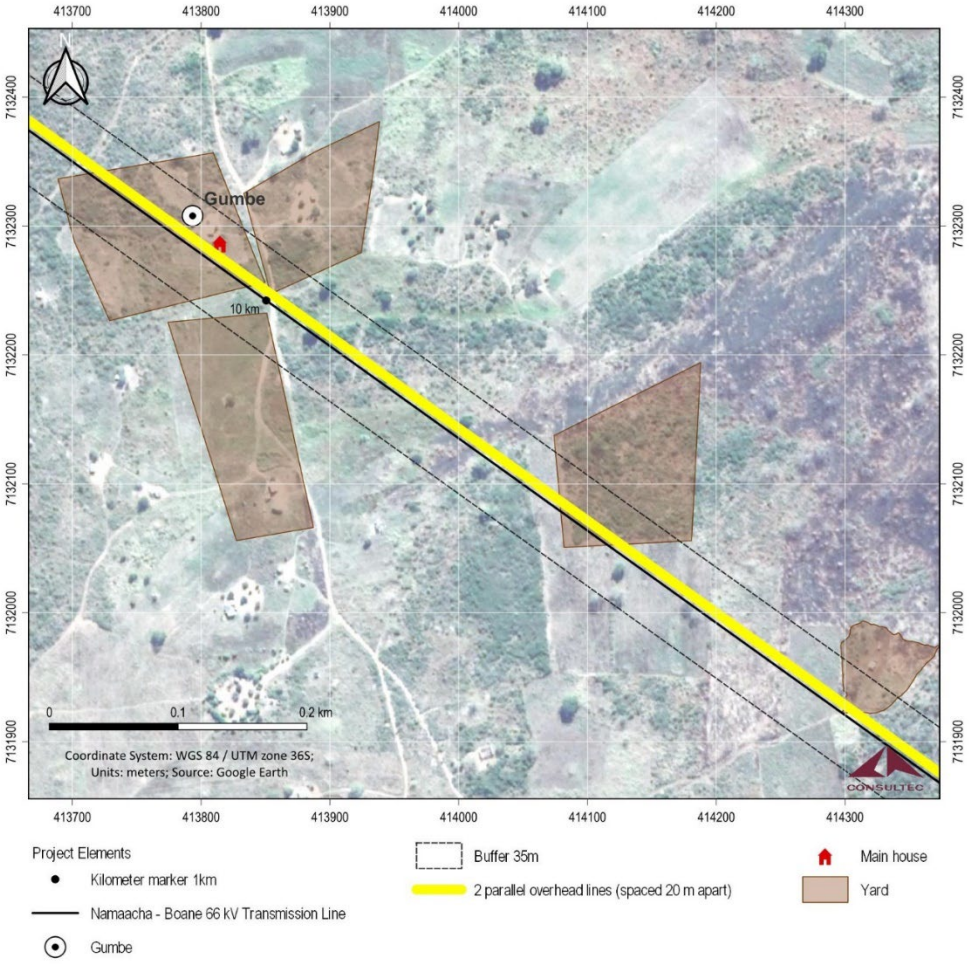
The project's land requirements will result in some form of involuntary resettlement of PAPs, either physical (permanent) or economic displacement (temporary or permanent).

The construction of the Namaacha - Boane Project will require the clearing of any built structure that currently exists in the Project's protection zone (for most of its extension, a 70 m wide corridor, as explained in the introductory section 7.11). The proposed alignment for the transmission line was designed with the general philosophy of avoiding crossing villages as much as possible, to minimize the number of structures affected by the Project's footprint. Nevertheless, the census survey confirmed what was initially anticipated through the assessment of existing satellite imagery, that is, the Project implementation will require the physical and economic relocation of a number of PAPs.

The towers will be placed every 200 meters in most cases, under which farming will be definitively lost. Tower footprints and foundation requirements will vary, depending on site specific geotechnical characteristics. Anti-vandalism steel monopoles can have a tower base diameter vary between 600 and 1800 mm. The below ground foundation on intermediates would typically be 3x3m and on the strains it would be dependent on the bending moment but can be as large as 6 m x 12 m. Approximately 169 towers will be required for the transmission line.

Survey results identified a total of 3 affected structures (main houses and their annexures, walls, warehouses, etc), that are within the project protection zone (see the introductory section 7.11) and will require demolition (see Figure 7-3). These are distributed per district in the following manner:

- Namaacha: 3 (PAPs total area is crossed by the 70 m wide corridor and directly impacts all of their structures, thus permanent resettlement may be required).


413700
413800
413900
414000
414100
414200
414300
7132400
7132300
7132200
7132100
7132000
7131900
Gumbe
10 km
0
0.1
0.2 km
Coordinate System: WGS 84 / UTM zone 36S;
Units: meters; Source: Google Earth
CONSULTEC
Project Elements
Kilometer marker 1km
Namaacha - Boane 66 kV Transmission Line
Gumbe
Buffer 35m
2 parallel overhead lines (spaced 20 m apart)
Main house
Yard

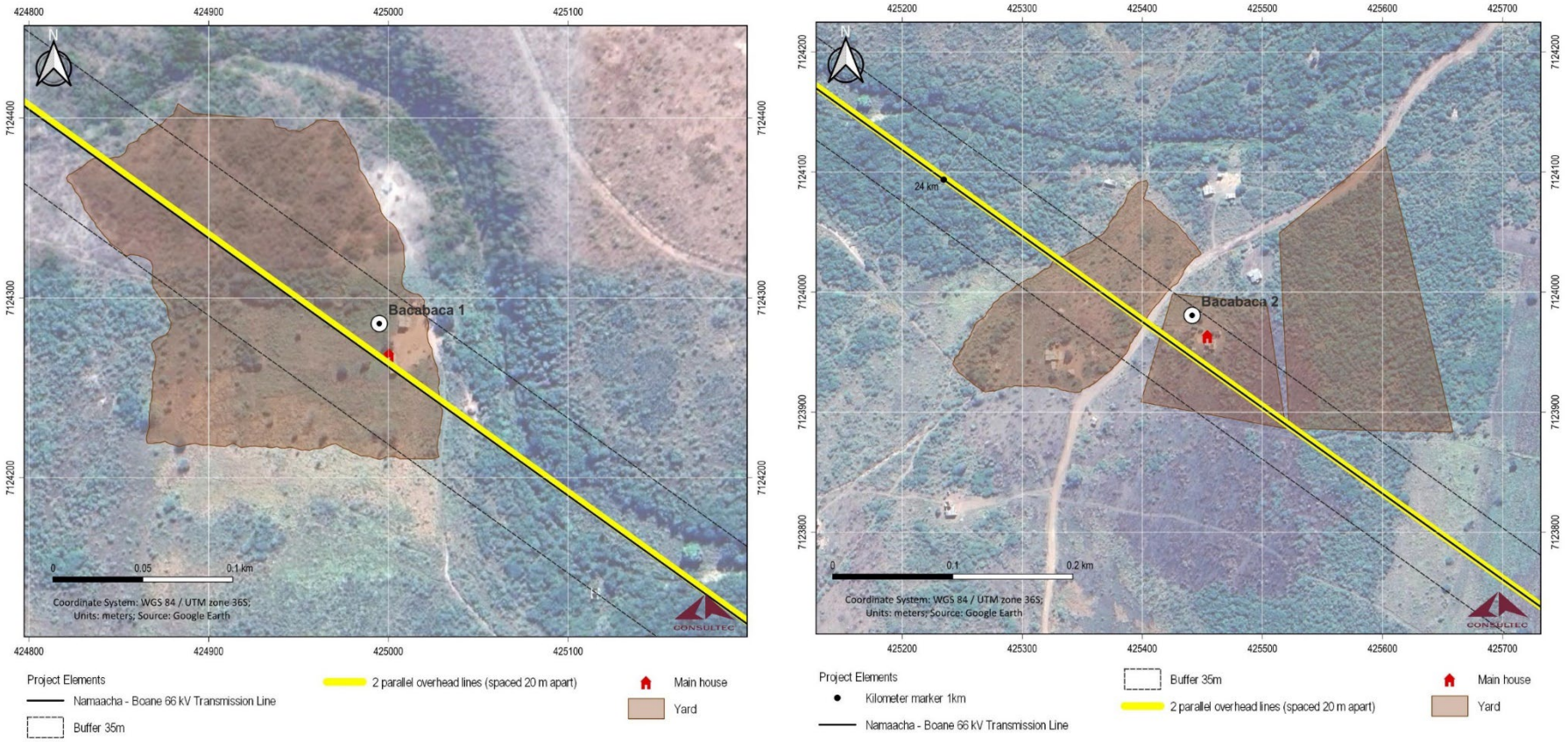


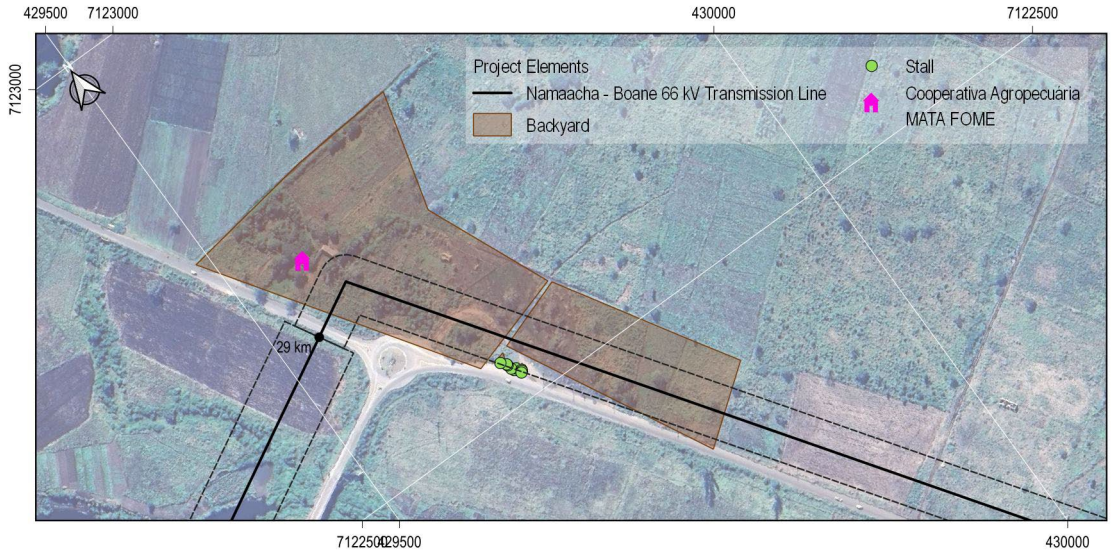
Figure 7-3 – Infrastructures location map

Regarding economic displacement, the project footprint affects agricultural plots (*machambas*), and other businesses. A total of 98 *machambas,* owned by 93 PAPs , are within the protection zone, being the distribution per district in the following manner:

- Namaacha: 32 (7 of which may only require temporary resettlement);
- Boane: 66 (6 of which may only require temporary resettlement).

More details on the impact on agricultural plots are in page 85.

For other businesses, a total of 12 are impacted only in Boane of which 11 located near the national road (*Estrada Nacional - N2*) and 1 guest house with 4 bedrooms is impacted near the Boane substation in Bairro 6, as is shown in Figure 7-4 below.



