VOLTALIA 40 MW SOLAR PV DWANGWA, MALAWI

DRAFT ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

CES

ENVIRONMENTAL AND SOCIAL ADVISORY SERVICES

PROPOSED 40MW SOLAR PV FACILITY NEAR DWANGA, MALAWI

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

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EXECUTIVE SUMMARY

Voltalia, a global renewable energy producer and independent power producer (IPP), intend to construct a 40 MWAC solar photovoltaic (PV) power plant near Dwangwa town in, Nkhotakota district, Central Malawi. The Dwangwa Solar PV power plant will comprise of photovoltaic solar panels that cover an area of approximately 60 ha (Figure 1). Additional infrastructure on site will include a security guardhouse, an operations and maintenance building, internal gravel roads, a single circuit 132kV powerline and a substation. The overall Project investment cost across all phases of the Project is approximately USD 60,951,442.

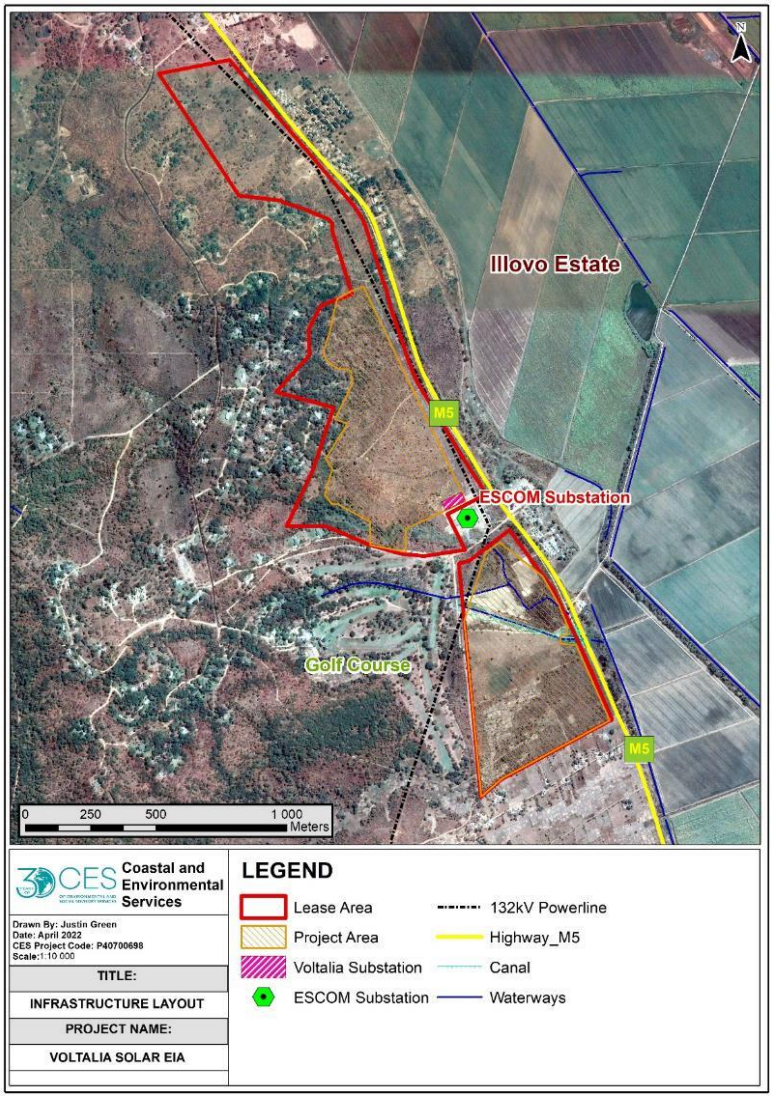

Figure 1 Project Site showing the lease area and smaller areas that will be used within those lease areas for the project infrastructure.

CES was appointed by Voltalia to undertake an EIA in line with the requirements of the Malawian laws (including the Environment Management Act (1996)) and regulations as well as the requirements of international finance institutions (IFI). On the basis of the initial design a Project Brief was submitted by Voltalia to the Environmental Affairs Department (EAD) now the Malawi Environmental Protection Authority (MEPA) on the 29 June 2021. Following a review of the Project Brief, in line with the EMA, it was confirmed by the MEPA on 30 July 2021 that the Project required a detailed Environmental Social Impact Assessment (EIA) (see Appendix 1).

A Scoping Report was prepared in February 2022. The purpose of the Scoping Report was to identify the potential interactions between the Project related activities and the existing environmental and social resources/receptors and to prioritise the scope of work for the ESIA assessment. Formal stakeholder engagement was undertaken with Government Departments and project affected communities (see Appendix 7 and 8).

The Scoping Report identified a number of potential impacts that required further assessment in the ESIA stage:

- Job creation / economic improvements
- Economic displacement
- Environmental impacts (loss of sensitive vegetation – miombo woodland)
- Site and community health, safety and security
- Waste (solid and liquid)
- Gender based sensitivities – HIV, pregnancies, GBV

It is important to note that the project layout has been modified to accommodate those impacts which were deemed to be significant and involving particularly sensitive habitat (Figure 2) informed by specialist studies (see Appendix 2, 3, 4). The main changes were to avoid the development within the closed miombo woodland to the west of the site and the exclusion of the wetland/rice paddy west of the ESCOM substation and the irrigation channel on the eastern side of the site, adjacent to the M5.

As a result, the project is likely to result in the loss of 4.83 ha (8% of the project site) of high sensitivity habitat and 22.03 ha (36.7% of the project site) of moderate sensitivity. Human activity has substantially modified the Project Area's primary ecological functions and species composition, and the habitats there conform to modified habitats as described in PS6 (paragraph 11). While some Species of Conservation Concern are considered likely to be present and areas of Miombo woodland and wetlands are considered to have high sensitivity no critical habitats are expected to occur. Therefore, a critical habitat assessment following IFC PS6 is not necessary.

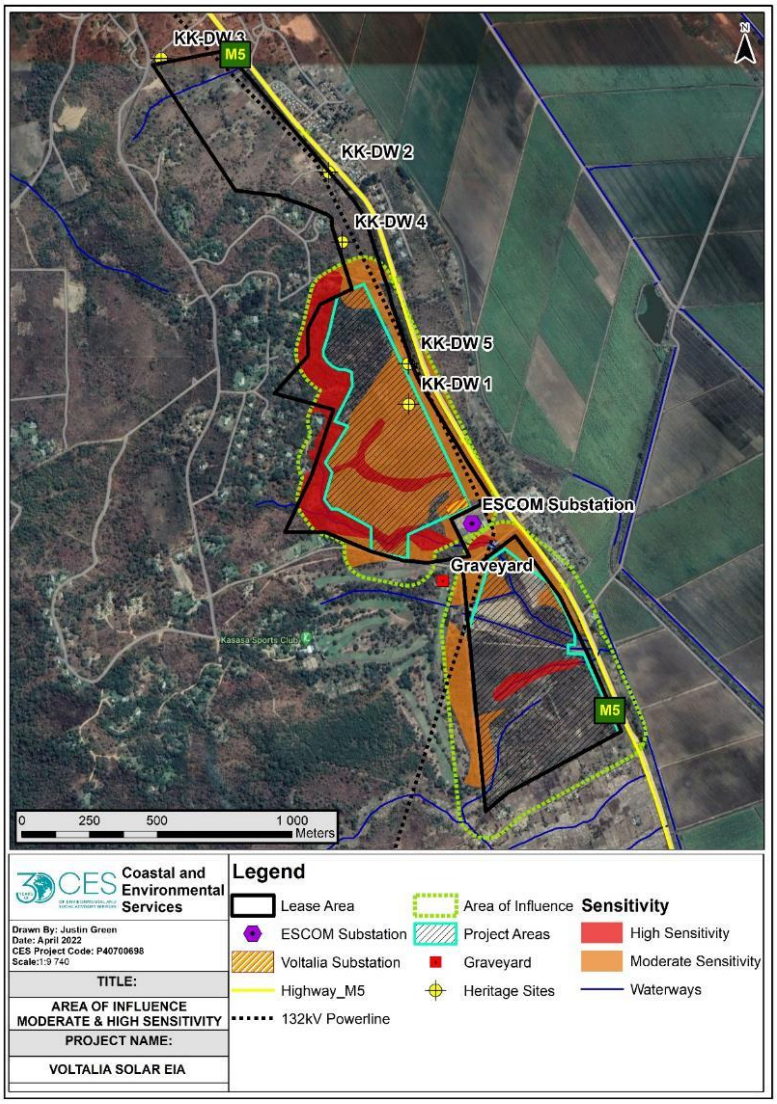

Figure 2 Environmental sensitivity identified through specialist field work and analysis.

The project area is located on Illovo's leased land. This is not customary tenure land and there are no traditional authorities involved in the allocation or management of land in this area. The land has been used by Illovo and by the Illovo staff and family members living immediately adjacent to the proposed project area (Figure 3).

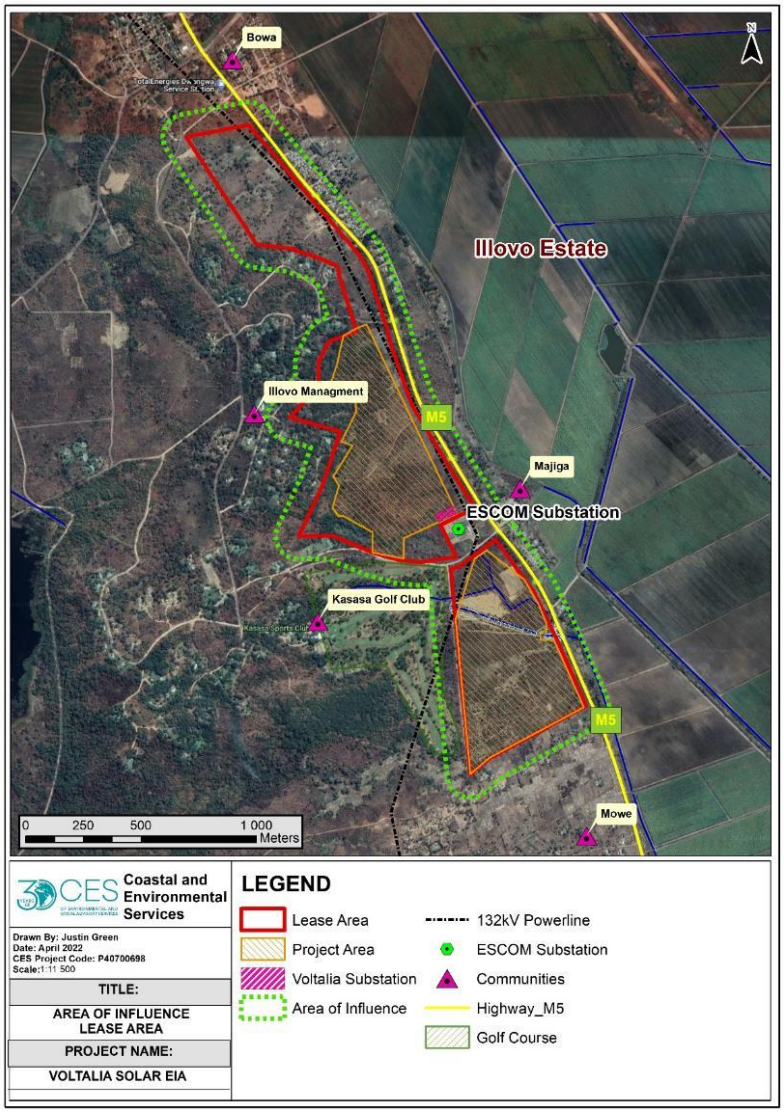

Figure 3 Communities in proximity to the site

These residents live in staff housing belonging to Illovo and to the Dwangwa Cane Growers Association and are informally using the proposed Voltalia project land for cultivation. The site is not used for collecting fuelwood or water, hunting or any other use.

In line with IFC requirements this Environmental and Social Impact Assessment (ESIA) has been prepared to identify impacts anticipated during the construction, operation and decommissioning phases of the project.

The impacts identified as part of the ESIA have been summarised in the sections below and in Table 1 and Table 2.

The construction phase of the project will have the most significant impact on the project area through the site preparation activities, the construction of the mounting structures and supporting infrastructure, and the transport of materials to site.

In addition, the modification of the hydrology of the area is anticipated to result in localised flooding in the southern portion of the site and an appropriate design of stormwater management needs to be considered.

The project infrastructure will result in the loss of approximately 0.57 ha of Closed Miombo Woodland, 2.14 ha of Open Miombo Woodland and 31.16 ha Grassland-Savanna Mosaic. Impacts associated with this development include the following:

- Loss of vegetation communities, biodiversity and species of conservation concern will occur as a result of direct clearing during construction and indirect clearing as a result of the displacement of farmlands. The loss of vegetation in these instances is difficult to mitigate and as such are typically high by their very nature.
- Impacts associated with habitat fragmentation, edge effects and the infestation of alien invasive species are easy to mitigate and are thus not considered to be a concern at this specific site.
- Reduction in water quality as a result of increased erosion and runoff.

The project area is on the eastern extent of any remaining natural habitat. Across the M5 road to Lake Malawi vast tracks of sugar cane have been planted. The habitat available within the project area is important for faunal species, particularly the rocky outcrops and rice paddies. The northern lease area is mostly intact. As one moves towards the south, the habitats are more disturbed due to agricultural practices and existing ESOM infrastructure (substation and overhead lines). The southern lease area is considered to be degraded due to sand mining, woodlot and community use of the land. The habitat available in the project area is not unique and occurs west and south of the project area.

As with the biophysical environment, the main impacts on the social environment will occur during the construction phase of the project. Key impacts will be associated with:

- The stripping of the vegetation creating dust nuisance and noise (see Appendix 6);
- The diversion of drainage features and unconsolidated surfaces leading to erosion and poorer water quality;
- Potential disturbance and accident risk through higher traffic volume surrounding the project site;
- The generation and management of waste which could lead to contamination of terrestrial and aquatic environments both on the site and at the receiving site; and
- Potential increase in flooding through the diversion of surface water features (see Appendix 5).

While many of these impacts are considered to be moderate, the application of well known and easily implementable mitigation measures can reduce these impacts to low significance. Further information on mitigation measures is contained with the ESMP (Appendix 9).

Socio-economic impacts are likely to be both positive and negative. All phases of the project are likely to result in job creation for those communities immediately adjacent to the site. In addition, the local community will benefit from being able to provide goods and services to workers on site.

Negative impacts may arise through:

- The limitation of access to the site and ecosystem services which the local communities make use of;
- The use of the land for crops will result in economic displacement; and
- Community health and safety due to the influx of workers and the perceived opportunities that the project brings can impact vulnerable groups.

There are no dwellings located in the proposed project area. The only structures within the site are the ESCOM substation, a water tower and various powerlines that largely run adjacent to the M5 road that forms the eastern boundary of the proposed project area. These structures will not be impacted by the proposed solar plant development. As such, there is only economic displacement (Figure 4), and a Livelihood Restoration Plan (LRP) will be developed to mitigate the impacts as a result. The plan will set out the extent and scale of displacement impacts, engagement related to land acquisition, eligibility and entitlements for affected persons and the implementation, monitoring and evaluation requirements.

In addition, mitigation and preventive measures have been included within the ESMP (Appendix 9) which will minimise the potential negative impacts and the residual risk remains of moderate or minor significance. Positive impacts are expected from the creation of local employment opportunities during the construction phase, capacity building and economic development as well as long term local employment opportunities through on the job training and capacity development. Enhancement measures have been proposed to maximise the potential positive benefits.

The project has the ability to deliver a significant contribution to the power availability and grid stability in the area and therefore, together with acceptable environmental and social impacts, it is recommended the Project continue as planned.

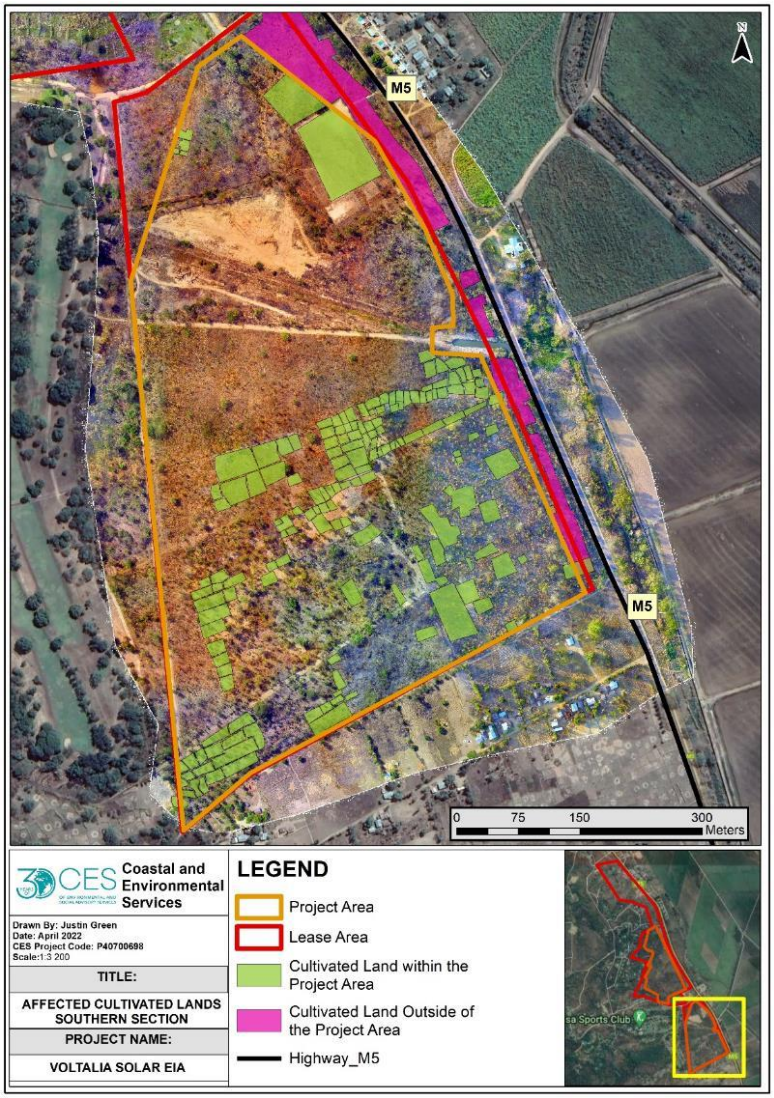

Figure 4 Plot locations within the southern project area.

Table 1 Summary of the significance of impacts for the construction phase

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Soil Quality	Reduction of soil quality as a result of the clearing of plants and trees including the incorrect stockpiling methodology.	MODERATE -	LOW -
Hydrology	The proposed site clearance and construction activities may interrupt surface and/or subsurface flows, leading to flow concentration, change in flow pathways, flow impoundment, increased surface runoff and increased risk of erosion.	LOW -	LOW -
	The results of the modelling show that the southern plot is most likely prone to flooding during heavy rainfalls.	HIGH -	LOW -
Vegetation	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 0.57 ha of Closed Miombo Woodland	LOW -	LOW -
	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the permanent loss of up to 2.14 ha of Open Miombo Woodland.	LOW -	LOW -
	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 31.16 ha of grassland-savanna mosaic.	MODERATE -	MODERATE -
	Only one species (*Pterocarpus angolensis*) was identified as a SCC due its status of Vulnerable on the National Red List.	MODERATE -	LOW -
Ecosystem Function and Process	Approximately 60 ha of near natural and transformed vegetation will be replaced by solar panels resulting in the loss of this natural ecological corridor that runs from the north to the south between the sugar plantations to the east and the residential area to the west.	MODERATE -	MODERATE -
Alien Plant Species	Disturbance to habitats often results in the infestation of alien species and displacement of indigenous vegetation unless these are controlled.	HIGH -	LOW -
Ecosystem services	Loss of ecosystems services through the removal of vegetation communities will result in the loss of ecosystem services provided by each vegetation type.	MODERATE -	MODERATE -
Water Quality	During the construction phase, vegetation clearance and earthworks, including excavation and infilling, may result in the partial loss of the wetland to the west of the existing ESCOM substation.	MODERATE -	MODERATE -
	During the construction phase, the clearance of vegetation and compaction of soil may result in increased run-off and erosion resulting in elevated levels of sediment entering the system. This could result in significant water quality concerns which in-turn may compromise the aquatic habitat.	MODERATE -	LOW -
	During the construction phase, accidental spillages of wet concrete and chemical / hazardous substances may result in soil and groundwater contamination, adversely affecting the aquatic ecosystems in the broader area.	MODERATE -	LOW -

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Fauna	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 0.57 ha of Closed Miombo Woodland, 2.14 ha of open miombo woodland and 35.9ha of grassland- Savanna mosaic. These all provide important habitat for a range of faunal species.	**MODERATE -**	**MODERATE -**
	The SCC that possibly occur on the project area include bat species which may utilise the woodland/forest habitat for shelter as well as the nearby buildings and forage over the wetland and grassland. It is possible that the terrapin and occasionally otters may utilise the river channels and wetland areas. Migrant species may utilise habitats on the project area but not exclusively and raptors may nest on existing powerlines and well-established trees in the woodland/riparian forest. The blue swallow was confirmed on the northern site in the savanna habitat trees.	**MODERATE -**	**LOW -**
	The movement of heavy machinery and an increased number of vehicles during the construction phase may result in the accidental mortality of faunal species, specifically fossorial species and slow-moving species.	**MODERATE -**	**LOW -**
	There are existing troops of baboons and monkeys which may cause damage to equipment and may raid any living quarters and waste disposal sites.	**MODERATE -**	**LOW -**
Air quality	During the construction phase, dust generated by construction vehicles and construction activities could result in significant dust during windy conditions.	**MODERATE -**	**LOW -**
	During the construction phase poor maintenance and servicing of construction plant and vehicles may result in an increase in vehicle emissions in the areas.	**MODERATE -**	**LOW -**
Noise	During construction phase the main potential impacts on the acoustic environment are related to the noise from construction machinery and construction vehicles being used for the following: • Site preparation such as vegetation clearance and minor earthworks. These activities will require heavy construction vehicles and equipment (excavators, dozers, dump trucks); • Civil works and installation such as drilling for mounting structure frames, construction of inverter and transformer station foundations and construction of stores, workshop, and office buildings; and • Road traffic offsite: the movement of vehicles for transport of materials and personnel on local roads and/or new access roads close to communities will also generate additional noise.	**MODERATE -**	**LOW -**
Traffic and Transport	The key regional road is the M5 that runs adjacent to the proposed project site. The road is single lane and is in disrepair in many places. There are frequent heavy goods vehicles that use the route carrying tobacco, maize, and sugar. The road passes through trading centres, where pedestrians, cyclists, and traders also use the road. The addition of project traffic increases the risk of road accidents.	**HIGH -**	**LOW -**
	An increase in traffic as a result of the project could cause congestion on public roads.	**MODERATE -**	**LOW -**

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Landscape and visual character	Construction activities may have an impact on the visual character of the landscape due to the following: • Clearance of vegetation (in particular clearance of trees and removal of crops); • Presence of large construction vehicles and equipment on site; • Fencing of works and restrictions to site access; and • Construction of the plant.	MODERATE -	LOW -
Heritage features	The study identified 5 areas within the site that contained heritage features. Given the nature of the construction activities it is anticipated that these will be disturbed.	MODERATE -	MODERATE -
	The study identified no buildings or structures of historical or heritage significance.	LOW -	LOW -
	No graves of human burial places were noted within the project site.	LOW -	LOW -
Socio-economic	Community members who are informally cultivating in the proposed project area will lose access to their existing cultivated lands in the proposed project area. The loss of such cultivated land would have negative livelihood impacts for the cultivators who are members of Illovo and DSGA staff households who live adjacent to the project area, as well as residents of neighbouring Mowe community.	HIGH -	LOW -
	During the construction phase there will be some temporary job opportunities associated the proposed solar facility.	LOW +	LOW +
	This solar power generation facility will generate 40 MW of power and provide an additional 10 MW of storage that will be sold to ESCOM and be added to the national grid.	MODERATE +	MODERATE +
	During construction phase, failure to anticipate and take measures to avoid and minimise potential occupational health and safety risks during the construction and operation phase may result in the injury and harm of labourers, staff, surrounding residents and road users.	MODERATE -	LOW -
	During all phases of the project failure to anticipate and take measures to avoid and minimse potential community health and safety risks may result in the injury and harm of surrounding residents and road users. This is a particular risk when external workers are brought into rural communities and engage socially and professionally with local residents. Substance abuse, crime and assault incidents are other social concerns. These community health risks also include the risk of sexual abuse and exploitation, sexual harassment (SEA/SH) and gender-based violence (GBV).	MODERATE -	LOW -
	Failure to plan for accidental fires during the construction and operation phase could result in potential harm to the public and/or surrounding landowners and their property.	MODERATE -	LOW -

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
	During the construction and operational phase, poor management of handling, disposal and storage of general and hazardous waste may lead to the pollution of the surrounding environment, including potential health risks to those on site and those communities who received the waste.	**MODERATE -**	**LOW -**

Table 2 Summary of the significance of impacts for the operational phase

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Soil Quality	The impacts to the soil quality are likely to take place during construction. No earthworks are expected during the operational phase.	**LOW -**	**LOW -**
Hydrology	Given that many of the deviations and changes will occur during the construction phase the impacts during operation are associated with the modified hydrology scenario and mostly concerned around the management of stormwater. The results show that the southern plot is most likely prone to flooding during heavy rainfall. It is anticipated that the project will need to design and install appropriate infrastructure to accommodate the increased runoff volumes as a result of the panels increasing the hardstand area. The stormwater management plan needs to ensure that the volume of water exiting the site is controlled and does not cause downstream impacts.	**MODERATE -**	**LOW -**
	A high volume of stormwater has the potential to reduce the water quality through increase sediment loading and any pollutants from the site.	**MODERATE -**	**LOW -**
Alien Plant Species	If laydown areas and roads are not rehabilitated, these disturbed areas can become places for alien invasive species to become established and if left unmitigated these species can spread and establish themselves in intact vegetation resulting in the displacement of indigenous species.	**HIGH -**	**LOW -**
	The shading effect of the panels results in a change in species composition. For example, it may favour more herbs and possibly “weeds” or ruderals.	**LOW -**	**LOW -**
Water Quality	During the operational phase, routine maintenance (e.g. the washing and servicing of panels) may lead to the introduction of chemical / hazardous substances (e.g. soaps, cement dust, oil spills from vehicles, etc.) into the watercourse and/or soil, adversely affecting the aquatic ecosystems in the broader area. The modification of the drainage features within the site will also lead to larger volumes of water and higher suspended sediment loading.	**MODERATE -**	**LOW -**

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Alien faunal species	Developments that introduce domestic waste streams create suitable habitats for the introduction of alien species. Introduced urban rodent pests such as the house mouse (*Mus musculus*), house rat (*Rattus rattus*) and the Norwegian rat (*Rattus norvegicus*) are likely to occur in populated areas such as construction camps and office buildings. These species generally tend to survive alongside human habitation, and don't spread in natural areas. The most widespread and common alien bird is the House Sparrow (*Passer domesticus*) and the Pied Crow (*Corvus albus*) which is now distributed almost worldwide and was recorded on site.	**MODERATE -**	**LOW -**
Avifauna	Bird fatalities could occur at the site through a number of mechanisms, including collision with PV panels, entanglement in perimeter fence and others. The impact of collision with and electrocution on the overhead power line and within the substation is possible.	**MODERATE -**	**LOW -**
Air quality	Fugitive dust, vehicle and site infrastructure emissions are expected to be very low during operation.	**LOW -**	**LOW -**
Noise disturbance	Very low vehicle movement is expected during the operational phase of the project. There are no moving parts or machinery involved in the operation of a solar PV facility.	**LOW -**	**LOW -**
Traffic and Transport	Very low vehicle movement is expected during the operational phase of the project.	**LOW -**	**LOW -**
Landscape and visual character	Impacts during the operational phase include the colour change and a massing effect created by the PV panels covering a large area, limited early morning glare and some security lights at night. Generally, the reflection from PV systems is low intensity, similar to the impact from a body of water. There site is adjacent to the M5 national road and adjacent to the Illovo plantation. The solar panels that have been selected for the Project are designed to absorb as much solar radiation as possible and therefore solar reflection is minimised.	**MODERATE -**	**LOW -**
Heritage and cultural resources	No excavations are anticipated during the operational phase. Should any cultural resources be identified during the construction phase these will be marked and either removed or "no-go" zones created.	**LOW -**	**LOW -**
Socio-economic	During the operational phase, there will be some temporary job opportunities associated with planning and design of the proposed solar park.	**LOW +**	**LOW +**
	This solar power generation facility will generate 40 MW of power and provide an additional 10 MW of storage that will be sold to ESCOM and be added to the national grid.	**MODERATE +**	**MODERATE +**

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
	During construction phase, failure to anticipate and take measures to avoid and minimise potential occupational health and safety risks during the construction and operation phase may result in the injury and harm of labourers, staff, surrounding residents and road users. This could be from the problematic use of or faulty equipment and machinery, as well as falls, accidents, fires, etc.	**MODERATE -**	**LOW -**
	During all phases of the project failure to anticipate and take measures to avoid and minimse potential community health and safety risks may result in the injury and harm of surrounding residents and road users. This is a particular risk when external workers are brought into rural communities and engage socially and professionally with local residents. Community health risks also include the risk of sexual abuse and exploitation, sexual harassment (SEA/SH) and gender-based violence (GBV).	**MODERATE -**	**LOW -**
	During the operational phase, failure to plan for accidental fires during the construction and operation phase could result in potential harm to the public and/or surrounding landowners and their property.	**MODERATE -**	**LOW -**
	During operational phase, poor management of handling, disposal and storage of general and hazardous waste may lead to the pollution of the surrounding environment, including potential health risks to those on site and those communities who received the waste.	**MODERATE -**	**LOW -**

CES TEAM

Mr Gregory Shaw, Principal Environmental Consultant CES
Gregory is a principal environmental consultant with more than 10 years' experience, who has carried out ESIAs for a variety of infrastructure developments in Africa and Europe. His experience is with development projects where there is creation or modification of infrastructure, via capital works and complex logistics.

He is able to engage with the full portfolio of diverse stakeholder groups and regulators via meetings, written material, face-to-face workshops, presentation events, negotiation and discussion to achieve mutually agreeable mitigation measures and solutions. As part of many of the ESIAs he has been involved in or managed he has been responsible for the development and execution of environmental surveys (and subsequent monitoring programmes), sub-contractor management (including contracting), report writing and project management. In addition, he has been responsible for developing and auditing plans associated with managing large infrastructure projects e.g. Environmental Management Plans (EMP).

Greg forms strong relationships and ensure that the team works together in an integrated way towards the clear common goal, making effective use of time and resources.

Dr A.M (Ted) Avis, Managing Director CES
Ted Avis is a leading expert in the field of Environmental Impact Assessments and environmental management, having project-managed numerous large-scale ESIAs and ESMPs to International Finance Corporation Performance Standards. Ted has been EIA study leader on numerous large scale ESIA's and ESHIA's for projects with capital investments ranging from US$200m to over US$1billion. He has been study leader for ESIA, and related environmental studies completed to international in, Egypt, Kenya, Liberia, Mozambique, Madagascar, Malawi Sierra Leone, South Africa and Zambia. Ted also has experience in large scale Strategic Environmental Assessments in southern Africa and has been engaged by the International Finance Corporation (IFC) on a number of projects.

Most of the ESIA work Ted has been involved in has included the preparation of various Environmental & Social Management Plans, Resettlement Action Plans and Monitoring Plans. These ESIA's cover a range of sectors including infrastructure, mining (heavy minerals, graphite, tin, copper, iron), agri-industrial, forestry, resorts and housing development, energy, ports and coastal developments.

Ted holds a PhD in Botany and was awarded a bronze medal by the South African Association of Botanists for the best PhD adjudicated in that year, entitled "Coastal Dune Ecology and Management in the Eastern Cape"). He has delivered papers and published in the field of EIA, Strategic Environmental Assessment and Integrated Coastal Zone Management and has been a principal of CES since its inception in 1990 and Managing Director since 1998.

Ted was instrumental in establishing the Environmental Science Department at Rhodes University whilst a Senior lecturer in Botany, based on his experience running honours modules in EIA practice and environmental management. He was one of the first certified

Environmental Assessment Practitioner in South Africa, gaining certification in April 2004. He has been a professional member of the South African Council for Natural Scientific Professionals since 1993.

Rob Hartley-Louis, Senior Environmental Manager C12 Consultants
Mr Hartley-Louis is an experienced project manager and Environmental specialist. He has worked in a variety of cultural and country contexts, engaging with stakeholders up to the ministerial level. He has written and presented high-level policy papers, Environmental Impact Assessments in multiple countries across a range of projects, and several process and technical guidance reports.

He holds a MSc in Environmental Management from London's School of Oriental and African studies (SOAS) focussing on EIA, SEA, International Environmental Law, Climate Change and Ethics. His Master's Thesis assessed the Malawian ESIA mechanism with a focus on stakeholder engagement. He also holds an Honours Degree in Social Anthropology from Goldsmiths College, University of London.

CES DETAILS

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ACRONYM LIST

Abbreviation	Definition
AC	Alternate Current
ADC	Area Development Committee
AoI	Area of Influence
ARI	Acute Respiratory Infection
CSR	Corporate Social Responsibility
DAoI	Direct Area of Influence
DC	District Commissioner
DC	Direct Current
DCC	District Consultative Committee
DEC	District Executive Council
DLO	District Lands Officer
EAD	Environmental Affairs Department
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EP	Equator Principles
EPC	Engineering, Procurement, Construction contractor
ERM	Environmental Resources Management
ES	Environmental and Social
ESCOM	Electricity Supply Corporation of Malawi
ESIA	Environmental and Social Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMP	Environmental and Social Management Plan
GVH	Group Village Headman
Ha	Hectares
IA	Impact Assessment
IAoI	Tractor-loader-backhoe
IFC PS	International Finance Corporation Performance Standards
ILO	International Labour Organisation
IPP	independent power producer
kV	Kilovolt
LACS	Land Acquisition and Compensation Specialist
LRP	Livelihoods Resettlement Plan
MBS	Malawi Bureau of Standards
MEPA	Malawi Environmental Protection Authority
MERA	Malawi Energy Regulatory Authority
MITC	Ministry of Trade and Commerce
MW	Mega Watt
NACP	National AIDS Control Programme
NEAP	National Environmental Action Plan
NEP	National Environmental Policy

Abbreviation	Definition
NGO	Non-Governmental Organisation
ORES	Other Renewable Energy Sources
PPA	Power Purchase Agreement
PV	Photovoltaic
RET	Renewable Energy Technologies
SDG	Sustainable Development Goals
SEP	Stakeholder Engagement Plan
TA	Traditional Authority
TLB	Tractor-loader-backhoe
ToR	Terms of Reference

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1.1 PROJECT INTRODUCTION AND LOCALITY

Voltalia, a global renewable energy producer and independent power producer (IPP), intend to construct a solar photovoltaic (PV) power plant near Dwangwa town in, Nkhotakota district, Central Malawi (Figure 1.1). The electricity produced by the solar PV power plant will be sold to the national grid.

The Dwangwa Solar PV power plant (40MWAC) will comprise of photovoltaic solar panels that cover an area of approximately 60ha (Figure 1.2). It is estimated that the total height of the panels, including the structure, will be 4.7m when tilted. Additional infrastructure on site will include a security guardhouse, an operations and maintenance building, internal gravel roads, a single circuit 132kV powerline, substation and a 10MW energy storage facility.

A more detailed description of the project and the accompanying Area of Influence (AoI) is presented in Section 4 and Section 5.1 respectively.

1.2 THE PROPONENT

Voltalia is French based International Integrated Renewable Energy Player with a Global footprint.

The Group was founded in 2005 and is listed on the regulated market of Euronext Paris since July 2014. They are an energy producer and service provider in renewable energy production from solar, wind, hydro and biomass and also develop combined storage solutions.

As an integrated industrial company, with over 1000 employees, Voltalia have developed extensive experience throughout the value chain of a renewable energy projects, including the development and financing of projects, EPC and the operation and maintenance. The Group is active in 20 countries, with around 1.5 GW owned by Voltalia in operation and construction. Voltalia have a strong focus of development in Africa (Morocco, Egypt, Kenya, Ivoire Coast, Malawi and South Africa) with a number of projects already in operation on the Continent.

1.3 THE PROJECT COST

The overall Project investment cost across all phases of the Project is approximately USD 60,951,442.

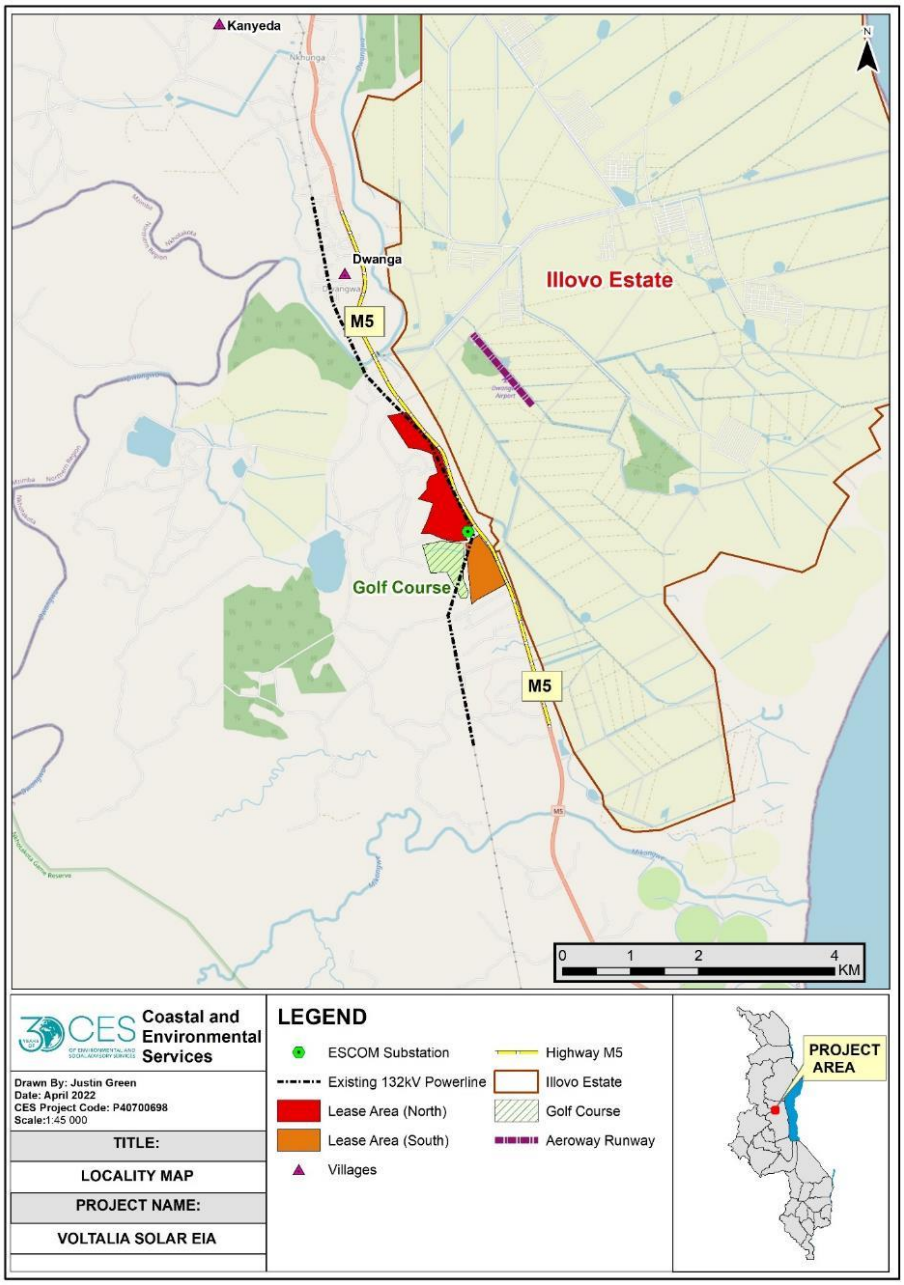


Figure 1.1 Locality map showing the location of the site in relation to the town of Dwanga.