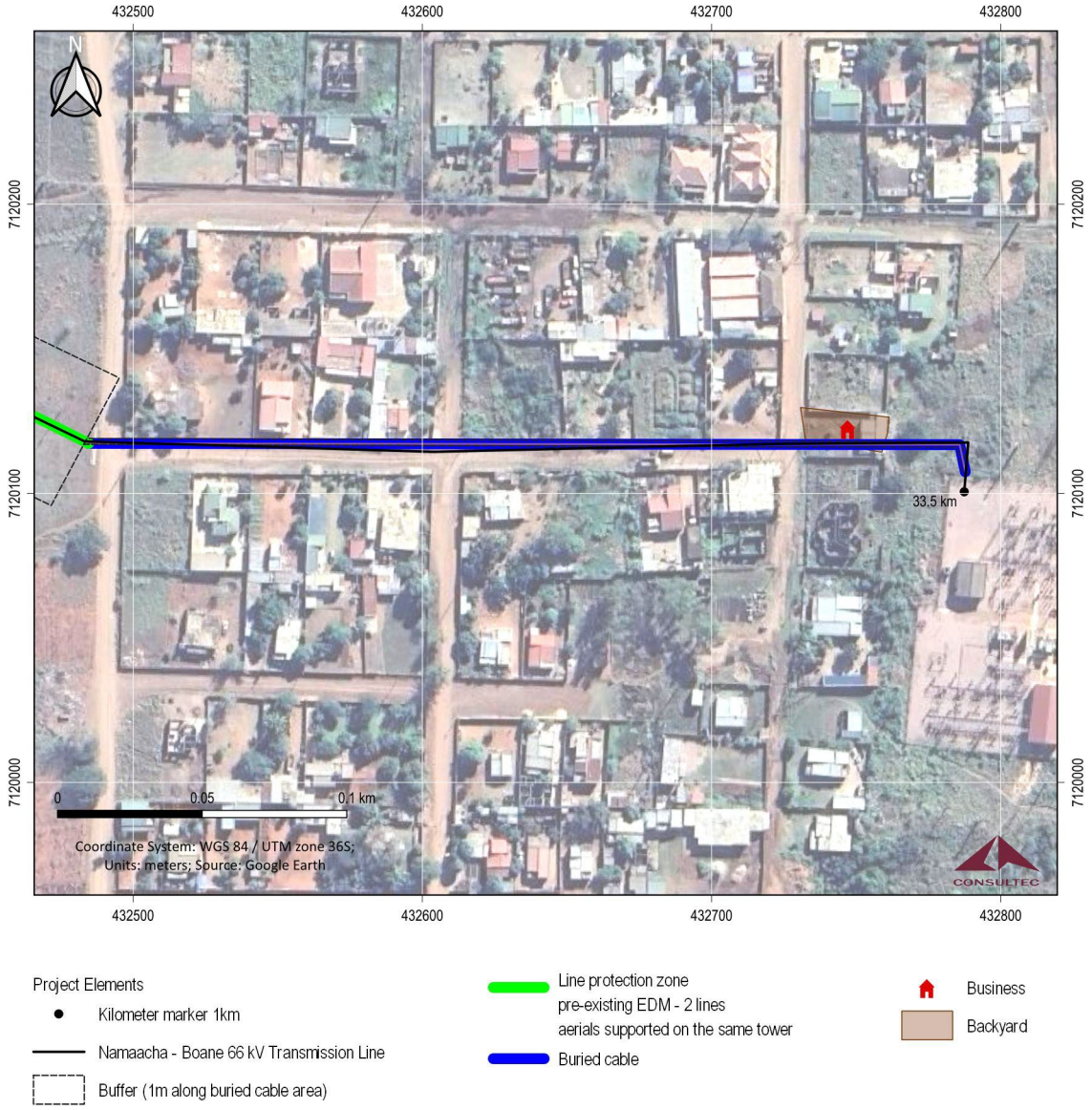


Figure 7-4 – Location of small business infrastructures in protection zone

While houses (and auxiliary structures) and residential plots, businesses, and trees with economic value (that can grow over the safe distance from the transmission line) located within the protection zone will be permanently lost, the land parcels (*machambas* and vacant land) will be subject to either permanent resettlement, temporary resettlement, or temporary resettlement with the permanent loss of land parcel meterage. Land parcels subject to temporary resettlement refers to land within the protection zone where land will be cleared of vegetation and usage prohibited during construction and where usage – albeit restricted – will be permitted during the Project operation phase. Such PAPs will, therefore, be subject to the temporary loss of their *machamba*s and land plots during Project construction and subsequently, once the *machambas*/land plots have been returned, they will be subject to conditional usage only. Land plots subject to permanent loss refers to land parcels and typically vacant land, where a meaningful section (over 10%) is within the protection zone and

can no longer be utilised by owner as intended, or where the protection zone runs through the land parcel, effectively creating an incontiguous land parcel.

If not well-managed, resettlement impacts have the potential to lead to destitution, impoverishment, loss of income, food insecurity and significant deterioration in living standards amongst the affected households, recovery from which is considered to be long term or in some cases, even generational. In addition, impacts may disturb or generate additional pressure (compounding effects) on the social and family networks of the affected households, thereby widening the scale of the impacts. Vulnerable individuals, households and/or groups are also considered likely to face additional barriers/challenges and/or burdens resulting from the resettlement impacts, as well as in relation to recovery strategies.

This impact is assessed as *negative*, of *local* extent (the impacts only occur within the Project's footprint), but of *high* intensity (as the social dynamics of the affected families are highly disturbed) and *long-term* in duration. This results in an overall *high* significance impact prior to mitigation.

Mitigation Measures

Given the high potential significance of the assessed impact, mitigation will be required to reduce the residual impact to acceptable significance levels. The general principle of mitigation is that all losses are fully compensated for, in such a way as to ensure that the current livelihoods and quality of life of the affected families are at least maintained, and if possible improved. Following the mitigation hierarchy, avoidance of impacts should be pursued wherever possible. The Project design has already been tailored to avoid new impacts through the use of the existing EDM servitudes, a change that was made specifically to avoid resettlement impacts (see EPDA and EIA Vol. I for details on project alternatives). This design change should have resulted in greatly reducing the predicted impacts; however, because the EDM servitudes for the existing line has not been maintained, this does not fully avoid all resettlement impacts in the Boane area. Mitigation measures should therefore include:

- During the detailed engineering design of the project, the route of the transmission line should be further evaluated for optimization in order to potentially reduce the number of households requiring resettlement.
- The Project will develop and implement a comprehensive Resettlement Action Plan (hereinafter referred to as the "RAP") based on the resettlement policy framework (RPF – refer to Vol. V of this EIA) and that is fully aligned with the Mozambican legislative framework (including Decree 31/2012 and directives No. 155/2014 and 156/2014) and the IFC's Performance Standards (including PS 1 and 5). As per the Mozambican legislative framework on EIAs, a *Relatório de Levantamento Físico e Socioeconómico* (RLFSE[6]), is required as part of the EIA process and a full RAP is required subsequent to the granting of a provisional environmental licence. As such, an RPF has been prepared that is fully aligned

6 Physical and Socioeconomic Survey (PSES), the national equivalent to the RPF

with IFC's PS 5 and that also includes all the specific requirements for a PSES under the Mozambican system (see Volume V of the EIA).

Some key resettlement principles and approaches that will be applicable to the Project's RAP process include:

i. That resettlement will take place prior to the commencement of Project activities.
ii. That resettlement will be guided by the relevant local legislation and the PS 5, with the overall objective of improving PAP living standards, or at the very least, ensuring no negative change in living standards from pre-resettlement levels occurs, in accordance with the GAP analysis detailed in the RPF.
iii. That all PAPs shall be fully compensated for all losses, and impacts on livelihoods, at full replacement value, including both tangible and intangible losses, in accordance with the eligibility and compensation methodology as defined in the RPF.
iv. That a full PAP census, which includes both qualitative and quantitative socioeconomic data and the identification of all lost assets, will be carried out, and shall, in accordance with Mozambican legislation, serve as the cut-off date (see Vol. V Section 8.2.2 for further details). The census shall include all the required information to serve as the PAP baseline from which livelihoods and living standards are monitored.
v. That, as part of the implementation of the Project-wide Grievance Redress Mechanism (GRM - as elaborated in the EMP (See Vol. III of the EIA) and the RPF (See Volume V of the EIA), specific additional requirements as per directives No. 155/2014 and 156/2014, including the establishment of the MSCT (Monitoring and Supervision Technical Committee for Resettlement), shall be integrated into the GRM for the duration of the resettlement process.
vi. That participation and engagement, based of the Projects Stakeholder Engagement Framework (SEF – refer to EMP Vol. III), shall be tailored to include specific resettlement related public participation requirements as detailed in the RPF, for the duration of the RAP elaboration and implementation process.
vii. That a detailed methodology for a participatory Livelihoods Restoration Plan (LRP) be elaborated, based on the approach to livelihoods, as detailed in the RPF. The methodology shall include a specific focus on vulnerable PAPs and utilize the full PAP census survey as a basis for the monitoring of PAP livelihoods.
viii. That a detailed monitoring and evaluation methodology, inclusive of both RAP implementation outputs and LRP outcome indicators be elaborated in accordance with the RPF.

Impact Summary

The impact assessment summary is provided in the following table. The implementation of the RAP and the LRP will, i) potentially reduce the Project impacts and, ii) ensure that all affected/impacted PAPs are provided with the appropriate compensation for all losses as well as livelihoods restoration measures, in accordance with the national legislation and the PS 5. This implementation will reduce the impact's duration, thus resulting in an overall *medium* impact significance.

Impact: Involuntary resettlement as a result of the establishment of the transmission line's Protection Zone					
Criteria	**Pre-mitigation assessment**		**Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- During the detailed engineering design of the project, the route of the transmission line should be further evaluated for optimization in order to potentially reduce the number of households requiring resettlement. - The Project will develop and implement a comprehensive Resettlement Action Plan (RAP) based on the resettlement policy framework (RPF – refer to Vol. V of this EIA) and that is fully aligned with the Mozambican legislative framework (including Decree 31/2012 and directives No. 155/2014 and 156/2014) and the IFC's Performance Standards (including PS 1 and 5).	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	High	3		High	3
Duration	Long-term	3		Medium-term	2
Consequence	High	7		Medium	6
Probability	Definite			Definite	
Significance	**High**			**Medium**	

Impact: Disturbance of cultivation areas due to the construction of the transmission line and establishment of the Protection Zone

Impact Assessment

Unlike built structures, the impact of the powerline construction on farming will be mostly temporary. Once the powerline is built, annual cultures may still be cropped in the protection zone, under the powerline. Fruits trees, however, will be cut in the 70 m wide clearance corridor, and will not be allowed to be replanted.

The Project will result in a significant temporary economic allocation, as 98 machambas have been identified as being directly impacted within the protection zone. Farmers impacted by this zone will lose at least one harvest season. Project deployment could result in the permanent loss of agricultural land in areas where the towers will be built, and possibly the temporary loss of other areas during line construction. It was recommended - in line with current practice in the region - that the families currently using the identified area within the protection zone be allowed to farm during the line's operation phase. It should, however, be noted that there will be restrictions on what can be done in this area. The planting of tall growth trees and the construction of any additional structures will not be permitted.

Given the above, the impact is assessed as *negative*, *local*, of *medium* intensity (even if the number of agricultural areas affected is not very high, and the impact is marginal, relevant changes will still be caused to the social processes of the affected farmers) and *long-term* duration (duration applicable to fruit trees cut down, given that annual harvests can be resumed without any restriction after completion of the construction phase), resulting in a *medium* significance.

Mitigation Measures

Given the significance of the impact, mitigation measures are required. These will include:

- During the detailed design of the Project, further optimization of the route of the Namaacha – Boane transmission line should be considered in order to reduce the economic resettlement on agricultural areas.
- The Project will develop and implement a comprehensive Resettlement Action Plan (hereinafter referred to as the "RAP") based on the resettlement policy framework (RPF – refer to Vol. V of this EIA) and that is fully aligned with the Mozambican legislative framework (including Decree 31/2012 and directives No. 155/2014 and 156/2014) and the IFC's Performance Standards (including PS 1 and 5). This will include livelihood restoration/economic resettlement. An RPF has been prepared that is fully aligned with IFC's PS 5 and that also includes all the specific requirements for a PSES under the Mozambican system (see Volume V of the EIA).

Some key economic resettlement principles and approaches that will be applicable to the Project's RAP process include:

- Any impact on agriculture, even if temporary, must be compensated according to market value / replacement cost. The tabulated values produced by the Provincial Directorate of Agriculture will be taken into account but will have to be validated by a market study. Compensation values adopted should be the highest between those obtained by market research and official government values.
- Inform farmers in advance about the upcoming construction activities, so that they can timely harvest existing crops or to prevent them from planting of new crops.
- Whenever possible, carry out the vegetation clearance during the fallow season, in order to reduce the loss of crops already planted;
- Support for the restoration of agricultural crops after completion of construction.

Impact Summary

The impact summary is presented in the table below. The proposed offsets will shorten the duration of the impact for the *medium term* (given that fruit tree losses will be offset), lowering the residual significance to *low*.

Impact: Disturbance of cultivation areas due to the construction of the transmission line and establishment of the Protection Zone					
Criteria	**Pre-mitigation assessment**		**Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- During the detailed design of the Project, further optimization of the route of the Namaacha – Boane transmission line should be considered in order to reduce the economic resettlement on agricultural areas. - The Project will develop and implement a comprehensive Resettlement Action Plan (hereinafter referred to as the "RAP") based on the resettlement policy framework (RPF – refer to Vol. V of this EIA) and that is fully aligned with the Mozambican legislative framework (including Decree 31/2012 and directives No. 155/2014 and 156/2014) and the IFC's Performance Standards (including PS 1 and 5). This will include livelihood restoration/economic resettlement. An RPF has been prepared that is fully aligned with IFC's PS 5 and that also includes all the specific requirements for a PSES under the Mozambican system (see Volume V of the EIA).	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Medium	2
Duration	Long-term	3		Medium-term	2
Consequence	Medium	6		Low	5
Probability	Definite			Definite	
Significance	**Medium**			**Low**	

Impact: Creation of employment opportunities

Impact Assessment

The construction phase will generate direct employment opportunities, the majority being unskilled or semi-qualified labour. Estimates provided by the Proponent indicate that an approximate total of 200 workers at the peak of construction, including specialized and non-specialized workers, will likely be involved in the construction works. Considering the wind farm construction, to be deployed in parallel, this number can rise to around 330, highlighting a cumulative impact between the two associated projects.

To note that the Proponent will not hire these workers directly, but instead will retain construction contractors, which will mobilize the adequate workforce. Most of these workers will be national. A small number of foreign workers may be required to provide specialized knowledge. Most of this workforce will likely be recruited locally, i.e., at district and provincial level, with a smaller percentage of specialized workers can be mobilized from other provinces or from abroad.

The significant investment will also generate indirect jobs not only in the construction sector (supplies, services, etc.) but in related sectors as well, such as security, cleaning, machine and vehicle's sale and maintenance, catering, amongst many possible others. Multiplier effect can reach 1,5 to 2 times the number of direct jobs.

At present, employment opportunities for the communities in the Project area are scarce. Thus, the jobs created by the Project, both directly and indirectly, will lead to an increase in family income of the workers hired locally, and the improvement of the wellbeing of their families. Note, however, that these are temporary jobs (the construction phase is expected to last 18 months). This is a *positive* impact, of *local* extent (Boane and Namaacha, and eventual neighbouring areas), and *low* intensity (given the relatively small number of expected direct jobs, plus some fraction of indirect jobs) and *short-term* duration (restricted to the 18 months expected for the construction phase), resulting in a *very low significance*.

Enhancement Measures

The adoption of the following enhancement measures is recommended that the Project:

- Develop a transparent, fair, non-discriminatory and ethical local recruitment plan. The recruitment plan shall be consistent with local labour legislation and international standards including the UNGPs and ILO standards (1 through to 17) and declarations.
- Ensure that, during the process of contracting workers, priority should be given to the local population and consideration on gender parity apply, provided applicants have the necessary skills for the relevant employment opportunity.
- Ensure that employment opportunities are adequately advertised, so as not to limit application opportunities.
- Carry out the process of contracting staff in a transparent manner, following pre-established and accepted criteria.
- Implement Globeleq's corporate GBVH procedure, which shall be applicable to all staff as well as third party contractors.

Impact Summary

The impact summary is provided in the following table. The enhancement measures will not be able to increase the residual significance rating and the overall impact will remain as *Very Low (positive)*.

Impact: Creation of employment opportunities					
Criteria	**Pre-mitigation assessment**		**Enhancement Measures**	**Post-mitigation assessment**	
Nature	Positive		- Develop a transparent, fair, non-discriminatory and ethical local recruitment plan. The recruitment plan shall be consistent with local labour legislation and international standards including the UNGPs and ILO standards (1 through to 17) and declarations. - Ensure that, during the process of contracting workers, priority should be given to the local population and consideration on gender parity apply, provided applicants have the necessary skills for the relevant employment opportunity. - Ensure that employment opportunities are adequately advertised, so as not to limit application opportunities. - Carry out the process of contracting staff in a transparent manner, following pre-established and accepted criteria. - Implement Globeleq's corporate GBVH procedure, which shall be applicable to all staff as well as third party contractors.	Positive	
Type	Direct/Indirect			Direct/Indirect	
Extent	Local	1		Local	1
Intensity	Low	1		Low	1
Duration	Short-term	1		Short-term	1
Consequence	Very Low	3		Very Low	3
Probability	Definite			Definite	
Significance	**Very Low**			**Very Low**	

Impact: Transfer of skills to local communities due to mobilization of construction workforce

Impact Assessment

Unskilled local people that will be employed by the Project will benefit not only from increased yields but also the development of training, including technical / professional issues and general issues (e.g., awareness about health and safety). This will result in a transfer of know-how and skills to the local communities and will naturally improve the chances of the trained personnel in obtaining employment in the future, with associated benefits for their families and dependents, resulting in an indirect long-term benefit.

This is a *positive* impact, which is assessed as *indirect*, of *long-term* duration (as the acquired skills will benefit these workers beyond the limit of this specific job), of *local* extent and of *medium* intensity (given the overall lack of worker specialization and know-how in the Project region), resulting in a *medium significance*.

Enhancement Measures

Even though a significant positive impact is already expected, some enhancement measures can be developed to increase the effectiveness of the skill transfer process, namely:

- The construction contractor should develop and implement a Training and Skill Transfer Program, with the following main goals:
  - Provide technical training programs for unskilled workers, with the objective of improving their job performance and giving them the skills to compete for other positions.
  - Provide environmental and social awareness training to all workers, including matters related to the code of conduct, non-discrimination and sexual harassment, abuse and exploitation.
- The construction contractor will provide environmental and social awareness training to all workers.
- The construction contractor will provide health and safety training to all workers.

Impact Summary

The impact assessment summary is provided in the following table. The enhancement measures defined above increase the impact probability, although this does not change the rating of the residual significance, which remains *Medium (positive)*.

Impact: Transfer of skills to local communities due to mobilization of construction workforce					
Criteria	**Pre-mitigation assessment**		**Enhancement Measures**	**Post-mitigation assessment**	
Nature	Positive		- The construction contractor should develop and implement a Training and Skill Transfer Program, with the following main goals: - Provide technical training programs for unskilled workers, with the objective of improving their job performance and giving them the skills to compete for other positions. - Provide environmental and social awareness training to all workers, including matters related to the code of conduct, non-discrimination and sexual harassment, abuse and exploitation. - The construction contractor will provide environmental and social awareness training to all workers. - The construction contractor will provide health and safety training to all workers.	Positive	
Type	Indirect			Indirect	
Extent	Local	1		Local	1
Intensity	Medium	2		Medium	2
Duration	Long-term	3		Long-term	3
Consequence	Medium	6		Medium	6
Probability	Probable			Definite	
Significance	**Medium**			**Medium**	

Impact: Local and regional economic stimulation due to construction expenditure

Impact Assessment

Although most of the materials needed (steel structures, cables, electrical gear, etc.) will likely be manufactured abroad and transported to Maputo by ship, from where they will later be taken by truck to the construction area, it is expected that a considerable part of the necessary materials (cement,

gravel, sand, fuel, general supplies, etc.) and services (security, cleaning, maintenance, catering, etc), for the construction phase are purchased on the domestic market, thus having an indirect positive effect on the tertiary/services sector. The increased income of the hired workforce for the construction supplies' companies can lead to an increase of levels of consumption, enhancing the economic stimulus.

This by its turn will lead to an increase in demand for consumer products, goods and services. Greater demand will develop the local markets, especially in the food sector, which will benefit the local, district and provincial economies, stimulating the creation of businesses and jobs. Informal commercial activities will also likely arise, benefiting some residents with increased family income.

This is an *indirect positive* impact, which is considered of a *regional* extent, since the products and services needed for the construction phase can be purchased from companies not only from Boane ana Namaacha Districts but also from Maputo Province (or even from other areas of the country), of *low* intensity and *short-term* duration, probably resulting in a *very low* significance prior to mitigation.

Enhancement Measures

Even though a positive impact is already expected, some enhancement measures can be implemented to increase the local and regional economy stimulation during the construction phase:

- The procurement of goods and services by the EPC Contractor will give priority to sourcing from the local and provincial markets, whenever possible. The EPC Contractor should:
  - Identify the goods and services required by the Project that can be supplied locally (e.g., meals and cleaning) and encourage and support local companies in the production and supplying of these goods and services.
  - Before the start of the activities of the Project the EPC Contractor should identify and disclose the types of services they will require, to enable local entrepreneurs the possibility of training, improvement of skills and services to offer.

Impact Summary

The impact assessment summary is provided in the following table. The enhancement measures likely can raise the impact's intensity and the residual significance becomes *Low (positive)*.

Impact: Local and regional economic stimulation due to construction expenditure					
Criteria	**Pre-mitigation assessment**		**Enhancement Measures**	**Post-mitigation assessment**	
Nature	Positive		- The procurement of goods and services by the construction contractor will give priority to sourcing from the local and provincial markets, whenever possible.	Positive	
Type	Indirect			Indirect	
Extent	Regional	2		Regional	2
Intensity	Low	1		Medium	2
Duration	Short-term	1		Short-term	1
Consequence	Very Low	4		Low	5
Probability	Probable			Probable	
Significance	**Very Low**			**Low**	

7.11.1.3 Impact assessment – Cultural Heritage Impacts

Impact: Loss of cultural heritage sites

Impact Assessment

The clearing of the Namaacha - Boane Project RoW may lead to the loss of cultural heritage. As part of the census developed for the preparation of the EIA, a cultural heritage survey was carried out, aiming to identify all archaeological or other cultural heritage sites, such as sacred sites, cemeteries, religious temples, or any other site or asset of cultural heritage relevance. This resulted in the identification of 3 cultural structures impacted by the project, with 1 household with a total of 8 graves in Namaacha, 1 *machamba* owner with a grave and 1 sacred house (spiritual house) in Boane.

In the pre-mitigation scenario, construction of the Project would lead to the loss of these cultural heritage sites. This impact is assessed as *negative*, of *local* extent (the impact would only occur within the Project implantation area), but of *medium* intensity (given the low total number of impacts, however with high cultural and social value of these sacred and religious sites) and of *long-term* duration (given that in the unmitigated scenario, this loss is permanent). This results in a pre-mitigation *medium* significance.

Mitigation Measures

Given the medium significance of the impact, mitigation will be required in order to reduce the residual impact significance. To this end, the loss of these sites should be prevented by relocating them or compensating where appropriate. Therefore, the following guidelines are recommended for RAP development regarding these cultural heritage sites:

- Affected graves will be exhumed and moved to a new location. The new location will be agreed with the community and this activity will be monitored by the local authorities. The Proponent will bear all costs of exhuming and relocating the graves, including professional services, as agreed with the community. Each community will organize a ceremony for the removal and transfer of graves, in accordance with religious beliefs and/or local customs. These rituals are conducted by a spiritual leader and/or community leader.

Although no other archaeological sites have been identified within the RoW, the existence of underground archaeological elements cannot be ruled out. The implementation of a Chance Finds Procedure will allow the safeguarding of any archaeological site or element that may be found during construction:

- Implement a Chance Finds Procedure for cultural heritage, during construction activities that involve vegetation clearance and earthworks (as detailed in the EMP, Vol. III of this EIA).