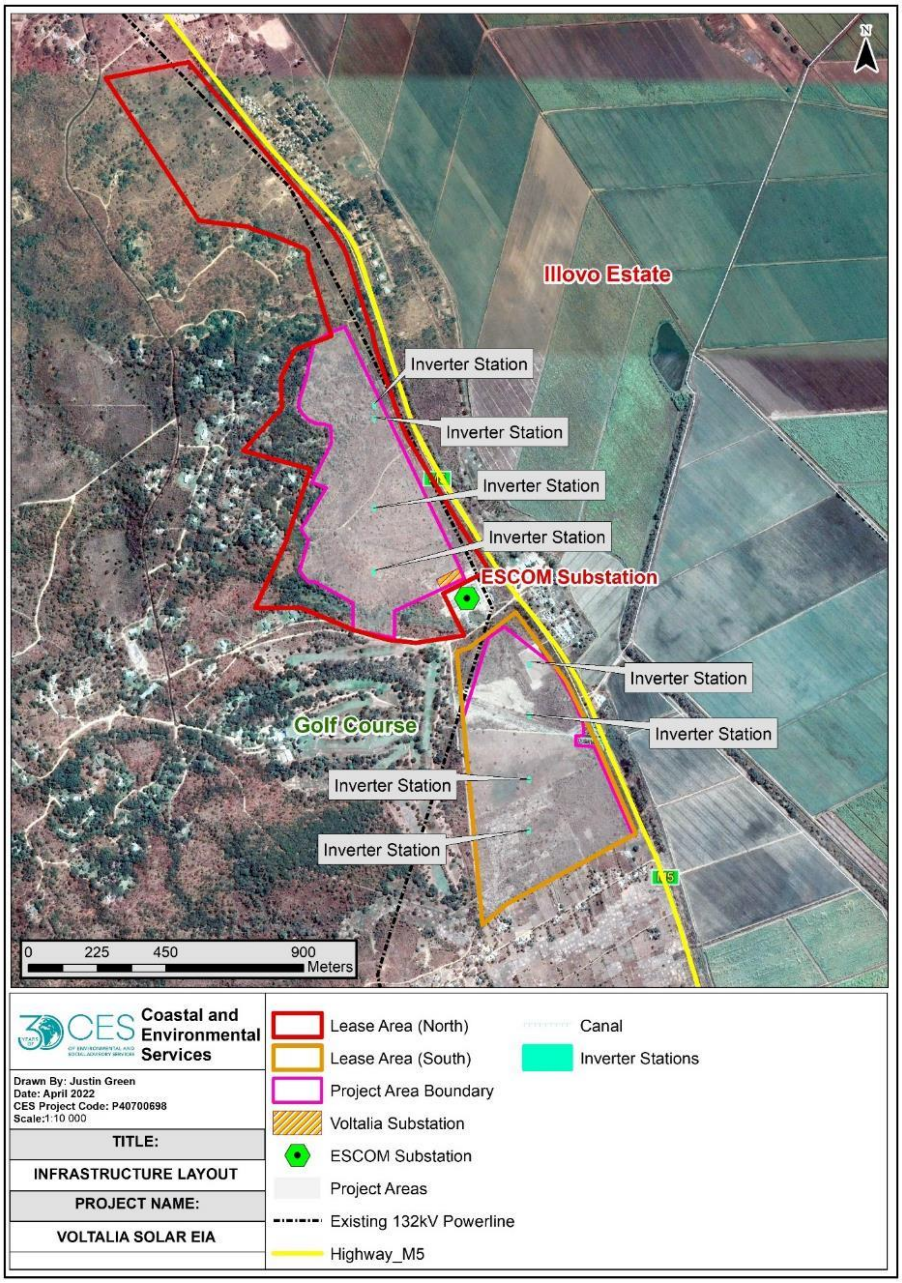


Figure 1.2 Proposed Infrastructure map

1.4 THE PURPOSE OF THE REPORT

CES has been appointed by Voltalia to undertake an EIA in line with the requirements of the Malawian laws (including the Environment Management Act (1996)) and regulations as well as the requirements of international finance institutions (IFI).

On the basis of the initial design a Project Brief was submitted by Voltalia to the Environmental Affairs Department (EAD) now the Malawi Environmental Protection Authority (MEPA) on the 29 June 2021. The MEPA is the authority responsible for the environmental permitting process, in line with the requirements of Section 24 of the Environmental Management Act (EMA, No 23 of 1996). Following a review of the Project Brief, in line with the EMA, it was confirmed by the EAD on 30 July 2021 that the Project required a detailed Environmental Social Impact Assessment (EIA) (See **Appendix 1** for the EAD acknowledgement).

In line with IFC requirements a Scoping Report was prepared to identify issues most important to Project planning, decision-making, and stakeholders. During scoping (November 2021 – February 2022), potential interactions between the Project and Project activities with environmental and social resources and receptors were identified and prioritised in terms of potential risk and impacts. These were presented through meeting with stakeholders and interested and affected parties for validation. The Scoping Phase also identified the areas which were not likely to have the potential for risks or impacts - these were eliminated from the detailed assessment below.

This Environmental and Social Impact Assessment (ESIA) has been prepared to:

- Identify relevant national and international legislation, policies and guidelines regarding environmental and social governance (Section 2);
- Present the ESIA process (Section 3);
- Provides a comprehensive description of the project and the approach to developing the project through the construction phase and goes on to describe those operational and decommissioning requirements (Section 4);
- An analysis of alternatives is included in Section 5 and describes the changes to the layout to avoid environmental and socio economic impacts;
- A description of the baseline environmental (Section 6) and socio economic (Section 7, 8 and 9) conditions;
- Describe the impacts (Section 10, 11, 12, 13, 14 and 15) associated with each of the project phases on each of the receptors;
- Demonstrate the stakeholder engagement process and present the feedback received to date (Section 16); and
- Provide a recommendation on how the project should proceed with suitable mitigation measures and in line with the IFC Performance Standards (Section 17).

A number of appendices have been included to support the ESIA report. Importantly **Appendix 4** includes the Environmental and Social Management Plan (ESMP).

2 LEGISLATION, POLICY AND GUIDELINES

2.1 APPLICABLE MALAWIAN LEGISLATION

This Chapter presents an overview of the national environmental and social legislation and policies applicable to the Project, as well as the relevant international treaties, conventions and best practices (e.g. international treaties and conventions to which Malawi is party and financial institution standards).

Information in this section is largely drawn from a local working knowledge of the legislation and regulations in Malawi.

2.2 MALAWIAN INSTITUTIONAL FRAMEWORK

2.2.1 Constitution of Malawi

The Constitution of the Republic of Malawi, 1995, is the supreme law of the country. The Constitution recognises that responsible environmental management can make an important contribution towards achieving sustainable development, improved standards of living, and conservation of natural resources (SADC, 2012). The Constitution states that the environment of Malawi should be managed in order to:

- Prevent the degradation of the environment;
- Provide a healthy living and working environment for the people;
- Accord full recognition of the rights of future generations by means of environmental protection; and
- Conserve and enhance biological diversity.

The Constitution also includes a framework for the integration of environmental consideration into development programs. Therefore, Government, its partners and the private sector have a responsibility to ensure development programs and projects are undertaken in an environmentally responsible manner.

The Constitution also sets the legislative basis for land acquisition in the country. Section 28 (2) of the Constitution states that “No person shall be arbitrarily deprived of property” and section 44 (4) states that “Expropriation of property shall be permissible only when done for public utility and only when there has been adequate notification and appropriate compensation, and appeal mechanism exists.

With regard to women’s rights, Section 24 of the Constitution states that:

“Women have the right to full and equal protection by the law and have the right not to be discriminated against on the basis of their gender or marital status which includes (a) to be accorded the same rights as men in civil law, including equal capacity to (i) enter into contracts, (ii) acquire and maintain rights in property, independently or in association with others, regardless of their marital status.”

The Project is in Malawi and it must abide by all applicable legislation. The Constitution of Malawi provides the overarching framework for all laws including environmental legislation.

2.3 NATIONAL POLICIES AND PLANS

2.3.1 National Environmental Policy (2004)

The National Environmental Policy (NEP) aims to create a balance between protection of natural resources and national development. The Policy promotes sustainable social and economic development through sound management of the environment and natural resources. The policy seeks, among other things, to:

- Secure an environment suitable for their health and well-being for all citizens of Malawi;
- Promote efficient utilisation and management of the country's natural resources and encourage self-sufficiency in food, fuel wood and other energy requirements;
- Facilitate the restoration, maintenance and enhancement of the ecosystems and ecological processes essential for the functioning of the biosphere and prudent use of renewable resources;
- Integrate sustainable environment and natural resources management into the decentralised governance systems and ensure that the institutional framework for the management of natural resources supports environmental governance in local government authorities;
- Enhance public education and awareness of various environmental issues and public participation in addressing them; and
- Promote local community, NGO and private sector participation in environment and natural resources management.

In the NEP, there are strategies on environmental planning and environmental impact assessment. The objective on environmental planning is to ensure that national and district development plans integrate environmental concerns, in order to improve environmental management and ensure sensitivity to local concerns and needs.

The objective of the NEP is to regularly review and administer the guidelines for EIAs, audits, monitoring and evaluation so that adverse environmental impacts can be eliminated or mitigated and environmental benefits enhanced.

2.3.2 National Environmental Action Plan (2004)

The NEAP was prepared in 1994 (updated in 2004) in response to Agenda 21 (Rio 1992 Declaration) as action plan for integrating environmental issues into socio-economic development programs. The objectives of the NEAP are to:

- Document and analyse all major environmental issues and measures;
- Promote sustainable use of natural resources; and
- Develop an environmental protection and management plan.

The NEAP outlines actions that need to be considered to ensure adequate environmental protection. For example, EIAs will be required for any development that may affect fragile

ecosystems and Government will ensure that workers are supplied with the appropriate protective equipment during construction and operation.

The Project has the potential to negatively impact the surrounding environment. Therefore, the environmental and social impacts, and management measures detailed in a management plan, need to be included in accordance with the objectives of the NEAP.

2.3.3 National Land Policy (2002)

The policy guides land management and administration issues, provides definitions of land ownership categories, and describes details on compensation payment for land.

In terms of land use planning, the policy provides that land allocation should make effective use of land and take into account environment and welfare of community. In terms of environmental management, the policy aims at lending support to the policies and strategies that are already in place. The policy covers issues related to both urban and rural management of solid and liquid waste, protection of sensitive areas, agricultural resource conservation and land use, community forests and woodland management, overdependence on fuel wood, forest programs, co-ordination of multiple land use, water resources and wetlands, lakeshore environmental management and mining and minerals.

The Project includes a land acquisition process and therefore the contents of the policy are applicable.

2.3.4 National Water Policy (2004)

Malawi's policy on water resources management requires that:

- Water should be managed and used efficiently and effectively in order to promote its conservation and future availability in sufficient quantity and acceptable quality; and
- All programs related to water should be implemented in a manner that mitigates environmental degradation.

It is likely that water for the Project will be drawn from groundwater resources. Permits for water abstraction are not part of the ESIA process but require the approved ESIA as part of the application. Once the ESIA has been obtained, an application for the water use licence will be submitted.

2.3.5 National Energy Policy (2013)

Other Renewable Energy Technologies

The Policy describes the following barriers to implementation:

- Technical barriers including lack of capacity in manufacturing, distributing, installing and maintaining Renewable Energy Technologies (RETs).

- Financial barriers include high initial cost, a large proportion (45%) of which emanates from import duties and surtaxes. Other key financial barriers are lack of dedicated and affordable financing mechanism, lack of financers and suppliers knowledge about establishing dedicated financing mechanisms and appraising applications for credit, lack of skills to develop business plans, lack of knowledge about local, regional and international financial facilities for RETs, lack of confidence in RETs and low returns on investment (for financiers) and the non-availability of loans (for end users).
- Institutional barriers include lack of standards and regulatory framework, limited delivery modes, small number of RET companies, a latent market and a small number of qualified technicians to undertake installations.
- Lack of deliberate policies and strategies; and lack of information about the efficacy of RETs among policy makers, NGOs and the public have further contributed to the entrenchment of institutional barriers.
- Social-cultural barriers include gender insensitivity in the design and operation of some RETs.

The Project is investing in renewable energy and is in line with the Policy

2.3.6 National HIV/AIDS Policy (2003)

The National HIV/AIDS Policy (2003) provides technical and administrative guidelines for the design, implementation, and management of HIV/AIDS interventions, programs and activities at all levels of the Malawi society. It offers:

- Guidance on critical intervention areas, for example social and economic support for people living with HIV/AIDS;
- Provision of care and support for treatment to achieve a better quality of life for all Malawians living with HIV/AIDS; and
- Protection of their human rights and freedoms.

The goals of the National HIV/AIDS Policy are to:

- Prevent the further spread of HIV infection; and
- Mitigate the impact of HIV/AIDS on the socioeconomic status of individuals, families, communities and the nation.

Potential HIV/AIDS impacts will be investigated in the ESIA. Mitigation measures to combat impacts will be in line with this National Policy

2.3.7 National Health Policy (2008)

The overall goal of the National Health Policy is to improve the health status of all the people of Malawi by reducing the risk of ill health and the occurrence of premature deaths.

The National Health Policy acknowledges the inadequate resources available for the health sector hence it also defines the Essential Health Package, which will be available to all Malawians free of charge.

The Project is committed to ensuring that the health of workers and the surrounding communities is not impacted negatively as a result of the development.

2.3.8 Republic of Malawi Gender Policy, 2008

The policy focuses on building a society where men, women, boys and girls equally and effectively participate in and benefit from development process. A key aspect of this is to increase land ownership for women and promote women's participation in community afforestation, water, land.

Gender equality will be promoted (where possible) in Project activities.

2.3.9 National Monuments and Relics Act (1990)

The Monuments and Relics Act (1990) provides statutory protection against all kinds of threats on all cultural resources as defined in it. One such threat is development that might alter the use of a landscape.

Section 29 of the Monuments and Relics Act (1990) (Cap. 29:01 Laws of Malawi) states as follows in relation to development:

(1) A person in charge of any survey, excavation, exploration, construction or new development shall, at the earliest stages of planning for such activities, give notice to the Minister to enable, where necessary, rescue archaeology to be carried out (…)
(2) (…) The cost of such work shall … be borne by the person in charge of any survey, excavation, exploration, construction or other development.

There is a likelihood that the Project may impact heritage and cultural resources in the area.

2.3.10 National Cultural Policy (2014)

Section 5.7.8, Objective 8, in the Cultural Policy demands taking *"…into account cultural factors in development projects, policies and programmes for the nation*". Its first strategy calls for *"…a cultural heritage impact assessment" for all development projects*".

The project will consider the potential impact to "cultural factors" as part of its ESIA process.

2.4 Environmental Legislation

2.4.1 Environment Management Act (1996)

This act acknowledges every person's right to a clean and healthy environment and provides the general environmental legislation to protect this right. The Act provides for the conservation of biological diversity and makes provision for the undertaking of Environmental Impact Assessments.

Part IV of the EMA makes provision for pollution control for air and water pollution and the Act prohibits the discharge of pollutants into the environment. In addition, the Act includes that it is the duty of every person to prevent the discharge of any pollutant into the environment otherwise than in accordance with specifications made by the Minister or director. Moreover, the Minister is able to direct anyone to prevent and/or minimise any pollutant discharged into the environment. Finally, any discharge of pollutants is in accordance with the EMA; however no regulations have been published.

Section 24 of the EMA provides information on the need for projects for which an EIA may be required. Details are as follows:

- The Minister may specify types and sizes of projects which shall not be implemented unless an EIA is undertaken;
- Before implementing a project that requires an EIA the project developer must submit the following information to the Director of the EAD (MEPA):
    - The description of the project;
    - The activities that shall be undertaken in the implementation of the project;
    - The likely impact of those activities on the environment;
    - The number of people to be employed by the project (construction and operation);
    - Details of the environment likely to be affected by the project; and
    - Any information that the Director deems to be relevant to the project.

The Director may require the developer to provide further information as necessary with regards to details of the project.

Section 77 of the EMA makes provision for the Minister to make regulations pertaining to any aspect of environmental management. However, no regulations on EIA have been gazetted (SADC, 2012).

A Project Brief was submitted to the EAD (MEPA) which outlined the scope of the Project. The EAD (MEPA) confirmed that an EIA was required.

2.4.2 Wildlife Policy (2000)

Provides the approach to the management of wildlife in Malawi. The policy seeks to layout objectives for the sustainable use of wildlife resources with emphasis on building constructive relationships between government and local communities in the management of wildlife.

The project will take into account the impacts on wildlife affected for example through the reduction of habitats.

2.4.3 National Land Resources Management Policy and Strategy (2000)

The overarching goal of this policy is to promote the sustainable use of land-based resources for agriculture and other uses in order to avoid sectoral land conflicts and ensure socio-economic development. Of relevance to this report is the requirement for an environmental impact assessment that assesses the trade-off between economic development and environmental protection and provides mitigation measures to minimise this.

The ESIA will present the potential impacts to both natural and social environments and make recommendations to reduce the impacts to as low as reasonably possible.

2.4.4 Plant Protection Act (no. 9 of 1969)

This act relates to the eradication of pests and diseases that would negatively impact plant species.

The project will ensure that any management plans develop consider this Act.

2.4.5 Guidelines for Environmental and Social Impact Assessment (1997)

Subsequent to the promulgation of the Environment Management Act (1996), the EIA Guidelines of 1997 were developed with the purpose to improve decision making and to ensure that projects under consideration and development are environmentally sound and sustainable (Republic of Malawi, 2014). A revised set of guidelines have been drafted in 2014 but not yet approved.

The purpose of these Guidelines, for Environmental and Social Impact Assessment (ESIA), is to facilitate compliance with Malawi's ESIA requirements by Government, project developers, donors and the general public (Republic of Malawi, 2014).

The ESIA will follow the EIA process through the submission of the Project Brief to the Director of MEPA and then prepare an EIA for approval by the Competent Authorities.

2.4.6 Forestry Act (1997)

The overarching goal of this policy is to ensure the sustainable use and conservation of forest resources to the benefit of the nation.

The Act aims to (amongst other elements):

- Protect trees and resources in forest reserves;
- Conserve and enhance biodiversity;
- Protect and facilitate management of trees on customary land; and
- Promote sustainable utilisation of timber and other forest produce and protect fragile areas such as riverbanks and water catchment.

The Project occurs in an area largely modified by human activities. There is no land take required from forest reserves, protected forest areas or plantations. However, any removal of trees will be in line with the Act.

2.4.7 Electricity Act (2004)

The Act suggests that the developer is required to give no less than 30 days' notice before placing, laying down or carrying any transmission line, or distribution line, water pipeline or other equipment through, over or under any land without the consent of the owner, lessee or

occupier of such land. Notice needs to be published in the Gazette or in a paper in general circulation. Notices should include the nature of the work and the name and location of the project.

Notice will also be provided to the affected person. It is the responsibility of the authorities to determine the amount of compensation, whether by way of payment of a lump sum or an annual rental, or of both, to such owner, lessee or occupier.

The Project are yet to secure the necessary project documents from PML and Ministry of Energy, namely the PPA (Power Purchase Agreement) and the IA (Implementation Agreement) and the license from MERA for the generation of electricity.

The requisite notifications will also be made prior to construction commencing.

2.4.8 Energy Regulatory Act (2004)

The Act established the Malawi Energy Regulatory Authority (MERA) as a corporate body and as the Energy Sector Wide Regulator. The mandate of MERA is to regulate the energy sector in Malawi in a fair, transparent, efficient and cost-effective manner for the benefit of the consumers and operators. Moreover, the Authority is mandated to promote renewable energy.

The Project will generate electricity from renewable resources and the operations of the Project will be regulated by MERA. The Project will adhere to all licensing and monitoring requirements.

2.4.9 Water Resources Act (2013)

The Water Resources Act deals with the control, conservation, apportionment, and use of water resources in the country. The Act also prohibits any person to divert, dam, store, abstract or use public water for any other purpose except in accordance with the provisions of the Act. The Act defines pollution of public water as the discharge into or in the vicinity of public water or in a place where public water is likely to flow, of any matter or substance likely to cause injury whether directly to public health, livestock, animal life, fish, crops orchards or gardens which such water is used or which occasions, or which is likely to occasion, a nuisance.

Permission to discharge into the environment must be sought from the Water Pollution Control Board. The right to use public water may be limited if the use may cause damage to natural resources of the area or in the vicinity.

The activities of the proposed Project will require water and have the potential to pollute the water resources surrounding the Project area. It is important to note no offence is committed if a discharge is, inter alia, under the authority of the Act or any other written law as under the Water Resources (Water Pollution Control) Regulations made the Act.

Permission to discharge into the environment must be sought from the Water Pollution Control Board. In addition, the right to use public water may be limited if the use may cause damage to natural resources of the area or in the vicinity.

2.4.10 Land Act (2016)

The Act is the principal act with respect to land administration and management in Malawi and for all matters relating to land such as land tenure, land transfer, land use and compensation. The Act vests all land in the Republic in perpetuity. The Act has two categories of land, which are public land and private land. Section 7(2) classifies Public land as Government land and unallocated customary land while Section 7(3) classifies private land as freehold, leasehold or customary estate.

All land related actions will occur in line with the Act.

2.4.11 Customary Land Act (2016)

Customary land is the land occupied and used by members of a community who live under customary law. Customary land, however, is not communal land. Most customary land is divided into pieces allocated for the use of individuals and their families. Rights to this land are usually well defined, often for exclusive use and transmissible.

All land related actions will occur in line with the Act.

2.4.12 Land Acquisition Act (1970)

The Lands Acquisition Act sets out in detail, the procedures for acquisition of customary land and freehold land. Any land acquisition should follow the steps as provided for in the existing Lands Acquisition Act. Procedures include steps to be undertaken for government to acquire land starting from issuance of formal notices to persons with existing land interests to payment of compensation for land ownership transfer.

All land related actions will occur in line with the Act.

2.4.13 Land Acquisition Amendment Act (2016)

The Lands Acquisition (Amendment) Act 2016 empowers the Minister to acquire land in the interest of Malawians.

All land related actions will occur in line with the Act.

2.5 Labour and other Social Responsibility Laws

The Ministry of Labour is mandated to provide policy direction and guidance on all labour administration and vocational training matters. The Ministry is also mandated to protect and develop the labour force in order to contribute to the socio-economic development of Malawi. Accordingly, the following Acts apply to the Project.

2.5.1 The Employment Act (2000) and Labour Relations Act (1996)

These two Acts regulate employment matters i.e. minimum wage, fair labour practices, non-discrimination, prohibition (in some cases) of employment of children.

All Project related employment will be in line with the Employment Act and the Labour Relations Act

2.5.2 Malawi Bureau of Standards

The Malawi Bureau of Standards (MBS) is charged with the preparation and promulgation of national standards. Formulation of standards is done through Technical Committees whose membership covers a variety of sectors. Current Technical Committees include one for environmental protection and pollution Control. Malawi is developing its own emissions standards. The standards developed to date by the Malawi Bureau of Standards are as follows:

- 13.020.10: Adoption of the ISO144000 series on environmental management
- MS691:2005: Tolerance limits for domestic sewage effluents discharged
- into inland surface waters
- MS214:2005: Drinking water – specification
- MS173:2005: Noise pollution – tolerance limits

All Project related activities will be in line with the Environmental Standards in Malawi.

2.5.3 Occupational Safety, Health and Welfare Act (1997)

The principal legislation that regulates OSH in Malawi is the Occupational Safety, Health and Welfare Act, 1997. The Act regulates conditions of employment in workplaces with regard to safety, health and welfare of employees. The Act imposes duties on employers, self-employed, other persons in control of premises, manufacturers and suppliers (Wage Indicator, 2017).

The Project will comply with all occupational health and safety regulations in Malawi.

Working conditions on site be monitored to ensure there is no contravention of the Act.

2.5.4 Public Health Act (1948)

The Public Health Act is the overarching legislation guiding health legislation in Malawi. The Act is currently under revision.

All Project related activities will be in line with the Public Health Act.

2.5.5 Gender Equality Act (2013)

The Act seeks to promote gender equality and equal integration of men and women in all functions of society. Prohibiting and providing redress for sex discrimination, harmful practices, sexual harassment and provide public awareness and promotion of gender equality (UNESCO, 2012).

The Project will (where possible) promote gender equality in project aspects, particularly through employment and community investment initiatives.

2.6 CONVENTIONS AND PROTOCOLS

Malawi also recognises the following international conventions and protocols that are relevant to this study:

2.6.1 International Union for Conservation of Nature (IUCN): Statutes and Regulations

The objective of the IUCN is to "influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable" (IUCN, Accessed: 27/08/2016).

To achieve this objective, the IUCN implements programmes, administered by the World Conservation Congress, in the form of a number of activities such as:

- Research on species and ecosystem function to ensure sustainable, equitable and ecological utilisation of natural resources;
- Determine biological diversity, identify threats and priority conservation areas;
- Develop sound practices for the conservation and sustainable use of species and ecosystems; and
- Develop tools for effective rehabilitation, mitigation or offsets.

The IUCN data base and principles are used for determining species of conservation concern in the study area.

2.6.2 Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD) deals with conservation, sustainable use and the equitable sharing of the benefits of natural resources. The CBD, ratified by Malawi in 1992, encourages the use of the "Ecosystem approach" which is based on the application of scientific methodologies focused on levels of biological organisation including process, functions and interactions between organisms and the environment (Convention on Biological Diversity, Accessed: 25 October 2016). The levels are extended to refer to any functional ecological unit at any scale.

The CBD emphasizes that adaptive management is necessary for complex and dynamic ecosystems. Impact responses of ecosystems are non-linear and often delayed, resulting in unpredictable reactive events. Management must be adaptive in order to respond to these events by incorporating a "lessons-learnt" approach and frequent considerations of "cause-and-effect".

The United Nations Framework Convention on Climate Change (UNFCCC), to which Malawi is a signatory, recognises the CBD and its objectives.

The objectives and principles outlined in the CBD should be used to assess impacts and develop management and monitoring plans.

2.6.3 African Convention on the Conservation of Nature and Natural Resources

Malawi is a signatory on the African Convention on the Conservation of Nature and Natural Resources which was revised in 2003. The objectives of this Convention are to enhance environmental protection, to foster the conservation and sustainable use of natural resources and to harmonize and coordinate policies in these fields with a view to achieving ecologically rational, economically sound and socially acceptable development policies and programmes.

Specific to this report is Article VIII which relates to vegetation cover and requires the Parties to take all necessary measures for protection, conservation, sustainable use and rehabilitation of vegetation cover.

2.6.4 Convention on International Trade in Endangered Species (CITES)

The Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora was ratified by Malawi 1982. This is an international agreement between governments that aims to control the trade of wild animals and plants to ensure that their survival is not threatened.

2.6.5 Other applicable Conventions and Protocols

The table below lists additional relevant international conventions and protocols to which Malawi has either ratified or concluded relevant to the Project. Many of these are incorporated into the various World Bank Operational Procedures and the IFC Performance Standards. By conforming to these two sets of standards, the Project will comply with the requirements of the relevant international conventions.

Year	Name of the Convention / Protocol
2003	The Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention)
2003	UNESCO Convention on safeguarding of the Intangible Cultural Heritage
2001	The International Labour Organisation (ILO) Fundamental Convention related to forced labour, freedom of association, discrimination and child labour
2000	International Covenant on Economic, Social and Cultural Rights
2000	International Covenant on Civil and Political Rights
1992	United Nations Framework Convention on Climate Change (UNFCCC)
1989	African Charter on Human and People's Rights
1989	Montreal Protocol on Substances that deplete the Ozone Layer
1985	Vienna Convention for the Protection of the Ozone Layer
1975	Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention), Paris
1971	Ramsar Convention on Wetlands of International Importance, especially Waterfowl Habitats (Ramsar, Iran)

2.7 International Lender Standards and Guidelines

In addition to national legislation, the Project is being developed in line with the standards and guidelines of international finance institutions. These standards and guidelines are intended

to complement and reinforce national legislation and ensure the Project is conducted in accordance with international best practice and in a way that minimises risks and impacts.

The Project is considering project finance from international lenders and therefore the Equator Principals (EP) and International Finance Corporation (IFC) Performance Standards (PS) (including the Environmental Health and Safety Guidelines) will have bearing on the project.

The applicability of these will be covered in more detail in the ESIA report.

2.7.1 The Equator Principles

The Equator Principles are a set of agreed principles by financial institutions to determine, assess and manage environmental and social risk in project financing. The EPs emphasise that lenders will seek to ensure that the Project is developed in a manner that is socially responsible and reflects sound environmental management practices.

These Principles have been adopted by a wide range of banks and lenders all over the world in order to manage the social and environmental risks associated with their potential investments. The Equator Principles III were adopted in June 2013 and are listed below:

- Principle 1: Review and Categorisation;
- Principle 2: Environmental and Social Assessment;
- Principle 3: Applicable Social and Environmental Standards;
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan;
- Principle 5: Stakeholder Engagement;
- Principle 6: Grievance Mechanism;
- Principle 7: Independent Review;
- Principle 8: Covenants;
- Principle 9: Independent Monitoring and Reporting; and
- Principle 10: Reporting and Transparency.

2.7.2 IFC Performance Standards

The IFC applies Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in the private sector. The IFC PS may be applied by other financial institutions electing to apply them to projects in emerging markets. Together, the eight Performance Standards establish standards that a project is to meet throughout the life of an investment by IFC or other relevant financial institutions. They are as follows:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Resource Efficiency and Pollution Prevention;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;

- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Performance Standard 7: Indigenous People; and
- Performance Standard 8: Cultural Heritage.

A summary of each PS and an indication of their applicability to the proposed project will be provided in more detail in the ESIA report.

In terms of the categorization of the project in terms of the IFC Policy and Performance Standards on Environmental and Social Sustainability (2012) it is likely that this Project would be categorised as a Category B project.

2.7.3 IFC Environmental, Health and Safety Guidelines

The Environmental, Health and Safety (EHS) Guidelines are technical reference documents that address IFC's expectation regarding the industrial pollution management performance of projects. This information supports actions aimed at avoiding, minimising, and controlling EHS impacts during the construction, operation, and decommissioning phase of a project or facility. In the context of the proposed project, the most relevant EHS Guidelines to be considered are:

- World Bank Group General EHS Guidelines (2007); and
- World Bank Group EHS Guidelines for Electric Power Transmission and Distribution (2007).

Note that guidelines on solar PV plant development are currently not available.
In terms of the IFC Performance Standards, this would be categorised as a Category A or B project, requiring a full ESIA.

3 ESIA PROCESS

The ESIA Process is applicable to all public and private developments. The first step in the Malawian Environmental Impact Assessment process is the submission of the Project Brief to MEPA to define the extent and type of environmental assessment required for a given project. Factors that are considered during the screening include:

- Scale and type of project;
- Location and sensitivity of the site; and
- Nature and magnitude of potential impacts.

The project being considered here is a subject to a full ESIA as defined by the regulations, due to the nature, scale and location of the proposed project.
An important consideration for projects that require an ESIA is the Public Participation Process. The Public Participation Process as an activity that involves public hearings and consultation. The Public Participation Process implies delivery of information regarding projects to all directly and indirectly interested and affected parties, responding to public requests for explanations on the project and the formulation of suggestions.
Public participation provides an opportunity for stakeholders to learn more about the proposed project and provide their opinions. These need to be incorporated into the ESIA process and should be used to guide further phases of the assessment and help mitigate potential conflict situations early on in the planning process.

There are effectively six (6) main steps in the ESIA process:

3.1 STEP 1: PRE-EVALUATION (PROJECT BRIEF)

All proposed projects must be screened against to determine whether the project requires ESIA. The project brief includes the following details:

- Name of Activity;
- Identity of Applicant;
- Address, contact details;
- Location – Street; Town; Locality; District; Province;
- Type of area;
- Zoning Information; and
- Description of Activity – Infrastructure; Associated Activities; Brief description of technology required for construction and operation; Type origin and quantity of labour; Type, origin and quantity of raw materials; Chemical Products to be used; Type, quantity and origin of water and electricity to be used; Other resources required; Land holding (legal status of physical area required); Alternative locations (reason for choosing the proposed location and identification of at least two alternative locations); Brief environmental description of the area and region; Supplementary information in the form of maps and diagrams.

The Project Brief was submitted to (MEPA) on the 29 June 2021. A copy of the MEPA ToR is provided in **Appendix 1**.

3.2 STEP 2: ENVIRONMENTAL SCOPING STUDY AND TERMS OF REFERENCE

An Environmental Scoping Study is not obligatory for local Malawian ESIA. However, given the intention to meeting international standards, the development of the Scoping Study provided the Project an opportunity to engage with stakeholders and interested and affected persons to ensure that all potential issues are covered in the subsequent ESIA stage.
The key objectives of the phase were to:

- Determine any fatal flaws or environmental risks associated with the implementation of the activity; and
- Determine the scope of the ESIA process and develop a Terms of Reference for this phase should no fatal flaws be identified.

The Scoping Report contained:

- A non-technical summary highlighting the key issues and conclusions;
- Details of the proponent and ESIA study team;
- Spatial extent of the proposed activity in terms of both direct and indirect influences as well as the pre-development land use in this zone;
- A description of the activity and the different actions to be undertaken, with respect to possible alternatives at the planning, construction, exploration and decommissioning stages;
- Identification of important biophysical and socio-economic characteristics of the affected environment;
- Identification of any potential fatal flaw;
- Identification of potential environmental issues or impacts; and
- Identification of aspects that need to be addressed in the ESIA study phase.

The Terms of Reference (ToR) describe in detail the issues to be investigated by each specialist study during the next phase of the ESIA (Environmental Impact Report and Environmental Management Programme).

3.3 STEP 3: THE PUBLIC PARTICIPATION PROCESS

The Public Participation Process (PPP) involves consultation with the wider public. The process facilitates the dissemination of information about the project and identification of indirectly and directly Interested and Affected Parties (I&APs). The proponent is required to undertake the PPP throughout the ESIA process. This includes providing sufficient advertising and allowing the opportunity for I&APs to participate in public meetings. The PPP will be undertaken based on any directives given by the relevant authority and the results of the process will be summarised in a final public participation report. A public meeting must be advertised in advance, to which all I&APs must be invited and the technical reports must be made available for public comment. Public meetings will be held for the disclosure of the draft Scoping Report and the ESIA Report at the villages that will be directly affected by the project activities as well as at the relevant local administrator offices in the area.

3.4 Step 4: Environmental Impact Study and Environmental and Social Management Plan (ESMP)

The ESIA process is the responsibility of the proponent and the ESIA team and will be undertaken in line with the Terms of Reference set out in the Scoping Report and confirmed by the MEPA. The study will be summarised in an ESIA report. To address the issues raised during the Scoping Study and in line with the ToR, the ESIA study will include specialist studies to provide a detailed and thorough examination of key environmental impacts. Once completed, these findings will be synthesized into the ESIA Report.

All specialist studies will include specific recommendations aimed at avoiding, or where this is not possible reducing negative impacts and maximizing positive impacts during the construction, operation and decommissioning phases of the proposed development. These recommendations are synthesised into the Environmental and Social Management Plans (ESMPs).

3.5 Step 5: Authority Review of the Environmental Impact Report and ESMP

Commented [GS1]: Rob, are there any official timings we can include in this section?

Commented [RHL2R1]: Nothing official. Best to leave it undefined

The ESIA Report (including Specialist Studies) will be provided to the MEPA for review.

Upon completion of the review, MEPA will provide a final Record of Decision which may be one of the following:

- Positive record of decision;
- Total rejection of the activity based on the outcomes of the reports and the final environmental impact statement; or
- Partial rejection of the activity based on the outcomes of the reports and the final environmental impact statement (requiring revision of the ESIA).

In providing an environmental license, the relevant authority may seek to place conditions of approval that are legally binding on the proponent. Furthermore, the authority may request changes to the project scope or additional ESIA studies.

4 PROJECT DESCRIPTION

4.1 INTRODUCTION

Voltalia, a global renewable energy producer and independent power producer (IPP), intends to construct a 40 MWAC solar photovoltaic (PV) power plant near Dwangwa town in Central Malawi (Figure 1-1). The electricity produced by the solar PV power plant will be sold to the national grid.

The Dwangwa Solar PV power plant will comprise of photovoltaic solar panels that cover an area of approximately 60 ha (Figure 1-2) on a leased area of 100 ha. It is estimated that the total height of the panels, including the structure, will be 4.7 m when tilted. Additional infrastructure on site will include a security guardhouse, an operations and maintenance building, internal gravel roads, a single circuit 132 kV powerline and a substation. A 10 MWh battery system will be connected to the solar facility to provide stability to the ESCOM distribution grid.

4.2 RATIONALE FOR THIS DEVELOPMENT

There are many factors, both at a national and local level that combine to make the Project a viable and sound solution from an economic, social, infrastructure and technical point of view.

Malawi needs to tackle poverty and regional disparities while, as a country particularly exposed to climate change, transitioning to a sustainable economy. The Project provides a tangible solution to both challenges.

In February 2017, ESCOM which manages generation, transmission, distribution across Malawi announced a plan to add solar capacities to the national grid using power supply provided by independent power producers. This plan is said to be one of the short-term mitigation measures it is implementing against the prevailing power crisis. ESCOM stressed it was not able to generate power at maximum capacity, due to dwindling water levels in Lake Malawi. Malawi's electricity generation relies predominantly on large hydro, which accounts for 94% of the total installed capacity, the remaining capacity comes from on-and-off isolated diesel mini-grids in Lilongwe, among other places. The project is a step toward a more balanced energy source mix of the country.

Commented [GS3]: Rob, do we know what is the national energy production capacity in Malawi? It would be interesting to present the potential increase associated with the project

Currently, Malawi has 20 mw of solar power actively generating for the national grid, with a further 40 mw in construction due to be added in 2023. The current total theoretical operating capacity for Malawi is 477 mw (African Data Tool 2022) made up of over 350 MW hydro-power and the remainder solar, biomass, and diesel generators. As of May 2022, this means that the proposed project would increase Malawi's grid capacity by 8.4%.

The country's electrification rate is currently at 9%, with a rural share of only 1%, according to the Malawi Energy Regulatory Authority. This project is expected to make energy more accessible and provide cheaper energy than the current LcoE of Malawi.

The Project is located at the District of Nkhotakota, which not only offers one of the best solar irradiation levels in Malawi. It is also particularly in need of power supply.

4.3 PROJECT SITE

The project site is located towards the middle of Lake Malawi, on the western bank, approximately 46 km north of Nkhotakota and 120 km south of Mzuzu as the crow flies.

The leased land for this project is located adjacent to the M5 road and within the Illovo Estate in the Nkhotakota District of Malawi (Figure 1.2).

Illovo Sugar (Malawi) Plc is listed on the Malawi Stock Exchange with 76% of the issued share capital held by the Illovo Group and the balance by public and other institutional investors. The corporate office is based at Limbe with two operations at Nchalo in the southern part of Malawi at Chikwawa and Dwangwa in the mid-central region of Nkhotakota, producing sugar cane and raw, brown, and refined sugar, together with speciality sugars especially at Nchalo. The company annually cultivates around 1.8 million tons of cane which together with approximately 350 000 tons produced by Malawian smallholder farmers (including the Dwangwa Cane Growers Association), results in the production of about 250 000 tons of sugar.

Illovo Malawi, which is one of two sugar producers operating in the country, supplies more than 60% of its total sugar sales into the domestic consumer and industrial markets, and a portion of the balance exported regionally within the sub-continent. Exports also take place to the EU and the USA markets, which include a range of speciality sugars.

There is staff housing belonging to Illovo and the Dwangwa Cane Growers Association to the east and west of the proposed Voltalia project area. The proposed project sites are bounded on the east by the M5 road and on the west by the Illovo management staff housing (in the northern half) and the Illovo golf course (in the southern half). In the middle of the project area adjacent to the M5 is the existing ESCOM substation which will be expanded.

The settlements immediately adjacent and to the east of the M5 road and on the opposite side of the road to the proposed Voltalia project sites are the Majiga village and the Dwanga Cane Growers Association (DCGA) and its settlement called ‘Small Holder’. Majiga is an Illovo staff housing village. The one informal and traditional looking settlement amongst these is reported to be additional accommodation constructed by Illovo staff and DCGA staff to accommodate family members.

To the south, the Voltalia project area borders on the Mowe village. This is the most northerly settlement of the original inhabitants and users of the Illovo estate land, who were displaced to make way for the sugar estate a number of decades ago. The other adjacent community’s further south (who were also affected by the development of the estate) include Mulala and Mazalala. Mowe is believed, by local residents, to be on Illovo land but the residents have been allowed by Illovo to continue to use this land and anticipate that they may at some stage be asked to move. The land on which the village has been developed is not within the proposed project area.

The Bowa settlement is located 250 m north of the northern boundary of the proposed Voltalia lease area, while Dwangwa town is located 1.5 km north of this boundary. The Toyota filling station is located adjacent to the northern boundary of the proposed lease area.

The majority of the site is natural with some subsistence agriculture and infrastructure. The northern and central areas of the site are relatively untouched, and the majority of land is in a natural state. No natural trees are harvested but grass is. Rice is grown in all rivers onsite. There is a drainage feature on the southern site that is canalised and dammed. It is anticipated that this is used by Illovo to facilitate irrigation on the eastern side of the M5 road. The canalised drainage feature is not within the proposed project area.

The majority of the southern portion is subsistence agriculture, rice paddies, fruit trees and woodlots. The infrastructure on site includes roads, substation, powerlines, water tower, buildings and soccer fields. There are also two sand mine areas one in the southern portion and one on the northern portion. A tree wind break has been planted along the M5 presumably for the neighbouring sugar plantation. Surrounding land use includes the town Bowa, Primary School (Majiga), Golf course (Kasasa Sports Club), Illovo houses and commercial agricultural fields (sugar cane).

4.4 Current Land Ownership

Currently the Land is managed by Illovo Sugar Malawi PLC (the Lessee) under a Lease (the Head Lease) dated the second day of April 1977, made between the Minister of Malawi Government Responsible for Land Matters and registered at the Deeds Registry as Deed Number 47178. The lease makes reference to a tract of land containing on area of 13,300 hectares or thereabout situate at Dwangwa Valley in Nkhotakota District (the Dwangwa Land).

By various transactions entered into by the Lessee and various parties, the Lessee has assigned and/or sub-let various pieces of land forming part of the Dwangwa Land to various parties. The remaining part of Dwangwa Land currently held by the Lessee comprises 12 094 hectares, from which Voltalia will sub-lease approximately 100 hectares, for a period of 30 years.

The delimitation of land identified as most suitable for the project development has gone through the Cadastral Survey process and registered at the Deeds Registry.

4.5 General Description of the Infrastructure

Voltalia has been developing the project since 2017 and has considered several possible designs and layouts. The Project is designed as a 55 MWp horizontal single-axis tracking photovoltaic plant and will deliver 40 MWAC to the grid.