Impact Summary

The summary of the impact assessment is presented in the following table. Implementation of the proposed mitigation will allow the relocation or compensation of all affected sites and assets, and still allow for the safeguarding of any chance finds, decreasing the intensity and duration of the residual impact, thus resulting in a residual impact of *Low* significance.

Impact: Loss of cultural heritage sites					
Criteria	**Pre-mitigation assessment**		**Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Religious temples will be relocated or compensated according to the RAP process. - The affected cemeteries will be relocated to a location to be agreed with the local communities, following all the necessary ceremonies and traditional practices. - Implement a Chance Finds Procedure for cultural heritage, during construction activities that involve vegetation clearance and earthworks (as detailed in the EMP, Vol. III of this EIA).	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Medium	2
Duration	Long-term	3		Medium-term	2
Consequence	Medium	6		Low	5
Probability	Definite			Definite	
Significance	**Medium**			**Low**	

7.11.1.4 Impact assessment – Community Health and Safety Impacts

Impact: Increase in road traffic and potential damage to existing roads and other public infrastructures

Impact Assessment

The construction works will lead to an increase in the number of heavy vehicles circulating on local roads, thus potentially affecting the living standards of residents in the surrounding areas, as well as increasing safety risks and inflicting possible damages to public roads and other infrastructures. Noteworthy that traffic in the main road accessing Boane from Maputo/Matola (N2) can currently be considered intense in some sections, such as the urban areas of Matola and Boane town center. In addition, the route of the OHL crosses N2 two times exiting Boane town, which may lead to temporary traffic restrictions during construction.

The construction of the power line will require a considerable transport logistics to supply construction materials (concrete, steel poles, electrical cables and gear) and equipment and workers to and from site. Approximately 400 containers for equipment/supplies and plant, approximately 3 busses for worker transportation, are expected, along the major transportation route from Maputo Port to the site (N2).

The increase of traffic due to the expected construction activities may increase road congestion, where additional vehicle movements could congest the flow of traffic causing delays and inconvenience to local road users, especially within the main roads located in the project area and connections to Matola and Maputo, from where most supplies are expected to come from, namely the N2, exacerbating the existing congestion at peak times. Increasing traffic flows on busy roads may also increase the risk of accidents affecting local people.

Traffic flows will also be disrupted if unusually wide or heavy loads are moved by vehicles travelling at slow speed especially within the main roads.

Movement of heavy vehicles may also cause some damage on the roads, especially on local dirt roads inland in the Namaacha district that are not suitable to support heavy traffic. Road enhancement will have to be implemented.

The impact of the increase in traffic is expected to be temporary (*short-term* duration), although potential damage to roads, if not immediately corrected, could have effects of *medium-term* duration. Given the current traffic conditions on the main routes (normally intense traffic till Boane), the impact is rated as *medium* intensity, especially during the periods in which the main road will likely have to be closed or severely restricted, i.e., during the N2 crossings outside Boane town lines, and/or when exceptionally heavy/long/wide equipment must be transported to site. In any case the non-mitigated scenario, the impact is assessed to be of *low* significance.

Mitigation Measures

To minimise the potential impacts associated with the potential traffic increase, the following mitigation measures are proposed:

- The EPC Contractor will develop, and submit for the Proponent's approval, a Traffic and Transport Management Plan. The EPC Contractor will then implement this plan throughout the construction phase.

This Traffic and Transportation Management Plan will include the following measures:

- Restrict the circulation of heavy vehicles to primary or specifically constructed/ enhanced local roads and avoid the use of roads not designed for supporting heavy loads.
- Set and enforce speed limits for construction heavy vehicles. This speed limit should not exceed 30 km/h in critical segments, such as when near residential areas.
- Plan material deliveries to work fronts so as to avoid traffic peak hours as much as possible.
- Install temporary official traffic signs on local roads around the work fronts before and during the execution of the works together with local transit authorities.
- Ensure that where temporary road closures do take place an alternative access is ensured.
- Ensure that timeous information on potential road closures is provided to all relevant stakeholders, in accordance with the stakeholder engagement plan (SEP, as defined in Vol. III of this EIA).
- Any damage to roads resulting from the Project construction should be restored as soon as the construction area is vacated.
- A training program, with documentation, to verify that all drivers are aware of the requirements of the Traffic and Transport Management Plan.

Impact Summary

The impact assessment summary is presented in the following table. The implementation of the proposed mitigation will likely reduce the interference of heavy vehicles with local traffic, decreasing the intensity of the residual impact, thus resulting in a residual impact of *very low* significance.

Impact: Increase in road traffic and potential damage to existing roads and other public infrastructures					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- The EPC Contractor will develop, and submit to the Proponent's for approval, a Traffic and Transport Management Plan. The EPC Contractor will then implement this plan throughout the construction phase.	Negative	
Type	Direct/Indirect			Direct/Indirect	
Extent	Local	1		Local	1
Intensity	Medium	2		Low	1

Impact: Increase in road traffic and potential damage to existing roads and other public infrastructures					
Criteria	**Pre-mitigation assessment**		**Key Mitigation Measures**	**Post-mitigation assessment**	
Duration	Short to medium-term	2		Short-term	1
Consequence	Low	5		Very Low	3
Probability	Probable			Probable	
Significance	**Low**			**Very Low**	

Impact: Potential public safety impacts as a result of Project construction and increased traffic volumes

Impact Assessment

Potential public safety risks as a result of Project construction and increased traffic volumes are primarily associated with the occurrence of accidents (from heavy machinery use and increased traffic volumes) and petty violence and GBV/SEA (from the concentration of labour at construction sites).

In terms of the increased traffic volumes, these risks are of concern particularly around the residential areas adjacent to the main routes that will be used by heavy vehicles and particularly if such vehicles are operative during the night-time period. Many of these roads have poor or no formal lighting, nor sufficient traffic lights or pedestrian crossings which will increase the associated safety risk.

Construction related risks associated with the concentration of labour, although considered very low, given the number of labourers, harbours risks, particularly in nearby residential areas, where there may be the opportunity for petty crime/violence and GBV/SEA committed by the Project labourers.

This increase in community hazard risk is considered of *high* intensity (as any death or serious injury caused by construction traffic would cause serious disruption of social functions and impact the Project and the Proponent's reputation), although of *short-term* duration (the increased risk will be limited to the construction phase, hence 18 months at maximum) and *local* extent. The significance is thus evaluated as *low*.

Mitigation Measures

Despite the low significance, all relevant mitigation will be implemented to mitigate the traffic-related safety risks associated with the construction phase. The same mitigation measures described to reduce traffic impacts will also lower the associated safety risks. To this effect, the EPC Contractor will develop and submit for Proponent's approval a Traffic Management Plan, detailing the management procedures and mitigation measures to minimize traffic related impacts. Among other issues, setting and enforcing speed limits for construction vehicles is essential, especially within and adjacent to residential areas, as well as placing traffic control staff on Project access routes that are near communities, to enforce the speed limits and help pedestrians and non-Project traffic to use the accesses safely. Where appropriate, the EPC Contractor shall deploy temporary mobile traffic lights and road lightings in critical areas or road sections to prevent accidents.

Prior to the construction phase, detailed and appropriate information related to traffic norms, speed limits and speed control procedures must be provided to operators and drivers, upon which services/employment must be made conditional. Additionally, where possible, install and maintain official traffic signs on new accesses that may be created to support the project construction, before and after the execution of the work, in conjunction with local transit authorities.

Further to the measures listed for the preceding traffic impact, the following additional measures will also be implemented:

- If an existing road or pedestrian access is cut due to Project construction activities, alternative routes will be provided, to restore pedestrian and road accessibility.
- The Project will implement Globeleq's corporate GBVH procedure for all labourers (including those subcontracted) and ensure all relevant labour policies are in place.
- The GRM shall be fully communicated and implemented along the impacted areas to ensure stakeholders are aware of and able to seek recourse from the Project.

Impact Summary

The impact summary is provided in the following table. The mitigation measures will be capable of decreasing the probability of occurrence of accidents, lowering the residual significance to *very low*.

Impact: Potential public safety impacts as a result of Project construction and increased traffic volumes				
Criteria	**Pre-mitigation assessment**		**Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- The EPC Contractor will develop and submit a Traffic and Transport Management Plan to the Proponent for approval. The EPC Contractor will then implement this plan throughout the construction phase. - If an existing road or pedestrian access is cut due to Project construction activities, alternative routes will be provided to restore pedestrian and road accessibility. - The Project will implement Globeleq's corporate GBVH procedure for all labourers (including those subcontracted) and ensure all relevant labour policies are in place. - The GRM shall be fully communicated and implemented along the impacted areas to ensure stakeholders are aware of and able to seek recourse from the Project.	Negative	
Type	Direct/Indirect			Direct/Indirect	
Extent	Local	1		Local	1
Intensity	High	3		High	3
Duration	Short-term	1		Short-term	1
Consequence	Low	5		Low	5
Probability	Probable			Possible	
Significance	**Low**			**Very Low**	

Impact: Risk of social conflicts elicited by the Project security personnel

Impact Assessment

One of the potential impacts associated with major developments is the potential risk of conflicts arising from the interactions of local communities with security workers, hired to safeguard construction personnel and property.

However, for the Namaacha – Boane Project this risk is generally low. Given the linear nature of the project (which will make it hard to establish large, concentrated construction camps in a single location) and the relatively low intensity and man-power requirements of the construction works,

security arrangements will likely be contracted to local security companies. No use of police or military personnel, or even para-military security is planned or likely.

Local security companies are staffed almost exclusively with national personnel, which helps minimize the risk of social conflicts with local communities. So, while it is likely that security personnel will be deployed in the construction camps, these will be unarmed, national workers, whose main functions will be guarding the camps against thefts and similar issues. The risk of conflicts with local communities will be very low.

As such, this risk is assessed as *negative*, *direct*, of *short-term* duration (limited to construction phase), of *local* extent (limited to the construction yards and laydown areas, if different) and of *medium* intensity (as even if low risk, it may result in physical violence and potential human rights abuses), however its probability is considered *possible*, rendering the non-mitigated scenario, the impact is thus assessed to be of *very low* significance.

Mitigation Measures

Despite the very low significance rating, best practices are still applicable in what regards the risks associated with security personnel. As such, the following mitigation will be implemented:

- The EPC Contractor will develop a Security Management Plan, detailing the security arrangements to be deployed during construction. This plan will be compliant with IFC's PS 4, and with the UNGPs and ILO standards, regarding human rights and labour and, and will be submitted for the Proponent's approval, prior to start of construction. This plan will include mandatory training for all security personnel, in what regards human rights, proportionate force use and adherence to the Contractor's code of conduct.
- The Project will implement Globeleq's corporate GBVH procedure for all labourers (including those subcontracted) and ensure all relevant labour policies are in place.

Impact Summary

The impact summary is provided in the following table. It is expected that the impact will become improbable, and the intensity will decrease to *low*, with the application of the mitigation. The residual significance remains as *very low*.

Impact: Risk of social conflicts elicited by the Project security personnel					
Criteria	**Pre-mitigation assessment**		**Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- The EPC Contractor will develop a Security Management Plan, detailing the security arrangements to be deployed during construction. This plan will be compliant with IFC's PS 4, and with the UNGPs and ILO standards, regarding human rights and labor and, and will be submitted for the Proponent's approval, prior to start of construction. This plan will include mandatory training for all security personnel, in what regards human rights, proportionate force use and adherence to the Contractor's code of conduct. - The Project will implement Globeleq's corporate GBVH procedure for all labourers (including those subcontracted) and ensure all relevant labour policies are in place.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Medium	2		Low	1
Duration	Short-term	1		Short-term	1
Consequence	Very Low	4		Very Low	3
Probability	Possible			Improbable	
Significance	**Very Low**			**Very Low**	

Impact: Potential impacts on workers' health and safety during the construction phase

Impact Assessment

As previously stated, the Project's construction phase will likely require the mobilization of roughly 200 workers. Impacts on worker's health and safety could manifest as a result of inadequate implementation of existing labour standards by the EPC Contractor or from work related injury or health effects. Work accidents could occur during several of the planned construction activities, such as site preparation, excavations, vegetation clearance, waste and hazardous materials management, transportation and circulation or worksite restoration.