Solar energy systems produce energy by converting solar radiation into electricity or heat (Figure 4.1). The proposed Project will use PV solar technology to generate electricity.

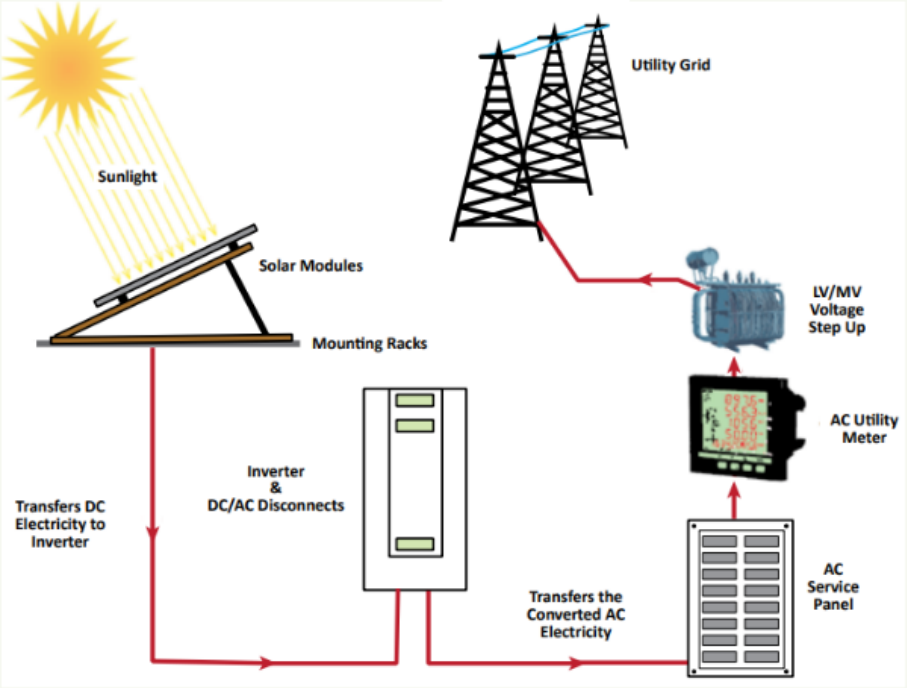


Figure 4.1 Schematic process flow diagram

The PV solar technology chosen for this Project consists of the following main components:

- PV cell: The PV cell is the device that generates electricity when exposed to solar radiation. The absorbed solar energy excites the electrons inside the PV cell and produces electrical energy. All PV cells produce Direct Current (DC). There are three main types of solar cells:
  - Monocrystalline – made from a single silicon crystal;
  - Polycrystalline — made from multiple silicon crystals; and
  - Thin film — common material used for thin film modules are cadmium telluride (CdTe) and copper indium gallium selenide (CIGS).

  The Project will use 660 W monocrystalline solar modules, potentially Trina TSM-60DEG21C.20, or similar depending on market availability, best pricing and final technical design.

- PV module: The PV module is the set of interconnected photovoltaic cells encapsulated between a transparent front (usually glass) and a backing support material then mounted in an aluminium frame. The modules will appear dark blue or black and will be mounted in an aluminium frame. The modules are designed to absorb the solar radiation and hence are not susceptible to reflection or glinting. The glare and reflectance levels from a given PV module are decisively lower than the glare and reflectance generated by a standard glass. The Project will use 83 340 panels and have an expected operational period of 25 years.

- Mounting structures: Multiple PV modules are bolted onto a mounting structure which tracks the suns progress across the sky in an east to west direction. The mounting structures will be either steel or aluminium sections extending between 1m and 3m into

the ground depending upon the ground conditions. Approximately 60 modules will be fitted per frame. There will be approximately 4.5 m spacing between each row.

- PV array: The PV array is the complete power generating plant consisting of multiple PV modules wired in series and in parallel. The PV modules will be connected by DC cables to combiner boxes mounted underneath the PV module mounting structures. Each combiner box will occupy an area of approximately one square metre. The power generated by many PV module strings is combined in the combiner box and transmitted via underground 400 V-1000 V DC cables to an inverter and transformer enclosure.

- Inverter: The inverter converts the DC to AC. The inverter (Power Electronics FS4390K, or equivalent) and transformer are anticipated to be housed within the same inverter station housing (typically an insulated, steel-framed 20-foot shipping container). The transformers transform the low voltage AC from the inverter to medium voltage. There will be approximately 11 inverters for the Project.

- Substation: The substation receives all power from the inverters via underground cables and provides protection and control equipment required to safely manage the plant and to ensure grid code compliance regulations. The substation will consist of at least one small building, outdoor electrical plant and equipment and the transformers and will be approximately 2,000 m^2.

- Storage system: A battery storage facility will be present on site. The capacity of the storage will be approximately 10 MWh. The batteries will be fully sealed self-contained units – likely to be Lithium Ion. The battery bank will be stored in the substation building. Given these batteries are sealed units and will be imported. Should there be any faults with the batteries, they will be swopped out. The supplier of these will be an international one and therefore any faulty batteries will be returned to the supplier.

- Transformer: The transformer steps up the AC power from the inverters (typically at 33 kV) to match the grid voltage (expected to be 132 kV).

- Stores, offices, guardhouse and control building: A small building containing space for spares, office seating, welfare facilities and computer control equipment will be located near the substation approximately 100 m^2 in size. This building will be on the perimeter of the plant. The guardhouse will include a small kitchen and toilet. Building will include a storeroom for spare parts kept onsite. The control room will contain switchgear and monitoring equipment for the PV plant. The buildings will be a standard height of approximately 3 m.

- Access tracks and fencing: The Project will include tracks throughout the site to permit access for maintenance vehicles and personnel. The tracks take into consideration the natural topography of the Project Site, to minimize the need of earthworks and turf removal. The pathways are to be designed with a minimum width of 3.5 m and a minimum middle radius of the curves of at least 7 m, allowing the access to all the transformer and inverter stations planned in the Project.

A security fence, alarm system, and close circuit television security cameras will surround the site. The fence will be made of galvanized steel mesh which is fixed on galvanized steel posts of a 2 m height. The foundation will be as per the supplier specifications. The gates will open in two sheets of 2 m high and 4 m wide

- Balance of system: The remaining components that will make up the Project, commonly referred to as 'balance of plant' components, typically include, but are not limited to, combiner boxes, DC cables, trenches, power conversion stations, AC cables and earthing and lightning protection.

- Transmission line: a 132 kV transmission line will connect the Project and the ESCOM substations. The transmission line will be approximately 50 m long and have two (2) poles, one on the line-out of the Project substation, and one on the line-in at the ESCOM substation. The wayleave for the transmission line will be 30 m.

- Connection to the grid: The grid connection requires transformation of the voltage from 480 V to 132,000 V. The normal components and size of a distribution rated electrical substation will be required. A small switching station for the plant will be located on the outside of the control room.

4.6 PROJECT PHASES

4.6.1 Project Planning and Design

The Project has been in the Project planning and design phase since 2017. During this time multiple pre-feasibility and feasibility studies and engagement with government and community stakeholders have been undertaken. The studies that have been undertaken during this phase include:

- Grid Analysis and Market Review;
- Grid Impact Assessment;
- Topographical Survey;
- Hydrological Study;
- Site Pre-feasibility Study;
- Feasibility Study;
- Energy and Yield Assessments;
- Land sub-lease process;
- Power Purchase Agreement;
- Implementation Agreement; and
- Grid Connection Agreement.

4.6.2 Site Preparation and Construction Phase

This phase of the Project will involve the clearance of vegetation, installation of fencing and levelling of the site and preliminary earthworks. The clearance of vegetation will be limited to the areas required for the fencing, access roads and array site. Any areas not demarcated for this infrastructure will not be cleared. The earthworks are likely to be limited in nature and cut and fill activities are expected to be limited. The preliminary design uses the existing topography as far as possible. Therefore, only those areas that are particularly steep will be excavated to provide a gentle slope. A number of heavy plant will be on site, clearing the vegetation, levelling the site where necessary and creating stockpiles of surplus material (Table 4.1).

Table 4.1 A list of potential heavy plant that will facilitate the construction activities

Equipment	Primary function
Bulldozers 	Land clearance and levelling
JCB Diggers 	Trenching for cables
Dump trucks 	Earth removal
Vibrating Roller 	Compacting access tracks
Piling machine (s)	Ramming piles of mounting frames into the ground

Equipment	Primary function
	
Telehandler (s) 	Distributing materials
Crane 	Capable of lifting inverter and transformer cabinets into place
Fuel bowser 	Refuel plant as required

It is not anticipated that blasting will be required at this stage. Should it be required, the proponent will approach MEPA and discuss the use of explosives and the safety and impact thereof.

The earthworks will include the removal of the surface soil (approx. 300 mm) which will be stockpiled for use post-construction as part of the rehabilitation of the site.

The site preparation phase will also include the establishment of a contractor laydown area, the construction of the permitter fence and site access roads. These are all expected to be within the project footprint (see Figure 1.2).

The fence will be constructed of posts and mesh to secure the site. It will be important to ensure that access to the electrical equipment by non-authorised personnel is not possible. In addition, the fencing will have CCTV installed and regular security patrols around the permitter.

The site access roads will be gravel and although during construction are likely to be temporary and change location, permanent roads will be established within the fence around the permitter and between sections of the array. The main site access will be where the existing Dwangwa substation is with a secure gate installed near the substation.

The following facilities will be constructed within the project footprint:

- Temporary and permanent workshop and maintenance areas;
- Temporary and permanent stores (for storing and handling fuel, lubricants, solvents, paints and construction material);
- Temporary contractor lay-down areas;
- Mobile and permanent site offices;
- Temporary and permanent waste collection and storage areas; and
- Parking area for cars and equipment.

During the construction phase the following activities are anticipated to take place:

- **Transportation and of equipment and components to site** – the heavy plant and vehicles required for the earthworks and construction activities will be transported in from other parts of Malawi (possibly Lilongwe/Blantyre) since the equipment is unlikely to be available locally. This will result in large, potentially oversized, trucks driving along the N5 to access the site;
- **Establishment of workshops, temporary laydown areas** – given the size of the site it is anticipated that one main laydown area will be used with a number of smaller laydown areas as the works progress. These will be located in areas with level ground, will be secured with temporary fencing and contain all the equipment required for the project. The laydown area is expected to also contain staff wellness facilities including toilets, sit-down areas and shelter out of the elements;
- **Excavation of cable trenches** – trenches will be constructed to facilitate the installation of the cabling. Tranches are likely to vary in size with the most common dimensions being 800 mm – 1000 mm deep and 500 mm wide. The trenches will be constructed in a way that they only remain open for sufficient time to install the cable;
- **Piling or drilling of the mounting structure frames (depending on the geotechnical condition of the ground)** – to ensure the frames holding the solar panels maintain their strength and integrity the construction method will include the drilling and piling of micro-piles into the ground. This will be through the use of an impact hammer which will be a mobile unit. There will be approximately 180 piles per day depending on the ground conditions;
- **Installation of the modules onto the frames** – Once the frames are installed the modules will be secured to them. Each module is approximately 2-3 m^2 and can be handled by a number of workers. Once secure, suitably qualified electricians will connect the panels to each other;
- **Installation of measuring equipment** – in order to monitor the performance of the facility during the operational phase of the project a number of measurement instruments will need to be installed. This will be done by the training and proficient electricians at the time of installing the modules;
- **Laying of cables between the module rows to the inverter stations** - Each panel will be connect in a string via underground cable. Strings will then be connected to a number of smaller inverter stations, which in turn will be connected to the new substation;

- **Construction of inverter and transformer station foundations and installation of inverter stations** – these are the locations where strings of the array will connect to reduce the number of cables and to ensure the maximum transmission of power to the substation and subsequently, the grid. The inverter stations will take the form of small installations on a concrete foundation and provides protection to the inverter and switch gear;
- **Construction of transmission lines, switch stations at the Project's substation** – The building will need to house all the high voltage switch gear and the battery storage facility. It will have a footprint of 100 m^2;
- **Construction of stores, workshop and office buildings** – in order to service machinery, equipment and vehicles temporary and permanent stores, workshops and offices will be established. These would need to contain a number of spares, tools and areas to repair equipment and vehicles and offices for site personnel;
- **Testing and commissioning**; and
- Removal of equipment and demobilisation of construction team's temporary infrastructure.

Construction will occur over 15 months and it is anticipated that during this phase there will be a peak of approximately 350 workers (skilled and unskilled) on the Project site during the period.

During the construction phase the primary Project components will be delivered in the following way:

- Inverters - 12 deliveries;
- Main Transformer - 4 specialised abnormal load deliveries;
- LV/MV Transformers – 12 deliveries;
- PV modules – 165 truck deliveries;
- Tracker/structure – 140 truck deliveries; and
- Miscellaneous – 30 truck deliveries.

At this stage it has not been confirmed where these primary components will come from. It could be via Tanzania or Mozambique. What is clear is that they will use the M5 at access the site.

4.6.3 Operational Phase

The solar PV power plant will be operated on a 24 hour, 7 days a week basis (although generation of electricity will only occur during sunlight hours). Operational activities will include:

- Cleaning of the modules by trained personnel using a high-pressure water hoses;
- Vegetation management for under and around the modules to allow maintenance and operation at full capacity;
- Maintenance of all components including modules, mounting structures, trackers, inverters, transformers switching station plant and equipment;
- Control room management and maintenance of the welfare facilities;
- Supervision of the electricity production; and
- Site security monitoring.

During the operations phase it is estimated that there will be up to 56 workers associated with the Project but not all on site at the same time necessarily. There will also be limited project related traffic.

The breakdown of workers will be as follows:

- Skilled (46 workers)
  - Technicians.
  - Operators.
  - Security (shift based).
- Unskilled (10 workers)
  - General facility housekeeping (vegetation maintenance).
  - Panel cleaning.
  - Cleaners.

4.6.4 Decommissioning Phase

The proposed Project is expected to operate for at least 25 years. Once the plant reaches the end of its life, the PV modules may be refurbished or replaced to continue operations or the facility may be closed and decommissioned. If decommissioned, all components would be removed and the site rehabilitated. Where possible all materials will be recycled, otherwise they will be disposed of in accordance with local regulations and international best practise.

4.7 Resource Requirements

4.7.1 Water

Water for construction activities will be sourced by means of trucks. Uses will include construction activities such as concrete mixing, and sanitary facilities for workers. It is estimated that the Project will require up to 150 cubic metres of water during construction.

Commented [GS4]: Voltalia to amend as per Nicolas comment

Water usage during the operational phase will include domestic use and panel cleaning. It is estimated that up to 1 000 cubic metres of water per annum will be required for panel cleaning during the dry season. Water will also be required for onsite staff. Should additional water be required during the operational phase of the project appropriate investigations and permitting will take place.

4.7.2 Wastewater

Wastewater from construction and operational activities include the following:

- **Temporary sanitary facilities** – during construction, portable sanitary facilities will be used and regularly serviced. Water will be made available to ensure cleanliness can be maintained;
- **Permanent sanitary facilities** - there will be minimal sewage from sanitary facilities during operation (i.e. septic tank with bi-weekly collection) due to the low numbers of personnel on site. No-one is expected to live on site; and
- **Drainage over potentially contaminated areas (e.g. concrete batching/ mixing areas and equipment storing areas)** - The EPC contractor will manage construction wastewater. Any hazardous wastewater will be stored on site and treated (if required) before disposal. Run-off from the panel cleaning or storm water are not expected to be contaminated and adequate drainage of the site will be a design requirement for the Project Site.

4.7.3 Storm water

The management of storm water is a very important element of solar PV installations. The proposed development is likely to have some impact on the natural surface water flow regime of the proposed site, particularly during the construction phase, thus impacting on the generation of stormwater, the associated potential for erosion and impact to surrounding wate quality. Therefore, the approach to managing stormwater and erosion control is to ensure clean and dirty water generating areas are firstly identified and then managed (volume and water quality) appropriately for both the construction and operation phases.

Solar panels are impermeable, and they are generally installed in a manner that allows stormwater to fall directly to the ground. To encourage infiltration and discourage erosion, the site is graded to encourage sheet flow of runoff across the site, including areas under the panels.

Sediment control is often necessary where vegetation is stripped away, exposing areas susceptible to erosion during significant storm events. Control of sediment is generally achieved through the inclusion of stormwater settling facilities. Silt laden waters (with a high TSS load) require a slowing down of the water for the suspended solids to settle.

In terms of stormwater management and erosion control, three options have been considered for the site, namely:

1. **A silt fence approach** - Silt fences may be used in conjunction with the berm and channel approach. As defined by the EPA guide, a silt fence *"is a temporary sediment barrier made of porous fabric. It's held up by wooden or metal posts driven into the ground, so it's inexpensive and relatively easy to remove. The fabric ponds sediment-laden stormwater runoff, causing sediment to be retained by the settling processes"*. A silt fence is easy to install, possibly a cost-effective approach to stormwater and erosion control management and ideal for the temporary nature of the construction phase of the proposed project. Should silt fences be used, it is recommended that water with suspended sediment runoff be distributed, rather than concentrated, in order to not to overwhelm the silt fence during significant storm events. The United States Environmental Protection Agency (EPA) guide can be consulted as to recommended design standards in this regard. Refer to (https://www3.epa.gov/npdes/pubs.siltfrnces.pdf) for the online document. The provides a detailed guide on the installation and maintenance of silt fences;
2. **A "clean" and "dirty" water diversion berm and channel** – A "clean water system", includes any dam, other form of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of unpolluted water. A "dirty water system", includes any dam, other form of impoundment, canal, works, pipeline, residue deposit and any other structure or facility constructed for the retention or conveyance of water containing waste. These areas are however anticipated to be associated with areas prone to erosion by rainfall due to the exposure of soil attributable to vegetation stripping. Without mitigation, disturbed areas will likely result in a higher proportion of Total Suspended Soils (TSS) compared to undisturbed areas. The construction of the dirty water management and containment infrastructure is deemed necessary. A system of clean water diversion trenches and berms should redirect the water around the solar panel complex and the water allowed to recharge the downgradient landscape after it has been released in a diffuse manner; and

3. A berm and channel approach routing to a sediment control area – For this approach a dirty water area will be defined around each of the construction sites using the excavated earth material for construction of the berm. A conceptual design guideline for the construction of a diversion will be developed. The side slopes for all berms and channels at a constant 1 vertical: 3 horizontal, a channel depth (a) of 1.5 and base width (b) of 2m. The berm will be on the outside of the construction area, with the channel component on the inside, thereby enhancing the settling of sediment. The preliminary design of this system should aim for a 1:10 year recurrence interval event as it represents a reasonable design event for sediment control.

4.7.4 Solid Waste

During construction, wastes will comprise of general domestic and food waste, office waste and organic material.

Hazardous wastes, namely: petrol and diesel by-products, will be generated from the transport of goods and personnel, generators and heavy construction equipment.

Large quantities of non-hazardous waste will be generated from the solar PV panel packaging material, which typically arrive in wooden pallets. The disposal and possible recycling of these materials will be investigated.

Waste will be separated at source, and labelled bins provided within the facility for the storage of the various categories. Staff will be trained in proper waste management practices and the importance of implementing them. Cleaning staff will be trained in safe handling and storage of waste and hazardous materials; they will also be provided with adequate PPE.

During construction all hazardous waste will be removed by the EPC contractor and safely disposed of in a licensed facility. The hazardous waste such as ink cans, oil spill kits, old machinery grease, etc will be collected for treatment by a specialised company. In the case of used oils, these will be collected and reused in industry as fuel. Voltalia are currently contacting companies in the region (outside Malawi) and conducting procurement in country.

Commented [GS5]: Rob are you aware of any facility available in Malawi?

Commented [RHL6R5]: No. the standard practice in Malawi for hazardous waste is for the company supplying to remove. There are a few organisations who recycle, I have heard of a company that collects waste oil to use as fuel as you have aleady mentioned.

Non-recyclable non-hazardous solid waste will be sent to the nearest waste site.

Minimal waste is expected to be generated during the operations phase. Hazardous materials used on site during operations will include fuels, oils, lubricants, cleaning products, and specialised gases (for use in switchgear). Oil that needs to be replaced will be recycled, if possible, or safely stored and removed from the site and correctly disposed.

Commented [GS7]: Voltalia to add waste volumes

It is possible that the solar panel may break or become faulty during the construction and operation of the facility. These panels are considered to be inert, in that they will not leak and do not contain substances that would lead to contamination of soils and/or water. There are no suitable disposal facilities in Malawi to handle these panels. Therefore, the panels will be stored on site. Once a sufficient number of panels have accumulated these will containerised and exported to a suitable receiving facility. At the time of writing the panel will be sent to a facility outside of Malawi.

For decommissioning, disposal or potential recycling processes, Voltalia has discussed with the manufacturer of the Battery Energy Storage System (BESS) system and a detailed End of

Life (EOL) treatment plan describing all EOL activities for these systems will be provided at the commissioning stage. Several materials found in the battery storage system are regulated and thus should be disposed of according to regional government requirements, such as directive 2006/66/EC of the European parliament and of the council, also known as the Batteries Directive. These will be returned to their original location after successful decommissioning. The return of the battery storage system will be arranged with the manufacturer, using the same procedure and logistics requirements used during the delivery."

4.7.5 Energy and Fuel

Electricity during the construction phase will be provided through the use of diesel-powered generators. It is estimated that 1 x 30 kW generator running for 8 hours a day, 5 days a week for 30 weeks will satisfy the electricity requirements of the office trailers during construction.

The following construction vehicles/machinery will be onsite during the construction period:

- 4 Dump trucks;
- 10 Bob Cats;
- 1 tractor;
- 1 Water truck;
- 6 Tractor-loader-backhoe (TLB)s;
- 6 Pick-up trucks;
- 4 Excavators;
- 3 Telescopic handler; and
- 1 100t crane (10 days).

Once operation has been established, the facilities power supply will be from sources in the following order: the solar generated electricity; then electricity purchased from ESCOM when the plant is not generating electricity; and finally diesel-powered generators when there is no supply from the facility or the grid.

Very limited vehicle use is anticipated during the operational phase, only vehicles for transporting workers, and a tractor for collecting waste from vegetation management.

5 PROJECT ALTERNATIVES

One of the objectives of an ESIA is to investigate alternatives to the proposed project. There are two types of alternatives - Fundamental Alternatives and Incremental Alternatives. Alternatives are defined as: "*different means of meeting the general purpose and requirements of the activity*" which includes alternatives to the:

- Location - where the proposed activity will be;
- Type of activity to be undertaken;
- Design or layout of the activity;
- Technology to be used in the activity; and
- Operational aspects of the activity.

5.1 FUNDAMENTAL, INCREMENTAL AND NO-GO ALTERNATIVES

5.1.1 Fundamental Alternatives

Fundamental alternatives are developments that are totally different from the proposed project and usually include the following:

- Alternative property or location where it is proposed to undertake the activity.
- Alternative type of activity to be undertaken.
- Alternative technology to be used in the activity.

5.1.2 Incremental Alternatives

Incremental alternatives are modifications or variations to the design of a project that provide different options to reduce or minimise environmental impacts and maximise benefits. There are several incremental alternatives that can be considered, including the design or layout of the activity, technology to be used in the activity, and the operational aspects of the activity.

Design: Design alternatives can include different types of infrastructure, which have not been finalised by the applicant at this stage.

Layout of Plant Site: As the project is at scoping level, the layout of the project is not fixed or entirely accurate at this time. A preliminary layout is provided as part of the Scoping Phase. Potential layout alternatives will be further investigated during the ESIA.

5.1.3 No-go Alternatives

A no-go alternative must also form part of the analysis of alternatives. The "no-go" alternative refers to the current status quo and the risks and impacts associated with it. Some existing activities may carry risks and may be undesirable (e.g. an existing contaminated site earmarked for a development). The no-go is the continuation of the existing land use, i.e. maintain the status quo.

5.2 ALTERNATIVES CONSIDERED

5.2.1 Location Alternatives

The location of this facility has changed significantly from where it was originally intended.

The original site was adjacent to the M1 road, north of Lilongwe city centre, in central Malawi, at geographic coordinates 13°51'39.27''S and 33°47'27.86''E, in the community of Kanengo, Area 26. The land location was proposed in the tender documents under which this project was awarded and surveyed jointly by the developer, ESCOM and Ministry of Lands to confirm site selection, prior to the Offer Letter issued by Ministry of Lands. The Land requested for this project considered a plot on the North side of an existent local service road, with a total area of approximately 60 ha. As the Project had access to a large land area, a site investigation based on design, selected equipment, site location and a geological and topographical survey of the terrain has been done to do project optimization, which after optimization the Layout was defined and engineering designed. Additionally, an approximately 4 km 66 kV line would need to be built to connect the Kanengo Substation.

At a later stage, and after the site development, the Ministry of Lands informed the developer that the above-mentioned site was not available anymore and that new sites had to be

considered. They proposed 4 new sites and 3 new locations in Dwangwa, Nkhoma and Kasungu, all in Central Malawi. After a site investigation and detailed investigation of each proposed site, analysis of the impact on the grid and preliminary analysis on the impact on the environmental and social aspects of the project development, the proposed Dwangwa location was proposed to be developed. Following on from the discussions with the Malawian Government, the Illovo site was identified and discussions between Illovo and Voltalia progressed to a point where approximately 100 ha of space was agreed to be leased.

The proposed lease area was situated north of Dwangwa, near the entrance to the Illovo Estate on the M5. The existing ESCOM substation formed the southern boundary with the 60 ha earmarked to the north of this infrastructure, between the M5 and the Illovo managerial housing and golf course. In early 2021, ecological specialists and land surveyors visited the proposed site (see Figure 5.1).

The initial findings of the studies and surveys described a mostly disturbed habitat but with smaller areas of intact sensitive habitats and species. Similarly, the topography of the land in the far northern portion of the site was less favourable. In order to avoid these areas, Voltalia approached Illovo again and requested whether the area to the south of the ESCOM substation was available. It was and the project is now planned to be equally split (i.e. 20 MWAC) between the northern portion and southern portions (see Figure 5.2).

5.2.2 Technological Alternatives

Commented [GS8]: Voltalia to provide text for Wind and HFO alternatives

Two technology alternatives were considered by Voltalia, namely:

- Solar photovoltaic (PV) panels, where the panels are comprised of a packaged interconnected assembly of solar cells, also known as photovoltaic cells; and
- Concentrated Solar Power (CSP), whereby sunlight is concentrating through a lens onto high performance solar cells, thus increasing the electricity generated.

Based on the project requirements, solar PV panels were identified as the preferred technology alternative. The advantages and disadvantages of the technology alternatives are presented below.

5.2.3 Layout Alternatives

This relates mostly to alternative ways in which the proposed development or activity can be physically laid out on the ground to minimise or reduce environmental risks or impacts.

As mentioned in Section 5.2.1, additional land was added to the proposed development site. This was based on Voltalia's desire to avoid sensitive ecological areas and areas of unfavourable topography to reduce the requirement for cut and fill operations. This desire to avoid sensitive habitats was taken a step further and the Miombo Woodland to the west of the site was also excluded from the development area as well as wetland habitat near the ESCOM substation (see Appendix 2 Ecological Specialist Report). What now remains is smaller discreet project development sites within the larger lease areas that take account of intact habitats and reduces the need for significant earthworks (see Figure 5.2).

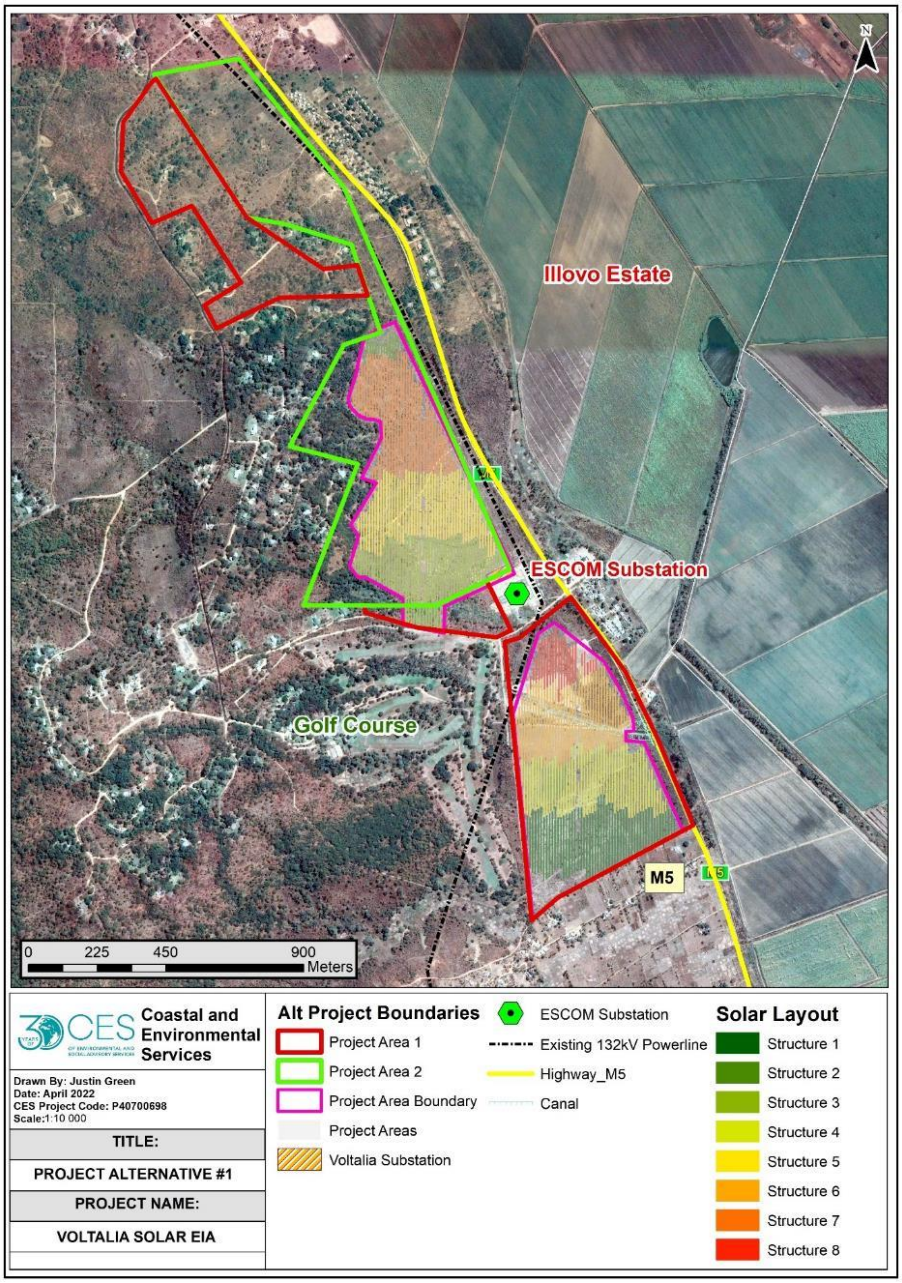


Figure 5.1 Original Illovo lease area

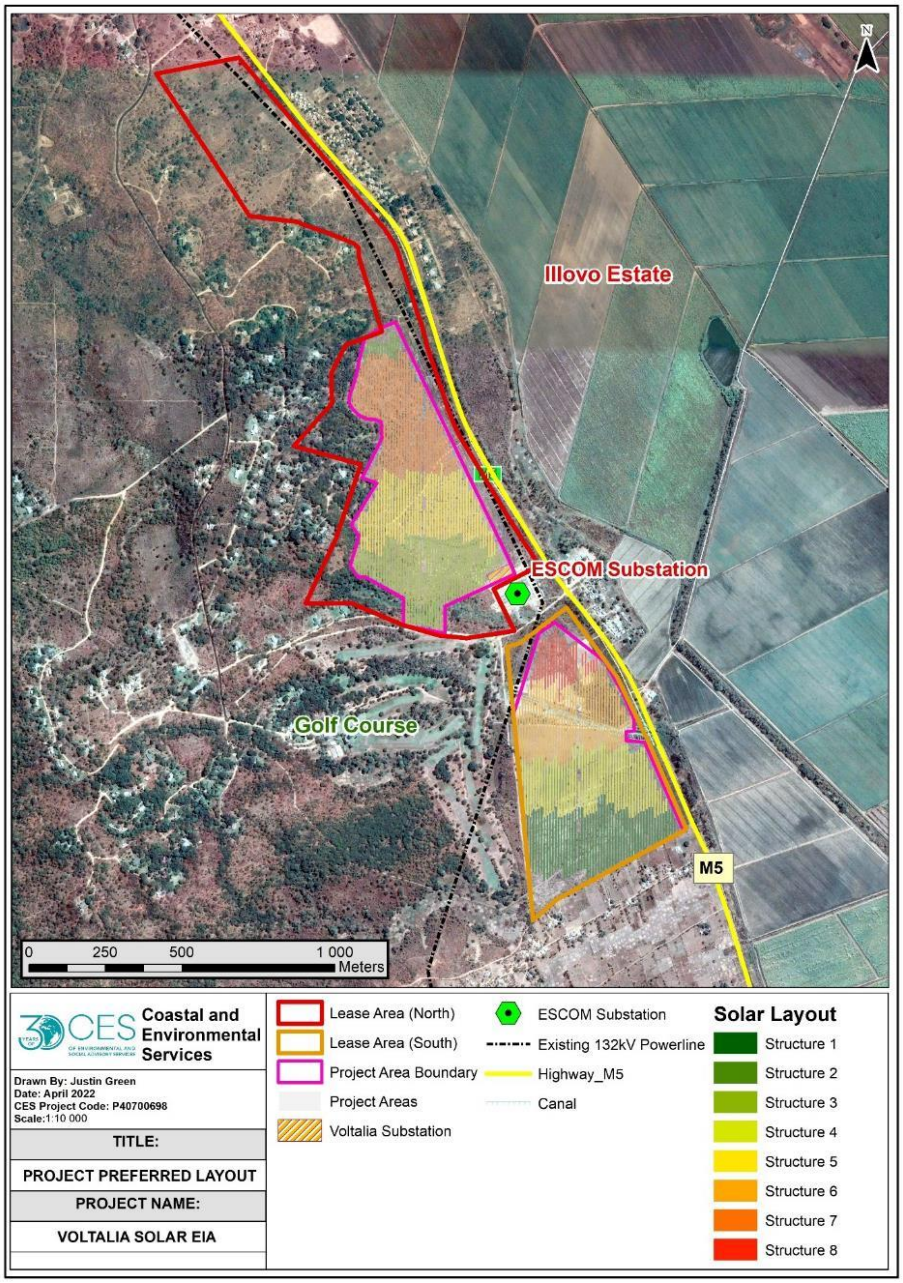


Figure 5.2 Location amendment to include the southern portion. The physical development area is also more discreetly located with the lease area to avoid sensitive habitats.

5.2.4 No-Go Alternative

The No-Go alternative in the context of this project implies that the solar PV plant would not be developed and the current land use would persist. If the project does not proceed the negative impacts such as loss of vegetation, the potential for the change in hydrology of the site and the ecological functionality would be avoided. However, it would also mean that the project would not provide the energy requirements the Malawian Government are seeking.

Table 5.1 Analysis of the proposed alternatives for the Solar PV facility at Dwangwa, Malawi

LEVEL	ALTERNATIVES	ADVANTAGES	DISADVANTAGES	REASONABLE AND FEASIBLE	FURTHER ASSESSMENT
Property or location	**Original Location**	• Sufficient space available • Suitable grid connection options • Good accessibility	• Government does not have authorisation to grant development on the proposed site.	NO	NO
	Illovo lease area (North)	• Single 60 ha land portion available. • Land portion is large enough to accommodate minor micro-siting. • The site could accommodate the 40 MW fixed module infrastructure. • The majority of the site is relatively flat. • Access road is easy and close to main tarred road (M5). • Proximity to the existing ESCOM substation (i.e. within 50m). • Full land ownership is with one landowner, Illovo.	• There is an existing OHL servitude that intersects the eastern side of the site and could have interfered with the proposed layout. • Ecological and topographic constraints in the far north of the site.	YES	YES
	Illovo lease area (South)	• Area already disturbed due to historical land use (i.e. Illovo). • Land portion is large enough to accommodate minor micro-siting. • The site could accommodate the 20MW fixed module infrastructure. • The majority of the site is relatively flat. • Access road is easy and close to main tarred road (M5).	• There is an existing OHL servitude that intersects the eastern side of the site and could have interfered with the proposed layout. • There will be some economic displacement due to the presence of seasonal farming. • A football field used by the local school and community will need to be relocated.	YES	YES

LEVEL	ALTERNATIVES	ADVANTAGES	DISADVANTAGES	REASONABLE AND FEASIBLE	FURTHER ASSESSMENT
		• Proximity to the existing ESCOM substation (i.e. within 50 m). • Full land ownership is with one landowner, Illovo.			
Technology	**Preferred Technology** Solar photovoltaic (PV) panels	• Better economic performance than CSP. • More cost effective than CSP meaning lower costs of capital resulting in lower tariffs. • Requires less water than CSP.	• Additional batteries required for storage. • Without batteries, only generates power during the daytime. • Large area required for solar panels.	YES	YES
	Alternative technology Concentrated Solar Power (CSP)	• Better electrical output than PV. • CSP systems can store energy in batteries that can be tapped for energy on demand, which helps the systems more consistently meet local power demands, especially during peak usage times.	• Very water intensive. • Higher negative visual impact than PV. • Large area required for solar panels.	NO	NO
Design or layout	**Preferred Design and Layout - Figure 5.2**	• The preferred design ensures the highest possible project capacity of 40 MW AC in the smallest development footprint, meaning the least amount of ecological damage. • Avoids the impacts to Miombo Woodland to the west of the site. • Reduces loss of ecological corridors through the site. • Reduced edge disturbance.	• Loss of vegetation. • Economic displacement of those using the land for crops.	YES	YES
	Original Illovo design and layout (Figure 5.1).	• Entire project could be contained on this portion. • Avoid additional economic displacement and the relocation of the football pitch	• Impacts to ecologically sensitive habitats. • Require more earthwork to provide suitable conditions for the panels.	YES	NO

LEVEL	ALTERNATIVES	ADVANTAGES	DISADVANTAGES	REASONABLE AND FEASIBLE	FURTHER ASSESSMENT
No-go option	Site alternatives remain in their existing condition.	• The environment will remain relatively undisturbed.	• Energy requirements of the Malawian Government will not be met if the proposed solar PV plant is not developed.	YES	YES

6 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

The objective of the environmental baseline is to establish the characteristics of the existing biophysical conditions in the Project area. This Section presents the baseline conditions in the Project Area and serves as the reference point against which impacts can be predicted and ultimately monitored.

The baseline has been informed through a combination of desktop research and in-field data collection. Where there has been in-field data collection a summary has been included in this report and a supporting "Specialist Report" has been included as an appendix. The reference to each of the specialist reports has been included in each chapter accordingly.

6.1 AREA OF INFLUENCE

The baseline section presents an overview of the biophysical and socioeconomic characteristics relating to the area in which the development will take place (i.e. within the Project 'footprint') as well as the surrounding areas which may be directly or indirectly affected by the proposed Project. This Area of Influence (AoI) includes the Project sites (land for the solar PV power plant site and transmission line), access roads to the site, the area surrounding the site potentially affected by the Project, and nearby communities.

The IFC Performance Standards require project proponents to identify and manage environmental and social risks and impacts within their Area of Influence (AoI). The AoI is defined in IFC Performance Standard 1 as:

The area likely to be affected by: (i) the project and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project;(ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or (iii) indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.

Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.

Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

In the context of this report, the Area of Influence (AoI) is applicable to the biological and social environments, which are slightly different. The AoI for the biological environment is limited to those areas within the Project Areas North and South. CES has added a buffer of 100 m as some of the potential impacts (i.e. dust) will occur outside of the project areas (Figure 6.1).

The AoI for the social environment includes the Lease Areas North and South, with a 100 m buffer. The AoI includes communities that may be directly and indirectly impacted by the Project during construction, operation and decommissioning. This includes villages that are impacted through use of land within the identified project footprint. This also includes villages that will be impacted by the health and safety impacts (including disturbance from noise and dust during construction), worker camps and in-migration of job opportunists into the local area (Figure 6.2).

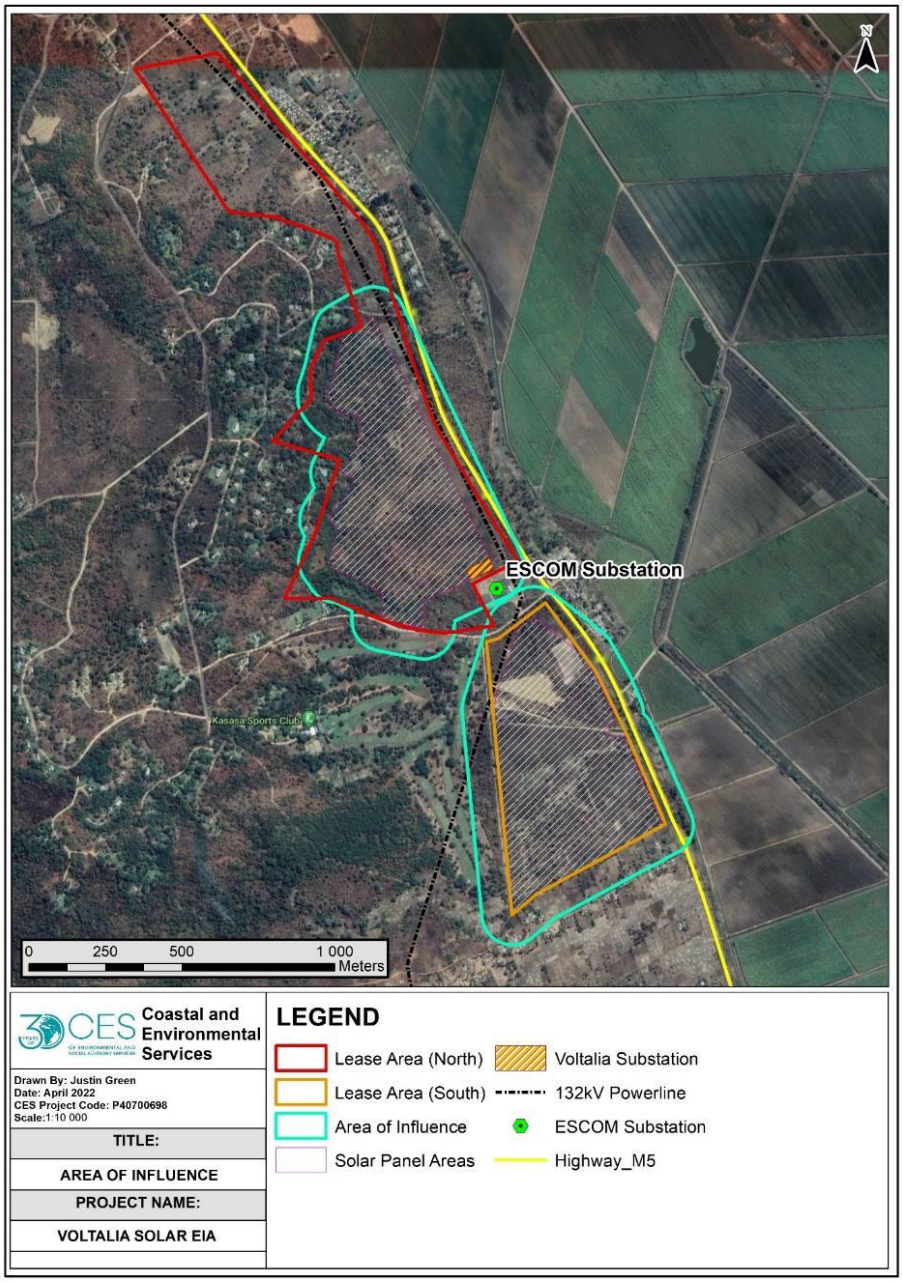


Figure 6.1 Area of Influence – biological environment

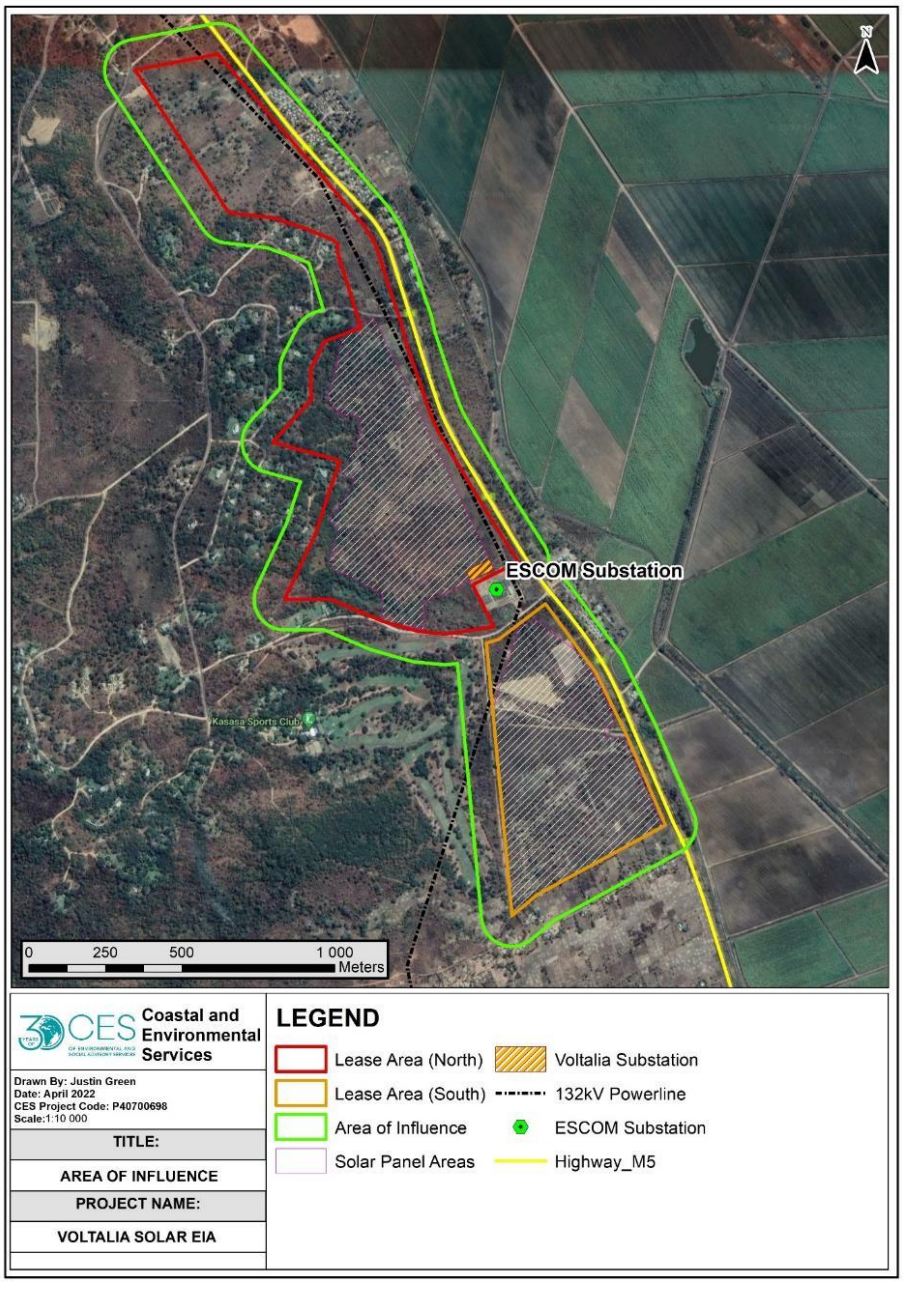


Figure 6.2 Area of Influence – social environment

6.2 CLIMATE

Malawi's climate is described as being subtropical and is strongly seasonal. It is characterised by a warm wet season that stretches from November to April and a cooler, drier season from May to October. The hottest months in Dwangwa are October and November with average temperatures of 29^{0}C and the coolest months are June and July with average temperatures of 22^{0}C (World Weather Online, 2021) (Figure 6.3).

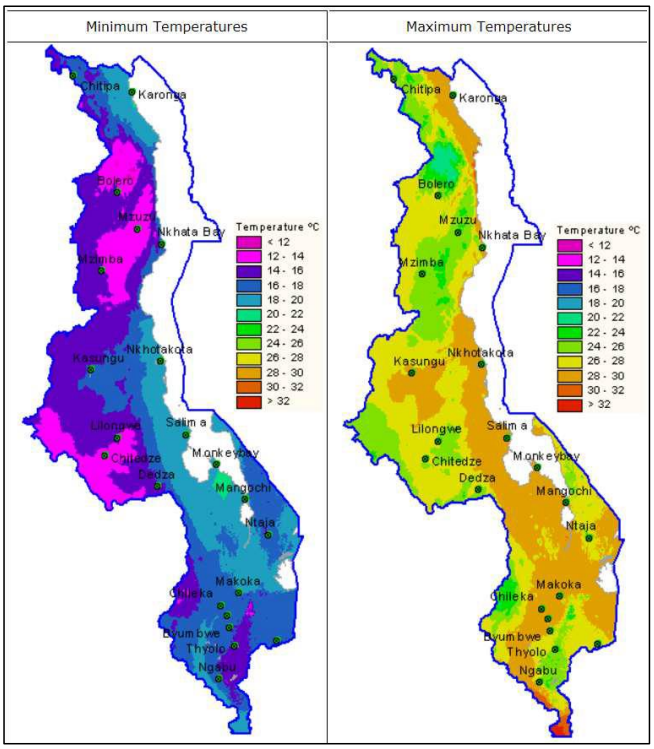


Figure 6.3 Maximum and Minimum temperatures across the Malawi region (source: Department of Climate Change and Meteorology, 2006).

Rainfall is markedly concentrated to the summer months and occurs as a result of the inter-tropical convergence zone which becomes established over the region (Brown and Young, 1965). Associated with the inter-tropical convergence zone are unstable air masses and higher moisture content which results in a high humidity of between 75-80% and heavy convectional storms. The average rainfall for Dwangwa ranges from 339 mm in January and February to 5mm in August and September. Most of the rainfall is received in the lower lying part of the catchment. The majority of catchment lies in an area that receives around 700-800 mm rainfall a year, and many of the main tributaries have their source in these regions.

During the dry season, the region is covered by a sub-tropical high-pressure belt which is associated with dry south-easterly winds (Brown and Young, 1965). Relative humidity is typically lower during this period (50-60%) and almost no rainfall occurs.

6.3 GEOLOGY

Malawi lies predominantly within the Mozambique Mobile Belt which comprises of rocks from the late Precambrian to early Palaeozoic age. The underlying geology is typically characterised by reworked metamorphic rock of igneous and sedimentary origin (Mshali, 2009) and collectively known as the Malawi Basement Complex.

The project site is underlain by the Muva Supergroup which forms most of the basement in south-central Malawi. It is characterised by the presence of semi pelitic rocks and pelites (Mica schists, Kyanite and Sillimanite Schist and gneisses) (Haundi *et. al.*, 2021).

6.4 SOILS

The study area is based in the Nkhotakota region where the main associated soil type are Lixisols (Figure 6.4). Lixisols are the most highly distributed soil profile across Malawi (Dijkshoorn et al. 2016). They are associated with old landscapes and occur in tropical climates that have a distinct dry season. They are comprised of strongly weathered soils where clay has washed out of an eluvial horizon. This soil type has a subsurface layer of accumulated kaolinitic clays.

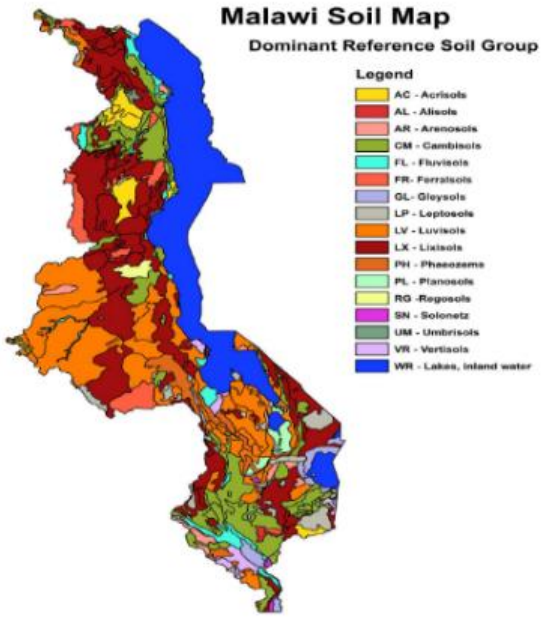


Figure 6.4 Soil distribution throughout the Malawi region (source: Dijkshoorn et al. 2016).

6.5 TOPOGRAPHY

The site is generally level, with gentle slopes and a small change in elevation (Figure 6.5).

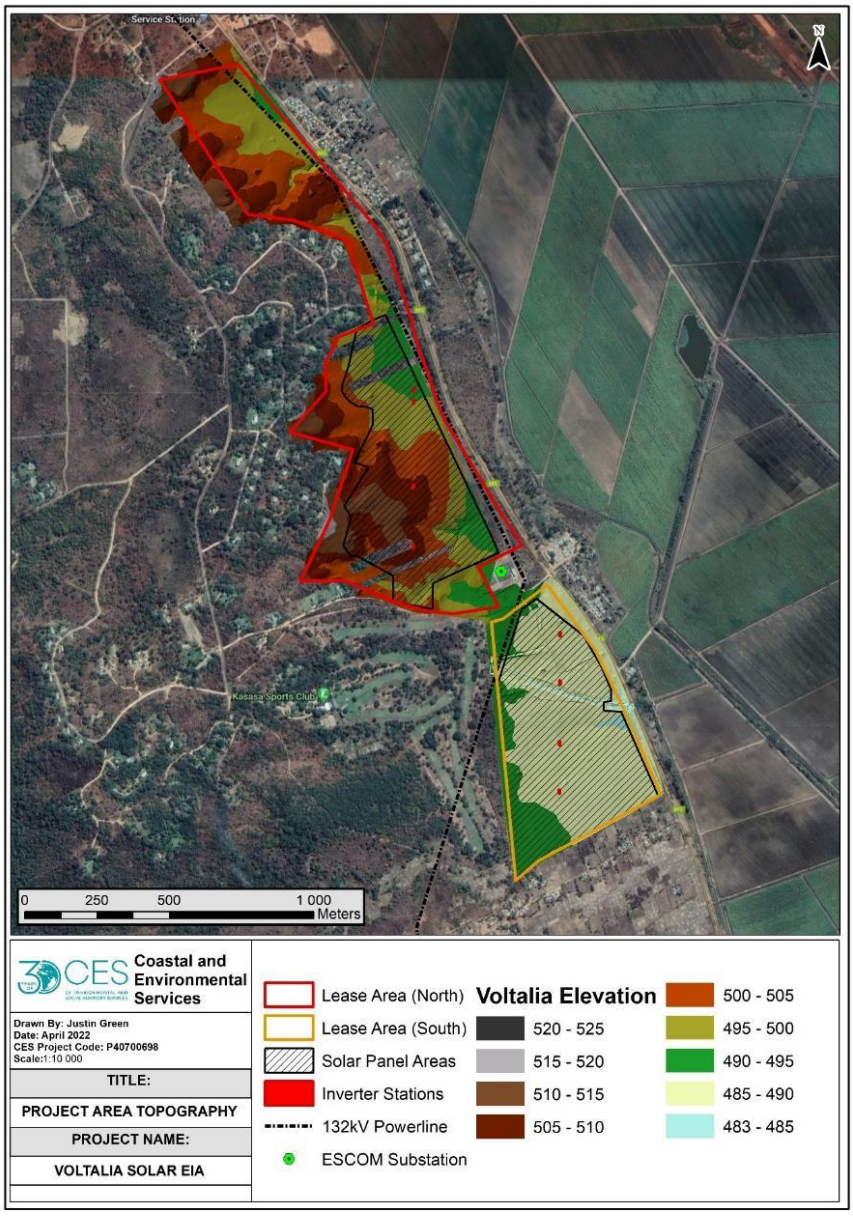


Figure 6.5 Site topography at 5 m intervals

The northern portion is a horseshoe shape with a depression running from a high point in the West (531 m) down the hill to the road in the East (500 m), a decrease in elevation of only 31 m (Figure 6.6). Slopes on either side are therefore gentle. The North slope (520 m) and South slope (513 m) descend into the valley (500 m). On a microscale the site can be described as a series of small foothills and depressions on an otherwise level surface.

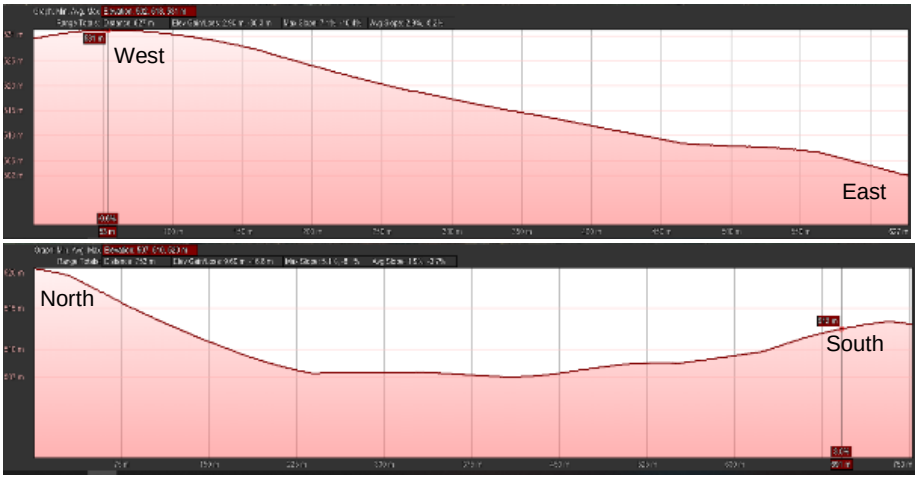


Figure 6.6 Elevation profile of the northern portion of the site.

The central portion is a foothill that slopes downhill from west to east and uphill from north to south. The high point in the west (517 m) slopes down from the forest to the road and powerline (495m). From the river in the south (501 m) the site slopes uphill to the crest (512 m) and then down hill again to the adjacent valley (Figure 6.7).

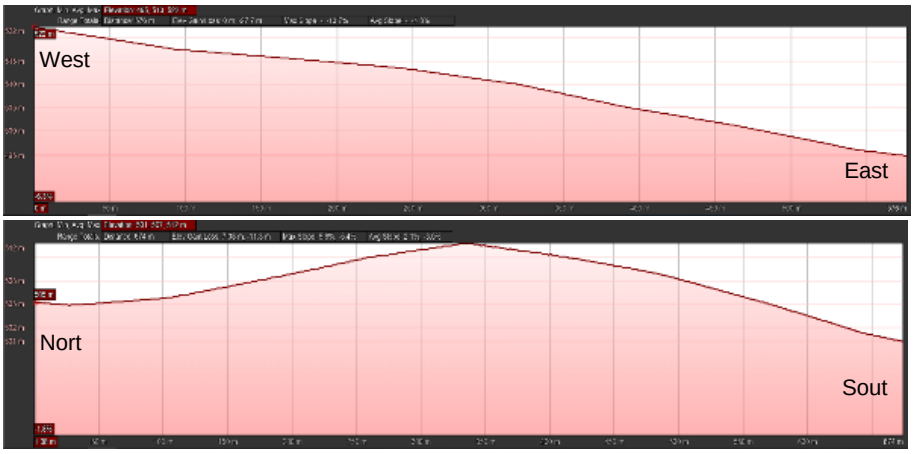


Figure 6.7 Elevation profile of the central portion of the site.

The southern portion is a relatively flat site with slight undulations. It has a shallow depression running from a high point in the West (498 m) bordering the golf course down the hill to the road in the East (491 m) with slopes on either side. The North slope (499 m) and South slope (498 m) runs into this depression (493 m) (Figure 6.8).

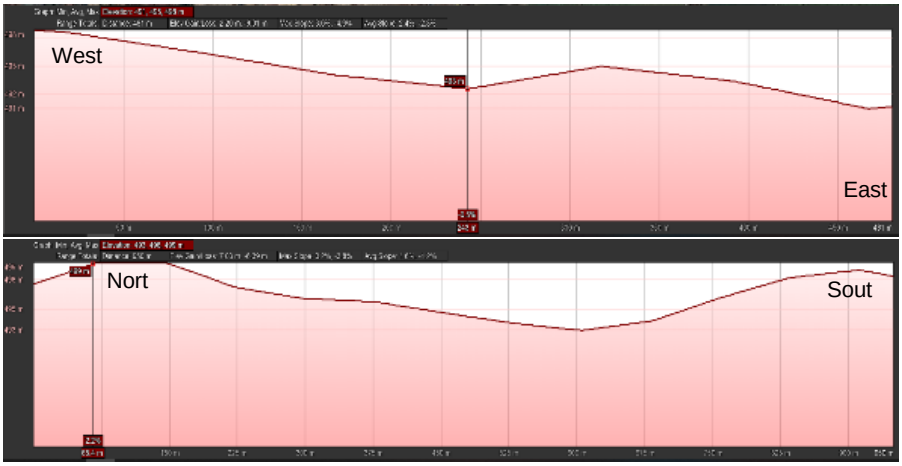


Figure 6.8 Elevation profile of the southern portion of the site.

6.6 HYDROLOGY

This section contains a summary of the Dwangwa Solar PV Draft Report Hydrological and Hydraulic Analyses (GET.invest, 2022). The report does not include geohydrology since all water provision for the project will be provided by Illovo from their resources.

6.6.1 Catchment Characteristics

The Dwangwa catchment is located in the central region of Malawi with approximately 15 % of the catchment area situated in the Mzimba District, 65% in the Kasungu District and 20 % in the Nkhotakota District (Figure 6.9). The Dwangwa River is approximately 160 km long and drains in an easterly direction towards Lake Malawi. The catchment size of the Dwangwa river by the proposed project site and to the outlet, Lake Malawi, is respectively about 7 525 km² and 7 800 km².

The source of the Dwangwa river is Kasungu National Park in Malawi's Central Plateau. The western and central part of the catchment consists mainly of the plateau with the highest point at 1 788 m.a.s.l. From the plateau, the river flows in a north-easterly direction. As the river nears Lake Malawi it drops sharply and the river flows through the lakeshore lowland before entering into the Lake Malawi (Ferreira, 2013). A large part of the plateau is covered by the National Park which consists mainly of well-preserved Miombo forest. In the lower lying part of the catchment, most of the wetlands have been converted to irrigated sugar cane cultivation.

The primary water demand in the catchment is irrigation, and there are no hydropower plants in the catchment (JICA, 2014).

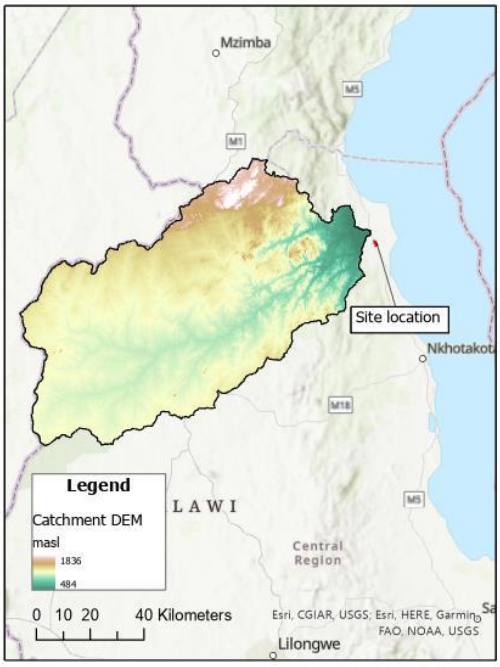


Figure 6.9 The Dwangwa catchment

The majority of catchment lies in an area that receives around 700-800 mm rainfall a year, and many of the main tributaries have their source in these regions. In the eastern and lower lying parts of the catchment, rainfall increases and reaches approximately 1 300 mm/year (Laisi, 2016).

Most of the river flow in Dwangwa river occurs during the rainy season, and the river is nearly dry during the dry season. The rainy season in the central region commences in November, and ends in April the following year, with the rainfall peaking in March. According to (Chisale, Chikabvumbwa, & Chisanu, 2020), the average flow rate of Dwangwa River in January is 112 m^3/s, whilst in September it is as low as 0,17 m^3/s. Thus, there is a high degree of annual flow variability.

The Dwangwa River is approximately 30 km north of the proposed project site which drains into Lake Malawi to the east (Figure 6.10). There are a few drainage features in both the northern and southern sites associated with this project. However, the only feature that contains water year-round is the feature near the existing ESCOM substation, and an man-made irrigation channel near the M5 in the southern site area.

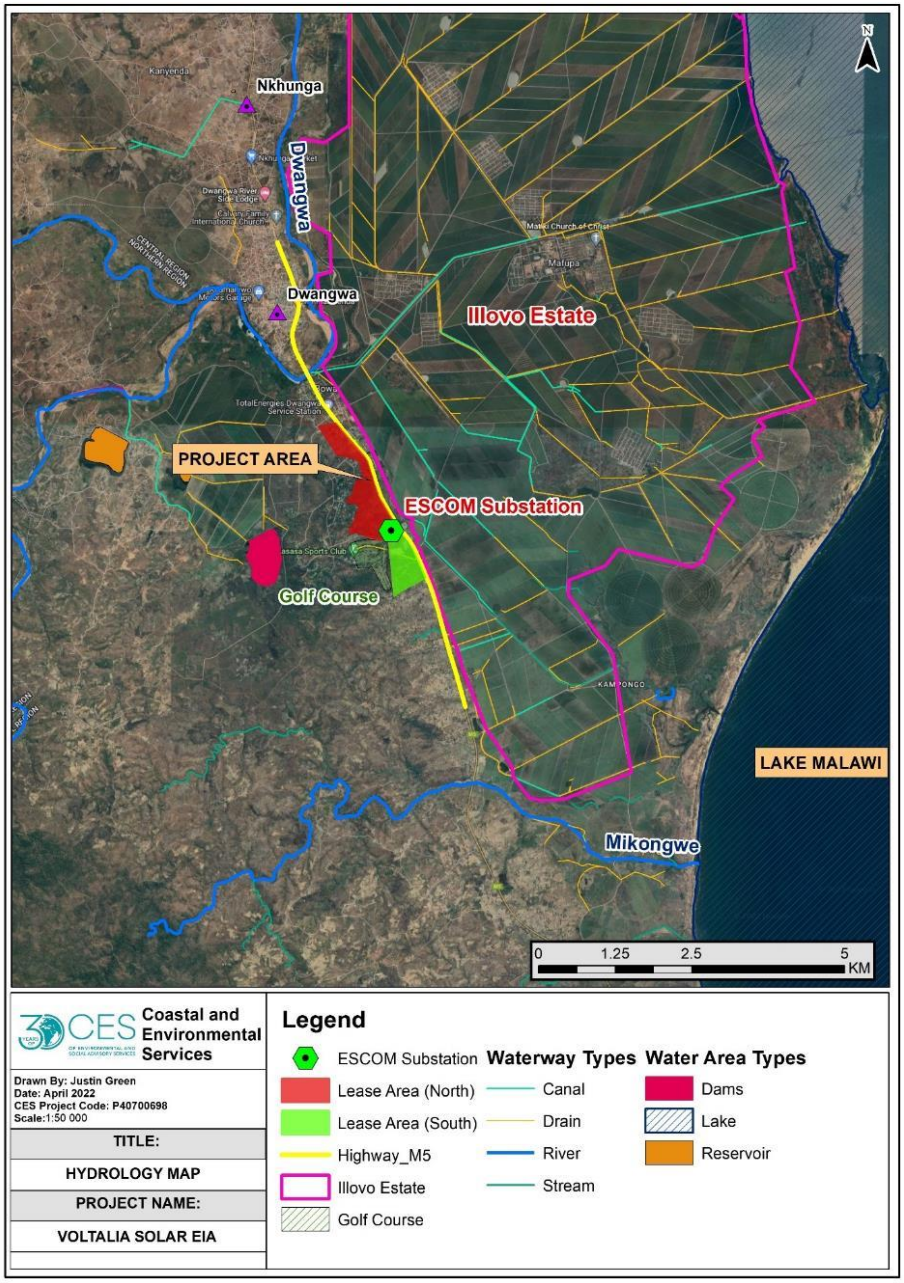


Figure 6.10 Local hydrology

6.6.2 Regional flood risk

The result from the flooding scenarios are provided in Figure 6.11 below. The results show that even with a conservative assumption that all flood water will enter the main river, the proposed project site is not flood prone to a 100-year return period flood. Water gathers in the flood plain to the north-west of the site, and due to the flat terrain, it is likely that the water will flow in either a northerly or a southerly direction, limiting the flood water passing in the main river course to the east. The proposed Dwangwa Solar PV project site will therefore not be affected by the 100-years return period flood level at Dwangwa river.

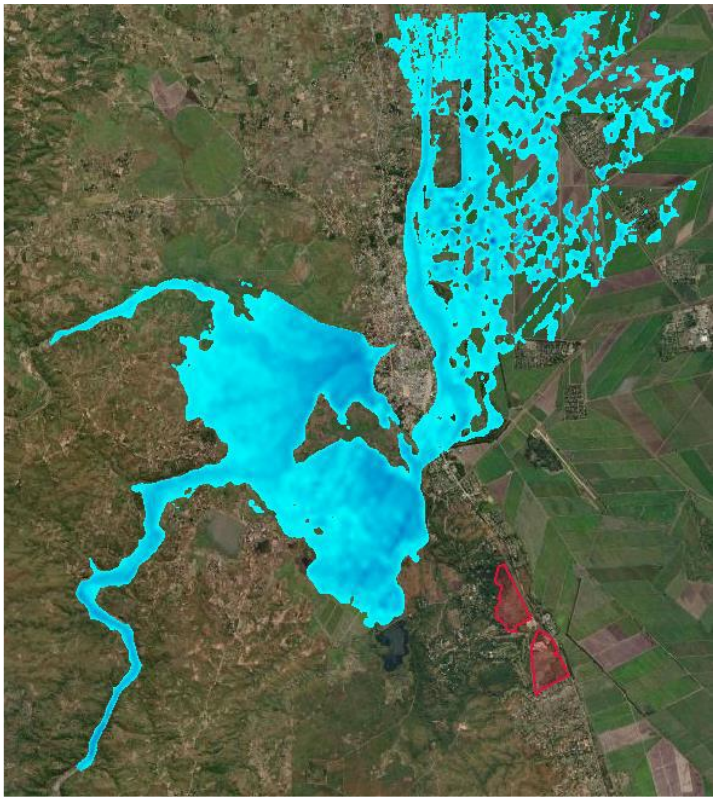


Figure 6.11 Results from the regional flood risk analysis in proximity to the site (indicated in red)

6.6.3 Local flood risk

In addition to identifying flood risks from the Dwangwa River, an analysis of local drainage lines and runoff estimations from and around the proposed project site was completed.

The site elevation difference from the crest of the hill (catchment borders) to the lower parts of the proposed project site is around 80-90 meters. Rainfall that falls on the upper parts of the site will accumulate and potentially flow through the project site (i.e. from west to east).

The terrain around and on the project site is influenced by man made changes due to irrigation and agricultural activities, as well as other permanent and temporary infrastructure (i.e. roads). These can influence the direction of flood flow and volume at locations within the project site. The GIS-analysis shows that most of the water will accumulate and flow towards the southern edge of the proposed project site towards the irrigation pond and its culvert below the M5 highway. The results show that the southern plot is most likely prone to flooding during heavy rainfalls (Figure 6.12).

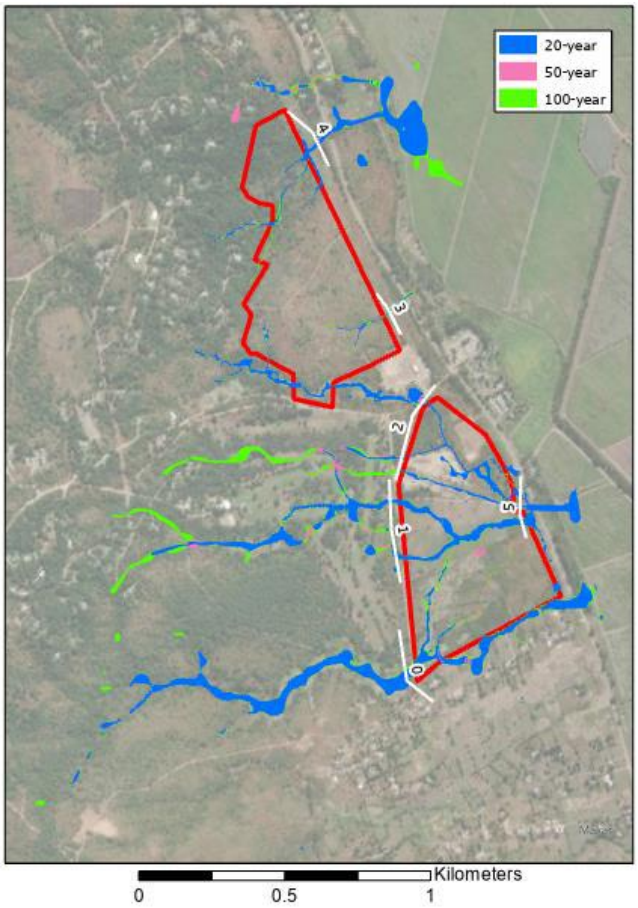


Figure 6.12 Inundated areas due to extremem rainfall for different return periods

Some water will also gather and flow through the northern plot but it will be less prone to flooding.

6.7 TERRESTRIAL BIODIVERSITY AND ECOLOGY

6.7.1 Miombo Woodland

The Miombo Ecoregion is defined by Byers (2001) as comprising of multiple vegetation types that reflect differences in species composition and ecological processes, but which are all dominated by one or more species of the Caesalpinioideae family. It is estimated that this ecoregion covers approximately 3.6 million km^2 across eleven countries in central and southern Africa (Timberlake and Chidumayo, 2011). It contains around 8,500 plant species of which 54% are endemic (White, 1984). It also supports a number of faunal species that are endemic or near endemic to the ecoregion. Due to this high level of endemicity and because it is an important habitat for several threatened species[1], it has been identified as one of five global wilderness areas that should be prioritised for conservation (Mittermeier et. al., 2003) (Table 6.1). However, compared to other global ecoregions, to date, this eco region has received little conservation and research attention (Kew et. al., 2015). See Appendix 2 for a more detailed report on the Terrestrial Biodiversity and Ecology.

Table 6.1 The number of species and endemic/near endemic species in the Miombo Ecoregion

Group	No. Species in ecoregion	No. endemic/near endemic species	% Endemics
Plants	8500	4590	54%
Mammals	318	35	11%
Birds	938	53	6%
Reptiles	284	83	29%
Amphibians	130	36	28%
Fish	200	30	15%
Butterflies	1300	90	7%
Total	11,670	4,915	42%

Although there is a high species diversity and a number of endemic and near endemic species are associated with this ecoregion, according to the Miombo Ecoregion Vision Report (2011), the conservation of the Miombo Ecoregion is more about “conservation of processes operating at a landscape scale across thousands of square kilometres than about conservation of species or individual habitats” (Timberlake and Chidumayo, 2011).

It is estimated that over 100 million people are directly or indirectly dependent on this ecoregion to meet their daily needs (Syampungani et al., 2009). Given that the population of sub-Sahara Africa has grown from 186 million to 856 million people from 1950-2010 and it’s estimated that by 2060, the population of sub-Sahara Africa could be as large as 2.7 billion people (The World Bank, 2015), pressure on this ecoregion is steadily increasing (Cabral et al., 2011; Dewees et al., 2010). However, these woodlands have historically been inhabited by people and the ecological dynamics have therefore been largely shaped by humans (e.g. burning these woodlands during the dry season) (Kew et. al. 2016). This interdependence between humans living in this ecoregion and the impact they have in shaping it led to Campbell (1996) describing the miombo ecoregion as a “social forest” (Figure 6.13). However, despite these links, little is known about the present-day response of biodiversity to land-use change, such as the clearing of land for agriculture and the utilisation of natural resources in the remaining woodland.

[1] It is estimated that 100 threatened species are thought to occur in the ecoregion, of which nine are Endangered or Vulnerable

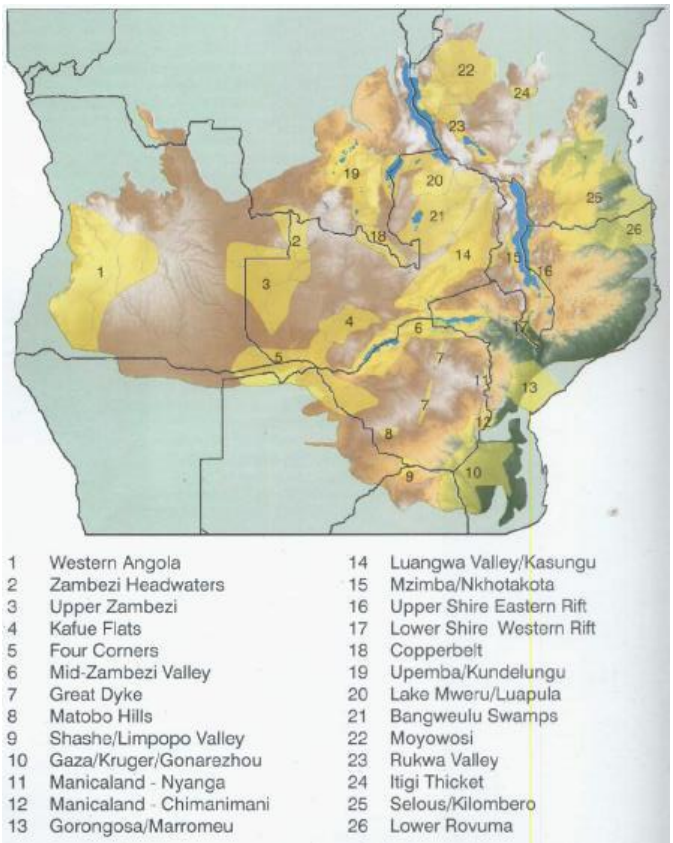


Figure 6.13 The Miombo Ecoregion (from WWF SARPO 2003)

The "*potential natural vegetation" (PNV)* map of eastern and southern Africa was used to determine the vegetation type expected to occur at the project site. The PNV is defined as *"the vegetation that would persist under current conditions without human intervention"* (VECEA, 2020). The map covers Burundi, Ethiopia, Kenya, Malawi, Uganda, Rwanda, Tanzania and Zambia and was created using a combination of historical national and local vegetation maps, available literature and input from leading experts.

The northern portion of the site falls within the vegetation type *Marsh (Edaphic) Grassland* (Figure 6.14). This vegetation type is characterised by the presence of woody species with a canopy cover of <2% within land dominated by grass species and occasional herbs.

The southern section of the site falls within Miombo Woodland which is characterised by the presence of the genus *Brachystegia*, of which there are nineteen species in total. The presence of three other tree species also characterise this vegetation type, namely: *Isoberlinia angloensis, Julbernadia globiflora* and *Julbernadia paniculata*. These species are rarely found outside of Miombo Woodland (Frost 1996).

The VECEA map has mapped four subtypes of Miombo Woodland:

- Drier Miombo Woodland
- Wetter Miombo Woodland
- Miombo Woodland on hills and rocky outcrops
- Zanzibar-Inhambane transition woodland

The southern portion of the project site is located within the *Miombo Woodland on hills and rocky outcrops.* Characteristic species other than *Julbernardia* and *Brachystegia* that are associated with this vegetation type in Malawi include:

- *Afzelia quanzensis*
- *Burkea africana*
- *Dombeya rotundifolia*
- *Erythrophleum africanum*
- *Faurea saligna*
- *Parinari curatellifolia*
- *Pericopsis angolensis*
- *Pseudolachnostylis maprouneifolia*
- *Pterocarpus angolensis*
- *Terminalia sericea*

In Malawi, disturbance such as clearing for agriculture and harvesting of trees for charcoal has resulted in the ongoing degradation of Miombo Woodland, with a significant loss of vegetation outside of protected areas.

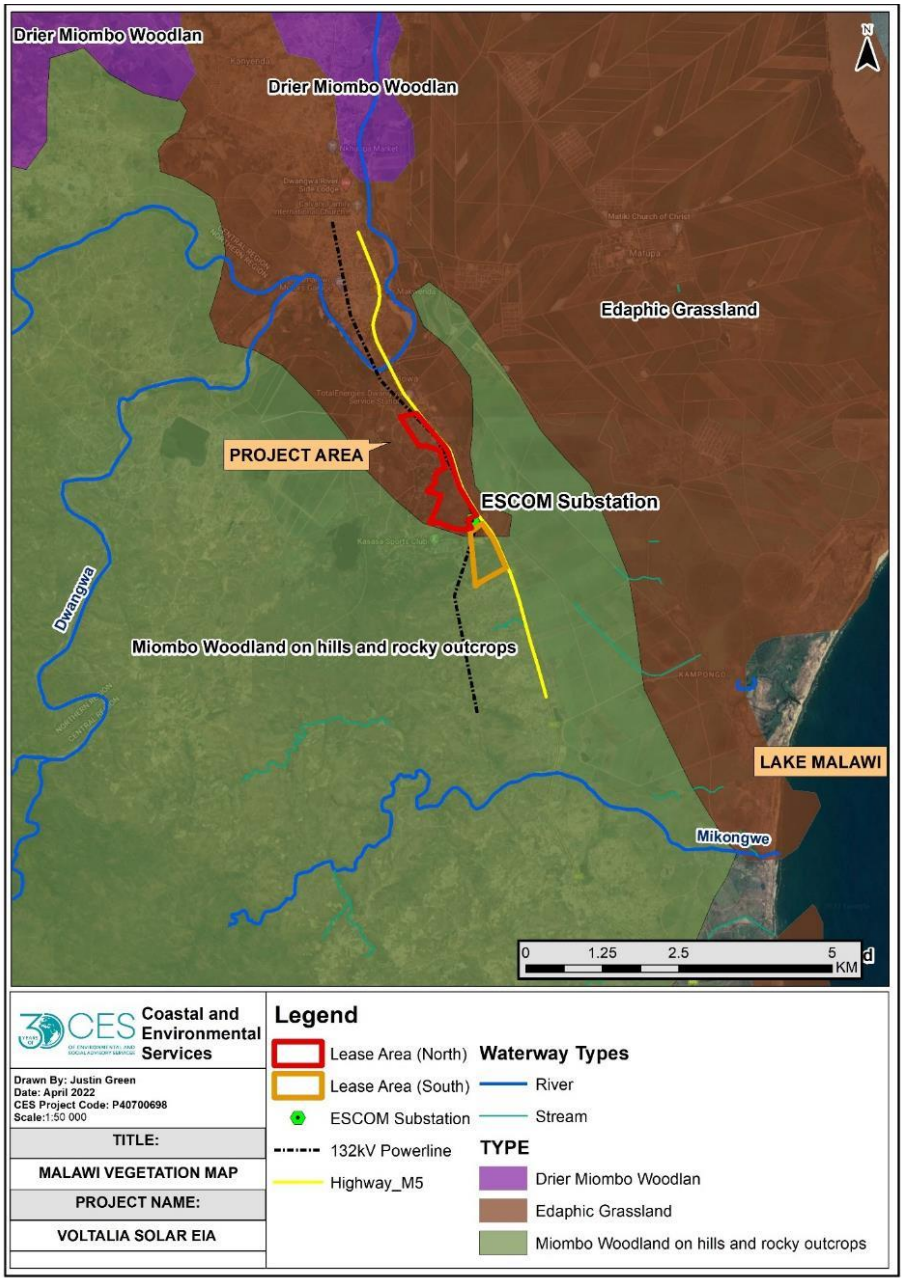


Figure 6.14 VECEA map showing the expected vegetation types present within the project area

Miombo woodland occurs in the middle of the site along the western border and can be divided into open and closed miombo woodland. Open Miombo Woodland has a canopy cover of 30-50% with an understory of grass species while Closed Miombo Woodland is characterised by a closed canopy of 75-90% with an understory that is typically herbaceous with some grass cover in areas where the canopy is more open. Tree height ranges from 2-4 m with emergent's reaching up to 5 m. This vegetation type is generally intact within the study area. Common species include shrubs and trees such as *Brachystegia boehmii, Brachystegia utilis, Brachystegia taxifolia, Brachystegia bussei, Julberrnardia paniculata* and *Julbernardia globiflora* as well as herbs and grasses such as *Loudetia simplex, Vernonia melleri, Vernonia glabra, Triumfetta annua* and *Achyranthes aspera.*

The Open Miombo Woodland occurs in the Northern Lease Area (2.14 ha) and the closed Miombo Woodland (0.57 ha), which in some patches may be considered forest due to the closed nature of the canopy and the herbaceous understory, occurs in the middle section. The Closed Miombo Woodland is associated with a riparian area and as such is of high sensitivity (Plate 6.1).