The main common causes of accidents in construction are:

- Working at height.
- Working in an unsecured excavation.
- Working on slippery surfaces.
- Accidentally falling objects.
- Moving heavy loads.
- Wrong working positions, often in confined spaces.
- Working on or near water (drowning).
- Encounters with dangerous fauna (i.e. venomous snakes).
- Working near live electrical wires and equipment (electrocution).

All workers could be exposed to accidents at the worksite. However, implementation of suitable health and safety procedures should help preventing or reducing the probability of accidents from occurring.

Child labour is also a risk during construction work that should be avoided at all costs. Child labour is described as having workers below 18 years of age. Therefore, child labour shall be strictly prohibited, and any case thereof should be reported to the Proponent by the individuals responsible for surveillance. The ultimate responsibility for preventing child labour lies with the EPC Contractor.

This potential impact on workers' health and safety is assessed as *negative*, *direct*, of *short-term* duration, of *local* extent (only the workers at the construction sites are potentially impacted) but of *high* intensity (as work accidents could result in serious injuries or even fatalities), resulting in a *Low significance* prior to mitigation.

Mitigation Measures

To mitigate the impact described above, it must be ensured that the labour and working conditions are of an acceptable standard. Specifically, the following mitigation will be implemented:

- The EPC Contractor will develop and implement an Emergency Response Plan (as per the guidance given in the EMP – see Vol. III of this EIA).

- The EPC Contractor will develop and implement a Health and Safety Management Plan to protect every worker involved in construction activities, even temporary workers. This plan will comply with national legislation, international best practices (OHSAS 18001:2007, NEBOSH or similar) and address all aspects of labour standards relevant to the project as specified by World Bank/IFC General EHS Guidelines and WBG/IFC Industry Sector Guideline for Electric Power Transmission. Sub-contractors will be contractually bound to comply with labour and health and safety legislation. Specific provisions must be included for:
  - Supply drinking water and maintain its quality and ensure sanitation at the construction sites.
  - Declaration of accidents through an accident reporting mechanism
  - Handling domestic and specialized waste, as well as dangerous goods
  - Procedures in case of injuries and accidents
  - Secure equipment and demarcate any excavation work areas
  - Sign and fence construction areas, where necessary
  - Implement a long-term training program throughout the construction phase to ensure adequate training and qualification of all staff employed for the project. Specific training must be provided for working at heights and working around live power lines.
  - Provide and ensure the use of appropriate personal protective equipment (PPE).
- Establish and develop a grievance mechanism for all workers.

Impact Summary

The impact summary is provided in the following table. The proposed mitigation lowers the intensity and probability of the impact/risk, resulting in a *very low* residual significance.

Impact: Potential impacts on workers' health and safety during the construction phase					
Criteria	**Pre-mitigation assessment**		**Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- The EPC Contractor will develop and implement an Emergency Response Plan. - The EPC Contractor will develop and implement a Health and Safety Management Plan to protect every worker involved in construction activities, even temporary workers. This plan will comply with national legislation, international best practices (OHSAS 18001:2007, NEBOSH or similar) and WBG General EHS Guidelines and WBG Industry Sector Guideline for Electric Power Transmission. - Establish and develop a grievance mechanism for all workers.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	High	3		Medium	2
Duration	Short-term	1		Short-term	1
Consequence	Low	5		Very Low	4
Probability	Probable			Possible	
Significance	**Low**			**Very Low**	

7.11.2 Operational phase

7.11.2.1 Impact-generating activities

The operational phase will have few activities with the potential to impact the socioeconomic environment. The main positive impact will be the increase in power supply in Maputo Province, which will help to stimulate development.

Once built, the transmission line will be handed over to EDM, that will be responsible for the maintenance and operation. The main works associated with transmission line operation are the maintenance of the OHL protection zone, tower and line inspections and line maintenance works. Control of vegetation regrowth is necessary to avoid disruption to the OHL and towers.

7.11.2.2 Impact assessment – Socioeconomic impacts

Impact: Creation of employment opportunities

Impact Assessment

The number of direct employment opportunities created by the Project during the operational phase will be very low. The operation of the overhead line will mostly be performed by EDM's existing personnel. Further to this, local teams may be employed to perform maintenance clearance of the protection zone and the substation will run with the existing workers.

While *positive*, this impact will be of *local* extent and *low* intensity, although of *long-term* duration. The resulting rating, considering the direct application of the adopted standardized impact assessment methodology, is *low*. However, given the very low number of jobs created, this impact is regarded as of *very low* significance.

Enhancement Measures

The adoption of the following enhancement measures is recommended that the Project:

- Develop a transparent, fair, non-discriminatory and ethical local recruitment plan. The recruitment plan shall be consistent with local labour legislation and international standards including the UNGPs and ILO standards (1 through to 17) and declarations.
- Ensure that employment opportunities are adequately advertised, so as not to limit application opportunities.
- Carry out the process of contracting staff in a transparent manner, following pre-established and accepted criteria.

Impact Summary

The impact summary is provided in the following table. The enhancement measures do not increase the significance rating, mostly given the very low number of jobs created.

Impact: Creation of employment opportunities					
Criteria	**Pre-mitigation assessment**		**Enhancement Measures**	**Post-mitigation assessment**	
Nature	Positive		- Develop a transparent, fair, non-discriminatory and ethical local recruitment plan. The recruitment plan shall be consistent with local labour legislation and international standards including the UNGPs and ILO standards (1 through to 17) and declarations. - Ensure that employment opportunities are adequately advertised, so as not to limit application opportunities. - Carry out the process of contracting staff in a transparent manner, following pre-established and accepted criteria.	Positive	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	Low	1		Low	1
Duration	Long-term	3		Long-term	3
Consequence	Low	5		Low	5
Probability	Definite			Definite	
Significance	**Very Low***			**Very Low***	

Note: * the significance rating has been downgraded to Very Low, given the discussed above.

Impact: Regional economic stimulation, due to increase in power availability

Impact Assessment

The Namaacha - Boane 66 kV powerline will evacuate the renewable energy generated at CEN in Namaacha to Boane substation, improving the evacuation of power generated within the southern region and subsequent future distribution. By injecting electricity generated from a renewable source into the grid, the project will indirectly contribute, cumulatively with the wind farm, to lower the current external dependence on fossil fuels to produce energy, which is a national priority in economic terms and also regarding climate change mitigation.

This increased power availability, facilitated by the Project, will have a positive impact on the economy and quality of life of Maputo province. On current conditions, the power supply in some areas is weak or even non-existent. The Namaacha - Boane Project will allow for the increase of power supply in Maputo Province and will allow a better distribution of power in areas which are currently not electrified, through the existing or new substations, from which distribution schemes can be developed at a later date.

This, along with the required maintenance activities, can also create business opportunities, mainly related with electrification and the acquisition of construction materials.

All these vectors of economic stimulation will in turn result in the creation of jobs.

This is thus a *positive indirect* economic impact, of *long-term* duration, of *regional* extent and of *medium* intensity, resulting in a *high significance*.

Enhancement Measures

No enhancement measures are required for this positive impact.

Impact Summary

The impact assessment summary is provided in the following table.

Impact: Regional economic stimulation, due to increase in power availability					
Criteria	**Pre-mitigation assessment**		**Enhancement Measures**	**Post-mitigation assessment**	
Nature	Positive		- No enhancement measures are required for this positive impact.	Negative	
Type	Indirect			Indirect	
Extent	Regional	2		Regional	2
Intensity	Medium	2		Medium	2
Duration	Long-term	3		Long-term	3
Consequence	High	7		High	7
Probability	Probable			Probable	
Significance	**High**			**High**	

7.11.2.3 Impact assessment – Community Health and Safety

Impact: Risks to community health and safety due to encroachment into the Protection Zone

Impact Assessment

As previously discussed, during the operational phase a 70 m wide safety protection zone along the power line will have to be maintained and enforced, in order to minimize risks to the transmission infrastructure but also to protect neighbouring communities in the event of an accident (e.g., the fall of a tower or the rupture of a power cable).

One common phenomenon, however, is the progressive encroachment in the protection zone. If uncontrolled, people will tend to start encroaching into the apparently unoccupied area, including building houses and other structures which poses a risk to both the power line and the infrastructures, in case of malfunction or accident.

This risk is assessed as a *negative* impact, *indirect*, of *long-term* duration, of *local* extent (applicable only to any house that encroaches into the protection zone), of *high* intensity (as any incident could result in serious injuries or even fatalities), but of *low probability* (possible) resulting in a *medium* significance prior to mitigation.

Mitigation Measures

This risk can be effectively mitigated by enforcing the restrictions to building houses in the protection zone. The encroachment into the restricted areas that may constitute a risk to the OHL is already one of the aspects that will be monitored during the planned technical inspections to the power line. As such, no further mitigation is required. The restrictions to new construction in the protection zone will be strictly enforced, in order to also safeguard community health and safety and also the line's integrity and safety.

Impact Summary

The impact summary is provided in the following table. With periodic inspection of the protection zone and control of encroachment, the intensity drops to low, resulting in a *very low* residual significance.

Impact: Risks to community health and safety due to encroachment into the Protection Zone					
Criteria	**Pre-mitigation assessment**		**Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Monitor encroachment of infrastructure into the protection zone and strictly enforce the restrictions.	Negative	
Type	Indirect			Indirect	
Extent	Local	1		Local	1
Intensity	High	3		Low	1
Duration	Long-term	3		Long-term	3
Consequence	High	7		Low	5
Probability	Possible			Improbable	
Significance	**Medium**			**Very Low**	

Impact: Potential impacts on workers' health and safety

Impact Assessment

During the operational phase, risks to workers' health and safety will mostly be associated with maintenance works in the transmission line, with the normal operations of the substations, transportation and circulation of workers and waste and hazardous materials management, hence it will not differ from the same risks already assessed for the construction phase.

EDM workers could be exposed to these accidents at the worksite. However, EDM already operates many similar infrastructures (both substations and transmission lines) across Mozambique, and as such already has suitable health and safety procedures and practices in place to address these health and safety risks. The application of the same existing procedures to the Project should help prevent or reduce the probability of accidents from occurring.

In the non-mitigated scenario, the potential impact on workers' health and safety during operations is assessed as *negative*, *direct*, of *long-term* duration, of *local* extent but of *high* intensity (as work accidents could result in serious injuries or even fatalities), resulting in a *high significance*.

Mitigation Measures

As stated above, EDM already has suitable health and safety procedures and practices in place to address the health and safety risks of the operation of substations and transmission lines, as they already operate similar infrastructure. These procedures and practices will be applied to the Project. No additional mitigation is required.

Impact Summary

The impact summary is provided in the following table. The mitigation lowers the intensity and probability of impact occurrence, resulting in a *low* residual significance.

Impact: Potential impacts on workers' health and safety					
Criteria	**Pre-mitigation assessment**		**Mitigation Measures**	**Post-mitigation assessment**	
Nature	Negative		- Implement EDM's existing health and safety policies and procedures for the operation of substations and transmission lines.	Negative	
Type	Direct			Direct	
Extent	Local	1		Local	1
Intensity	High	3		Medium	2
Duration	Long-term	3		Long-term	3
Consequence	High	7		Medium	6
Probability	Probable			Possible	
Significance	**High**			**Low**	

7.12 Decommissioning Phase

As described in Section 4.2.4 of **Volume I**, the design lifetime of the infrastructure is 35 years, although this may be prolonged via maintenance and/or upgrades. The Project's decommissioning phase is thus likely to occur in a relatively distant timeframe, and as such the degree of confidence regarding the activities to be developed at that stage is relatively low. In general, however, the decommissioning phase will likely include the following activities:

- Removal of foundations and towers;
- Removal of wastes and decontamination of sites;
- Disposal of wastes and hazardous materials, in adequate waste disposal facilities; and
- Devolution and reuse of RoW, in line with the proposed end use.