Plate 6.1 Closed Miombo Woodland

6.7.2 Grassland

Grassland (Plate 6.2) is confined to the northwest portion of the proposed lease area and is generally intact in most areas, with little evidence of harvesting by local communities. Dominant species include *Loudetia simplex, Heteropogon contortus, Hyparrhenia nyassae, Cyperus filiformis, Melinis repens and Themeda triandra* among others.

Plate 6.2 Image depicting the grassland on site

6.7.3 Savanna

Savanna is the most common vegetation type occurring throughout the site and together with grassland extend for 31.16 ha within the project areas.

It is characterised as a mix of woodland and grassland with an open canopy (10-25%) of woody species. Canopy height ranges from 1-3 m and common woodland species include *Terminalia sericea, Brachystegia boehmii, Annona senegalensis, Pseudolachnostylis maprouneifolia, Strychnos innocua, Dichrostachys cinerea, Ozoroa insignis, O. reticulata, Combretum collinum, C. zeyheri, C. molle, Eriosema buchananii, Eriosema englerianum* and *Pterocarpus rotundifolia.* The understory is comprised of the grass species found within the grassland vegetation type i.e. *Loudetia simplex, Heteropogon contortus, Hyparrhenia nyassae, Cyperus filiformis, Melinis repens and Themeda triandra. Gmelina arborea* and *Eucalyptus* have been planted within the site and if not controlled can displace this vegetation.

The Savanna (Plate 6.3) in the northern section of the site is considered near natural and shows evidence of degradation towards the middle and southern sections, with the southern section being the most degraded.

Plate 6.3 Typical example of Savanna

6.8 FAUNA

Climate, hydrology, topography, vegetation and current land use all influence the geographical distribution of species and therefore play a significant role in the type of habitat and fauna present at a site.

6.8.1 Habitat

Habitats are defined as the natural environment or place where an organism, population or species lives, breeds and/or forages. Each habitat type has different environmental conditions which influences a species distribution range. Eight faunal habitats were identified and mapped (Figure 6.15) in the study area, namely:

1. Miombo woodland
2. Grassland
3. Savanna
4. Riparian Woodland
5. Rivers (annual and perennial), wetlands and incidental pools
6. Rocky outcrop
7. Agricultural and Woodlots
8. Manmade

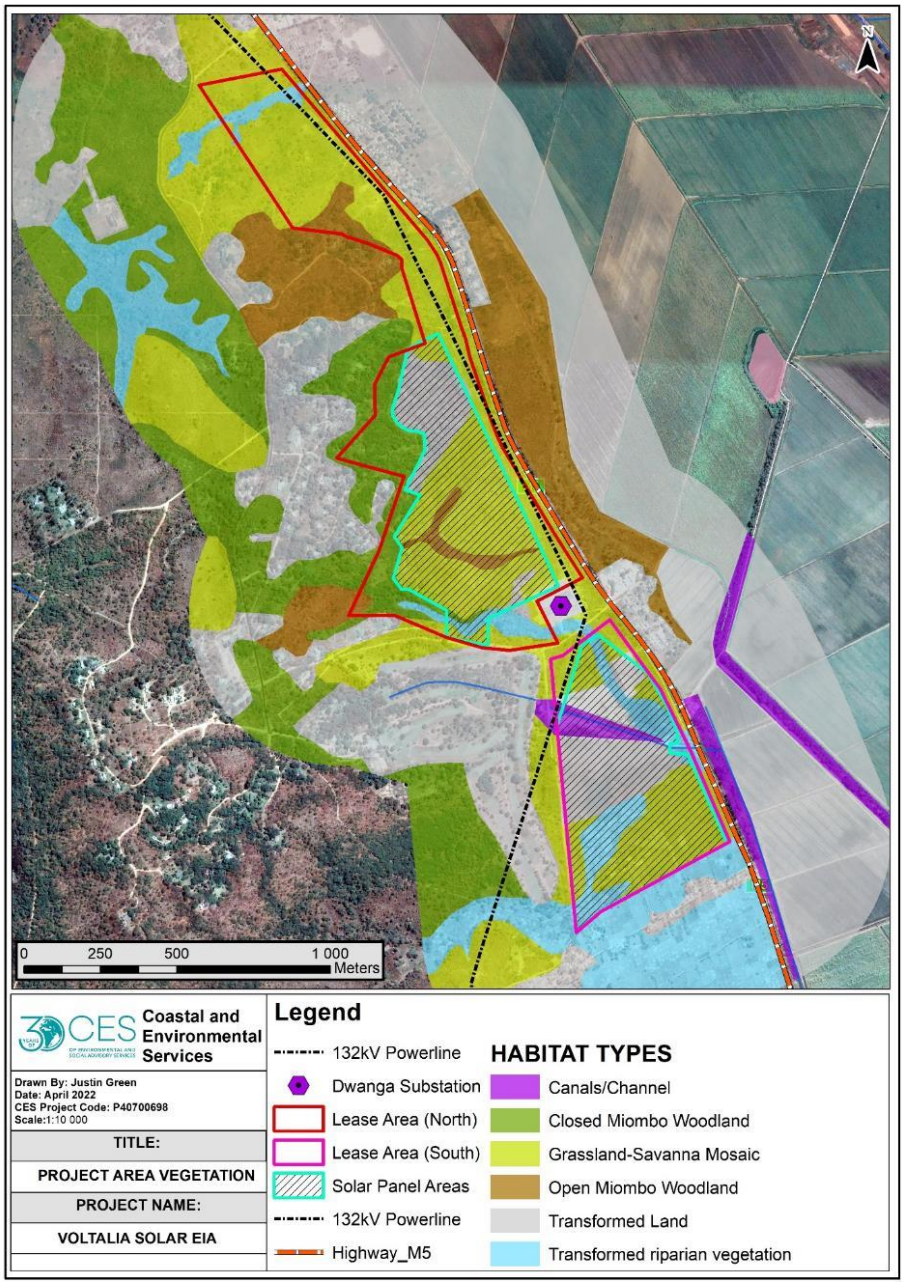


Figure 6.15 Faunal habitats within the study area

For descriptions of habitats 1 - 3 please see Section 6.7 above. Descriptions of habitats 4 – 8 are presented below.

Transformed Riparian Woodland

The Riparian Woodlands (Plate 6.4) within the study area are characterised by a closed canopy of 75-100% cover with a tree canopy of up to 20 m and emergents that reach up to 40m. The understorey is typically comprised of an herbaceous layer with some grass cover in areas where the canopy is more open. This vegetation type occurs in the central site river system and is considered intact with little to no natural harvesting.

Plate 6.4 Riverine vegetation

Riverine systems, Wetlands and incidental pools

Watercourses are contained within a channel except in time of flooding. When there is no water flow the natural channel still exists. The project site experiences high levels of summer rainfall and limited winter rainfall. The majority of riverbeds are dry for most of the year, with the exception of sparsely scattered pools of water concentrated in depressions within the annual streams and rivers. The slow-moving sections of the river wetland characteristics with vegetation running across the riverbed and in some sections has been planted with rice paddies (Plate 6.5,Plate 6.6,Plate 6.7,Plate 6.8).

Plate 6.5 River with vegetation and pool of water

Plate 6.6 River planted with rice

Plate 6.7 River in the southern portion running under the M5 into a canal

Plate 6.8 Dry vegetated stream

Rocky Outcrops

Geologically the project site is underlain by the Muva Supergroup which forms most of the basement in south-central Malawi. It is characterised by the presence of semi pelitic rocks and pelites (Mica schists, Kyanite and Sillimanite Schist and gneisses) (Haundi *et. al.*, 2021) (Plate 6.9).

These small outcrops form important habitat for many reptiles, and also some birds.

Plate 6.9 Rocky outcrop in Savanna Vegetation

Agricultural and Woodlots

Farmland, woodlots, and commercial plantation have little to no natural vegetation remaining (Plate 6.10, Plate 6.11).

Plate 6.10 Agricultural field within the OHL servitude

Plate 6.11 Woodlot

Manmade

Substation, residential buildings, soccer fields and sand mines (Plate 6.12,Plate 6.13).

Plate 6.12 Erosion in the southern lease area into the southern river looking onto the sand mine.

Plate 6.13 Buildings and paved areas – Dwangwa substation in the background

6.8.2 Amphibians

The number of amphibian species in Malawi ranges from 82 to 88 species, the variation depends on the source consulted (IUCN, 2021; IBAT, 2021; NBSAP, 2015). The Bowa Region likely hosts up to 58 species of amphibian (See Annexure 2 of Appendix XX for a more detailed report on the Terrestrial Fauna).

Eleven species were recorded in and around the project area (Plate 6.14), namely, the Common Reed Frog (*Hyperolius viridiflavus*), Mitchell's Reed Frog (*Hyperolius mitchelli*), Fornasini's Spiny Reed Frog (*Afrixalus fornasini*), Mascarene Grass Frog (*Ptychadena mascareniensis*), Plain Grass Frog (*Ptychadena anchietae*), Guibes Grass Frog (*Ptychadena guibei*), Mozambique Grass Frog (*Ptychadena mossambica*), Southern Flat-Backed Toad (*Sclerophrys pusilla*), Mababe Puddle Frog (*Phrynobatrachus mababiensis*); East African Puddle Frog (*Phrynobatrachus acridoides*) and Muller's Clawed Toad (*Xenopus muelleri*).

The majority of amphibians were recorded from various points along the perennial river running through the central site past the Dwangwa Substation.

Malawi hosts 12 amphibian species of conservation concern (SCC) of which four are threatened and two near-threatened, four endemic and eight range-restricted (Table 6.2). None of the amphibian SCC have a range distribution which includes the project area.

Table 6.2: Amphibian species of conservation concern in Malawi

Common name	Scientific Name	Conservation status (IUCN)	Endemic
Johnston's River Frog	*Amietia johnstoni*	Endangered	Endemic
Mulanje Mongrel Frog	*Nothophryne broadleyi*	Endangered	Endemic
France's Squeaker	*Arthroleptis francei*	Vulnerable	RR
Spiny Throated Reed Frog	*Hyperolius spinigularis*	Vulnerable	RR
Broadley's Ridged Frog	*Ptychadena broadleyi*	Near-Threatened	Endemic
Nyika Dwarf Toad	*Mertensophryne nyikae*	Near-Threatened	RR
Eiche's Squeaker	*Arthroleptis reichei*	Least concern	RR
Kirk's Caecilian	*Scolecomorphus kirkii*	Least concern	RR
Variable Reed Frog	*Hyperolius pictus*	Least concern	RR
Ukinga Puddle Frog	*Phrynobatrachus ukingensis*	Least concern	RR
Stewart's Puddle Frog	*Phrybobatrachus stewartae*	Least concern	RR
Friedemanns Long Reed Frog	*Hyperolius friedemanni*	Data Deficient	Endemic

*RR- Range Restricted/Near-Endemic

Plate 6.14 Amphibians recorded in the study area

Top left to bottom right – Hyperolius viridiflavus, Afrixalus fornasini, Phrynobatrachus acridoides, Hyperolius mitchelli, Ptychadena anchietae, Ptychadena guibei, Sclerophrys pusilla, Ptychadena mossambica and Ptychadena mascareniensis.

6.8.3 Reptiles

As with amphibians the number of reptile species in Malawi varies depending the source consulted IUCN (2021) states Malawi hosts 48, whereas, the NBSAP (2015) states 145 reptile species inhabit Malawi.

The Bowa Region likely hosts up to 16 species of reptile (See Annexure 3 of Appendix XX for a more detailed report on the Terrestrial Fauna). Three reptiles were observed onsite. The Variable Skink (*Trachylepis varia*) was recorded from the dry riverbed in the central portion, the Striped Skink (*Trachylepis striata*) was observed at the substation and the Agama sp. (*Acanthocercus branchi*) was observed on the westerner boundary on the northern portion in the Miombo woodland (Plate 6.15).

Plate 6.15 Reptile species recorded in the project area
Top left to bottom right: Variable Skink (*Trachylepis varia*), Striped Skink (*Trachylepis striata*) and Agama sp. (*Acanthocercus branchi*)

Malawi hosts 14 reptile species of conservation concern (SCC) of which four are threatened and two near-threatened, five are endemic and seven are range-restricted (Table 6.3). Only

one of these SCC has a range distribution which includes the project area, the Zambezi Flapshell Terrapin (*Cycloderma frenatum*) which is listed as Endangered (Van Dijk, 2016). *C. frenatum occurs* at altitudes between sea level and 1,000 m (Spawls, *et al*, 2018). Although not much is known about its usage of habitat adults have been recorded mainly from large rivers and lakes while hatchlings apparently inhabit floodplain marshes (Van Dijk, 2016). It is known to occur in Lake Malawi (Spawls, *et al*, 2018). *C. frenatum* is carnivorous and feeds on fish, aquatic insects, crabs, crustaceans, clams, snails and amphibians (Spawls, *et al*, 2018; Van Dijk, 2016). It is preyed on by Otters and Crocodiles and people living around Lake Malawi eat the eggs. *C. frenatum* was not recorded in the project area and is considered shy and difficult to catch. *C. frenatum* is fairly widespread (Figure 6.16) and may occur on site in the riverine habitat.

Figure 6.16 Distribution of Zambezi Flapshell Terrapin (Cycloderma frenatum) in relation to the project area (star) (Van Dijk, 2016).

Table 6.3 Reptile species of conservation concern in Malawi

Common name	Scientific Name	Conservation status (IUCN)	Endemic
Chapman's Pygmy Chameleon	*Rhampholeon chapmanorum*	CE	Endemic
Zambezi Flapshell Terrapin	*Cycloderma frenatum*	EN	-
Mount Mulanje Chameleon	*Nadzikambia mlanjensis*	EN	Endemic
Mount Mulanje Pygymy Chameleon	*Rhampholeon platyceps*	EN	Endemic
King Dwarf Gecko	*Lygodactylus rex*	NT	RR
Braun's Skink	*Tetradactylus brauni*	NT	RR
Bons' Dwarf Gecko	*Lygodactylus bonsi*	LC	Endemic

Common name	Scientific Name	Conservation status (IUCN)	Endemic
Mulanje Skink	*Trachylepis mlanjensis*	LC	Endemic
Mitchell's Flat Lizard	*Cordylus nyikae*	LC	RR
Whyte's Water Snake	*Lycodonomorphus whytii*	LC	RR
Black Limbless Skink	*Melanoseps ater*	LC	RR
Nyika Girdled Lizard	*Platysaurus mitchelli*	LC	RR
Ukinga Hornless Chameleon	*Trioceris incornutus*	LC	RR
Nyika Serpentiform Skink	*Eumecia johnstoni*	D	-

*RR- Range Restricted/Near-Endemic

6.8.4 Mammals

Malawi host approximately 200 mammal species and has experienced a severe decline in population due to poaching and habitat loss. The NBSAP (2015-2025) has attributed this to threats such as habitat loss through transformation to agriculture, bushfires, exploitation of natural resources (charcoal, timber, food and medicine), alien invasive species and pollution. The majority of large mammal (e.g. elephants) only occur in national parks and wildlife reserves. The SOER states that an essential part of the overall biodiversity programme for Malawi is the conservation and management of semi-natural habitats.

The project area intersects with the distribution range of 120 mammal species, 45 of which are bat species, many of the larger herbivours and large carnivours are unlikely to occur in the project area but may occur 6.3 km southwest of the site at the Nkotakhoto Wildlife Reserve. The project area likely hosts bat and rodent species, some of the smaller antelope and small carnivores.

The mammals recorded in the project area include the Yellow Baboon (*Papio cynocephalus*), Vervet Monkey (*Chlorocebus pygerythrus*) (Plate 6.16), African Savanna Hare (*Lepus victoriae*), Sharpe's Grysbok (*Raphicerus sharpie*), Mongoose sp. and Fruit Bat sp.

Plate 6.16 Vervet Monkey recorded in the project area

There are 11 threatened, eight near-threatened and three endemic mammal species in Malawi (Table 6.4). Of these five threatened and seven near-threatened mammal species have a distribution which includes the project area. The three bat species are likely to occur in the project area and the two otter species may occasionally use the riverine area. The Temminck's Pangolin is unlikely to occur in the project area. However, its preferred habitat (Grassland, woodland and rocky hills) is present.

Table 6.4 Mammal distribution which includes the project area

Common Name	Species	Threat status (IUCN)	Likelihood of occurrence
Black Rhino	*Diceros bicornis*	Critically Endangered	Nil
African Savanna Elephant	*Loxodonta africana*	Endangered	Nil
Temminck's Pangolin	*Smutsia temminckii*	Vulnerable	Unlikely
Lion	*Panthera leo*	Vulnerable	Nil
Leopard	*Panthera pardus*	Vulnerable	Nil
Spotted-necked Otter	*Hydrictis maculicollis*	Near-Threatened	Possible
African Clawless Otter	*Aonyx capensis*	Near-Threatened	Possible
African Straw-coloured Fruit-bat	*Eidolon helvum*	Near-Threatened	Probable
Striped Leaf-nosed Bat	*Macronycteris vittatus*	Near-Threatened	Probable
Large-eared Free-tailed Bat	*Otomops martiensseni*	Near-Threatened	Probable
African Buffalo	*Syncerus caffer*	Near-Threatened	Nil
Plains Zebra	*Equus quagga*	Near-Threatened	Nil

6.8.5 Birds

The number of bird species in Malawi ranges from 630 to 662 species depending on the source consulted (IUCN, 2021; IBAT, 2021; NBSAP, 2015). Of these approximately 467 bird species have a distribution which includes the project area. During the field survey 37 bird species were recorded (Plate 16 and 17). Nightjars were prevalent across the site with the majority in the grassland habitat on the central site. There was a conspicuous lack of ground fowl which is not unusual in locations that may rely party on hunting. A Francolin species was however recorded from the savanna habitat in the northern portion of the project site which hosted the most intact vegetation. Of note is the presence of predatory birds including Hawks, Goshawks and Falcons which hunt for their prey indicting a healthy system. The Black Herons were seen hunting at multiple locations along the river in the central site. The most abundant species were the Swallows, Bee eaters and sunbirds which were seen on forest and woodland edges (ecotone).

There are 22 threatened and 18 near-threatened bird species in Malawi. Of these 14 threatened and eight threatened bird species have a distribution which includes the project area. Based on habitat preference and behaviour (migration, nesting and foraging) requirements the likelihood of occurrence of each species was determined (Table 6.5). One SCC was confirmed onsite, the Blue Swallow (*Hirundo atrocaerulea*) listed as Vulnerable was observed in the northern portion of the site in the savanna habitat. Although the bird SCC in Table 6.5 may occur on site none are range restricted and all have a large a much large

distribution range than the site (Table 5.4). There is only one endemic species in Malawi, the Yellow-throated Apalis (*Apalis flavigularis*) and does not have a distribution which includes the project area.

Table 6.5 Bird distribution which includes the project area

Common name	Scientific name	Threat Status (IUCN)	Likelihood of occurrence
White-backed Vulture	*Gyps africanus*	CE	Unlikely
Hooded Vulture	*Necrosyrtes monachus*	CE	Nil
White-headed Vulture	*Trigonoceps occipitalis*	CE	Nil
Grey Crowned-Crane	*Balearica regulorum*	EN	Unlikely
Madagascar Pond-Heron	*Ardeola idea*	EN	Possible (non-breeding)
Secretarybird	*Sagittarius serpentarius*	EN	Unlikely
Steppe Eagle	*Aquila nipalensis*	EN	Possible, unlikely permanent
Martial Eagle	*Polemaetus bellicosus*	EN	Possible
Bateleur	*Terathopius ecaudatus*	EN	Probable, disturbance tolerant
Lappet-faced Vulture	*Torgos tracheliotos*	EN	Unlikely
Tawny Eagle	*Aquila rapax*	VU	Possible
Southern Ground-Hornbill	*Bucorvus leadbeateri*	VU	Unlikely
Taita Falcon	*Falco fasciinucha*	VU	Nil
Blue Swallow	*Hirundo atrocaerulea*	VU	Confirmed
Denham's Bustard	*Neotis denhami*	NT	Unlikely
Curlew Sandpiper	*Calidris ferruginea*	NT	Unlikely
Great Snipe	*Gallinago media*	NT	Possible, unlikely permanent
Eurasian Curlew	*Numenius arquata*	NT	Unlikely
African Skimmer	*Rynchops flavirostris*	NT	Unlikely
Pallid Harrier	*Circus macrourus*	NT	Possible, unlikely permanent
Crowned Eagle	*Stephanoaetus coronatus*	NT	Possible
Olive-headed Weaver	*Ploceus olivaceiceps*	NT	Possible

6.9 PROTECTED AREAS

6.9.1 Important Bird Area

The nearest Important Bird Areas to the project area are the Nkhotakota Wildlife Reserve 7.4 km southwest and the South Viphya IBA more than 36 km northwest (BirdLife Int., 2021) (Figure 6.17).

The Nkhotakota Wildlife Reserve IBA and covers a huge area of escarpment wilderness 180,000ha in size. The reserve vegetation type is primarily woodland with riparian forests running the length of its rivers and includes the Chipata Mountain mid-altitude rainforest (44 ha). The IBA hosts 21 SCC including the Taita Falcon (*Falco fasciinucha*) (VU) and the Olive-headed Weaver (*Ploceus olivaceiceps*) (NT) (BirdLife Int., 2021).

South Viphya Forest Reserve is the second largest montane complex in Malawi extends for 160,000 ha with half the area above 1550 to 1600 m. The vegetation in the IBA is compiled of forests, plantations (48,000ha) and primarily rank montane grassland and shrubland. Down the eastern escarpment the vegetation becomes miombo woodland with dambos in drainage

channels (BirdLife Int., 2021). This IBA hosts 287 bird species that rely on the area hosts 39 SCC, namely, Wattled Crane (*Grus carnculatus*), Blue Swallow (*Hirundo atrocaerulea*) (VU), East Coast Akalat (*Sheppardia gunningi*) (NT), Olive-headed Weaver (*Ploceus olivaceiceps*) (NT) and most notable is the endemic population of Scaly Spurfow (*Francolinus squamatus*) (BirdLife Int., 2021) (Plate 6.17, Plate 6.18).

Plate 6.17 Birds recorded within the project area

Top left to bottom right: Black-headed Heron (*Ardea melanocephala*), Square-tailed Nightjar (Caprimulgus fossii), Common Waxbill (Estrilda astrild), Common Bulbul (Pycnonotus barbatus), Red-backed Mannikin (Spermestes nigriceps) and Variable Sunbird (Cinnyris venustus).

Plate 6.18 Birds recorded within the project area

Top left to bottom right: Little Bee-eater (*Merops pusillus*), African Pied Wagtail (*Motacilla aguimp*), Brimstone Canary (*Crithagra sulphurate*), Black-winged Bishop (*Euplectes hordeaceus*), Lesser Striped

Swallow (*Cecropis abyssinica*), Gabar Goshawk (*Micronisus gabar*), Striped Kingfisher (*Halcyon chelicuti*) and Cardinal Woodpecker (*Chloropicus fuscescens*).

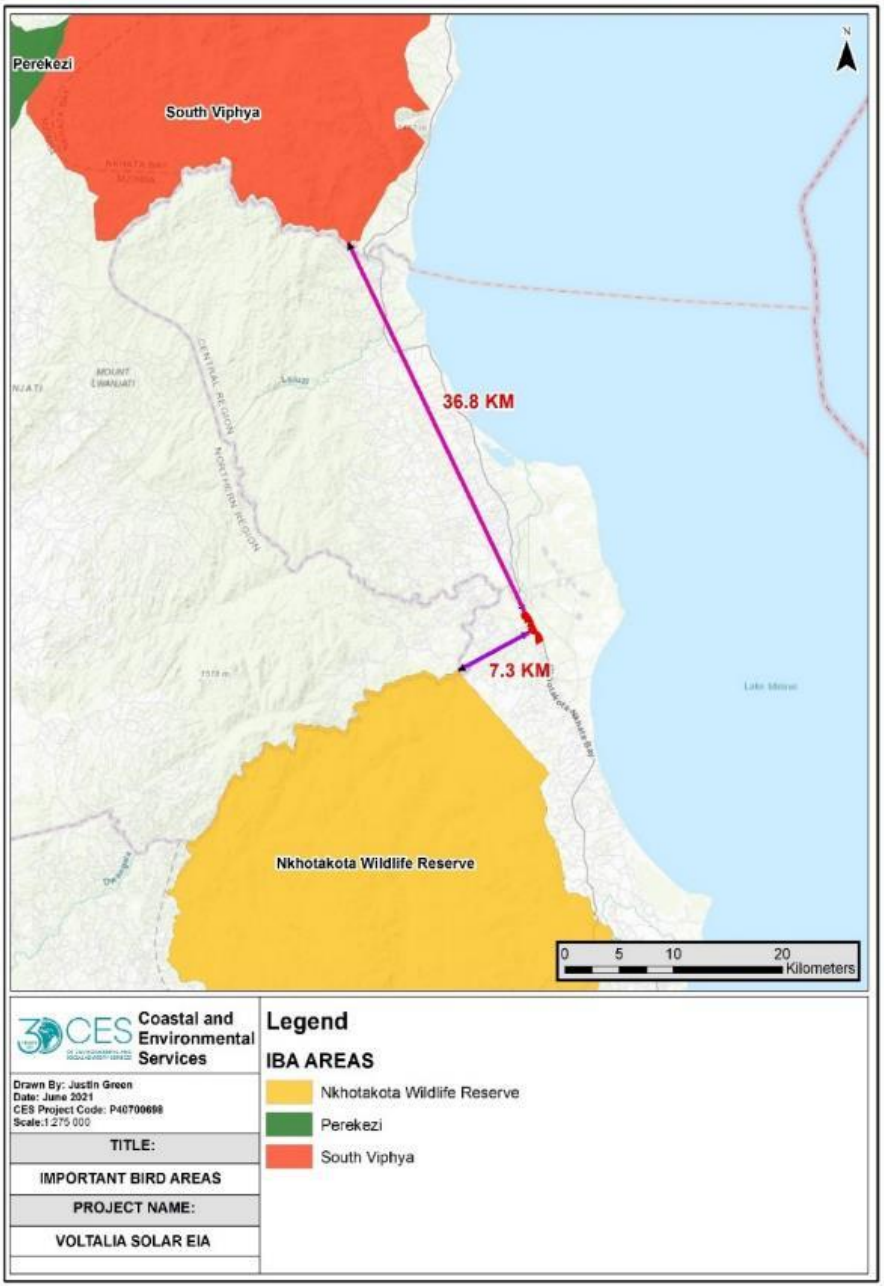


Figure 6.17 IBA's of Malawi and their associated distant from the proposed project development

6.10 Overall Sensitivity Assessment for terrestrial biodiversity and ecology

The overall sensitivity for closed miombo woodland is HIGH due to its level of intactness (Figure 6.18). This habitat type is likely used by all faunal species as it acts as an ecological corridor for fauna to move through as it offers a high level of shelter from predators. The open miombo woodland has an overall sensitivity of MODERATE as there is only one botanical species of conservation concern and it is seemingly able to recover relatively quickly after a disturbance. The majority of raptors rely on large trees for nesting and there are a number of bird Species of Conservation Concern that possibly occur in the project area and thus may use this habitat type for nesting as well as Fruit Bat species which were heard and seen feeding in the trees near the substation. When the local community was asked why they do not harvest the established trees in this habitat type they responded that it belongs to Ilovo Sugar and they are prohibited.

The grassland-savanna mosaic has an overall sensitivity of MODERATE. While there are no plant species of conservation concern, and this vegetation type is resilient to disturbance (recovering within 10 years), the site is likely used for foraging, shelter and breeding by nocturnal species such as hares, small antelope and rodents due to the potential for human exposure.

The transformed land (low sensitivity) includes agricultural fields, woodlots, recreational areas, buildings and substation. All faunal species (amphibians, reptiles, mammals and birds) utilise these areas despite the disturbance. However, the majority of faunal species will be generalist species and fairly common. Non-generalist species may move through these areas to access other intact areas or to access water and will do so predominantly at night to avoid human interaction. The Sharpe's Grysbok (*Raphicerus sharpie*) spoor was recorded from the southern portion of the site on the road towards the river. This species requires good vegetation cover adjacent to open patches of grass and will likely be hunted if found was likely moving through the area rather than utilising it as it's primary habitat. Transformed habitat is rated as having a LOW sensitivity due to the lack of primary use by non-generalist faunal species.

The majority of wetlands in the area have been transformed into rice paddies. Although the vegetation has been transformed the faunal habitat essentially remains the same. The structure that the sedges and reeds would have offered, and still exists in parts, is now offered by the rice stalks and leave. Wetlands an important habitat for the amphibian breeding, foraging and shelter, terrapins, snakes and lizards for hunting as and well as wetland and river adapted mammals (e.g. shrews, rodents, otters etc.) and bird species that may use the wetland for shelter, nesting and foraging. Wetlands offer an important food source in the form of insect for many bat species. Other faunal species likely rely on the wetlands as a source of water. The wetland habitats are rating as having a HIGH faunal sensitivity.

As a result, the project is likely to result in the loss of 26.86 ha of sensitive habitat across the 60 ha site. That is made up of:

- 4.83 ha of high sensitivity habitat; and
- 22.03 ha of moderate sensitivity habitat.

Human activity has substantially modified the Project Area's primary ecological functions and species composition, and the habitats there conform to modified habitats as described in PS6 (paragraph 11). While some Species of Conservation Concern are considered likely to be present and areas of Miombo woodland and wetlands are considered to have high sensitivity no critical habitats are expected to occur. Therefore, a critical habitat assessment following IFC PS6 is not necessary.

PS6 does not stipulate minimum requirements for developments within modified habitats, but states measures should be taken to minimise impacts on remaining biodiversity and implement mitigation as appropriate.

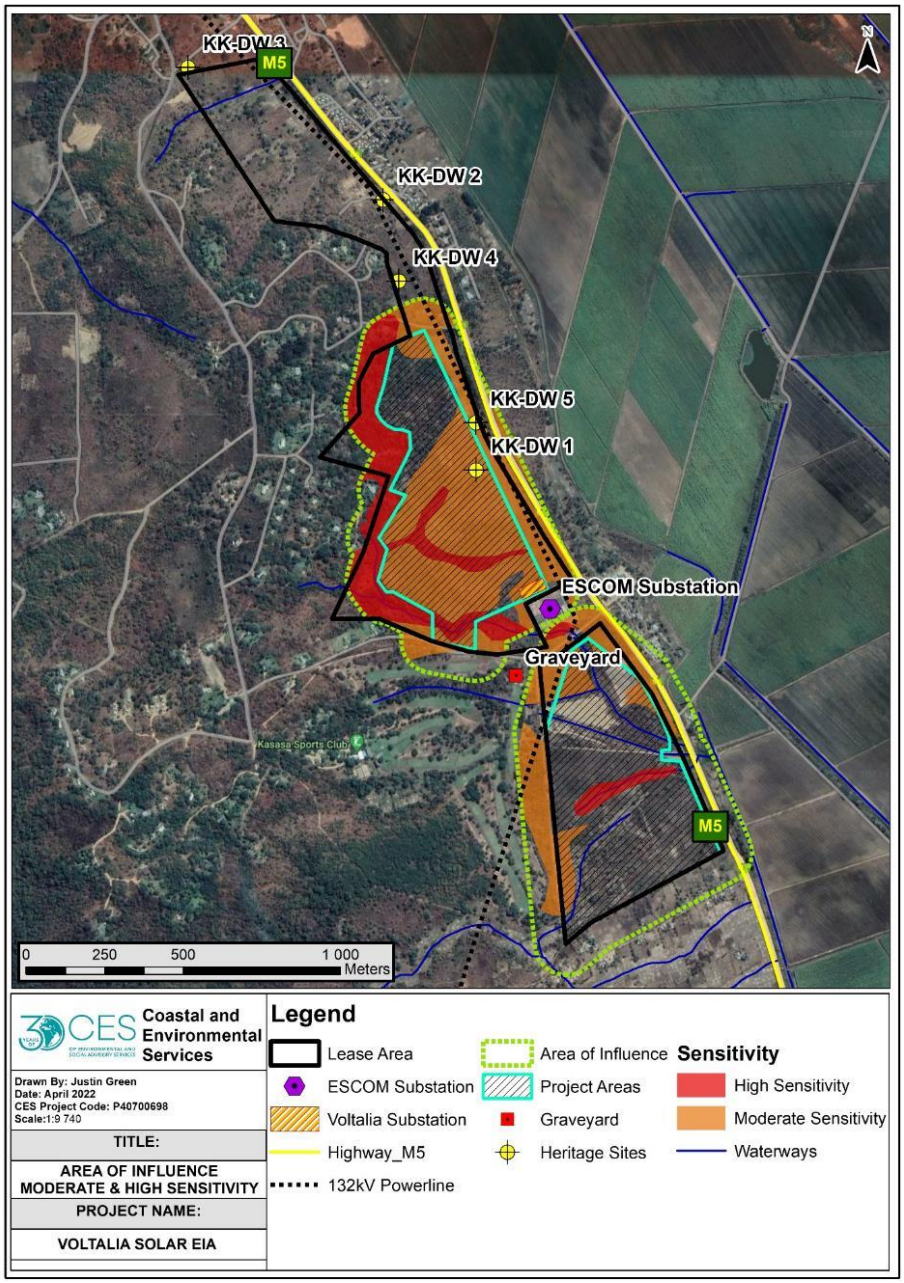


Figure 6.18 Sensitivity map showing areas of high and moderate sensitivity

7 DESCRIPTION OF THE SOCIAL ENVIRONMENT

The objective of the social baseline is to establish the characteristics of the existing conditions within the AoI experienced by the local communities and those who may be potentially affected by the project.

The site is located in the Nkhotakota District with the nearest town being Dwangwa. The site does not contain any dwellings and is surrounded by 3 communities (Figure 7.1).

The Bowa settlement is located 250 m north of the Project area North's northern boundary. The town, Dwangwa town, is located 1.5 km north of this boundary. The Toyota Fuel station is located adjacent to the northern boundary of the Project Lease Area.

The settlements immediately adjacent and to the east of Project areas North and South, and on the opposite side of the road, are the Majiga village and the Dwanga Cane Growers Association (DCGA). Majiga is an Illovo staff housing village.

To the south, the Voltalia Project area South borders on the Mowe village. This is the most northerly settlement of the original inhabitants and users of the Illovo estate land, who were displaced to make way for the sugar estate a number of decades ago.

This Section serves as the reference point against which impacts can be predicted and ultimately monitored. The baseline has been informed through a combination of desktop research and in-field data collection. Where there has been in-field data collection a summary has been included in this report and a supporting "Specialist Report" has been included as an appendix. The reference to each of the specialist reports has been included in each chapter accordingly.

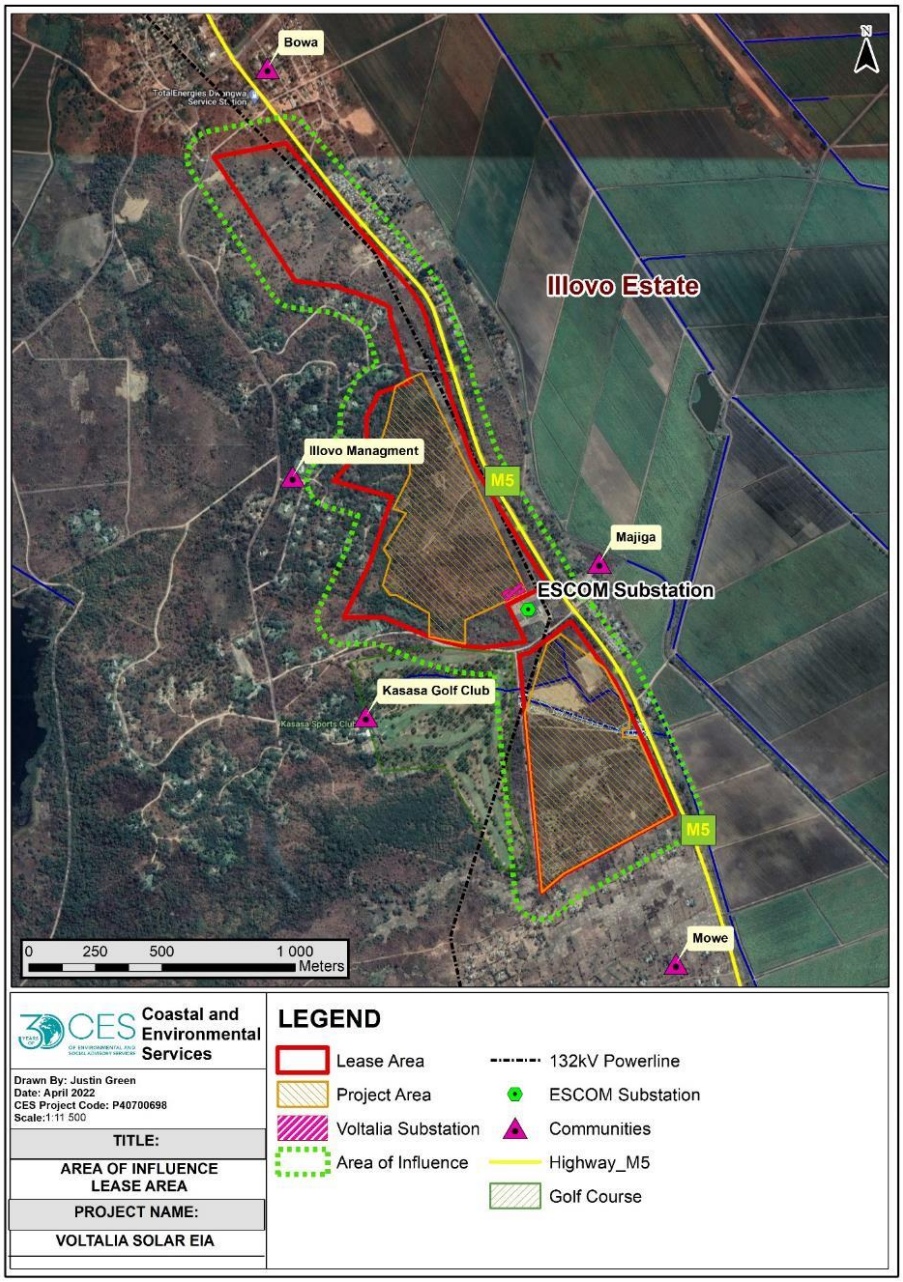


Figure 7.1 Social environment AoI and surrounding communities

7.1 AIR QUALITY AND NOISE

Commented [GS9]: To be updated with baseline information from the field.

In rural areas indoor air quality is likely to be poor, with rural homes cooking almost exclusively with wood resulting in exposure to elevated respirable particulate matter (PM10 and PM2.5). However, in rural areas outdoor air quality is not expected to be degraded and air quality is typically affected by dust from roads and periodic burning of land. This is particularly true for this location adjacent to Illovo plantations where seasonal burning of crops is a seasonal practice.

There are a number of sensitive receptors close to the project site, which are a particular concern during the dry season so as part of the ESIA a baseline particulate matter (PM2.5 and PM10) assessment was undertaken. The summary of the findings were that across the project site currently the ambient particulate readings were well within WHO recommended levels. The full assessment can be found in Appendix 6.

There are no notable point source emissions to air in the Project area and there are no major urban or industrial activities near the Project site. However, there is a sensitive receptor close to the project site on the M5 which is on the likely route of delivery vehicles to the proposed project site. $N0_2$ (Nitrogen Dioxide) is the highest density harmful pollutant to be likely emitted by this activity, so a baseline assessment was undertaken to measure the current ambient levels. An average reading of 30 µg/m³ was detected across 3 sample points, over a 24 hour period. The WHO recommended limit is 40 µg/m³ over a 24 hour period. The full assessment can be found in Appendix 6.

In addition, there are no notable point source noise emissions. The Project site is surrounding by agriculture (sugar cane). While there are no major industrial or urban centres near the Project site (i.e. within 40 km) the Illovo plantation is adjacent with periods of increased activity and noise.

It is anticipated that during the construction phase of the project, for the closest receptors there may be the risk of disturbance caused by excessive noise, over a prolonged period during the day. As such baseline noise readings were taken during working hours at 5 locations across the project site, dictated by the closest receptors. The noise levels measured were between 42 and 49 dBA, which are below the 24 hour WHO safe limit of 70 dBA. The full assessment can be found in Appendix 6.

7.2 TRAFFIC AND TRANSPORT

At this stage in the planning and design of the solar PV project, it is not possible to accurately quantify the volumes of traffic that will be generated by the project. However, estimates of traffic volumes have been made based on a thorough review of available project planning documents, and these are considered to be sufficient to assess the potential environmental and social impacts of project-related traffic on the roads in the project area, and especially between the project site and the port of entry for equipment and materials (see Section 4.6).

It is estimated that 90% of construction material will be imported, with the material either coming in from Tanzania (Mtwara Port or Dar es Salaam Port) or the Port of Beira in

Mozambique. The conditions of the roads vary but are mostly of fair to poor quality single lane. Generally, these roads have no runoff/shoulder.

Figure 7.2 The condition of the M5 looking south, adjacent to the project site

Figure 7.3 Condition of the M5 looking north, adjacent to the project site

The possible routes are:

1. Via road (Dar es Salaam Port) – 1 354km:
    - A7: Dar es Salaam to Igumbilo;
    - A104: Igumbilo to Uyole;
    - B345: Uyole to Ipinda;
    - M1: Ipinda to Mzuzu; and
    - M5: Mzuzu to the site.

2. Via road (Mtwara Port) – 1 634km:
    - B2: Mtwara to Mingoyo;
    - B5: Mingoyo to Masasi;
    - A19: Masasi to Tanga;
    - B4: Tanga to Makambako;
    - A104: Makambako to Inyala;
    - B345: Inyala to Ipinda;
    - M1: Ipinda to Mzuzu; and
    - M5: Mzuzu to the site.

3. Via road (Beira Port) – 1 153km:
    - N6: Beira to Ginto;
    - N7: Ginto to Mwanza;
    - N6: Mwanza to Zalewa;
    - M1: Zalewa to Chingeni;
    - M5: Chingeni to the site.

These potential delivery routes are displayed in Figure 7.4**Error! Reference source not found.**, Figure 7.5**Error! Reference source not found.** and Figure 7.6**Error! Reference source not found.**.

A range of vehicle types are likely to be used during the construction of the plant. Heavy vehicles which will be required to transport goods, materials and equipment to site will include:

- Three, five and seven axle trucks;
- Flatbed semi-trailers; and possibly; and
- Road trains pulling a number of trailers.

Tracked vehicles such as excavators and bulldozers will be transported to site on low-loaders. A Step-up transformer will also need to be delivered to site. This will be an abnormal load.

The following site infrastructure will be required to facilitate the plant's operations:

- Solar PV panel arrays;
- Mounting structures;

- Workshops;
- Offices;
- Stores; and
- Medical Station.

The detailed design of the plant and the ancillary structures on site is not yet at a stage where accurate estimates of quantities and weights of materials and equipment are available.

Construction staff and personnel will have to be transported to the site during construction. It is assumed that all construction staff will reside in, or be accommodated in Dwangwa, approximately 40 km from the project site. It is assumed that the Design Engineers, Site Manager and Technical Workers will have their own vehicles, while the remainder of the workforce will be transported to site in buses/mini vans.

During the operations phase, activity on site and the number of staff present will be minimal. Personnel will be those associated with monitoring of the solar facility, maintenance technicians, grass cutters, panel cleaners and security guards.

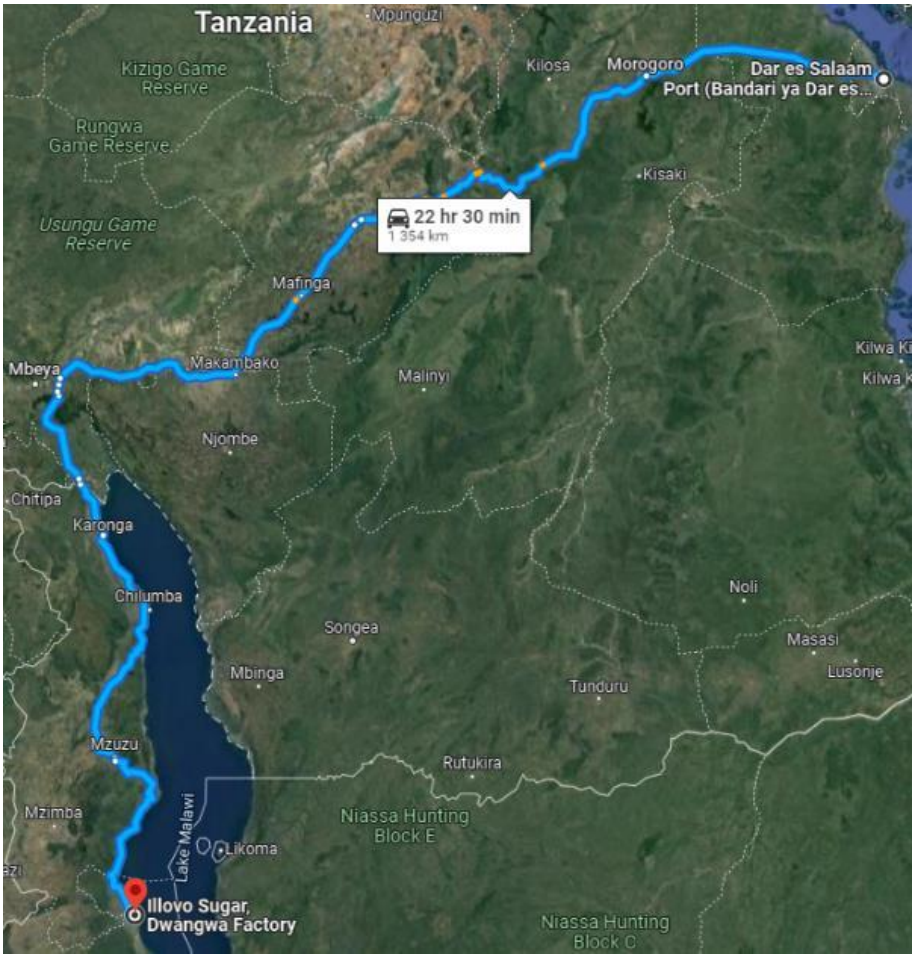


Figure 7.4 Road access to the site via Dar es Salaam Port

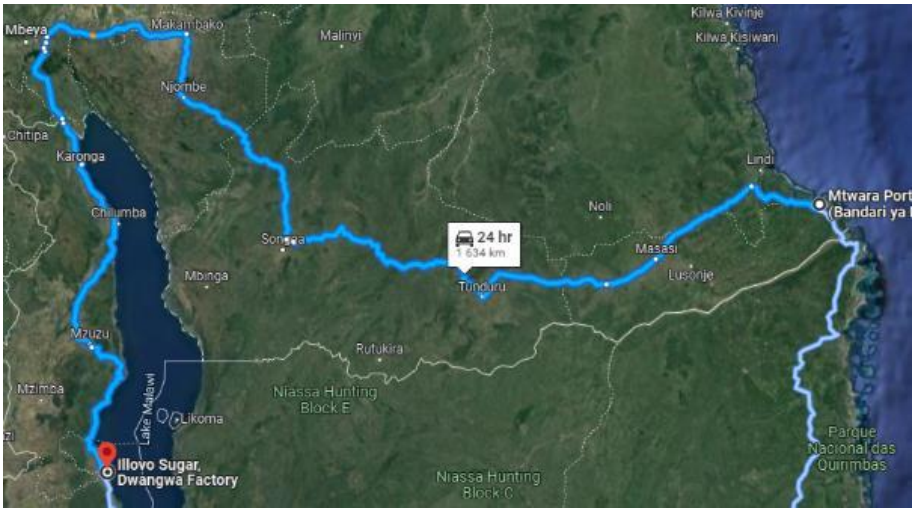


Figure 7.5 Road access via Mtwara Port

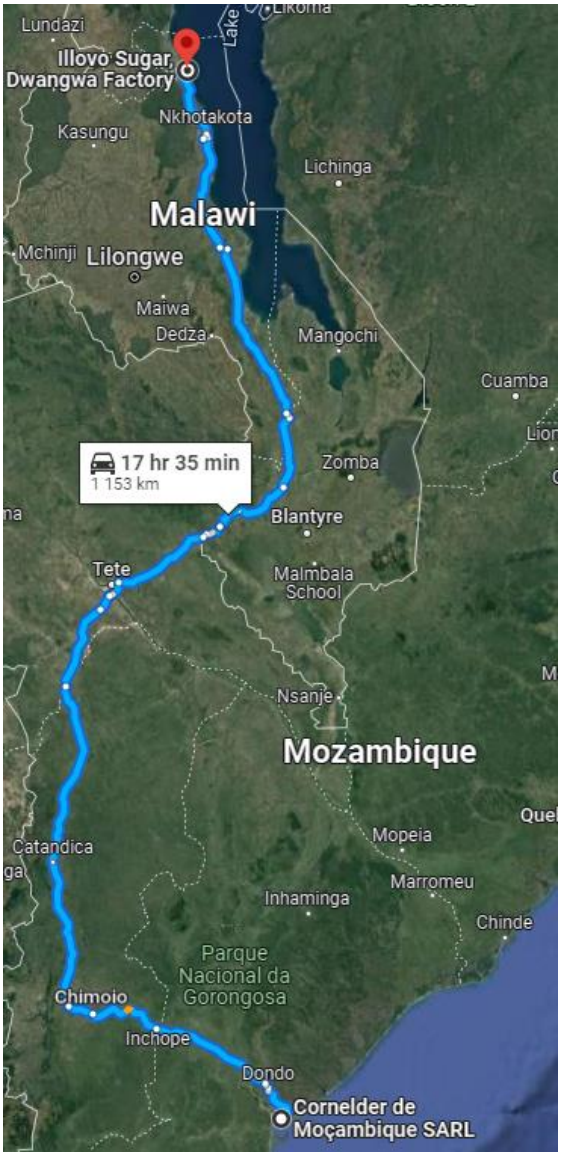


Figure 7.6 Road access via Beira Port

The M5 is considered to be an important road for those travelling from North to South and visa versa. In addition, the M5 is the road for those accessing sites along Lake Malawi. Traffic is seasonal and the flow of traffic is significantly affected during the rainy season. Vehicles using this particular stretch of road include cars, minibus people carriers, goods truck and those trucks employed by Illovo.

7.3 LANDSCAPE AND VISUAL

This assessment was undertaken during the planning stage of the project and is based on information available at the time.

The study area for the visual impact assessment encompasses a geographical area of approx. 100 ha. The topography of the site determines the potential for the site to be observable to surrounding communities and land users (Figure 7.7**Error! Reference source not found.**). In addition, the coverage, type and location of vegetation on the site will determine how visible the site will be.

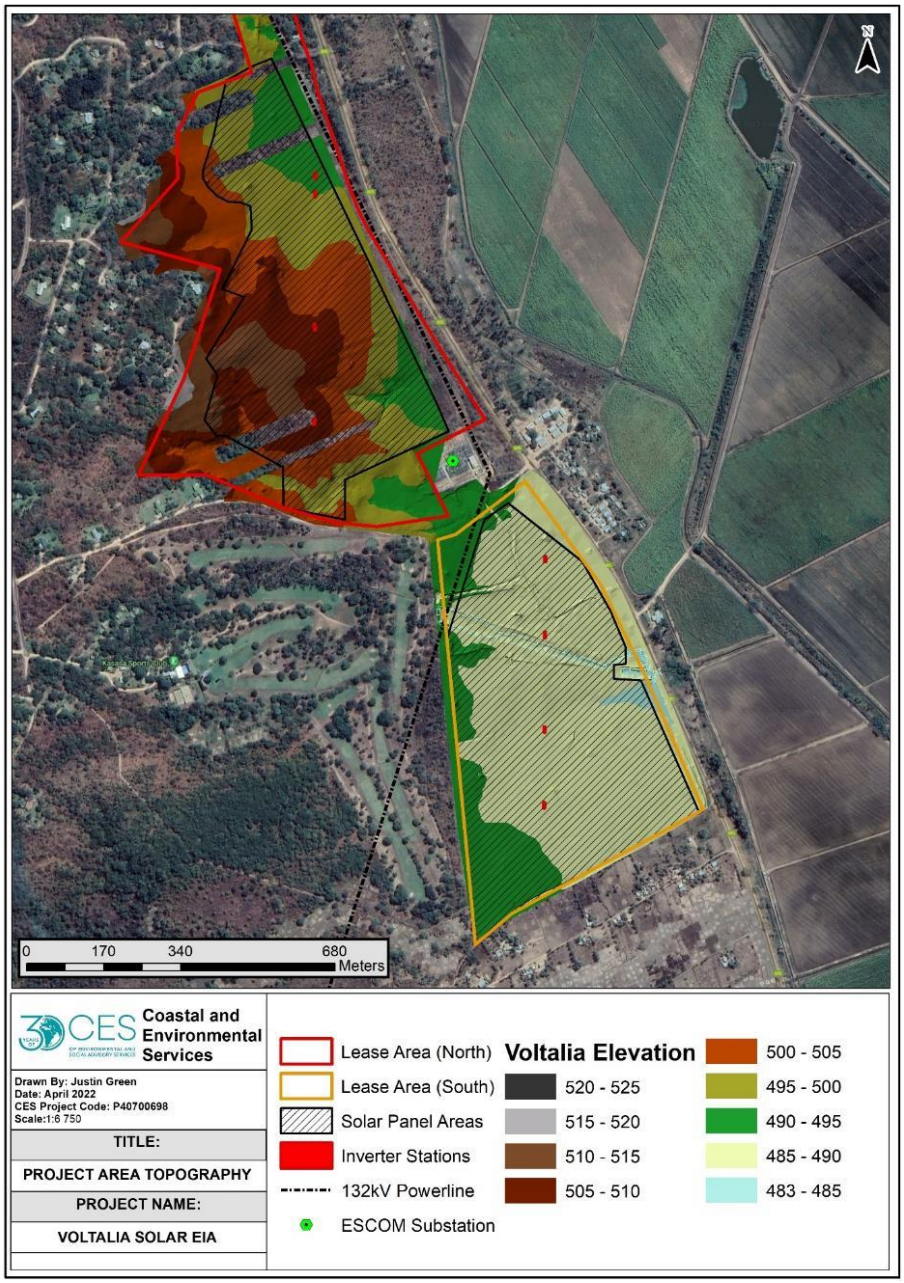


Figure 7.7 Topography informing the potential for site visitibility

The northern site elevation drops from west to east where the elevation remains fairly consistent “down” to the lake (see Section 6.5 and Section 6.6) (Figure 7.8). Those panels located on the slopes of the higher elevations are likely to be more visible than those at lower elevations**Error! Reference source not found.**.

Figure 7.8 Elevated view (+5 m) of the northern site, looking south towards the M5 and eastern boundary.

The southern site is considerably flatter and elevation changes are not as significant. The overall level of the site is low, being similar to that of the M5 and adjacent Illovo plantation (Figure 7.9**Error! Reference source not found.**).

Figure 7.9 View from the road into the site where existing OHL can been seen

Both sites have significant vegetation cover on the western boundaries (see Section 6.11) and the surrounding communities are used to seeing infrastructure on the project site. There is an existing ESCOM substation (Figure 7.10**Error! Reference source not found.**) and OHL (Figure 7.11**Error! Reference source not found.**) running from south to north along the eastern boundary.

Figure 7.10 Existing ESCOM substation

Figure 7.11 Overhead lines transversing through the site

Anticipated issues related to the potential visual impact of the proposed PV facility include the following:

- The visibility of the facility to, and potential visual impact on, observers travelling along the national (M5), and secondary roads within the study area.
- The visibility of the facility to, and potential visual impact on residents of homesteads or farm dwellings within and adjacent to the study area.
- The potential visual impact of the facility on the visual character or sense of place of the region.
- The potential visual impact of the facility on tourist routes or tourist destinations/facilities including the golf club.
- The potential visual impact of the construction of ancillary infrastructure (i.e. internal access roads, buildings, etc.) on observers in close proximity to the facility.
- The visual absorption capacity of the natural vegetation (if applicable).
- Potential cumulative visual impacts (or consolidation of visual impacts).
- The potential visual impact of operational, safety and security lighting of the facility at night on observers residing in close proximity of the facility.
- Potential visual impact of solar glint and glare as a visual distraction and possible hazard to road users (or an aviation safety risk to pilots).
- Potential visual impacts associated with the construction phase.

It has been assumed that once constructed the solar PV panels will be no higher than three metres above the ground and the substation building will be no higher than five metres above the ground.

7.4 HERITAGE AND CULTURAL RESOURCES

The Department of Museums and Monuments carried out an assessment of the project impact on cultural heritage resources within the Study Site. This is line with Malawi Monuments and Relics Act (1990) which stipulates that Cultural Heritage Impact Assessment needs to be carried out before any large-scale development that would result in permanent alteration of the landscape and disturbance to the relics buried in the ground. The study involved assessing the direct and indirect impacts of the proposed solar power project on archaeological and cultural heritage resources found in the project area. See Appendix 4 Heritage Impact Assessment for more detailed information.

Nkhotakota as a District is rich with cultural heritage studies both anthropological and archaeological research. Past archaeological research works in Nkhotakota have identified Later Stone Age (LSA) sites, Iron Age (IA) sites and rich rock paintings. The main documents/ research that were used for the purposes of this work which outline the archaeology of Nkhotakota with closer affinities to Dwangwa were few (Cole-King, 1973; Robinson, 1975; Mgomezulu, 1978; Juwayeyi, 2010; Boucher, 2012).

The team identified only 5 archaeological sites and 1 graveyard close to the project site.

The most common findings that point to settlement of early people are pottery fragments (sherds). Analysis of these fragments show that there were distinct types used during various historic time periods. This site has numerous clusters of pot sherds. Most of the pot sherds found were undiagnostic – although a few were decorated. Mawudzu ware is characterised with vessels that are simple. The pot vessels are spherical with constricted mouths and sometimes shouldered with conical or concave necks. Other pots are large U-shaped pots while most bowls are hemispherical or open and may have flat or pedestal bases, though less usual than rounded ones. Mawudzu ware is characterized by impressed chevrons and scallops; tooth patterns that run around the very slightly shouldered u- part of the pot; incised herringbone; dentate motif in false relief; incised festoons around the slight and pendant arc and stamping, though it is rare. The finish is normally a polychrome burnish which sometimes occurs with an outline of incision. Most of the pot sherds found were identified as rim sherds and body sherds.

7.4.1 Identified Archaeological / Historical Sites

The identified sites have been numbered as KK-DW (referred to as Nkhotakota-Dwangwa Site).

7.4.1.1 KK-DW 1

Potential stone age site in an eroded river gully. Pieces of stone flakes are exposed on the eroded stratigraphic units (**Error! Reference source not found.**).

Figure 7.12 Exposed gully with embeded archaeolgical artefacts

7.4.1.2 KK-DW 2

An Iron Age Site and a historic settlement along a footpath leading to an existing water tank. Recorded a high concentration of embedded pot sherds, some decorated with rims intact (**Error! Reference source not found.**, **Error! Reference source not found.**)

Figure 7.13 Scatters of embeded pottery along a pathway

Figure 7.14 Scatters of embeded pottery along a pathway

7.4.1.3 KK-DW 3

A historical settlement/potential iron age site, with presence of pottery fragments scattered on the ground (**Error! Reference source not found.**). The site is close to Total filling station.

The area has been planted with trees. Other cultural materials present included rugs, old metal implements, old house foundations, mounds and dagga.

Figure 7.15 Scatters of pottery recorded at the site

7.4.1.4 KK-DW 4

A historical settlement/potential iron age site close to residential houses with high concentration of pottery fragments scattered on the ground (**Error! Reference source not found.**). Other cultural materials present included old metal implements and dagga.

Figure 7.16 Pottery and metal fragments recorded at the site

7.4.1.5 KK-DW 5

An iron age site, with presence of pottery and old metal fragments scattered on the ground covered with thick grasses (**Error! Reference source not found.**). Situated about 50m from the main road.

Figure 7.17 Pottery fragments with rims recorded at the site

7.4.1.6 Graveyard

A graveyard locally known as Manda a Jodi has been recorded in proximity to the project area, the Dwangwa sub-station. This graveyard is fenced together with the Kasasa Golf Club.

Currently, the graveyard is no longer used. It used to serve Bowa Village. Since it is outside the project area and fenced, it will not be affected by land clearing activities.

7.4.2 Site Significance (Heritage)

In order to define the significance of the sites located within the project area, the cultural heritage sites need to be classified according to their importance and the required appropriate intervention. The prioritization of a site is not a definite measure of its scientific importance but rather a temporary classification regarding potential and further treatment requirements. In this regard, some high priority sites may well be re-evaluated as non-important after further study. The criteria used to define the value of a site are multiple and complex. However, regarding the area's archaeological and historical sites, the aim is to understand both the history of the region and the way of life of past populations. In this context these criteria would be summarized as follows:

- Age of the finds;
- Context of the finds;
- Density and/or variety of the finds;
- Social significance of the finds; and
- Precursory archaeological knowledge of the area.

When taken together, a preliminary site prioritization classification has been illustrated as shown in **Error! Reference source not found.** below.

Table 7.1 Site significance classification

Site	Old Age	Primary Context	High Artefact Density or Variety	High Social Significance
	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	No
	No	Yes	Yes	Yes
	No	Yes	No	Yes
	Yes	Yes	No	No
	No	No	No	Yes
	No	No	Yes	No

Commented [GAS10]: There are no site labels associated with this classification?

Commented [RHL11R10]: Chasing

The following categories (**Error! Reference source not found.**) have been defined for the heritage resources identified in this project area (each category implies specific mitigation measures to be taken):

- Low Priority Site: No further treatment;
- Medium Priority Site: Further monitoring during project development and other construction works to ascertain final priority/importance; and
- High Priority Site: Further treatment warranted.

Table 7.2 Site priority classification

Site	Priority
	High
	High
	High
	High
	Medium
	Medium
	Low

Commented [GAS12]: I have split this out but will need the site locations.

Commented [RHL13R12]: Chasing

7.4.3 Site Significance (Cultural)

Commented [GAS14]: Rob to comment on where this section is in the Dept report

Commented [RHL15R14]: Still chasing

7.5 Land Tenure and Use

The project area is located on Illovo's leased land. This is not customary tenure land and there are no traditional authorities involved in the allocation or management of land in this area. The land has been used by Illovo and by the Illovo staff and family members living immediately adjacent to the proposed project area. These residents live in staff housing belonging to Illovo and to the Dwangwa Cane Growers Association and are informally using the proposed Voltalia project land for cultivation. The site is not used for collecting wood or water, hunting or any other use.

There are no dwellings located in the proposed project area (Figure 7.18). The only structures within the site are the ESCOM substation, a water tower and various powerlines that largely run adjacent to the M5 road that forms the eastern boundary of the proposed project area. These structures will not be impacted by the proposed solar plant development. The sections which follow below outline the land uses that are and have been made of the various parts of the proposed project area**Error! Reference source not found.**.

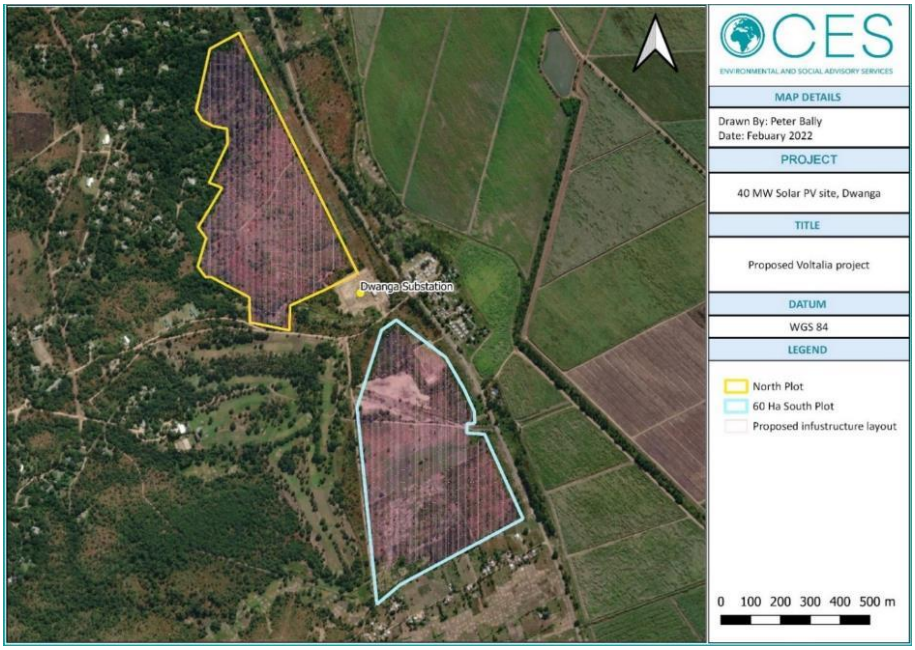


Figure 7.18 Proposed area within which the panels will be installed. Note this is not the entire lease area.

Illovo has made use of the southern project site in three ways:

- To plant exotic trees which they fell when needed to fuel their boilers. Local residents are not allowed to fell the trees and only allowed to harvest fruit from the trees. There is no evidence of extensive fruit tree plantings in this area as is normally typical in community common and arable lands;
- The sand mine that is located in the southern project area is also used by Illovo's contractors to source topsoil and sand for their maintenance works on the estate; and
- The soccer field was also developed by Illovo for the community and particularly the primary school located directly across the M5 road from it.

7.5.1 Cultivation in the Southern Portion

From the drone imagery taken in July 2021 and the google earth imagery from August 2021, a total of 183 cultivated fields were identified in the AoI (Figure 7.21**Error! Reference source not found.**). One hundred and sixty-six (166) of these cultivated fields on 5.134 ha were found in the southern project area where the solar panels are proposed to be constructed. The average plot size was 0.027ha but this ranged from 0.003 to 0.245 ha. The direction of the pathways to these cultivated lands indicates that these plots are cultivated by members of the families who live in the Illovo staff housing on the other side of the M5 road. Some of this cultivation is taking place amongst the exotic and remaining indigenous trees in the southern portion of the project site and resembles the traditional practices of shifting cultivation in Malawi where the ground under the trees is cleared and planted to crops.

Table 7.3 Summary of area data on cultivated lands in and around the AoI.

Areas	Hectares	# Cultivators	Ave Size
Cultivated land in Southern project area	5.134	166	0.027
Cultivated land in Northern project area	0.572	17	0.034
Total affected cultivators in project area	**5.706**	**183**	
Cultivated land along roadside/powerlines	3.5		
Unused land along roadside/powerlines	9.026		
Cultivated land in far northern leased area	6.3		
Total Area of land in far northern leased area	23		
Uncultivated land in far northern lease area	16.65		
Soccer field area	0.64		

7.5.2 Cultivation in the Northern Portion

With regard to the northern portion of the proposed solar project area, two separate areas have been demarcated by the developers. The southern wider portion will be used for the solar panels and substation, while the northern section will be avoided and may be used for other purposes as required. There are less exotic trees in this area and it is not known whether Illovo has felled some of the trees that were in this area to feed its boilers. Illovo's restrictions on its staff and other residents from cutting the trees in this area may be the reason why the Miombo woodland is relatively well preserved in the western part of this site, as well as the southern site.

In the wider southern half of the northern Voltalia project area, there are two areas where there is evidence from the aerial imagery from July and August 2021 of cultivation of small arable lands. One of these is a series of small rice paddies along the water course that exit's the plot adjacent to the existing substation (Figure 7.19**Error! Reference source not found.**). Analysis of the drone imagery from July 2021 indicate around 36 rice paddies. Only 5 -7 of these rice paddies may be affected by the project. The proponent is proposing to avoid impacting most of these rice plots and the valuable and sensitive forest resources on the western side of this southern boundary. However, there will also be a short underground powerline cutting across the stream to connect with the substation – which may also affect some of the rice paddies.

Figure 7.19 Aerial image of rice paddy next to existing ESCOM substation

Seventeen affected cultivated lands (0.572 ha) were identified in the northern portion of the proposed development area**Error! Reference source not found.** below demarcates the northern cultivated lands. Some of the 17 are the affected rice paddies in the southern part of the northern development area adjacent to the existing ESCOM substation (Figure 7.20**Error! Reference source not found.**).

This cultivated area is also under the existing two powerlines that run parallel to the M5 road. Consequently, these areas under the powerlines will not be used for the solar panels and will not result in displacement of the cultivators.

7.5.3 Cultivation alongside the M5 road and under the existing powerlines

Alongside the southern and northern Voltalia project infrastructure areas, there are also some cultivated areas under the powerlines running parallel to the M5 and alongside the road (Figure 7.22**Error! Reference source not found.Error! Reference source not found.**). Analysis of the imagery indicate that 28% of this area is being cultivated (approximately 3.5 of the 12.5 ha). These cultivated lands will not be affected by the proposed solar panel infrastructure, and the unused portions could potentially be used as alternative cultivation land for those affected by the Voltalia project.

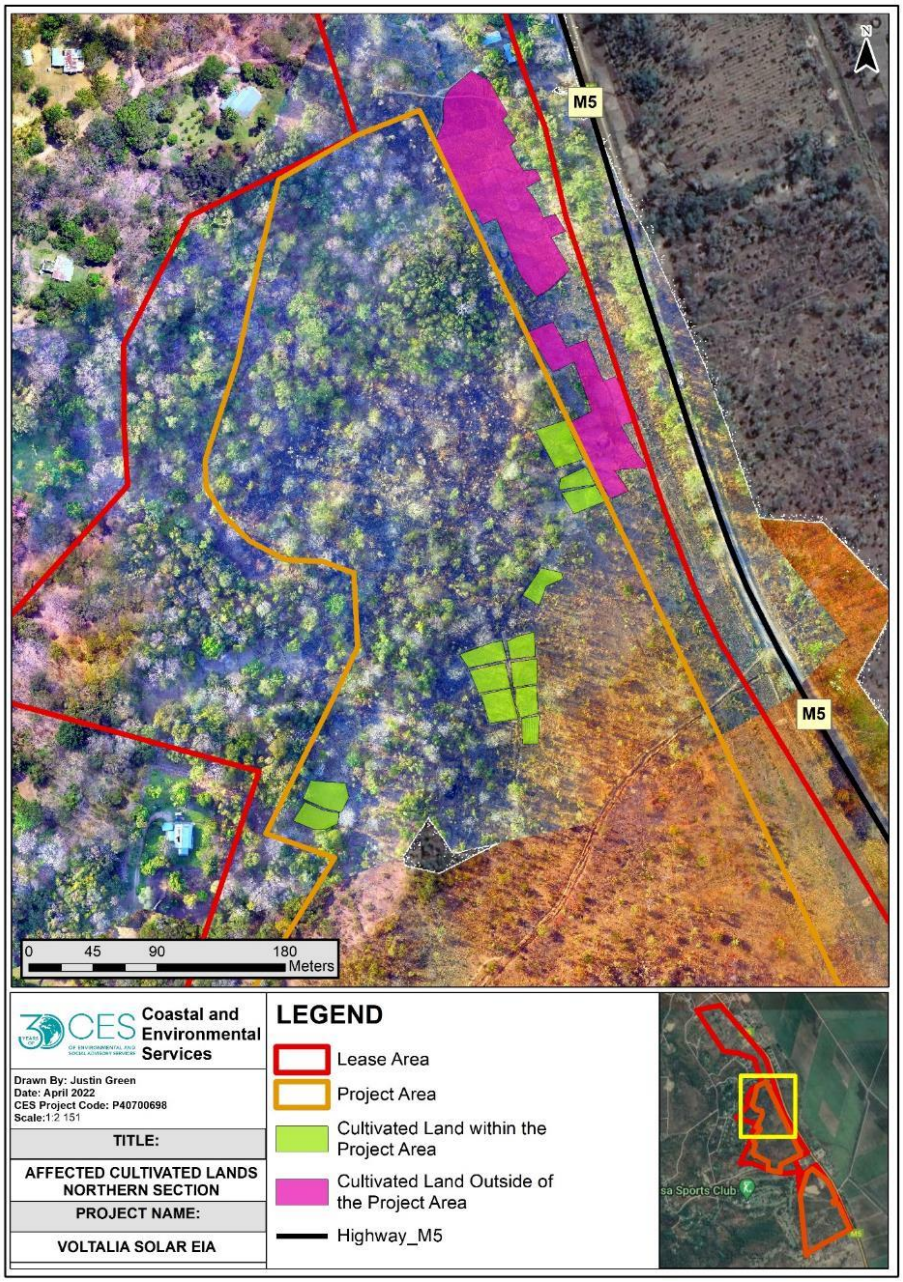
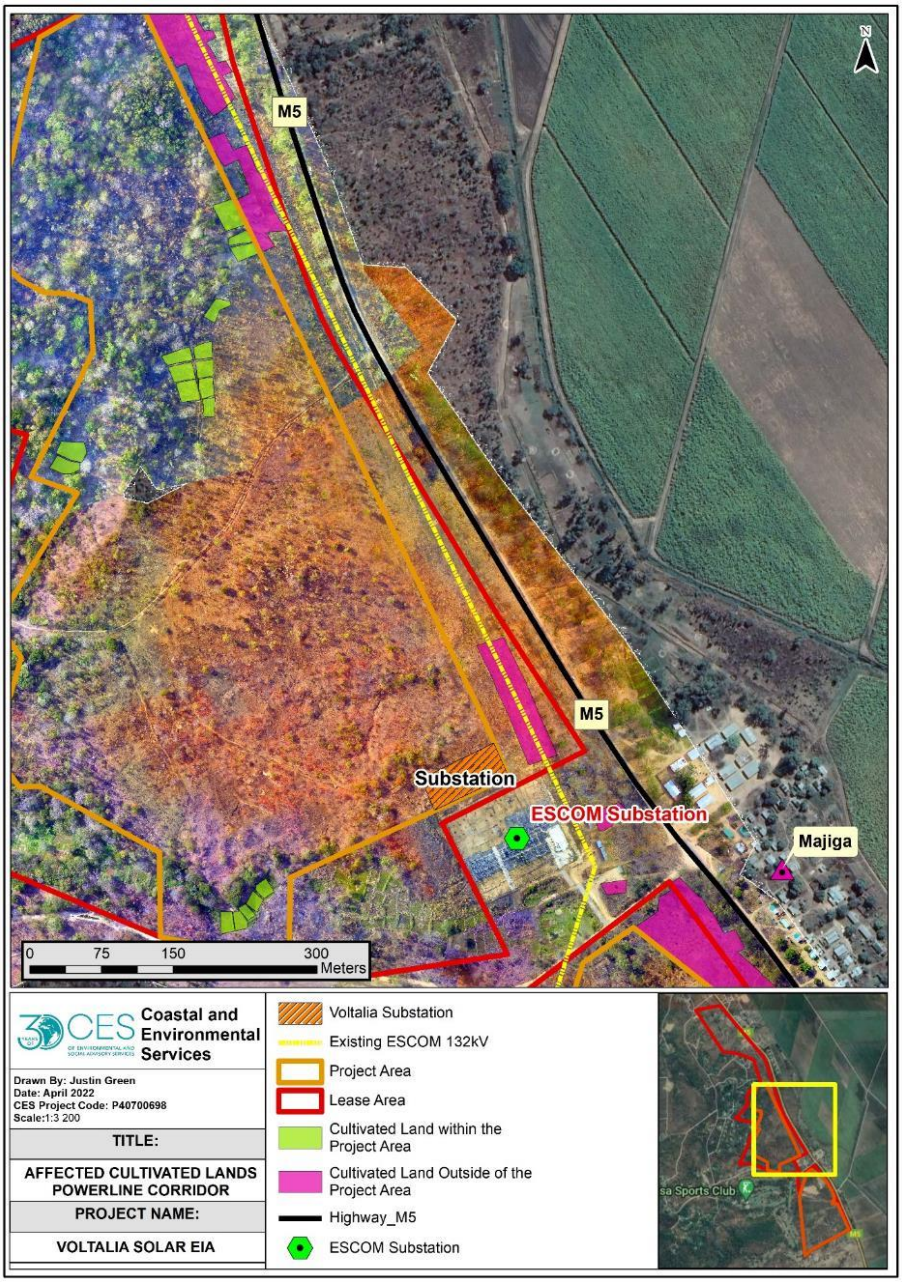


Figure 7.20 Affected cultivated lands in the northern portion of the lease area. Note the polygons outside the powerline corridor that runs parallel and west of the M5 road).

Figure 7.21 Powerline corridor alongside the M5 and outside the southern portion. Cultivated areas are delineated in red.


N
M5
M5
Substation
ESCOM Substation
Majiga
0
75
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CES Coastal and Environmental Services
Drawn By: Justin Green
Date: April 2022
CES Project Code: P40700698
Scale:1:3 200
TITLE:
AFFECTED CULTIVATED LANDS POWERLINE CORRIDOR
PROJECT NAME:
VOLTALIA SOLAR EIA
Voltalia Substation
Existing ESCOM 132kV
Project Area
Lease Area
Cultivated Land within the Project Area
Cultivated Land Outside of the Project Area
Highway_M5
ESCOM Substation

Figure 7.22 Powerline corridor alongside the M5 and outside the northern portion. Cultivated areas are delinated in red.

7.5.4 Cultivation in the far northern lease area that will not be used for infrastructure

The northern half of the longer far northern portion of the proposed Voltalia solar lease area, is not proposed to be used for solar panels or other project infrastructure. Much of the western portions of this area has also been excluded due to the existence of sensitive and valuable Miombo woodland. There is little evidence of harvesting of this woodland by local residents.

In the lands adjacent to the M5 road, an estimated 6.3 ha of land is being cultivated and there are access pathways linking to the Dwangwa Small Growers settlements on the other side of the M5 road (Figure 7.23**Error! Reference source not found.**). Many of these lands are being cultivated under the existing powerlines. These cultivated lands, including those not under the existing powerlines, will not be affected by the development of the solar panels. Another 16.65 ha of land in this far northern lease area is not being cultivated and could potentially be used to provide alternative arable land to those cultivators affected/displaced by the solar project.

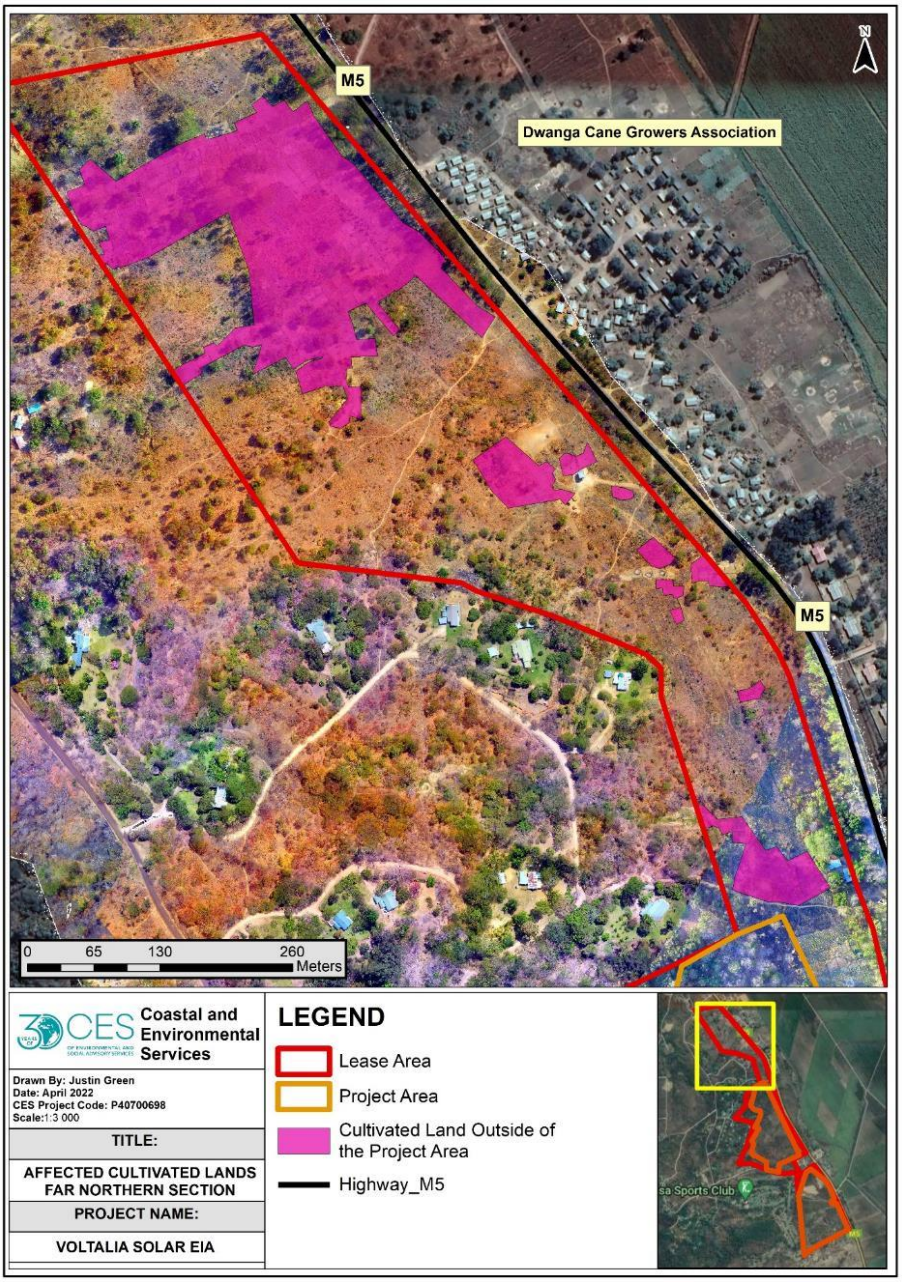

Figure 7.23 Cultivated lands in the far northern portion of the leased land.