Given the distant timeframe of these activities, a Decommissioning Plan should be developed by EDM prior to decommissioning, which should include all specialist studies required to guide the decommissioning activities and minimize their environmental and social impacts. Decommissioning will be done according to the relevant environmental policies and technical procedures relevant at the time of decommissioning.

The decommissioning of the infrastructure will involve some construction-like activities, mainly dismantling equipment, some demolitions (likely restricted to the tower's foundations), and cleaning/rehabilitating the project affected areas, which can typically cause some localized negative impacts similar to the ones expected for the construction phase, but normally with less extent, intensity and duration, resulting in a lower significance (which is already generally low in construction, as assessed previously).

The most obvious examples of impacts from decommissioning are dust and noise from construction equipment and truck traffic, which can originate nuisances to the sensitive receptor that may exist around the sites or road accesses at the time, but typically short-termed and of low significance. Apart from the short period of air and noise emissions, no other relevant emissions are expected that can cause significant impacts on soils, water resources and or biodiversity. Water and wastewater management plan will be prepared as part of the plan for decommissioning activities.

7.13 Impact Assessment Summary

This section presents a summary of all impacts assessed for the Project, including pre and post-mitigation assessments. It further presents the proposed key mitigation in order to facilitate a global perception of the Project's impacts. The impact assessment summary is presented in tabulated form, separated by environmental component and per project phase, as follows:

- Table 7-20 – impacts associated with the construction phase;
- Table 7-21 – impacts associated with the operational phase.

Table 7-20 – Summary of Project impacts – Construction Phase

#	Impact Description – Construction Phase	Significance Rating		Nature of Impact
		Pre-mitigation	Post-mitigation	
Climate and Climate Change				
1.	GHG emissions during the construction phase	**Very Low**	**Very Low**	(-)
Air Quality				
2.	Increase of dust emissions near sensitive receptors	**Very Low**	**Very Low**	(-)
3.	Increase in atmospheric concentrations of exhaust gases from vehicle and equipment operation	**Very Low**	**Very Low**	(-)
Noise				
4.	Increase of noise levels near sensitive receptors during construction	**Low**	**Very Low**	(-)
Geology				
5.	Potential slope instability	**Very Low**	**Insignificant**	(-)
6.	Adverse effects on geological heritage or mineral resources	**High**	**Insignificant**	(-)
7.	Changes in erosion, transport and sedimentation processes	**Low**	**Insignificant**	(-)
Soils				
8.	Impacts on irrigation lands and on soils with suitability for irrigation	**Low**	**Insignificant**	(-)
9.	Increased soil erosion and compaction	**Very Low**	**Insignificant**	(-)
10.	Potential soil contamination	**Very Low**	**Insignificant**	(-)
Water Resources				
11.	Changes to natural run-off patterns and water bodies	**Low**	**Insignificant**	(-)
12.	Accidental contamination of surface and/or ground waters	**Low**	**Very Low**	(-)
13.	Increase of suspended sediments in water bodies	**Low**	**Very Low**	(-)
14.	Changes in groundwater recharge	**Insignificant**	**Insignificant**	(-)
Landscape				
15.	Temporary degradation of landscape at worksites	**Low**	**Very Low**	(-)
Biodiversity				
16.	Wetlands and riverine areas degradation	**Medium**	**Very Low**	(-)
17.	Direct loss of vegetation units and habitats	**Medium**	**Very Low**	(-)
18.	Degradation of nearby vegetation units	**Insignificant**	**Insignificant**	(-)
19.	Reduction of feeding, breeding and roosting areas	**Medium**	**Low**	(-)
20.	Increased fauna mortality and decreased species diversity	**Low**	**Very Low**	(-)

#	Impact Description – Construction Phase	Significance Rating		Nature of Impact
		Pre-mitigation	Post-mitigation	
21.	Possible introduction or spread of invasive species in the Project area	**Very Low**	**Insignificant**	(-)
22.	Exclusion of fauna species due to increase of disturbance	**Very Low**	**Insignificant**	(-)
Socio-economic environment				
23.	Involuntary resettlement as a result of the establishment of the transmission line's Protection Zone	**High**	**Medium**	(-)
24.	Disturbance of cultivation areas due to the construction of the transmission line and establishment of the Protection Zone	**Medium**	**Low**	(-)
25.	Creation of employment opportunities	**Very Low**	**Very Low**	(+)
26.	Transfer of skills to local communities due to mobilization of construction workforce	**Medium**	**Medium**	(+)
27.	Local and regional economic stimulation due to construction expenditure	**Very Low**	**Low**	(+)
28.	Loss of cultural heritage sites	**Medium**	**Low**	(-)
29.	Increase in road traffic and potential damage to existing roads and other public infrastructures	**Low**	**Very Low**	(-)
30.	Potential public safety impacts as a result of Project construction and increased traffic volumes	**Low**	**Very Low**	(-)
31.	Risk of social conflicts elicited by the Project security personnel	**Very Low**	**Very Low**	(-)
32.	Potential impacts on workers' health and safety during the construction phase	**Low**	**Very Low**	(-)

Table 7-21 – Summary of Project impacts – Operational Phase

#	Impact Description – Operational Phase	Significance Rating		Nature of Impact
		Pre-mitigation	Post-mitigation	
Noise				
33.	Wind-induced noise	**Low**	**Very Low**	(-)
Landscape				
34.	Permanent alteration to the landscape	**Medium**	**Low**	(-)
Biodiversity				
35.	Indirect degradation of vegetation units and habitats along the RoW	**Very Low**	**Insignificant**	(-)
36.	Increased mortality of bird and bat species due to collisions and electrocution	**Medium**	**Low**	(-)
37.	Habitat fragmentation due to the presence of the RoW	**Medium**	**Low**	(-)
Socio-economic environment				
38.	Creation of employment opportunities	**Very Low**	**Very Low**	(+)
39.	Regional economic stimulation, due to increase in power availability	**High**	**High**	(+)
40.	Risks to community health and safety due to encroachment into the Protection Zone	**Medium**	**Low**	(-)
41.	Potential impacts on workers' health and safety	**High**	**Low**	(-)

7.14 Cumulative Impacts

7.14.1 Potential Cumulative Effects on Valued Environmental and Social Components

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity in combination with other existing, planned, and/or reasonably anticipated future ones.

According to IFC (2013), a cumulative impact assessment (CIA) is the process of:

- Analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on chosen Valued Environmental and Social Components (VECs) over time; and
- Proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risks to the extent possible.

Because it is unrealistic to think that every environmental and social component can be subjected to a cumulative impact assessment, it is good practice to focus on VECs. VECs are sensitive or valued receptors of impact. In other words, they are environmental and social aspects that are considered to be important in assessing the risks and may include physical features, biodiversity (e.g., habitats or wildlife populations), ecosystem services, natural processes (e.g., water and nutrient cycles, microclimate), social conditions (e.g., health, economics), or cultural aspects (e.g., traditional spiritual ceremonies).

The key analytical task is to discern how the potential impacts of a proposed development may combine cumulatively with the potential impacts of existing or future project within the project area of influence. To a certain extent, cumulative impacts with other human activities and other natural stressors such as droughts or extreme climatic events may need to be addressed. Other human activities of greatest importance in a cumulative impact assessment are those that (a) will occur in the future, or, if already existing, have ongoing influences on the environment in the future, and (b) are expected to interact with the same VECs in the future as does the development under assessment.

The selection of the VECs to consider in this assessment was based on *(i)* their biophysical and/or socioeconomic importance in the areas crossed by the proposed Project, *(ii)* the degree of impact on the VEC resulting from the proposed Project and *(iii)* the findings of the EIA public consultation activities. As the goal is to assess cumulative impacts, in principle only VECs which are significantly affected by the proposed Project should be considered. This means that, in principle, only VEC's for which the Project is expected to generate relevant negative or positive residual impacts should be included in the assessment (i.e., environmental and social aspects with residual impacts of medium or higher significance).

However, considering the transmission line project's inherent interconnectedness with the CEN wind power plant, exceptions to this were impacts associated with habitat loss and fragmentation and avifauna, which were all assessed to be of low residual significance but were included in the analysis, given the concerns regarding potential cumulative impacts. In the same way, impacts on employment were also included, as obvious cumulative impacts will arise.

A total of 3 VECs have been selected for the current assessment: They are listed below, along with the indicative aspects that will be considered for the evaluation of cumulative aspects (the indicative aspects reflect the way in which the Project impacts the VEC):

- Flora and vegetation. Indicative aspect: loss of habitats and habitat fragmentation;
- Avifauna. Indicative aspect: decrease of populations (increased mortality);

- Local communities and socio-economic impacts. Indicative aspects: employment opportunities; resettlement impacts; Economic and social development due to increased electricity supply.

The cumulative impact assessment also requires that a realistic area and time period be established within which present and future projects are identified, i.e., the definition of spatial and time boundaries, as per IFC (2013). These were defined as follows:

- Spatial boundary - the Project's Area of Indirect Influence (AII), i.e. the territory of the Districts crossed by the OHL route was selected (please see a more detailed description of the Project's AII in Chapter 5 of **Volume I**). This is the widest area where Project impacts will be felt, and thus that cumulative impacts with other projects can be generally expected;
- Time boundary - a period of 5 years was selected, as the predictions of new projects and developments beyond that timeframe is very uncertain. However, cumulative impact assessment (CIA) will consider the project's expected lifespan, at least 35 years.

As far as relevant planned new developments for the area of interest (Districts crossed by the Project):

- The CEN wind power plant (CEN WPP), a 120 MW wind farm within a site of approximately 855 ha near Namaacha town The generated electricity from this power plant will be evacuated by the 66kv transmission line. The wind farm followed its own EIA process and has already secured its environmental license from the MTA.

Figure 7.4 shows the new developments selected for Cumulative Impact Assessment.

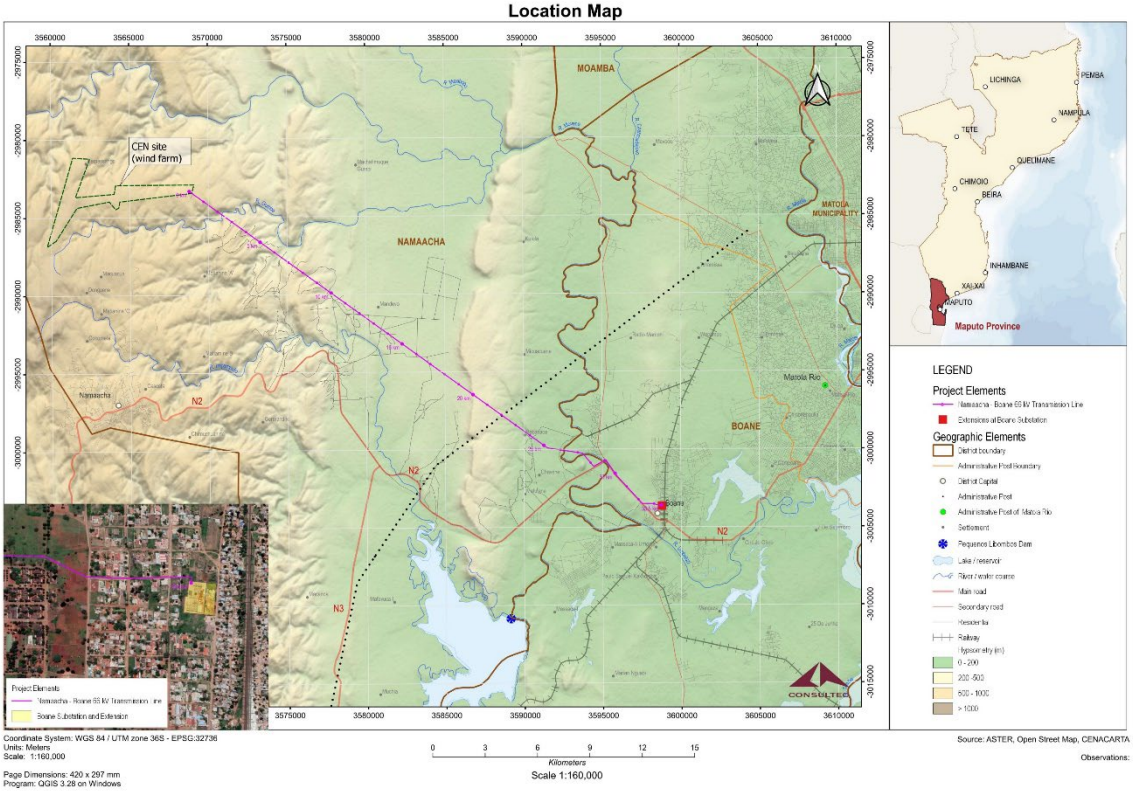


Figure 7.5 – Planned developments considered for Cumulative Impact Assessment

No other major developments that might generate relevant interactions with the proposed Project are known to be planned for these districts[7]. However, it is likely that the 66 kV Namaacha – Boane transmission line will contribute to the development of the distribution electric grid, and as such the following generic development was considered:

- Continuous development of the secondary electric grid, enabled by the new transmission lines.

In terms of existing vectors of human development, which may have cumulative impacts with the Project, these include:

- The continuous expansion of the major urban centres in these districts, both from natural growth and from migration from rural areas;

7 Note that the STE Project Phase I – 400 kV OHL Vilanculos - Maputo is likely to be implemented in the near future, but despite terminating in the eastern edge of Boane District (Maputo substation, at Beluluane) does not seem capable of having relevant interactions with the Namaacha – Boane 66 kV line.

- The increasing clearance of woodlands, due to the expansion of slash and burn agricultural practices and the exploitation of natural resources, namely firewood collection and charcoal production. This occurs in all concerned districts.

The potential effects of these planned projects and development vectors on the selected VECs are listed in Table 7.22.

Table 7.22 – Potential effects of planned development and vectors of development on VECs

Planned projects and vectors of development	Potential Effects on VECs		
	Flora and vegetation	Local communities and socio-economic impacts	Avifauna
The CEN wind power plant	- Local loss of habitats and habitat fragmentation	- Local resettlement impacts - Employment opportunities - Increased electricity supply; Economic and social development	- Loss of habitats - Increased avifauna mortality
Development of secondary electric grid	- Localized loss of vegetation	- Typically, no relevant resettlement impacts, as the RoW for the secondary grid is much smaller and typically low voltage power lines routes follow existing roads - Increased access to electricity; Economic and social development	- May have some localized impacts on avifauna mortality, but much lower than that caused by high-voltage power lines
Expansion of major urban centers	- Increased loss of natural habitats	- Not applicable	- Loss of habitat, but no direct impact on avifauna mortality
Clearance of woodlands due to farming and natural resources exploitation	- Increased loss of woodland habitats	- Not applicable	- Loss of habitat, but no direct impact on avifauna mortality

7.14.2 Assessment of Cumulative Impacts on VECs

Evaluation of cumulative effects takes into consideration the potential impacts that could be generated by the Project and adds those generated by the identified planned developments and vectors of human development.

7.14.2.1 Flora and Vegetation

Impacts on flora and vegetation resulting from the Namaacha – Boane 66 kV Project include:

- Direct loss of vegetation units and habitats (mostly undifferentiated woodlands, after agricultural land) during the construction phase, due to the clearance of the RoW. This

negative impact was assessed to be of *medium* significance, prior to mitigation, with a residual very *low* significance impact remaining after mitigation;

- Indirect degradation of natural habitats (mostly undifferentiated woodland habitats) along the RoW during the operational phase, in particular due to the expanse of agriculture and natural resources exploitation along the RoW, given the increased ease of access to presently inaccessible areas. This negative impact was assessed to be of *very low* significance, prior to mitigation, with a residual insignificant impact remaining after mitigation;
- Habitat fragmentation, caused by the establishment and maintenance of the RoW, translating into a linear long corridor with modified vegetation, which will likely be composed of secondary shrub (as the growth of larger trees will be controlled through maintenance activities. This negative impact was assessed to be of *medium* significance, prior to mitigation, with a residual *low* significance impact remaining after mitigation.

The identified projects and vectors will affect this VEC as follows:

- The CEN wind power plant will result in similar impacts regarding loss of vegetation (mostly degraded acacia woodland) but globally of lower magnitude, generally insignificant after mitigation. No fragmentation impacts are expected.
- The development of the secondary grid may result in localized loss of vegetation, but no relevant impact at habitat level is expected, as typically the secondary grid develops along existing roads;
- The expansion of urban areas, and of agriculture and natural resources exploitation, will result in a progressive loss of natural habitats, in particular woodland habitats, in the areas surrounding urban centres. Depending on the way these areas expand, they could also cause fragmentation of habitats. This aspect, however, is impossible to assess without the knowledge on how exactly human presence will expand in this territory.

The direct loss of habitats caused by the Project will have a cumulative effect with the losses of habitat caused by the listed development and vectors of human development. However, the cumulative effect is not anticipated to be significant.

7.14.2.2 Avifauna

Potentially relevant impacts on avifauna are the increased mortality of birds (particularly birds with large wing spans) and bats, due to collisions and electrocution with the overhead line and towers. This impact is one of the major impacts of high-voltage power lines and is typical of this project typology. The conducted assessment concluded that the pre-mitigation negative impact could be of medium significance, but the proposed mitigation measures would be able to reduce it to low.

In a similar way, bird and bat mortality (due to collisions) and disturbance are also one of the main negative impacts associated with wind farms. These impacts for CEN wind power plant have been assessed as having low to moderate significance negative impacts prior to mitigation but resulting in low to insignificant residual impacts considering the proposed measures.

In face of the above, it is not expected that the cumulative effect between the two projects will be able to significantly increase the individually anticipated impacts, thus keeping the residual cumulative impact of low significance.

No other considered planned project or vector of development has a similar direct impact on bird mortality. The secondary electric grid may result in a small increase of bird mortality, but localized and of a much lower intensity than the WPP and the 66 kV OHL, due to the different characteristics of the line infrastructure. All the vector of development will likely result in loss of habitats over time, which could result in an indirect cumulative impact on bird and bat populations, but this effect is expected to of minor relevance.

7.14.2.3 Local communities and socio-economic impacts

The most important impact of the Project on local communities are the one deriving from resettlement - the loss of dwellings and other built infrastructure, as well as agricultural plots and businesses - due to the clearance of the RoW. This negative impact was assessed to be of *high* significance, prior to mitigation, with a residual *medium* significance impact remaining after mitigation.

The CEN wind power plant project is expected to also require resettlement of receptors being affected by the shadow effect, noise, or both. Initial studies indicated around 30 cases, still to be confirmed in the RAP phase. There may also be PAPs that require resettlement for both the transmission line and the wind farm itself.

While these numbers will sum up, particularly in the Namaacha District, they are considered to still translate into a residual medium significance impact, admitting the correct implementation of the correspondent RAPs, as proposed in the EIA/RPFs.

Concerning employment opportunities:

- The 66 kV OHL will have a construction workforce estimated to reach a peak of 200 people (spread over an 18 month period), backed by indirect jobs, that may reach 1,5 to 2 times the number of direct jobs. Nevertheless, the positive direct and indirect impact on employment was assessed as of very low significance even post enhancement.
- Considering the wind farm's construction, to be deployed in parallel, this number can rise to around 330, highlighting a cumulative impact between the two projects. The wind power

plant's EIS considers the positive impact on employment as of high significance after enhancement.

As for economic and social development, both developments go in the same direction, combining synergies to boost the regional energy sector, by providing clean energy and reducing dependence on fossil fuels for power generation, which is a national priority in economic terms and also regarding climate change mitigation. A wide range of cascading indirect impacts will be stimulated by increased power availability, such as general economic development, that by its turn will create jobs/income, demand for a wide range of products and services, tax revenue, social development, etc. This will confirm an expected high significance cumulative positive impact.

8 Public Participation Process

8.1 Introduction

Public participation Process (PPP) is one of the key components of an EIA process. It involves relevant stakeholders, including those interested in or affected by the proposed project, in terms of opportunities, risks, and issues of concern. Public participation thereby assists the Project team to take into accounts relevant local conditions instead of imposing project designs that potentially pose risks and impacts to environment and social receptors. Fulfilling the basic requirements of public participation is a legal requirement, and failure to address this aspect can create significant risks to project development.

The PPP undertaken in this EIA process was developed according to Mozambican EIA Regulations and in line with international best practices. The relevant documents that guided the PPP were the following:

- General Guidelines for Public Participation Process in the EIA process, Ministerial Diploma No 130/2006: this diploma provides the guidelines to be followed in any PPP undertaken as part of an EIA process, as regulated by Decree 54/2015.
- Equator Principle (EP4 revision) 5 (Stakeholder Engagement), which states that public consultation with project affected communities shall be well structured and undertaken in a culturally adequate manner.
- IFC Performance Standard 1 (Assessment and Management of Social and Environmental Risks and Impacts).

In accordance with national legislation and in line with international best practice and standards, the Project requires public participation and stakeholder engagement during the various stages of the Project's lifespan and in relation to specific Project activities. Given the nature of the Project, participation and engagement with stakeholders has, thus far, been carried out in accordance with national legislation and the licensing procedure. The PPP was initiated during the EPDA phase in December 2022 (first-round of PPP), following the national EIA guidelines, rather than as a part of a single coherent overall plan as per the IFC's performance standards.

In accordance with Ministerial Diploma No. 130/2006, the PPP for the EIA process includes consultation in two phases: early in the EIA process (Scoping/EPDA Phase) and again during the EIA/EIS phase. This is also in accordance with Equator Principle 4, which states that disclosure should occur early in the assessment process and on an ongoing basis during the preparation of EIA. This approach was adopted given the facts that the Project requires significant participation of the local and district authorities, and that the legislative framework grants decision making powers –

with respect to the number of engagements and the final choice of participants – to the provincial and district authorities. Having said this, however, public participation and stakeholder engagement has adhered to the principles outlined in the IFC's performance standards.

The overall PPP as per national legislation includes:

- Mapping and identification of stakeholders.
- Definition of engagement principles and methodology.
- The disclosure and availability of documentation for a 30-day period (15 days prior to and after public meetings).
- Public meetings and other stakeholder engagement activities, including community level stakeholder engagement, undertaken simultaneously with the social surveys field work and to disclose the RPF, in coordination with the EIA/EIS phase PPP.
- Inclusion of issues raised in the public meetings on the reports drafted as part of the EIA process. and
- Documenting stakeholder concerns, issues, and feedback/input.

The PPP for the EPDA phase was undertaken in December 2022. The main activities of the PPP for the EPDA phase are described in Section 8.3 below, including a comment register table, which provides a summary of all the main comments and issues raised by Interested and Affected Parties (I&APs) at that stage, and the way they were considered or addressed in the EIS preparation.

The Draft EIS Report, following the EPDA phase, was compiled to support the PPP activities of the EIS phase. A summary of the main activities is presented in section 8.4. After the conclusion of the EIS PPP, the main findings are documented in the PPP Report (**Volume V**), which maker part of the EIS final report, for submission to MTA.

8.2 Objectives of the Public Participation Process

The main objective of the consultation process is to inform all I&APs of the proposed activities and their potential impacts, allowing them an opportunity to present their views, concerns, and expectations regarding the project.

The PPP is based on the following principles:

- Understanding the social and environmental context of the project's footprint area is a key element for a successful impact assessment. I&APs are valuable sources of relevant local information, context, and issues.