7.6 NATURAL RESOURCE USE / ECOSYSTEM SERVICES

The analysis of ecosystem services is an adaptation of the approach adopted by the World Research Institute (WRI), which complies with requirements of the IFC Performance Standard 6 (PS6). The WRI approach provides a breakdown of ecosystem services that are classified into Provisioning, Regulating, Supporting and Cultural Services.

This list has been adjusted to match the suite of services that are relevant to the areas associated with the Project site. The WRI approach provides a simple and logical process to identify priority Ecosystem Services (Figure 7.24).

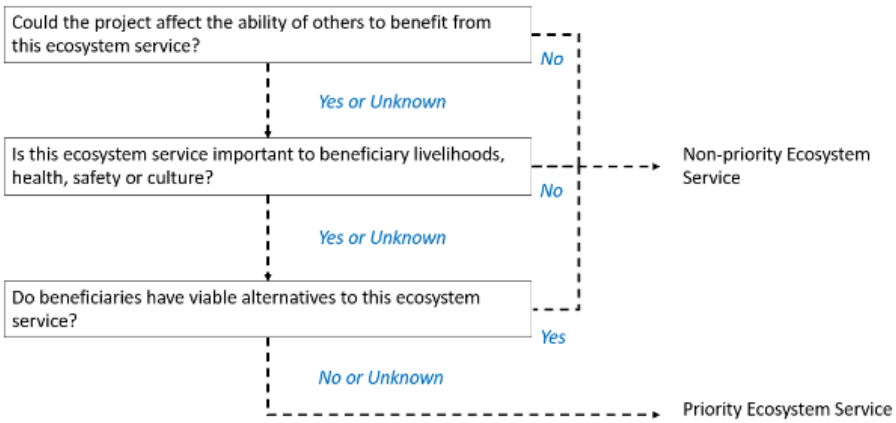

Figure 7.24 Adapted Approach for Prioritisation of Ecosystem Services Adopted by the WRI

The PS6 requires that disruptions to priority ecosystem services are assessed as part of an impact assessment, with mitigation measures developed to address the impacts.

During the site survey, various ecosystem services were reported by communities and/or observed by the project team. The use of ecosystem services, dependence of local beneficiaries and an assessment of replaceability have been investigated through processes of consultation and incorporating expert opinion.

An overview and description of ecosystem services relevant to the Project area is provided below and summarised in Table 7.4, together with a high-level assessment of the potential impact, dependence of beneficiaries and replaceability of services.

The majority of the site is natural with some subsistence agriculture and infrastructure (Plate 7.1). The northern and central site is relatively untouched, and the majority of land is in a natural state. No indigenous trees are harvested, but there is evidence of grass being harvested and small woodlots of Eucalyptus are present (Plate 7.2) which are used by Illovo.

Rice is grown in all the streams on site, and the small river on the southern site has been dammed, and water is pumped from this small dam to feed into the irrigation canal on the other side of the M5 road.

The majority of the southern portion is used for subsistence agriculture, which includes rice paddies. The existing infrastructure on the site includes roads, a substation, powerlines, a water tower, buildings and soccer fields. There are also two sand mine areas; one in the southern portion and one on the northern portion. A tree wind break has been planted along the M5 presumably for the neighbouring sugar plantation.

Plate 7.1 Grass is harvested from the project area and used as thatch

Plate 7.2 Portions of the site are used as woodlots to grow Eucalyptus trees. Illovo uses wood from these trees in the power plant associated with their operations.

Surrounding land use includes the town Bowa, Primary School (Majiga), Golf course (Kasasa Sports Club), Illovo houses and commercial agricultural fields (sugar cane).

Table 7.4 Description and Assessment of Ecosystem Services in the Project Area

Ecosystem service	Description	Location	Likely impact	Importance to beneficiaries	Replaceability	Prioritisation
Provisioning Ecosystem Services						
Crops cultivated at the Project site are a source of income	Rice is the main cash crop grown on the site.	Project site	Yes The project will displace cultivated land	Yes Crops are a source of income	Yes There is alternative land available	Non-priority Ecosystem Service
Fuelwood	Although fuel wood is available on site it is not harvested due to instruction from the landowner	Project site	No The project will not impact the use of fuelwood	n/a	n/a	n/a

Ecosystem service	Description	Location	Likely impact	Importance to beneficiaries	Replaceability	Prioritisation
Thatch grass	The communities harvest thatching for their houses	Project site	Yes Clearing of the grassland will have an impact on the ability to harvest thatch	Yes Grass is used for thatching houses and livestock pens	Yes Thatch grass is also found on other surrounding lands within the project lease area as an alternative source	Non-priority Ecosystem Service
Natural medicine	Some species of flora found on the Project site and along the transmission line route are harvested by communities to be used in traditional medicine which cure various illnesses.	Project site	Yes The project will have impact on people due to loss of some medicinal plants	Yes Medicinal plants are used to treat various illnesses at local level	Yes Medicinal plant species found on the Project site are also found in adjacent woodland areas	Non-priority Ecosystem Service
Wild plant fruits	Fruits are harvested by communities for food and income	Project site	Yes The project will restrict the ability to harvest some fruits	Yes Fruit is a source of food and income	Yes Fruit trees are available on adjacent properties and available to the communities for harvesting	Non-priority Ecosystem Service
Regulating Ecosystem Services						
Regulation of water flows	The rice paddies found on the northern Project site play a role in the prevention of floods.	Project site	Yes The project will have impact on regulation of water flows especially during rainy season due to partial clearing of the rice paddies and drainage features	Yes The rice paddies regulates flow of water which can reduce the effect of flooding	Yes Although the rice paddies will be lost, appropriate storm water management will be implemented	Non-priority Ecosystem Service
Soil erosion control	The Project site has grasses which are important in prevention	Project site	Yes Clearing of grasses on the Project site	Yes Erosion may lead to deterioration of soil quality outside the project site	Yes Erosion control measures will be implemented	Non-priority Ecosystem Service

Ecosystem service	Description	Location	Likely impact	Importance to beneficiaries	Replaceability	Prioritisation
	of the effects of erosion		will have impact on soil erosion			
Cultural Ecosystem Services						
Ethical values	There are no services which will influence cultural significance of the site	Project site	No Nothing was identified during the field work and engagement	n/a	n/a	n/a
Supporting Ecosystem Services						
Biodiversity maintenance	The Project site has the potential to support biodiversity such as trees, insects and birds.	Project site	Yes The Project area supports habitat which will be impacted through vegetation clearing, installing of project infrastructure and faunal disturbance.	Yes Biodiversity underpins a host of ecosystem services, many of which are discussed above.	Yes There is high quality habitat adjacent to the project site. Although there is no intention to replace biodiversity there is consideration of increasing the capacity of the intact habitats through mechanisms to informally/formally protect what remains	Non-priority Ecosystem Service

The assessment reveals that while there is diversity in the provision of ecosystem services present within the project site, they have all been assigned a non-priority status. This is due to viable alternatives being available to provide similar services. In this case suitable alternative land will be provided. This is the subject of a separate Livelihood Restoration Programme (LRP).

Given that some of the services are underpinned by biodiversity the impacts to the biodiversity and thus disruptions to biodiversity based services are addressed through appropriate mitigation in the biodiversity sections of this report. See Section 6.10 for further information on the biodiversity sensitivity assessment.

8 SOCIO-ECONOMIC ENVIRONMENT

8.1 INTRODUCTION

This Social Specialist study is one of the specialist studies commissioned as part of the Environmental and Social Impact Assessment of the proposed Voltalia Solar Power generation facility at Dwangwa. The study is informed and guided by the legal requirements for such studies in Malawi and the IFCs environmental and social Performance standards, including PS 2, 4 and 5.

8.2 METHODOLOGY

The terms of reference for the research on the local social environment required a focus on issues related to project impacts such as resettlement, food security and social structures and interactions. The specific terms of reference to be used by CES are as follows:

a) Describe the local social environment, with particular reference to the communities that will be directly affected by the project.
b) Determine the number of households (and people) that may need to be resettled as a result of the project.
c) Determine the current land use within the development footprint and the areas outside of the development boundary that are likely to be indirectly affected.
d) Assess the significance of potential environmental and social impacts on the local populace and the district.
e) Evaluate how the project could contribute to community upliftment programmes.
f) Establish a baseline understanding of the current state of livelihoods, income sources, education levels and food security.
g) Investigate possible effects on livelihoods, income levels, education levels, food security and other factors relevant to the affected communities.
h) Describe and investigate possible effects on traditional structures and cultural and religious customs.
i) Develop a monitoring programme to ensure effective implementation of the recommended mitigation measures.
j) Assess the significance of the potential impacts of the project on the directly and indirectly affected communities.
k) Identify suitable mitigation actions that can reduce negative impacts, and recommend strategies that could optimize social benefits, where possible.

This research for this study drew on the following sources of information:

- The project description
- The aerial and spatial data for the study area
- GIS data capture and analysis of the cultivated areas within the project area
- Local public meetings and the inputs from stakeholders
- Interviews with local key informants from Illovo and the neighbouring communities
- A field visit to the project site
- The 2017 Census data for the Nkhotakota District.
- Literature on Malawian livelihoods and socio-economic trends.

8.3 ADMINISTRATION

The Voltalia project area falls within the Nkotakota District and the Kanyenda Traditional Authority area (Figure 8.1). The project area is located on Illovo's leased land. This is not customary tenure land (See Section 7.5 Land Tenure and Use above) and there are no traditional authorities involved in the allocation or management of land in this area.

The Nkhotakota District Council is the highest policy making body in the district responsible for promoting infrastructural and socio-economic development in the district. The Council is

made up of two bodies: an elected council and an administrative body called the council secretariat.

The Council comprises ten councillors, five members of parliament, six Traditional Authorities and five members of Special Interest Groups. The council is headed by the chairperson who is elected among councillors by vote. The District Council's main functions are policy making, coordination and supervision of development activities in the district. It also reviews, approves or rejects proposed projects identified by the communities. The District Council makes resolutions regarding implementation of management functions of the secretariat. The Council has six Service Committees namely: Finance and Audit, Development and Public Works, Education, Health and Environment, Agriculture and Natural Resource, and Human Resource.

The District Secretariat's function is to implement the resolutions and policies of the Council, coordinate sector development programmes and manage council resources. The District Commissioner (DC) is the head of the secretariat and is assisted by directors and departments/sector heads namely: Finance, Planning and Development, Administration, Public Works, Health, Education; Agriculture; Youth and Sports; Water; Labour; Gender, Social Welfare, Rural Housing, Irrigation, Forestry, Fisheries, Environment, National Registration Bureau, Trade and Immigration.

The District Executive Committee (DEC) is the technical advisory body to the District Council. It is composed of all heads of departments, line ministries, statutory corporations, and Non-Governmental Organizations working in the district. DEC is the technical arm of the District Council. It facilitates development planning, capacity building and formation of the decentralized lower level planning institutions namely: Area Development Committee (ADC) and Area Executive Committee (AEC). It also harmonizes district level policies and activities with national level policies and activities. The District Commissioner chairs the DEC and the Directorate of Planning and Development provides secretarial services. It has 60 members.

Each Traditional Authority Area has an Area Development Committee (ADC) which is a representative body of all Village Development Committees (VDCs) under the jurisdiction of a Traditional Authority (T/A). There are 6 Traditional Authorities in the Nkotakota District namely Senior Chief Malengachanzi, Senior Chief Mwadzama, Senior Chief Kanyenda, T/A Mwansambo, T/A Mphonde and T/A Kafuzila whose area of jurisdiction is shown in Figure 8.1.

The ADC is comprised of elected chairpersons of Village Development Committees (VDC), Members of Parliament, Ward Councillors, representatives of religious faiths, representatives of youth and women groups in the area, representatives from the business community and chairperson of the AEC. The ADC co-opts a maximum of four representatives from interest groups such as representatives of people living with HIV and AIDS, and people with disabilities. The main functions of ADCs are to assist in the identification, prioritization, and preparation of community projects and to submit project proposals to DEC. ADCs supervise, monitor, and evaluate implementation of projects at Traditional Authority level. The term of office of an ADC is 5 years. Women comprise 42 percent of all ADC membership in the Nkotakota District which in line with the 40:60 recommended women representation in decision making bodies.

The Area Executive Committee (AECs) is the representative body of all extension workers of government ministries, non-governmental organizations and statutory corporations working within a Traditional Authority. The AEC advises the ADC in identification, assessment, formulation and preparation of project proposals and is also responsible for capacity building in development planning for all the VDCs in the area. Each ADC has one AECs. However, due to financial constraints, these AECs have not yet been trained to facilitate effectively and efficiently at community level.

Village Development Committees (VDCs) are the smallest planning unit. It is the representative body of villages under the VDC's jurisdiction. It is responsible for facilitating planning and development at the village level. It is composed of elected members from each village within the Group Village Head (GVH), Ward Councillors, four women representatives nominated by people within the VDC and elected extension workers. The Kanyenda TA has 22 VDCs and Group Village Heads with 90 village Heads and had a population of 125 365 persons in 2017.

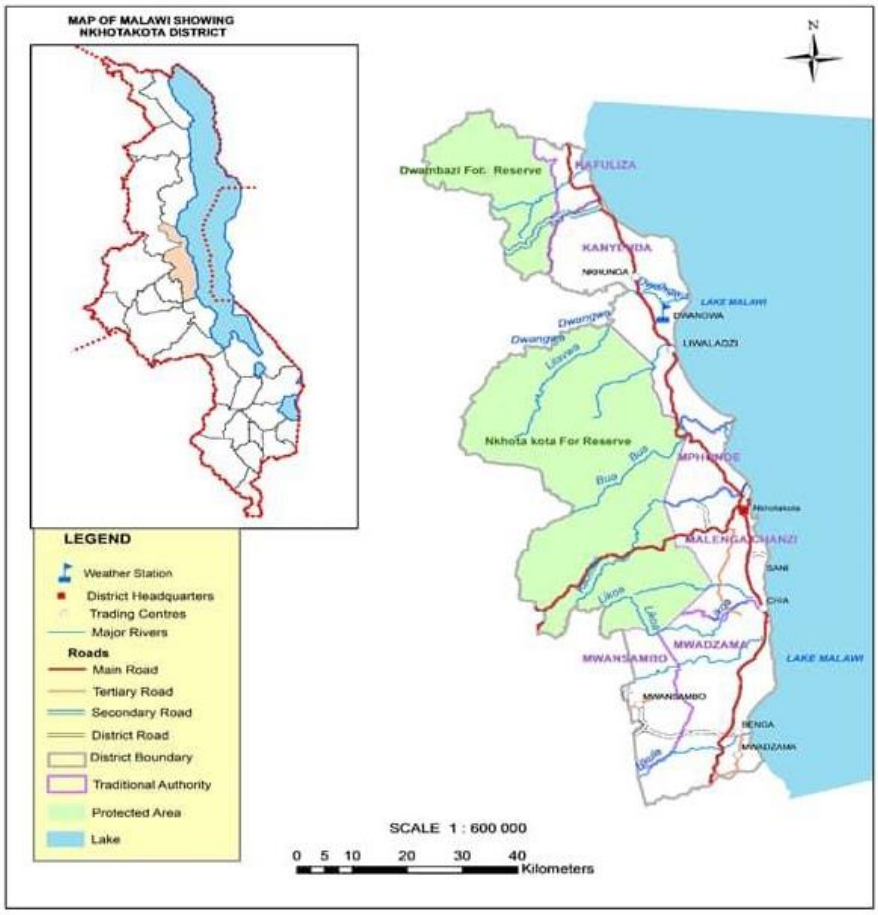

Figure 8.1 Map of the Khotakota District and Traditional Authority Area

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8.4 DEMOGRAPHICS

8.4.1 Population and Characteristics

According to 2008 Population and Housing Census enumeration report the population of the Nkhotakota District has been growing at an average rate of 3.13% per year and increased from 356,459 in 2013 to 404,02 in 2017. The growth rate of the district is lower than that of the national growth rate which is 3.16. The population of the Nkhotakota District contributes 2.33% to the total population of Malawi.

The district's population comprises 203 226 males and 200 876 females which gives a ratio of 50.2:49.8 men:women. This is significantly different to the national population trend where there are more females than males with 50.7:49.3 respectively. The population density of the district is 91 persons per square kilometre.

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The district has a Crude Birth Rate (CBR) of 45.29 and a Crude Death Rate (CDR) of 9.59. The CBR of 45.29 is a slight reduction from 47.39 in 2013.

The CDR trend also shows a decrease from 11.54 in 2013 to 9.59 in 2017. This CDR is lower than the national CDR of 20.8.

According to the 2008 Population and Housing Census report the fertility rate for the district decreased from 6.24 in 2013 to 6.0 on 2017. This is higher than the national fertility rate of 5.39. The median age is 15.9, characterising the district with a youthful population which implies a high dependency burden. Therefore, there is a need for the awareness of family planning and use of contraception to further reduce the fertility rate.

8.4.2 Migration Patterns and Urbanization

Nkhotakota experiences in-migration and out-migration. According to the 2008 Census, the district has an in-migration rate of 18.3% which is the third highest in the central region. Table 8.1 shows the migration rate for the district and compares into other districts.

Table 8.1 Migration rates of Nkhotokota and other Central Region Districts

District	In-Migration rate (%)	Out-Migration rate (%)	Net Migration (%)
Nkhotakota	18.3	14.2	4.6
Kasungu	23.9	10.9	12.5
Ntchisi	10.3	18.1	7.8
Dowa	9.3	16.8	-7.5
Salima	15.7	14.5	1.2
Lilongwe	5.8	12.9	5.8
Mchinji	13.7	9.0	4.7
Dedza	5.5	16.2	-10.7
Ntcheu	10.3	19.0	-8.7
Lilongwe City	52.2	11.0	41.2

Source: NSO, 2008 PHC

The out-migration for the district is 14.2% and the net migration in 4.6%. People leave the Nkhotakota district to migrate to urban areas such as Lilongwe, Blantyre, Mzuzu and Zomba. They also migrate to other countries such as South Africa and Tanzania searching for employment.

People migrate into the district in search of employment in the agriculture and fisheries sectors, particularly in sugarcane, rice and fish industries. They then return to their original villages when farming or fishing seasons are closed.

Nkhotakota is one of the important districts in the Central Region. According to the 2008 Population and Housing Census, 8.1% of the inhabitants in Nkhotakota live in the urban areas of the district, contributing to 1.2% of the urban population in Malawi. The district is ranked ninth in terms of urbanization and the district's growth rate is 4.9%.

8.4.3 Dwelling types

The census data categorises dwelling units as permanent, semi-permanent and traditional. The 2008 PHC found that 44% of the dwelling units are traditional while 17.2% are permanent. With regards to building materials, 82.2% of the structures are grass thatched while 17.2% of the structures are roofed with iron sheets. No dwellings were found on site.

8.5 EMPLOYMENT SECTORS

8.5.1 Employment Rates

The District Labour Office is mandated to protect and develop the labour force in order to contribute to socio-economic development of Nkhotakota district and nation.

In 2017 the employment rate in Nkhotakota district is 37% for men and 37% for females. Agriculture is the main source of income for 73% of the district's population (NSO, 2008). The remaining population depends on fishing and other businesses because the Government, statutory corporations, Non-Governmental Organisations and private companies provide very limited employment opportunities. The majority of those who are employed work in the sugar sector such as Dwangwa Sugar Company, Dwangwa Cane Growers Limited, Unitrans, Ethanol, Cane Hauliers Limited and KK Security.

Table 8.2 shows the trend of employment or job seekers in the district from 2013 to 2017.

Table 8.2 Trend of employment (Job seekers and placements) (Source: Nkhotakota Labour Office (2017)

Year	No of job seekers		No of job placements		Employment Rate (%)	
	M	F	M	F	M	F
2013	325	32	133	3	41	9
2014	397	26	97	8	24	31
2015	286	23	102	6	36	26
2016	402	14	186	2	46	14
2017	214	19	79	7	37	37
TOTAL	1624	114	597	26		

Between 2013 and 2017 job placement was very low in Malawi due to the economic difficulties in the country at the time. As a result most construction companies were to recruiting new labour force. There are more males seeking employment than females due to the nature of the work. Additionally the placement rate for females is very low due to the fact they lack requisite academic and professional qualifications. Females are also deemed to be unfit for some jobs such as working labourers in construction companies.

There are 847 registered businesses in the district according to 2017 Council business register. This is an increase from 470 in 2013. Table 8.3 below shows the business categories.

Table 8.3 Business Categories No

#	Business Category	Number
1	Commercial (trade & Services)	800
2	Manufacturing	2
3	Mining	0
4	Agro-based(Cooperatives)	20
5	SACCOs	5
6	COMSIP	4
7	Construction	18

Source: 2017 Census Data for Nkotakota District.

Table 8.4 below provides details of the number of traders in each kind of commercial category sourced by the Nkotakota Trade Office in 2017. The high number of hawkers is attributed to the low incomes and capital investment.

Table 8.4 Number of traders in each commercial category for the Nkotakota District

Business type	Number of traders
Hawkers,Grocery/shops	322
Welding shops	15
Restaurants	38
Hardware shops	47
Tea rooms	12
Barbershops	61
Butchery	20
Tailors	31
Photo studio	7
Saloon	54
Cell phone repair	70
Video show	13
Bottle stores/bars	50
Filling station	4
Maize mills	60
Lodges/rest houses	37

Source: 2017 Census Data for Nkotakota District.

8.5.2 Child Labour

Nkhotakota district is currently struggling with serious childcare problems and needs. This is common in the rural communities where service coverage is low, askew and fragmented. Such a situation is further compounded by the prevalence of the HIV and AIDS pandemic that has resulted into some consistent rise in number of orphans, widows and widowers due to increasing deaths from HIV/ AIDS related illnesses. Such trends have resulted into children being looked after by single headed parent, the aged or fellow children. These children are more vulnerable to child labour and exploitation because they have no option for survival.

The cases of child labour are common in fishing industry, tobacco estates, herding cattle, vending along the roads, which have contributed to the untimely withdrawal from school and commercial sex exploitation.

8.5.3 Tourism

Tourism in Malawi thrives on natural resources and major resource attractions include water bodies, parks, mountains and cultural heritage. It was estimated that tourism, which is dominated by game viewing contributed 3.2% of the GDP.

Nkhotakota is one of the major tourist destinations in the country. The district is rich in geographical and historical sites. The geographical sites include Lake Malawi, Lake Chilingali, Chia Lagoon, Unaka Lagoon and Nkhotakota Wildlife Reserve. In addition to these, other sites are: Sungu Island; Mawira Hotspot spring; Kamuzu First Convention tree; Jumbe's mosque; Livingstone tree; Anglican Church and Curio markets at the Boma. Nkhotakota has also some hot springs which indicate some previous volcanic activities and these are; Chikwidzi, Chombo, Ling'ona, Mawira and the 78 ^{o}C Chiwi.

However, the tourism sector in the district faces a number of challenges which include;
1. Poor Road access to the district as well the tourism facilities which become inaccessible during the rainy season.
2. Low population of wildlife due to poaching has led to low number of tourists.

Despite the challenges, Nkhotakota Wildlife reserve has put measures to reduce poaching and has translocated some animals like elephants to boost wildlife numbers.

8.6 AGRICULTURE AND LIVELIHOOD STRATEGIES

8.6.1 Land Use

Nkhotakota district covers 435 800 ha which is used for agriculture, wildlife conservation and infrastructure development.

Public land occupies 127.77 km^2 (3%) and largely consists of forest reserves, built up areas and used for schools, hospitals and other social government amenities.

Customary land covers 2299.86 km^{2}representing 54% of the land area of the district while private freehold is at 17% and public land only at 3%.

Nkhotakota is one of the districts endowed with high forest cover in Malawi. There are two major protected upland vegetative areas which are Dwambazi Forest Reserve and Nkhotakota Wildlife Reserve. They constitute about 50% of the total land area.

8.6.2 Agriculture

Over 30% of Malawi's gross domestic product (GDP) is accounted for by the agricultural sector. This sector supports 64.1% of the country's workforce, supplies more than 80% of the country's national export earnings and is of crucial importance to global, national and household food and nutritional security.

Agriculture continues to be the major driver of the country's economy and accounts for 30% of the country's gross domestic product (GDP), over 80% of the export earnings, and absorbing the largest labour force of 64.1%.

The country is highly vulnerable to the adverse impacts of climate change and extreme weather events. This situation is exacerbated by increasing population pressure on a limited land resource base, land degradation arising from agricultural expansion and the cultivation of marginal lands, increasing deforestation to meet the increasing demands for energy, food and construction.

The sector plays an important role for the sustainable livelihoods of people in Nkhotakota district. The district has a total area of 435 800 ha; of which 237 200 ha (54%) is under customary land and is used by the small-holder farmers. Another 76 272 ha (17.5%) of the district has been allocated for irrigated estates but only nine of these are functional estates on 17 015 ha (4%) of land that operate on commercial basis. The largest of these successful commercial estates is the Illovo sugar estate on 12 000 ha, followed by the Dwangwa Cane Growers on 4 200 ha. However, only 6839 ha and 1 976 ha respectively are under cultivation.

The food crops grown in the district include maize, rice, groundnuts, roots and tubers plus some pulses while cotton, tobacco and Sugarcane are the major cash crops which are largely grown by corporations and large scale farmers. Maize and cassava are major food crops. The area planted with these main crops cover about 31% of cultivable land in the district. It has been estimated that food crops account for about 70 percent of agricultural value added (World Bank, 2003). There is concern amongst the district agricultural offices that the production of cash crops like cotton, tobacco, rice, groundnuts and sugarcane are on a downward trend.

The main factors contributing to low productivity to the agricultural sector include dry spells, market prices, floods, use of poor quality seed, pests and diseases, low incomes, high cost and inadequate use of inputs, lack of access to credit, untimely planting, poor agronomic practices, poor infrastructure and market access, high illiteracy and low skills levels, inadequate extension services, weak agricultural legislation and governance capacity, as well as vandalism and poor financial support from local residents for irrigation schemes. The pervasive problems with irrigation schemes indicate serious capacity and management constraints. Rapid population growth has also decreased the area of land families can farm on and increased competition for land.

8.6.3 Livestock

The livestock sector plays a crucial role in the agriculture economy, in Nkhotakota District. The major livestock species found in the district include cattle, goats, sheep, indigenous chickens and pigs (Table 8.5).

There are also some non-conventional livestock species such as rabbits, ducks, guinea fowls and doves. Livestock is raised mainly as a source of income, animal protein from meat and eggs and in some instances as source of prestige. Table below shows estimated livestock product produced in 2016/17. Attempts to set up three livestock markets, one in Nkhunga, were not successful.

Table 8.5 Livestock products produced in Nkotakota District in 2016/17.

Commodity	Census	Slaughters	Beef/ meat (tons)	Hides & skins
Cattle	11 419	1 412	169.4	1 412
Goats	106 217	16 026	192.3	16 026
Sheep	24 150	3 117	37.4	3 117
Pigs	47 057	17 405	870.3	

Livestock sub-sector constitutes an important segment of the Malawi agriculture. It contributes about 7% of the total GDP and about 20% of the value of total agricultural production. Livestock has contributed a lot to Nkhotakota District through revenue generated as a result of sale of meat, milk, hides and skin, source of employment (dipping tanks, veterinary services, slaughterhouses etc). It has also contributed a lot in crop production through the use of manure.

Limited land and the use of prime land for cultivation is a major constraint to the development of the livestock sector, along with limited support services and traditional subsistence practices.

8.6.4 Fisheries

Fisheries resources remain one of the potential areas in contributing to the socio-economic wellbeing of not only Nkhotakota but also the nation. Fisheries sector is important in contributing substantially to food and nutritional security, livelihoods of the rural population and economic growth which is one of the priority areas in the Malawi Growth and Development Strategy (MGDS) III which focuses on increased sustainable fish production within the medium-term outcome.

Lake Malawi is the major fishing ground in the district which borders with Nkhata-Bay district to the North and Salima district to the South. However, the current landings from capture fisheries are diminishing. The situation has been further affected by high population growth and resultant increase in fish demand.

There are 420 fishponds in total, of which 280 (67%) are functional and 140 are non-functional. 146 fishponds are owned by fish clubs and 134 fish ponds are owned by individual fish farmers. The district has 1 666 farmers directly involved in fish farming activities of which 56% are male and 44% are female. There are also a significant number of youths (162) directly involved in fish farming activities in the district. There are only 86 fish farmers recorded in the

Nkhunga EPA and Kanyenda TA. In 2017 there was an estimated 6 637 men are reported to be employed in fishing activities in the District, which 1 773 persons owning fishing gear and 2 175 different types of boats used, mostly un-motorised. Only 4 women were reported to be fishers.

The Nkhotakota fishery is classified into small-scale artisanal and semi-commercial fisheries (Pair Trawling). Small-scale artisanal dominates fishing activities and contributes over 90% of the total landings of the district while semi-commercial fishing contributes less than 5%. The district contributes over 38% of total annual income for Nkhotakota and the sector is a significant source of job creation, directly employing about 8 410 fishers and crew members (Annual frame survey 2017) and indirectly about 100 000 people involved in the value chain of fish processing, fish marketing, fish transportation, net making, boat building and engine repair, fuel and spares supply.

8.7 Income and Expenditure

According to Integrated Household Survey 3 (IHS3), 32.1 % of the population in Nkhotakota are poor while 11.2% are ultra-poor. As identified in the previous section, the main economic drivers in Nkhotakota are fishing, agriculture; sugarcane production, cultivation of rice, groundnuts, cassava and livestock production.

Agriculture has been identified as the major driver of the country's economy accounting for 30% of the country's gross domestic product (GDP), over 80% of the export earnings, and absorbing the largest labour force of 64.1%.

Livestock and fisheries resources remain essential in contributing to the socio-economic wellbeing of not only Nkhotakota but also the country. Tourism also remains a key driver of revenue generation for the district.

The district has high potential of commercial and industrial development which will generate revenue. Lake Malawi has a potential for fishing activities which brings income at household and district level. Nkhotakota has places for tourist attraction such as Nkhotakota Wildlife Reserve and Lakeshore beaches. Furthermore, value addition initiatives on agricultural produce can boost commercial growth and district economy.

Effective marketing of agricultural produce is critical to household food security and income. In Malawi the majority of households rely on markets for sale of agricultural produce and for food.

8.8 Access to Social Infrastructure

Malawi is one of the poorest countries in Sub-Saharan Africa and the country's continual growth is stretching the per capita per income. Consequently, a large proportion of the population are living in extreme poverty. Although public spending has increased on education and healthcare - which are government priority areas - the United Nations Commission on trade and Development (UNCTAD, 2017) revealed that 71% of Malawians live in extreme poverty, according to their definition.

8.8.1 Health Services and Status

The life expectancy at birth for Nkhotakota has risen from 51.40 years to 58.18 years for females and 48.30 years to 54.0 years for males (Table 8.6).

Table 8.6 Nkhotakota Projected Life expectancy at birth

Year	Male	Female
2007	48.3	51.4
2010	51.03	54.0
2015	55.45	58.18

Source: NSO 2008 Census Projections

The district continues to experience a high burden of diseases including malaria, acute respiratory infections (ARI), diarrhoea, HIV related infections and malnutrition as the top leading causes of the disease burden in the district. Malaria is still the leading cause of morbidity and mortality in Nkhotakota and accounted for 32% of all outpatient visits in 2014/15, 48.5% in 2015/16 and 51.7% in 2016/17.

Malaria incidence rates have increased. In 2013/14, 576 episodes of malaria for every 1 000 population was recorded but increased to 692 episodes in 2016/17. ARI is among the leading causes of childhood morbidity and mortality. In 2012/13 ARI accounted for 5% of all cases seen in the out-patient departments.

Health services that are provided in the district include; curative, preventive, promotive and rehabilitative. The district's Health sector focuses on the provision of the Essential Health Package (EHP) which consists a group of cost-effective and proven interventions accessible and delivered together so as to reduce the cost to patients.

The current essential health package includes provision of the following services at primary and secondary levels of care: antenatal care; family planning; delivery services including caesarean section at secondary level only; essential vaccine package; prevention, diagnosis and treatment of uncomplicated and complicated malaria; IMCI package (treatment of pneumonia and diarrhoea; treatment of severe diarrhoea); community health package; NTDs (Schistosomiasis mass drug administration); HIV & AIDS prevention (CPT for children and PMTCT), testing and treatment (all ages); nutrition (Vitamin A supplementation to children and pregnant women, de-worming and management of severe malnutrition in children); TB; NCDs (mental health and diabetes) and oral health.

The district has 21 main health facilities comprising of hospitals, health centres and dispensaries with various ownerships. Other privately-owned small-scale health facilities report through the main facility within their catchment. The district has other privately owned health facilities.

Nkhotakota district has:

- 4 hospitals (Table 8.7); two full Hospitals (The district hospital and St Anne's Mission Hopital), one Rural hospital (Dwambazi Rural Hospital) and one Community Hospital (Alinafe Community Hospital).

- 14 Health Centres, 10 owned by the Ministry of Health, 3 by the Christian Health Association of Malawi (CHAM) and only 1 is private
- 5 clinics
- 3 dispensaries

Table 8.7 Hospitals in Nkhotakota (Source: Nkhotakota DHO, 2017)

Name of TA	Area service is being provided	Ownership	Number of people benefiting from the service	Facilities available (beds)
TA Malengachanzi	Nkhotakota District Hospital	MoH	72 396	300
	St Anne's Hospital	CHAM	6 277	180
TA Mwadzama	Alinafe Community Hospital	CHAM	8 407	69
TA Kafuzila	Dwambazi Rural Hospital	MoH	10 867	35

Table 8.8 below describes the number of health facilities by ownership and traditional authority. T/A Kanyenda has the highest number of health centres due to large population compared to the rest of the district and it has two private owned health centres under its jurisdiction.

Table 8.8 Number of Health Facilities by Ownership and by Traditional Authority

Name of TA	Population	MoH	CHAM	Private	TOTAL
Kanyenda	126 027	5	1	4	10
Kafuzila	20 453	1	1	0	2
Malengachazi	108 918	2	2	2	6
Mwadzama	83 494	3	2	1	6
Mwansambo	29 114	1	0	0	1
Mphonde	23 569	1	0	0	1
TOTAL	391 575	13	6	7	26

There are several challenges the Nkhotakota Health Sector is facing and these are:

1. High maternal and infant morbidity and mortality rates
2. Inadequate human resource for health
3. Insufficient transport availability
4. Inadequate funding
5. Inadequate medical equipment and supplies
6. Low contraceptive prevalence rate

The causal factors are: Inadequate ambulances to serve the population in case of emergency, high disease burden especially malaria and poor-quality care due to staff shortage.

8.8.2 Water and Sanitation

A household is considered to have access to safe water if it has at least 27 litres of water per person per day from an improved water source. Improved water sources include; piped water into dwelling or yard or plot, communal stand pipe, boreholes, protected shallow well and springs.

The proportion of people having access to safe water in the district is at 83.9%. This has increased from 66% in 2013 but is lower than national access rate of 87% (Figure 8.2). The district has recorded a steady increasing trend in access to safe water over the years.

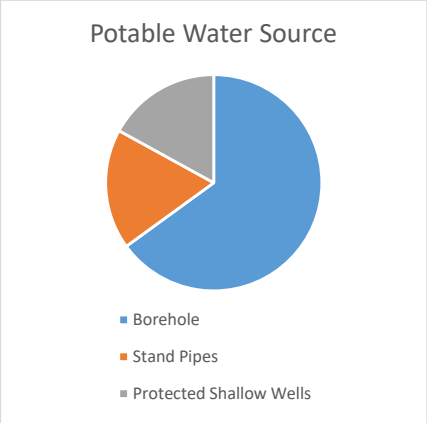

Figure 8.2 Potable water source

The number of people accessing safe water increased due to increased investment by the Government and WASH partners towards construction and rehabilitation of water supply infrastructure. Currently the government through Nkhotakota District Council are implementing safe water access points and a total of 134 boreholes have been drilled and 247 communal taps are being installed.

Boreholes are the main source of potable water in the district representing 65% (Figure 6.1) of all water supply facilities. These are followed by stand pipes (taps) at 18% and protected shallow wells (17%). Protected spring technology is the lowest with one facility in TA Kanyenda representing 0.05% of all safe water sources.

In the district the average population per borehole is 305 people. TA Kanyenda has the highest number of boreholes (354) then TA Mwadzama (328). TA Kafuzira has the lowest number of boreholes (87). Borehole population ratio reveals that TA Kanyenda has the highest BPR of 1:329 followed by TA Mwansambo with BPR of 1:317. On the other hand, TA Mphonde and TA Kafuzira have the lowest BPR of 1:274 and 1:276 respectively due to small land size as well as small population.

The district has one mechanised piped water scheme at Liwaladzi in TA Kanyenda which supplies water to rural population through stand pipe technology.

A total of 2 791 taps at Nkhotakota Boma have been connected to households serving a population of 25 895 representing 85% water coverage while Dwangwa has 1 185 taps which provide safe water to population of 7 500 representing 75% coverage.

It is estimated that 88% of households in the district use basic latrines.

Although there has been a rise in access to safe water supply, there are disparities across the district. Some communities are either un-served or underserved due to topography, accessibility, scattered settlement pattern, dilapidated and non-functional water supply infrastructure.

8.8.3 Education and Literacy

One of the priority areas of the MGDS III is education and skills development. Education is vital for human capital development and is an important requirement for socio-economic development and industrial growth. Skills development offers economic empowerment for various groups of people including women, youth and people with disabilities.

For this report literacy is described as the ability to read and write. The proportion of the population aged 15 years and over that is literate in Nkhotakota is 70.8% which is a decrease from 71.5% in 2011.

Table 8.9 Literacy Rate by Gender in Nkhotakota

	2010-2011			2017		
	M	F	Average	M	F	Average
District	79	65	71.5	80	62	70.8
National	73	57	65.4	81	66	72.8

The above Table 8.9 shows the district's literacy level is higher for men at 80% compared to 62% for females. The average literacy level for the district is at 70.8% which has dropped below the national average literacy rate of 72.8%.

The district has 161 primary schools of which 155 are public primary schools and 6 are private primary schools. The schools are in 17 zones of which 15 are main education zones and 2 are sub-Zones.

The enrolment rates in the district have been increasing and in 2017 enrolment was 122,723 students (61,723 boys and 60,936 girls.) The improvement in girl enrolment has been attributed to the improvement in provision of education support services such as school health and nutrition services.

There has been a decrease in student dropout rate in primary schools. The dropout rate has decreased to 4.2% (5 135 out of from 122 723) but it is still above the desired National rate of 3%. Although the dropout rate has decreased, a lot of pupils are still out of school and the rate is higher amongst girls due to lack of appropriate guidance and parental interest, illness, failing in examinations, early marriages, and poverty.

There has been an increase in the pass rate from 58 % in 2013 to 80 %in 2017.

There are 1 673 teachers of which 1 059 are male and 596 are female; making the ratio of male to female teachers in Nkhotakota 2:1.

The district has 25 Secondary Schools of which 1 is Government Boarding Secondary School (GBSS), 3 Day Secondary Schools (DSSs), 16 Community Day Secondary Schools (CDSSs) and 5 Private Secondary Schools (PSSs).

TA Kanyenda and Malengachanzi have the largest number of secondary schools (8 each), followed by TAs Mwansambo and Mwadzama have 3 Secondary schools each. The least number of secondary schools are in TA Mphonde (1). The secondary schools enrolled 4 915 students (2 281 Female and 2 634 Males) in 2017. The enrolment increased from 5 367 in 2015 to 4 915 in 2017.

The pass rate for the MSCE is very fair and currently only 69% for boys and 50% for girls who sit for these examinations pass.

The district has 1 Community Technical College which is based at Mbandira and 3 Vocational colleges.

The district has a 10.58% student dropout rate with more females dropping out than males. Pregnancy and marriages are the main causes of dropout. T/As Kanyenda and Mwadzama have the highest dropout rates.

The education sector in Nkhotakota is faced by one major issue which is the low quality of education standards which is cause by the following; high dropout rate at 13%; high repetition rate; inadequate school infrastructure; inadequate teachers in the rural schools; inadequate teaching, learning and assessment resources.

8.8.4 Infrastructure

Efficient transport infrastructure increases productivity and enhances competitiveness of the economy and indispensable to the economic development of the nation. Although Malawi has a multi-modal system consisting of road, rail, air and inland water transport, the emphasis has been placed on road transport which is expensive comparing to other modes (MGDS III).

Nkhotakota district has a poorly developed road network with accessibility reducing to about fifty percent during rainy season due to slippery road sections and impassable waterways. The total length of the road network is about 980 kilometres.