- The development and promotion of trust in the PPP are fundamental for a positive and effective communication and involvement of I&APs and to ensure a successful impact assessment process. The fundamental element in creating the referred trust is to ensure an open and transparent EIA process.
- Engaging I&APs allows for a more comprehensive and supportive EIA process through comments received and opinions expressed.
- I&APs have the right to express their opinions and receive answers to their concerns. and
- The process of disclosure and availability of information is a fundamental element for a participatory EIA process, constitutes a legal requirement and follows best practices.

Based on such principles, and in accordance with the above-mentioned guidelines, Table 8.1 summarizes the main objectives of the EIA PPP.

Table 8.1 – Summary of PPP Objectives

OBJECTIVE	METHOD / APPROACH
Identify all Project I&APs	Involving as many I&APs as possible can facilitate good communication and capture a wider range of issues and concerns. Interaction with stakeholders should aim to represent the perspectives of all stakeholders, including relevant civil society groups.
Disseminate accurate information about the project	Ensure that information is available to the I&AP in their local languages, particularly those directly affected by the proposed project, to allow them to make appropriate comments and enable them to plan for their future, thereby reducing levels of uncertainty and anxiety. The information should allow parties to develop an understanding of the potential impacts, risks, and benefits of the Project.
Collect relevant information for technical and environmental studies	Identifying issues through people familiar with the local environment and social context, and including them in the scope of the assessment, ensures expert focus on relevant issues. It is also important to ensure the best appropriate Project design and management.
Promotion of constructive interaction between all parties	Developing a relationship of trust between the developer and I&APs contributes to proactive interactions and avoids, where possible, unnecessary conflicts based on rumours and lack of information. Identifying structures and processes for resolving conflicts and complaints, rather than stonewalling disputes, can provide a better understanding of *stakeholder* concerns and expectations, thereby increasing the opportunities to enhance the benefit of the Project for them.
Record and respond to the public's concerns, questions, and suggestions	Documentation of I&AP issues allows for follow-up and justification of Project decisions and provides the opportunity for participants to track the inclusion of their input into the planning and design process. This documentation reduces the potential concern of I&APs that their consultation is merely a token gesture by developers to comply with legal requirements.
Manage I&AP's expectations	Maintaining realistic expectations (e.g., about employment opportunities, provision of local infrastructure, social development, disruption to daily life and applicable compensation), limits disillusionment and frustration of directly affected parties at later stages of Project implementation. Frustration and unrealized expectations are conflict instigating factors and require mitigation and management, which can be avoided through proper PPP.
Comply with national and international public consultation requirements	Ensuring compliance with regulatory standards can avoid potential project delays resulting from purely procedural issues.

8.3 Public Participation Process of the EPDA Phase

In accordance with the EIA regulations and international standards, a PPP was undertaken in the EPDA phase. The following sequence of activities were carried out:

Table 8.2 – Main PPP activities for the EPDA phase

Activity	Objective
Compilation of I&APs database	To identify the I&APs to be included in the consultation process
Disclosure of the Draft EPDA report	To allow the authorities and general public to comment on the Project and the EPDA
Media advertisement for the public meetings	To convoke the I&APs to participate in the public meetings
Delivery of invitations to the public meetings (letters and faxes)	
Telephone follow-up calls to confirm the reception of invitations	
Public meetings	To receive and document comments and questions from the participants
Written comments reception period	To receive written comments to the Project or EPDA
Compilation of the PPP Report and its integration in the EPDA Final Report	For review, comment, and approval of MTA

A total of two public meetings were held for the EPDA PPP, as listed in Table 8.3.

Table 8.3 – Public meetings held for the EPDA's PPP

Location	Venue	Date	No. of participants
Namaacha	Centro de Formação de Professores	13/12/2022	49
Boane	Boane District Administration Meeting Venue	14/12/2022	37

The main questions, suggestions and comments raised during the public participation process were related to the following aspects:

- The consideration of a Security Plan for potential threats (during construction works and during operation);
- The potential use of the right-of-way for illegal activities and the role of the Mozambique Police;
- Expectations regarding employment; Hiring of local workforce and involvement of local leaderships in the recruitment; preparation of local youth to assist on the project construction;
- Questions and recommendations regarding the resettlement process; Conducting a fair and transparent process (involving communities and leaders);

- Benefits of the project for the districts;
- Allocation of energy at a lower price to affected communities;
- Opportunities to build a substation in Namaacha;
- Concerns about the concrete poles that are being placed along the road, whether they belong to the project or not;
- Corporate Social Responsibility: Support for the communities where the project will cross - Construction of health units and schools; energy allocation (a direct connection from the wind farm to the community without having to go through Boane);
- Evaluation of the possibility of energy support to the Kingdom of Eswatini, considering that in times of water shortages these have increased the river flows to Mozambique;
- Liaise with CFM regarding their future projects that may interfere with the line; and
- Analyse the risk of contributing to global warming due to the trees felling.

The raised questions, suggestions and comments were considered in the EIA preparation, especially in Section 7 (impact assessment and mitigation measures).

8.4 PPP in the EIS Phase

8.4.1 Identification of I&APs

For the PPP during the EIS phase, the I&AP database that was compiled during the EPDA Phase was updated.

8.4.2 Disclosure of the Draft EIS for Comments

The Draft EIS, along with a Non-technical Summary (NTS), was made available to I&APs to allow public analysis and comments. These documents were available at the following venues, from the 3rd of October 2023:

- National Directorate for the Environment (DINAB - MTA) in Maputo.
- Maputo Provincial Environment Services.
- Namaacha District Administration;
- Boane District Administration; and
- Consultec's office in Maputo.

Additionally, the EIS Draft Report was also available on Consultec's website (www.consultec.co.mz) throughout the consultation period. The website was be mentioned in the public announcement. The

Draft EIS was available to I&APs for comment 15 days prior to the public meetings (see Section 8.4.4), to allow enough time for I&APs to review the EIS and effectively participate in the public meetings (18th and 19th of October 2023). The documents will be available for an additional 15 days after the public meetings (2nd of November 2023) to allow for any written comments.

8.4.3 Advertisement and Notifications

As per the EIA regulations and considering the type and nature of the I&APs identified, two specific information disclosure methods will be used, namely public announcements in the media and direct invitation letters.

Media disclosure aims to inform the public in general regarding the PPP. As such, advertisements were placed in Mozambique's main newspaper (*Jornal Notícias*) in the two weeks preceding to the public meetings (3rd of October 2023).

In addition, individual invitation letters and facsimile were sent to all I&APs on the stakeholder database. During the week prior to the consultation meetings, telephone calls were made as a follow up.

8.4.4 Public Meetings

As in the EPDA phase, two public meetings were held as part of the EIS PPP, in Namaacha and Boane.

The meetings took place on October 18th and October 19th, 2023, 15 days after the disclosure of the Draft EIS Report, to allow I&APs to review and thus participate in public meetings with a background knowledge of the project. Table 8.4 indicates the venues and dates of the consultation meetings, as well as the number of participants registered at each meeting.

Table 8.4 – Public meetings held for the EIS's PPP

Location	Venue	Date	No. of participants
Namaacha	Centro de Formação de Professores	18/10/2023	40
Boane	Boane District Administration Meeting Venue	19/10/2023	.38

The consultation meetings were conducted face-to-face using an audio-visual presentation covering the Project and the main findings of the EIS Draft Report. A Non-Technical Summary (NTS) was distributed to all meeting participants to allow a better understanding of the project.

The presentation was followed by an open question and answer period, during which the I&APs were encouraged to express their views and to raise questions and concerns regarding the project and the EIA process.

At the end of the meetings, I&APs were informed that further comments and suggestions could be sent by either e-mail, fax or postal address till the next 15 days after the meetings (2nd of November 2023).

The PPP Report (**Volume V** of the EIS) provides additional information and documentation on these meetings, including attendance register, minutes and photographs.

9 Conclusions and Recommendations

EDM (the Proponent) propose the construction of a new 33.5 km long 66 kV Transmission Line connecting the Namaacha Wind Power Plant (CEN) to Boane Substation, in Maputo Province. This report presents the findings of the impact assessment of the proposed project, developed in compliance with the terms of reference for the EIS, defined in the EPDA phase. All expected positive and negative impacts on the receiving biophysical and socioeconomic environment were identified and assessed both in the pre-mitigation scenario and following the implementation of the recommended mitigation and enhancement measures (the residual impacts).

The construction and operation of the transmission line will generate a wide range of different impacts on the receiving environment. In the construction phase, these are mostly related to the changes to land use in the construction site, the clearance of the RoW and the construction activities themselves, which require the mobilization of the workforce and the operation of heavy machinery and equipment along the (linear) construction area. In the operation phase, most of the transmission line impacts are associated with the presence of the overhead line itself, as well as with the RoW maintenance activities. Regarding the substation, only minor upgrades are needed within EDM's existing Boane site, thus the related impacts are irrelevant.

The results of the impact assessment exercise conducted in this EIS are summarized in a tabulated form in Section 7.13 (a detailed discussion of the impacts is provided in section 7). Assuming the implementation of the mitigation requirements, almost all of the Project's negative impacts (35 out of 36 identified negative impacts in both phases) were rated as of insignificant, very low or low significance in the post-mitigation scenario.

No high significance negative residual impacts were identified and only one negative impact was rated as of medium significance in the mitigated scenario, thus being the most relevant one: Involuntary resettlement as a result of the establishment of the transmission line's Protection Zone.

Despite the proposed alignment for the transmission line has been designed with the general strategy of not crossing settlements, as much as possible, it will nevertheless require the physical and economic relocation of some affected people,. In this context, further refining of the transmission line route is a recommendable next step to further reduce this impact.

The general principle of mitigation is that all losses are to be fully compensated for, in such a way to ensure that the current quality of life of the affected families is at least maintained, and if possible improved. This will be achieved through the development and implementation of a Resettlement Action Plan, to keep the final impact significance at a social and economic acceptable level.

A broad set of other mitigation measures were recommended to avoid or minimize other less significant impacts, of which some of the more relevant include the implementation the adoption of control measures in the design of line and towers, to minimize bird collisions.

The mitigation of the indirect impact of the possible encroaching into the RoW during the operational phase will require coordinated effort by several government agencies, to avoid the establishment of settlements in the RoW and to control human activities with the potential to impact own and the powerline's safety, as well as impacts on biodiversity, such as hunting, deforesting, harvesting, etc.

In what regards positive impacts, a highly significant primary impact was identified in the socioeconomic environment, along with others of lesser importance, and which can be summarized as follows:

- By injecting electricity generated from a renewable source into the grid, the project will indirectly contribute, cumulatively with the wind farm, to lower the current external dependence on fossil fuels to produce energy, which is a national priority in economic terms and also regarding climate change mitigation.
- This increased power availability, facilitated by the Project, will have a positive impact on the economy and quality of life of Maputo province. On current conditions, the power supply in some areas is weak or even non-existent. The Namaacha - Boane Project will allow for the increase of power supply in Maputo Province and will allow a better distribution of power in areas which are currently not electrified, through the existing or new substations, from which distribution schemes can be developed at a later date.
- For the same reasons, the development of the Project could also create business opportunities. All these vectors of economic stimulation will in turn result in the creation of jobs and economic and social development, in general. This impact, which is indeed the main goal of the Project, was assessed as a high significance residual positive impact.

Considering the above, the Project will result in both positive and negative impacts on the receiving environment, which was to be expected. However, it should be noted that no high significance residual negative impacts were identified and that the positive impacts seem to outweigh the negative ones, resulting in a favourable balance, and as such the Project is considered to be environmentally feasible, if all mitigation and enhancement measures outlined in the EIS are implemented by the Proponent.

The Project's EMP (**Volume III** of the EIS) summarizes and provides structure for managing the prevention and mitigation measures during construction and operational phases and monitoring its effectiveness. It is recommended that the EMP is strictly adopted and further developed, by the Project Proponent, into an Environmental and Social Management System (ESMS), to ensure that the Project is conducted and managed sustainably. The Project Proponent shall ensure that its contractors contractually abide by the EMP and relevant environmental and social action plans (ESAP), by making it as part of the contractors' contractual obligations, whenever applicable and pertinent.

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