The roads are classified into two main categories: designated and undesignated. The designated roads include main, secondary, tertiary, and district roads. Unpaved roads which comprise of 45% designated roads are in poor conditions which create accessibility problems especially during the rainy seasons. The undesignated roads include community roads or feeder roads. Most of these roads require drainage structures such as bridges, drifts and culverts.

There are two main roads in the district, the M005 and M018. The total length of these roads is 217km with a total of 37 bridges. The entire 170km of the M005 road is paved whilst only 22km of the 47km of M018 is paved

8.8.5 Transport

There are several forms of transportation services in Nkhotakota district, including postal services, financial services, courier services, local buses and minibuses, *matola* transport, cycle transport, cart transport, water transport, and truck transport.

The district has seen a growing number of tricyles, motorcycle and bicycle taxis throughout the major trading centres. These forms of transport are popular because of their affordable fares and easiness to use even on very poor roads.

Cart transport is important in Nkhotakota District. These are powered by men, oxen and donkeys. Carts powered by men are smaller and lighter compared to those driven by oxen and donkeys. They are normally used on short distances within the trading centres and carry goods up to 500kg.

8.8.6 Communication

The main form of communication in the district is through letters sent in the post, mobile phones and emails. There are two major mobile phone service providers, Airtel and Telecom Network Malawi (TNM) although the network coverage does not cover the whole district. Communication is made easier and faster because most people in rural and urban areas have access to phones.

There are both post-paid and pre-paid telephone systems installed in Nkhotakota. There are 290 telephone lines in service located around business areas. The district has 2 automatic telephone exchange. The two exchanges have 826 telephone subscribers shared among private telephones (487), institutional telephones (181) and e-mails (18)

There is one community radio station and several national public and private broadcasters including Television Networks accessed in Nkhotakota. Radio listenership is estimated at 95% of the district population. Nkhotakota Community Radio has good reception. There are several television stations with signals in Nkhotakota. The number of viewers is estimated at 24.6% of the total population.

8.8.7 Energy

Accessing clean, affordable and sufficient energy for everyone is important for a country's development. In Malawi according to the 2018 PHC the main source of energy for household lighting was battery (52.9%) followed by electricity (11.4%) as well as solar, candles and firewood being used. The main source of energy used for cooking in Malawi was firewood (77.4%) followed by charcoal (18%).

Rural and peri-urban communities in Nkhotakota do not have access to modern energy services that are affordable. They people rely on biomass fuel (firewood and charcoal) to provide energy for cooking and heating.

Currently, renewable energy of grid and off-grid alternatives are being scaled up through various projects such as Malawi Rural Electrification programme (MAREP) and Solar initiatives. These programmes are helping the poor to meet their energy needs and develop small-scale enterprises.

ESCOM is the main provider of electricity in Malawi and according to ESCOM, the generation of electricity has decreased by up to 40% in 2019 because of Lake Malawi water levels and Shire River water flows dropping due to low rainfall in the last two rainy seasons. This has significantly impacted the capability of electricity generation. The cost of electricity is comparatively high and inaccessible to the rural areas and the poor.

Consequently, there has been increased pressure and reliance on firewood, charcoal and gas by the poor, resulting in significant deforestation. Electricity is inaccessible to most of the population, including Nkhotakota district, hence high demand for firewood, charcoal and agricultural residues for cooking and heating.

9 IMPACT ASSESSMENT METHODOLOGY

9.1 INTRODUCTION

The purpose of the Environmental and Social Impact Assessment Report is to identify the potential interactions between the Project related activities and the existing environmental and social resources/receptors and to determine the nature of the impact that may arise as a result.

The impact assessment process has been undertaken in line with Malawian Environmental Management Act of 1996 and international best practice (IFC Performance Standards) by evaluating the Project activities against the existing baseline conditions at the Project site.

This impact assessment chapter has been subdivided into three sections that cover:

- Construction Phase (summarised in Section 17 below);
- Operational Phase (summarised in Section 18**Error! Reference source not found.**); and
- Decommissioning Phase (summarised in Section 12).

9.2 METHODOLOGY AND APPROACH

The CES rating scale has been developed to take the following criteria into consideration, and includes criteria for assessing post mitigation significance (residual impacts), by incorporating the principles of reversibility and irreplaceability:

1. Nature of impact
2. Type of impact
3. Duration
4. Extent
5. Probability
6. Severity or benefits

The overall significance rating for the impact is then obtained from the above six criteria.

9.2.1 Explanation of the six impact rating criteria

Criterion 1: Nature
Negative or positive impact on the environment.

Criterion 2: Type
Direct, indirect and/or cumulative effect of impact on the environment.

Criteria 3, 4, & 5: Temporal, Spatial, and Likelihood Scales
These four factors need to be considered when assessing the significance of impacts, namely:
Relationship of the impact to temporal scales - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.
Relationship of the impact to spatial scales - the spatial scale defines the physical extent of the impact.
The likelihood of the impact occurring - the likelihood of impacts taking place as a result of project actions differs between potential impacts. There is no doubt that some impacts could occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance. In this case likelihood equates to some extent with risk. If the impact is definite, then there is a high risk that it will occur. However, likelihood and risk are not to be confused, and for certain impacts (e.g. risk of a vehicle accident) a risk assessment will be required.

Table 9.1 below provides definitions for Criteria 3,4 & 5.

Table 9.1: Temporal, Spatial, Likelihood Scales defined.

Duration (Temporal Scale)		***Score***
Short term	*Less than 5 years*	*1*
Medium term	*Between 5-20 years*	*2*
Long term	*Between 20 and 40 years (a generation) and from a human perspective also permanent*	*3*
Permanent	*Over 40 years and resulting in a permanent and lasting change that will always be there*	*4*
Extent (Spatial Scale)		
Localised	*At localised scale and a few hectares in extent*	*1*
Study Area	*The proposed site and its immediate environs*	*2*
Regional	*District and Provincial level*	*3*
National	*Country*	*3*
International	*Internationally*	*4*
Probability (Likelihood)		
Unlikely	*The likelihood of these impacts occurring is slight*	*1*
May Occur	*The likelihood of these impacts occurring is possible*	*2*
Probable	*The likelihood of these impacts occurring is probable*	*3*
Definite	*The likelihood is that this impact will definitely occur*	*4*

Criteria 6: Severity Scales
The severity of the impact - the severity/beneficial scale is used in order to scientifically evaluate how severe negative impacts would be, or how beneficial positive impacts would be on a particular affected system (for ecological impacts) or a particular affected party. The severity of impacts can be evaluated with and without mitigation in order to demonstrate how serious the impact is when nothing is done about it, and how effective the mitigation might be. The word ‘mitigation’ means not just ‘compensation’ but includes concepts of containment and

remedy. For beneficial impacts, optimization means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable (Table 9.2).

Table 9.2: Impact Severity explained

Impact Severity *(The severity of negative impacts, or how beneficial positive impacts would be on a particular affected system or affected party)*		***Score***
Very severe	**Very beneficial**	**4**
An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example the permanent loss of land.	A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit. For example the vast improvement of sewage effluent quality.	
Severe	**Beneficial**	**3**
Long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming, or some combination of these. For example, the clearing of forest vegetation.	A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these. For example an increase in the local economy.	
Moderately severe	**Moderately beneficial**	**2**
Medium to long term impacts on the affected system(s) or party (ies), which could be mitigated. For example constructing the sewage treatment facility where there was vegetation with a low conservation value.	A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way. For example a 'slight' improvement in sewage effluent quality.	
Slight	**Slightly beneficial**	**1**
Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example a temporary fluctuation in the water table due to water abstraction.	A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.	
No effect	**Don't know/Can't know**	
The system(s) or party(ies) is not affected by the proposed development.	In certain cases it may not be possible to determine the severity of an impact.	

** In certain cases it may not be possible to determine the severity of an impact thus it may be determined: Don't know/Can't know*

9.2.2 Applying the criteria to Assess environmental significance before mitigation

The scores for the three criteria in Table 9.1 are added to obtain a composite score. They must then be considered against the severity rating to determine the overall significance of an activity. This is because the severity of the impact is far more important than the other three criteria. The overall significance is then obtained by reading off the matrix presented in

Table 9.3. The overall significance is either negative or positive (Criterion 1) and direct, indirect or cumulative (Criterion 2).

Table 9.3: Matrix used to determine the overall significance of the impact based on the likelihood and effect of the impact

SEVERITY		COMPOSITE DURATION, EXTENT & PROBABILITY SCORE									
		3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Slight	3	4	5	6	7	8	9	10	11	12
	Mod severe	3	4	5	6	7	8	9	10	11	12
	Severe	3	4	5	6	7	8	9	10	11	12
	Very severe	3	4	5	6	7	8	9	10	11	12

The environmental significance scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts of especially a social nature need to reflect the values of the affected society.

It is clear that an impact that has a slight severity could be of MODERATE significance because it is permanent (4), has a regional affect (3) and is definite. This elevates it from a LOW to a MODERATE rating. Conversely, a moderately severe impact could be rated as LOW since it is short term (1), localised (1) and only probable (3). An impact rated as severe could be of VERY HIGH significance because it is permanent (4), of national importance (3) and is definite (4). For example, the impact on a frog species of conservation concern (SCC) might only be rated as severe as a result of the project actions, but because the loss is permanent and of national importance (it's a SCC) and is definite, we rate the significance as VERY HIGH and not HIGH. If the impact was long term and not permanent then it would be rated as HIGH.

The Significance Rating Scale is defined in Table 9.4 below.

Table 9.4: Description of Environmental Significance Ratings and associated range of scores

OVERALL SIGNIFICANCE *(The combination of all the above criteria as an overall significance)*	
VERY HIGH NEGATIVE	**VERY BENEFICIAL**

OVERALL SIGNIFICANCE *(The combination of all the above criteria as an overall significance)*	
These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or social) environment, and usually result in severe or very severe effects, or beneficial or very beneficial effects. *Example: The loss of a species would be viewed by informed society as being of VERY HIGH significance.* *Example: The establishment of a large amount of infrastructure in a rural area, which previously had very few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH significance.*	
HIGH NEGATIVE	**BENEFICIAL**
These impacts will usually result in long term effects on the social and/or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light. *Example: The loss of a diverse vegetation type, which is fairly common elsewhere, would have a significance rating of HIGH over the long term, as the area could be rehabilitated.* *Example: The change to soil conditions will impact the natural system, and the impact on affected parties (such as people growing crops in the soil) would be HIGH.*	
MODERATE NEGATIVE	**SOME BENEFITS**
These impacts will usually result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by society as constituting a fairly important and usually medium term change to the (natural and/or social) environment. These impacts are real but not substantial. *Example: The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant*.	
LOW NEGATIVE	**FEW BENEFITS**
These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by the public and/or the specialist as constituting a fairly unimportant and usually short term change to the (natural and/or social) environment. These impacts are not substantial and are likely to have little real effect. *Example: The temporary changes in the water table of a wetland habitat, as these systems are adapted to fluctuating water levels.* *Example: The increased earning potential of people employed as a result of a development would only result in benefits of LOW significance to people who live some distance away.*	
NO SIGNIFICANCE	
There are no primary or secondary effects at all that are important to scientists or the public. *Example: A change to the geology of a particular formation may be regarded as severe from a geological perspective, but is of NO significance in the overall context.*	
DON'T KNOW	
In certain cases it may not be possible to determine the significance of an impact. For example, the primary or secondary impacts on the social or natural environment given the available information. *Example: The effect of a particular development on people's psychological perspective of the environment.*	

9.2.3 Significance Post Mitigation

Once mitigation measure are proposed, the following criteria are then used to determine the overall post mitigation significance of the impact:

- Reversibility: The degree to which an environment can be returned to its original/partially original state.
- Irreplaceable loss: The degree of loss which an impact may cause.

- Mitigation potential: The degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. The four categories used are listed and explained in Table 9.5 below. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty.

Table 9.5: Criteria considered post mitigation

Reversibility	
Reversible	*The activity will lead to an impact that can be reversed provided appropriate mitigation measures are implemented.*
Irreversible	*The activity will lead to an impact that is permanent regardless of the implementation of mitigation measures.*
Irreplaceable loss	
Resource will not be lost	*The resource will not be lost/destroyed provided mitigation measures are implemented.*
Resource will be partly lost	*The resource will be partially destroyed even though mitigation measures are implemented.*
Resource will be lost	*The resource will be lost despite the implementation of mitigation measures.*
Mitigation potential	
Easily achievable	*The impact can be easily, effectively and cost effectively mitigated/reversed.*
Achievable	*The impact can be effectively mitigated/reversed without much difficulty or cost.*
Difficult	*The impact could be mitigated/reversed but there will be some difficultly in ensuring effectiveness and/or implementation, and significant costs.*
Very Difficult	*The impact could be mitigated/reversed but it would be very difficult to ensure effectiveness, technically very challenging and financially very costly.*

10 BIOLOGICAL ENVIRONMENT IMPACTS – CONSTRUCTION PHASE

This section covers the physical and biophysical impacts anticipated during the construction phase of the project. Note that this should be read in conjunction with the baseline section (Section 6 above) and the Impact Summary Tables (Section 17)

10.1 SOIL QUALITY

Cause and comment:
Site preparation and construction activities will include some limited earthworks and site clearance. These activities could lead to the following effects on soils resources within and surrounding the Project footprint:

- Loss of topsoil and associated soil nutrients;
- Soil compaction;
- Soil erosion from wind and water runoff (and sediment release to land and water); and
- Introduction of pollutants through poor waste management, hazardous materials and spills.

Approximately 70 ha of the 100 ha Project site will be cleared of vegetation and where necessary some earthworks to create a favourable gradient for the installation of the mounting structures. As a result of the clearing of plants and trees necessary for the implementation of the proposed project, there will be a direct loss of nutrients made available to the topsoil. This is likely to result in the interruption of the nutrient cycle and decrease the soil fertility of the area.

In addition, the compaction of the subsoils through site grading and levelling, and the presence of heavy vehicles and machinery during construction, will result in lower permeability of the soil. This will decrease infiltration and increase run-off, altering the natural drainage characteristics of the soil. Without appropriate measures, run-off from hardstanding areas, in addition to exposure to wind and rainfall, may increase erosion.

Erosion may occur when surface water flows in areas of bare soil, particularly on sloped terrain. Heavy rainfall, like that experienced during the wet season, speeds up surface runoff and the topsoil which binds the soil together for more stability will have been removed resulting in erosion.

The environmental consequence of the direct loss of topsoil is considered to be moderate negative due to the permanent nature of the loss, the compaction of remaining soils and the potential for the remaining soil to be lost through erosion (wind and water). However, the severity of the impact and the overall environmental consequence can be reduced to low negative, providing that the recommended mitigation measures are adopted (Table 10.1).

Table 10.1 Reduction of soil quality (see Section 17 for more information)

Impact: Loss of topsoil and subsequent soil nutrients		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	LOW -
Impact: Compaction of soils through construction activities		
	MODERATE -	LOW -
Impact: Introduction of pollutants		
	MODERATE -	LOW -
No-go Alternative		
	LOW -	N/A

Mitigation measures:

- The removal of trees and plants must be limited to the absolute minimum;
- Compaction as soil must be limited to areas where it is absolutely necessary;
- Erosion control measures such as intercept drains and toe berms will be constructed where necessary to reduce the loss of topsoil;

- Stockpiles must not exceed 1.5 m in height to maintain their viability;
- Stockpiles must be covered during windy periods and during heavy rainfall;
- Stockpiles stored longer than six weeks should be vegetated or covered (with sheeting, shade cloth or tarpaulin) to reduce soil loss from wind or storm water runoff;
- Topsoil stripped during construction must be used to rehabilitate disturbed areas; and
- All trenches/excavations must be backfilled and rehabilitated using topsoil from the stockpiles, where applicable;
- No machinery must be parked overnight within 50 m of the rivers/wetlands;
- All stationary machinery must be equipped with a drip tray to retain any oil leaks;
- Any hazardous substances/waste must be stored in impermeable bunded areas or secondary containers 110% the volume of the contents within it;
- All general waste and refuse must be removed from site and disposed and windproof temporary storage area before being disposed of at a registered landfill site; and
- Emergency plans must be in place in case of spillages onto bare soil or within water courses

10.2 HYDROLOGY

Cause and comment:
This section provides an indication of the impacts as a result of the mechanical changes of the hydrological features. The ecological impacts are covered in Section 6.6.

The proposed site clearance and construction activities may interrupt surface and/or subsurface flows, leading to flow concentration, change in flow pathways, flow impoundment, increased surface runoff and increased risk of erosion. Any activity that impedes or alters the natural subsurface flow in the catchment's soils could have indirect but potentially significant effects on the drainage features and wetlands.

Given that many of the deviations and changes will occur during the construction phase it is pertinent to report on impacts during construction and operation. Therefore, based on the short-term impacts during construction and the reduced regional flooding risk the impact of the construction of the project on the regional hydrology is considered to be low negative.

The terrain around and on the project site will be influenced by construction activities and temporary infrastructure (i.e. roads). These will influence the direction of flood flow and volume at locations within the project site. The GIS-analysis showed that most of the water will accumulate and flow towards the southern edge of the proposed Project area South site towards the irrigation pond and its culvert below the M5 highway. The results show that the Project area South is most likely prone to flooding during heavy rainfalls (Figure 6.12). The northern site is less likely to flood. Therefore, the impact, due to the magnitude and severity are considered to be high negative. Even with the implementation of mitigation measures, the residual impacts will be moderate negative.

Impacts resulting from erosion are likely to be localised to watercourse crossings or where water resources are located directly downslope of construction works. Should the mentioned hydrological impacts result in scouring and gully erosion, impacts may persist for some time after the construction phase, especially if rehabilitation is not implemented. This will result in

a moderate negative impact before the implementation of mitigation measures. A low negative impact is expected following the application of mitigation.

Table 10.2 Impacts to the hydrology of the site (see Section 17 for more information)

Impact: Increase in regional flooding risk		
	Before mitigation	**After mitigation**
All Alternatives	LOW -	LOW -
Impact: Increase in local flooding risk		
All Alternatives	HIGH -	MODERATE -
Impact: Increase in erosion leading to scouring		
All Alternatives	MODERATE -	LOW -
No-go Alternative		
	MODERATE -	N/A

Mitigation measures:

- Consideration of the option to channel water through the proposed project site, either by a closed pipe or a channel designed to accommodate the design flood. Because the flood water will flow from different directions/sources upstream of the proposed project site, a diversion of the water from these areas is necessary to ensure that the water will reach the desired inlet points.
- Ensure that drainage construction is implemented either early in the construction phase or before the wet season.
- Monitor local water resources to ensure that project activities are not negatively impacting, especially during the wet season or when groundworks have been undertaken.

10.3 Terrestrial Biodiversity and Ecology

10.3.1 Closed Miombo Woodland

Cause and comment:
The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 0.57 ha of Closed Miombo Woodland (Table 10.3).

Portions of this vegetation type have already been lost due to farming activities to the east, expansion of residential areas to the west, harvesting of vegetation by local communities for building and thatching as well as from grazing of livestock.

Table 10.3 Impact to closed miombo woodland (see Section 17 for more information)

Impact: Loss of closed miombo woodland		
	Before mitigation	**After mitigation**
All Alternatives	LOW -	LOW -
No-go Alternative		
	LOW -	N/A

Mitigation measures:

- Construction vehicles and machinery must not encroach into identified 'no-go' areas or areas outside the project footprint;
- Where feasible Closed Miombo Woodland should be avoided as it provides important refugia for faunal species in the area and is an important seedbank for indigenous woody species;
- Topsoil (20 cm, where possible) must be collected and stored in an area of low sensitivity and used to rehabilitate impacted areas that are no longer required during the operational phase (e.g. laydown areas);
- Only indigenous species must be used for rehabilitation;
- Lay down areas must not be located within any watercourses or drainage lines;
- Employees must be prohibited from making open fires during the construction phase; and
- An alien invasive management plan for the site must be created.

10.3.2 Open Miombo Woodland

Cause and comment:

The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the permanent loss of up to 2.14 ha of Open Miombo Woodland. Since this will be permanently lost, the overall significance will be moderate negative even after mitigation measures have been implemented. (Table 10.4).

Table 10.4 Impact to open miombo woodland (see Section 17 for more information)

Impact: Loss of open miombo woodland		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	MODERATE -
No-go Alternative		
	LOW -	N/A

Mitigation measures:

- Construction vehicles and machinery must not encroach into identified 'no-go' areas or areas outside the project footprint;
- Where feasible Open Miombo Woodland should be avoided as it provides important refugia for faunal species in the area and is an important seedbank for indigenous woody species;
- Topsoil (20 cm, where possible) must be collected and stored in an area of low sensitivity and used to rehabilitate impacted areas that are no longer required during the operational phase (e.g. laydown areas);
- Only indigenous species must be used for rehabilitation;
- Lay down areas must not be located within any watercourses or drainage lines;
- Employees must be prohibited from making open fires during the construction phase; and
- An alien invasive management plan for the site must be created.

10.3.3 Grassland-Savanna mosaic

Cause and comment:
The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 31.16 ha of grassland-savanna mosaic. Since this vegetation type is intact and will be permanently lost, the overall significance will be moderate negative even after mitigation measures have been implemented (Table 10.5).

Table 10.5 Impact to grassland-savanna mosaic (see Section 17 for more information)

Impact: Loss of grassland-savanna mosaic		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	MODERATE -
No-go Alternative		
	LOW -	N/A

Mitigation Measures:

- Construction vehicles and machinery must not encroach into identified 'no-go' areas or areas outside the project footprint;
- Where feasible grassland-savanna should be avoided as it provides important refugia for faunal species in the area and is an important seedbank for indigenous woody species;
- Topsoil (20 cm, where possible) must be collected and stored in an area of low sensitivity and used to rehabilitate impacted areas that are no longer required during the operational phase (e.g. laydown areas);
- Only indigenous species must be used for rehabilitation;
- Lay down areas must not be located within any watercourses or drainage lines;
- Employees must be prohibited from making open fires during the construction phase; and
- An alien invasive management plan for the site must be created.

10.3.4 Aquatic/riparian habitat

Cause and comment:
During the construction phase, vegetation clearance and earthworks, including excavation and infilling, may result in the partial loss and disturbance of the wetland to the west of the existing ESCOM substation.

In addition, the clearance of vegetation and compaction of soil may result in increased run-off and erosion resulting in elevated levels of sediment entering the system. This could result in significant water quality concerns which in-turn may compromise the aquatic/wetland habitat.

It is also possible that accidental spillages of wet concrete and chemical / hazardous substances may result in soil and surface water contamination, adversely affecting the aquatic ecosystems within the site.

Although the wetland to the west of the ESCOM substation has been modified by the local communities through planting rice, wetlands are deemed to be sensitive habitats. The other drainage features on the site are mostly man-made and also show evidence of significant modification with those in the southern site mostly dry during a field trip in January 2022.

Given the sensitivity of water features generally and within this site a moderate negative impact is expected as a result of the construction activities (i.e. diversions) before mitigation. Based on the design available it seems that many of the drainage features in the southern site will be modified while the wetland in the northern site will only be partially modified. Mitigation measures are available and need to be implemented but they are unlikely to result in a reduction in the residual impact (Table 10.6).

Similarly, the potential for sedimentation and pollution as a result of erosion is probable and this impact too is expected to be moderate negative. The implementation of the mitigation measures will result in a residual impact of low negative (Table 10.6).

Table 10.6 Aquatic/riparian habitat (see Section 17 for more information)

Impact: Loss of wetland habitat		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	MODERATE -
Impact: Sediment loading through erosion		
All Alternatives	MODERATE -	LOW -
Impact: Pollution/spillage		
All Alternatives	MODERATE -	LOW -
No-go Alternative		
	MODERATE -	N/A

Mitigation Measures:

- The wetland buffers should be demarcated, and no activities should be allowed to occur within these buffers;
- Construction materials must not be stored within the moderate sensitivity areas;
- Stockpiles must not be stored within the moderate sensitivity areas;
- Construction activities should be undertaken during the driest part of the year, to the extent possible, to minimize erosion and downstream sedimentation due to excavation, etc;
- Appropriate stormwater structures must be implemented as early in the construction phase as possible to control run-off and minimize erosion;
- Vegetation clearing must be kept a minimum and only to the site footprint;
- Erosion controls and sediment trapping measures must be put in place;
- Stockpiles must be monitored for erosion and mobilisation of materials towards watercourses;
- Stockpiles must not exceed 1.5 m in height. Stockpiles must be covered during windy periods;
- Disturbed areas must be monitored for erosion channels and these must be rehabilitated; and
- All trenches/excavations must be backfilled and all disturbed areas backfilled, compacted and revegetated, where applicable.

10.3.5 Plant species of conservation concern

Cause and comment:
Only one species (*Pterocarpus angolensis* / *African Teak*) was identified as a SCC due its status of Vulnerable on the National Red List. Although the permanent loss of this plant species of conservation concern within the site may occur, it is relatively widespread and the loss will not impact this species survival at this stage (Table 10.7).

The additive effect associated with the cumulative loss of *Pterocarpus angolensis* will be of moderate significance (Table 10.7).

Table 10.7 Vegetation species of conservation concern (see Section 17 for more information)

Impact: Loss of species of conservation concern		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	LOW -
Impact: Cumulative impact of the loss of species of conservation concern		
All Alternatives	MODERATE -	LOW -
No-go Alternative		
	LOW -	N/A

Mitigation Measures:

- A botanical walkthrough of the development area, by an experienced botanist with knowledge of the SCC identified as possibly occurring within the site, is recommended to be undertaken during the flowering season.
- If restricted range SCC populations are found, the development must be shifted to avoid these populations.
- The Environmental Control Officer (ECO) must monitor for potential additional plant SCCs not found during search and rescue activities.
- No plant SCCs may be removed from the development footprint unless the relevant permits have been obtained.
- The identification of SCCs is recommended as part of the on-site induction and toolbox talk requirements.

10.3.6 Disruption to the ecosystem function and process

Cause and comment:
Fragmentation is one of the most important impacts on vegetation as it creates breaks in previously continuous vegetation, causing a reduction in the gene pool and a decrease in species richness and diversity. It also impacts on fauna as it separates habitats and necessitates fauna having to move across exposed areas like roads to get to another section of their habitat or territory. This impact occurs when more and more areas are cleared, resulting in the isolation of functional ecosystems, which results in reduced biodiversity and reduced movement due to the absence of ecological corridors. Approximately 60 ha of near natural and transformed vegetation will be replaced by solar panels resulting in the loss of this natural ecological corridor that

runs from the north to the south between the sugar plantations to the east and the residential area to the west.

There is already a fair amount of habitat fragmentation as a result of the surrounding land-uses. The additive affect associated with the loss of natural vegetation will be of moderate significance (Table 10.8).

Table 10.8 Disruption to ecosystem function (see Section 17 for more information)

Impact: Disruption to ecosystem function through fragmentation		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	MODERATE -
Impact: Cumulative impact on ecosystem function through fragmentation		
All Alternatives	MODERATE -	N/A -
No-go Alternative		
	LOW -	N/A

Mitigation Measures:

- Rehabilitate laydown areas.
- Use existing access roads and upgrade these where necessary.
- Where feasible, situate new powerlines adjacent to existing ones.
- Faunal species are important for the dispersal of seeds and their movement must therefore not be inhibited. As such it is recommended that an ecological corridor through an area of natural vegetation is included to ensure the continued movement of species from north to south between the existing sugar plantation and residential area. It is recommended that the Closed Miombo Woodland, which forms a natural corridor is used.
- Avoid locating panels in riparian areas as these provide natural ecological corridors.

10.3.7 Establishment of alien plant species

Cause and comment:
Disturbance to habitats often results in the infestation of alien species and displacement of indigenous vegetation unless these are controlled. There are already two species of Eucalyptus on site as well as Gmelina. Should this happen, the impact will be of high significance. However, this impact is easily mitigated through the implementation of an alien invasive management and monitoring plan (Table 10.9).

There is already evidence of alien species on site. These are mostly being grown within woodlots but there is the risk that they could escape into the natural environment if not controlled. The clearing of vegetation for the construction of the solar PV plant could result in the disturbance of the seedbank and establishment of alien species outside of the controlled woodlots (Table 10.9).

Table 10.9 Establishment of alien plant species (see Section 17 for more information)

Impact: Establishment of alien plant species

	Before mitigation	After mitigation
All Alternatives	HIGH -	LOW -
Impact: Cumulative impact of the establishment of alien plant species		
All Alternatives	MODERATE -	LOW -
No-go Alternative		
	LOW -	N/A

Mitigation Measures:

- The site must be checked regularly for the presence of alien invasive species;
- An alien invasive management and monitoring plan must be incorporated into the ESMP; and
- The ECO must create a list with accompanying photographs of possible alien invasive species that could occur on site prior to construction. This photo guide must be used to determine if any alien invasive species are present.

10.3.8 Ecosystem Services

Cause and comment:
Loss of ecosystems services through the removal of vegetation communities will result in the loss of ecosystem services provided by each vegetation type. This is relevant since the local communities are reliant on these areas as a source of food and medication, for construction materials and fuel wood and as a source of income through activities such as charcoal production. These species, however, are fairly widespread and are also found outside of the footprint of the proposed project area (Table 10.10).

The cumulative loss of natural resources as a result of development occurring in the area will mean that communities reliant on the project site for ecosystem services will need to look further afield and possibly travel longer distances to find what they need. Given that there is development on either side of the project site this impact will be of moderate significance.

Table 10.10 Impact to ecosystem services (see Section 17 for more information)

Impact: Disruption to ecosystem services		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	MODERATE -
Impact: Cumulative impact on ecosystem services		
All Alternatives	MODERATE -	N/A -
No-go Alternative		
	LOW -	N/A

Mitigation Measures:

- Allow local communities the opportunity to harvest plants prior to the start of the construction phase activities.

10.4 FAUNA

10.4.1 Faunal habitat

Cause and comment:
The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 10.6 ha of Closed Miombo Woodland, 5 ha of open miombo woodland and and 35.9 ha of grassland- Savanna mosaic. These all provide important habitat for a range of faunal species.

The loss of extent of faunal habitat will result in the loss of feeding, breeding, shelter and roosting sites for faunal species and the impact associated with this loss, will be a reduction in species diversity.

However, to place this impact in context, it should be noted that the habitat that will be lost is directly adjacent to large plantations of sugar cane along the eastern border and there is already likely to be a lower species diversity due to existing habitat fragmentation and edge effects. The further loss of habitat will result in faunal species being displaced to the east, north and south.

This impact is difficult to mitigate since the loss of extent of faunal habitat will be permanent and as such the impact significance remains the same even after mitigation (Table 10.11).

Portions of faunal habitat have already been lost due to farming activities to the east, expansion of residential areas to the west, harvesting of vegetation by local communities for building and thatching as well as from grazing of livestock. The additional loss of faunal habitat will therefore have a moderate cumulative impact.

Table 10.11 Loss of faunal habitat (see Section 17 for more information)

Impact: Loss of faunal habitat		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	MODERATE -
Impact: Cumulative impact on faunal habitat		
All Alternatives	MODERATE -	N/A -
No-go Alternative		
	LOW -	N/A

Mitigation Measures:

- Construction vehicles and machinery must not encroach into identified ‘no-go’ areas or areas outside the project footprint;
- Where feasible Closed Miombo Woodland as identified in the Botanical report, should be avoided as it provides important refugia for faunal species in the area;
- Lay down areas must not be located within any watercourses or drainage lines;
- Employees must be prohibited from making open fires during the construction phase;
- Employees must be prohibited from poaching wild animals within or adjacent to the site;

- The development footprint of the proposed solar PV plant and associated infrastructure (roads and laydown areas) must be demarcated to prevent any encroachment of construction or operational activities into surrounding natural areas;
- Edges of roads, sidewalks and any elevated area must not have steep sides and must have a gentle slope;
- Any fencing required must be wildlife permeable especially at strategic places such as along drainage lines or other areas of dense vegetation. This allows for small and medium sized animals to move between their natural habitat unencumbered. If electrified strands are to be use, there are to be no strands within 30 cm of the ground. As an example, if a tortoise touches this strand it automatically retreats into its shell and does not move because it senses danger, and the repeated shocks eventually kill it (Arnot & Moteno, 2017); and
- Create additional faunal micro habitats e.g. rocky outcrops, corridors of shrubbery, stumperies.

10.4.2 Faunal species of conservation concern

Cause and comment:
The SCC that possibly occur on the project area include bat species which may utilise the woodland/forest habitat for shelter as well as the nearby buildings and forage over the wetland and grassland. It is possible that the terrapin and occasionally otters may utilise the river channels and wetland areas. Migrant species may utilise habitats on the project area but not exclusively and raptors may nest on existing powerlines and well-established trees in the woodland/riparian forest. The blue swallow was confirmed on the northern site in the savanna habitat trees.

The project area borders an urban area and already experiences a level of disturbance. SCC are often sensitive to disturbance (except the Bateleur) and probably have already moved away from the area. The project will be removing the eastern extent of the natural area decreasing it in site but not necessary creating fragmentation.

It is expected that a moderate negative impact will result from a permanent but partial loss of individuals of conservation concern prior to the implementation of mitigation. However, following mitigation the residual impact will be low negative (Table 10.12).

Table 10.12 Faunal species of conservation concern (see Section 17 for more information)

Impact: Loss of faunal species of conservation concern		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	LOW -
Impact: Cumulative impact on faunal species of conservation concern		
All Alternatives	MODERATE -	N/A -
No-go Alternative		
	LOW -	N/A

Mitigation Measures:

- The facility layout should avoid the identified wetland on site and place a no-go buffer around them;
- Removal of any trees must only occur after fledging's have left the nest;
- All lighting must be kept to a minimum, only down lighting is to be used and low UV emitting lights (LED); and
- A clause must be included in contracts stating that: "no wild animals will be hunted, killed, poisoned or captured. No wild animals will be imported into, exported from or transported in or through the province. No wild animals will be sold, bought, donated and no person associated with the development will be in possession of any live wild animal, carcass or anything manufactured from the carcass." A clause relating to fines, possible dismissal and legal prosecution must be included should any of the above transgressions occur.

10.4.3 Faunal mortalities

Cause and comment:
The movement of heavy machinery and an increased number of vehicles during the construction phase may result in the accidental mortality of faunal species, specifically fossorial species and slow-moving species. This will result in a moderate negative impact before the application of mitigation following which will be reduced to low negative (Table 10.13).

There are no similar construction activities in the area and as such there is unlikely to be a cumulative impact.

Table 10.13 Loss through mortality (see Section 17 for more information)

Impact: Loss of faunal species through mortality		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	LOW -
Impact: Cumulative impact on faunal species		
All Alternatives	N/A -	N/A -
No-go Alternative		
	LOW -	N/A

Mitigation Measures:
- Staff and contractors' vehicles must comply with speed limits of 40km/hr
- Vehicles shall be restricted to areas of operation, for example vehicles will not be permitted to be used in the miombo woodland zone.
- Project must start and be completed within the minimum timeframe. i.e. may not be started and left incomplete;
- ECO to walk ahead of clearing construction machinery and move slow moving species e.g. tortoises out of harms way and into suitable neighbouring habitat;
- Any faunal species that may die as a result of construction must be recorded (photographed, gps co-ordinates) and if somewhat intact preserved and donated to a Malawian University equipped to preserve the remains;
- Any faunal species observed onsite must be recorded (photographed, gps co-ordinates); and

- Staff and contractors are not permitted to capture, collect or eat any faunal species onsite.

10.4.4 Displacement as a result of noise and fugitive dust

Cause and comment:
Construction activities will result in an increase in noise in the study area, increased activity levels and increased levels of fugitive dust. These disturbances are likely to result in the displacement of faunal species as they vacate the area to avoid the disturbances. These disturbances may also disrupt breeding cycles of faunal species resulting in the loss cohorts for the year. This will result in a moderate negative impact. With the application of mitigation measures this can be reduced to low negative.

There are no similar construction activities in the area and as such there is unlikely to be a cumulative impact.

Table 10.14 Displacement through noise and dust (see Section 17 for more information)

Impact: Loss of faunal species as a result of noise and dust		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	LOW -
Impact: Cumulative impact on faunal species		
All Alternatives	N/A	N/A
No-go Alternative		
	N/A	N/A

Mitigation Measures:

- Vehicles and machinery must meet best practice standards;
- Staff and contractors' vehicles must comply with speed limits of 40km/hr;
- Project must start and be completed within the minimum timeframe. i.e. may not be started and left incomplete;
- Staff and contractors are not permitted to capture, collect or eat any faunal species onsite; and
- Dust suppression measures must be implemented during the construction phase to reduce fugitive dust levels.

10.4.5 Increased human-animal conflict

Cause and comment:
There are existing troops of baboons and monkeys which may cause damage to equipment and may raid any living quarters and waste disposal sites.

This will result in a moderate negative impact. With mitigation it will be possible to reduce this down to low negative (Table 10.15).

Table 10.15 Increased human-animal conflict (see Section 17 for more information)

Impact: Increase in human-animal conflict		
	Before mitigation	**After mitigation**

All Alternatives	MODERATE -	LOW -

Mitigation Measures:

- Refuse should be isolated to one area;
- Consider separating organic refuse out and store in baboon proof bins.
- All refuse bins must be baboon proof;
- Project related staff must not feed wildlife. Include in the Code of Conduct;
- Project employees must be made aware of the risks associated with encountering potentially dangerous animals (venomous snakes and baboons); and
- If a snake is encountered development staff and residents are to contact the designated snake handler for removal and relocation.

11 BIOLOGICAL ENVIRONMENT IMPACTS – OPERATIONAL PHASE

11.1 SOIL QUALITY

Cause and comment:
The impacts to the soil quality are likely to take place during construction. No earthworks are expected during the operational phase. There is a risk of erosion during heavy rainfall events in areas that have not been rehabilitated.

Therefore, the impact to soil quality is expected to be low negative (Table 11.1).

Table 11.1 Soil quality

Impact: Decrease in soil quality		
	Before mitigation	**After mitigation**
All Alternatives	LOW -	LOW -

11.2 HYDROLOGY

Cause and comment:
Given that many of the deviations and changes will occur during the construction phase the impacts during operation are associated with the modified hydrology scenario and mostly concerned around the management of stormwater.

The GIS-analysis showed that most of the water will accumulate and flow towards the southern edge of the proposed project site towards the irrigation pond and its culvert below the M5 highway. The results show that the southern plot is most likely prone to flooding during heavy rainfalls (Figure 6.12). It is anticipated that the project will need to design and install appropriate infrastructure to accommodate the increased runoff volumes as a result of the panels increasing the hardstand area. The stormwater management plan needs to ensure that the volume of water exiting the site is controlled and does not cause downstream impacts. Similarly, the stormwater management needs to ensure the water quality downstream is not adversely impacted (Table 11.2).

Therefore, due to the sensitivity of the receptors, the significance of the impact is moderate negative. With a suitable design and management of the modified hydrology the residual impact will be low negative.

Table 11.2 Alterations in site hydrology leading to increased erosion and decrease water quality (see Section 18 for more information)

Impact: Increase in erosion		
	Before mitigation	**After mitigation**
Preferred Alternative	MODERATE -	LOW -
Impact: Decrease in water quality		
Preferred Alternative	MODERATE -	LOW -

Mitigation Measures:

- Consideration of the option to channel water through the proposed project site, either by a closed pipe or a channel designed to accommodate the design flood. Because the flood water will flow from different directions/sources upstream of the proposed project site, a diversion of the water from these areas is necessary to ensure that the water will reach the desired inlet points;
- The development of a stormwater management plan that aims to:
    - Reduce the volume and runoff speed as a result of the project;
    - Manage the quality of the water discharging to water resources outside the project area.

11.3 Terrestrial Biodiversity and Ecology

11.3.1 Infestation of alien plant species

Cause and comment:
If laydown areas and roads are not rehabilitated, these disturbed areas can become places for alien invasive species to become established and if left unmitigated these species can spread and establish themselves in intact vegetation resulting in the displacement of indigenous species.

The impact is expected to be moderate negative due to the severity of the impact should these species become established. With the implementation of the mitigation measures, a residual impact of low negative is anticipated (Table 11.3).

Table 11.3 Alien plant species (see Section 18 for more information)

Impact: Infestation of alien plant species		
	Before mitigation	**After mitigation**
Preferred Alternative	MODERATE -	LOW -
Impact: Cumulative infestation of alien plant species		
Preferred Alternative	MODERATE -	LOW -

Mitigation Measures:

- The site must be checked regularly for the presence of alien invasive species. When alien invasive species are found, immediate action must be taken to remove them;
- An alien invasive management and monitoring plan must be incorporated into the ESMP; and
- The ECO must create a list with accompanying photographs of possible alien invasive species that could occur on site prior to construction. This photo guide must be used to determine if any alien invasive species are present.

11.3.2 Change in species composition

Cause and comment:
The shading effect of the panels results in a change in species composition. For example, it may favour more herbs and possibly "weeds" or ruderals.

The impact is expected to be low negative due to the slight magnitude of the impact (Table 11.4).

Table 11.4 Change in species composition (see Section 18 for more information)

Impact: Change in species composition		
	Before mitigation	**After mitigation**
Preferred Alternative	LOW -	LOW -
Impact: Cumulative impact of change in species composition		
Preferred Alternative	N/A	N/A

Mitigation Measures:

- Ensure that "weeds" or ruderals do not move into natural habitat.

11.3.3 Aquatic/Riparian habitat

Cause and comment:
During the operational phase, routine maintenance (e.g. the washing and servicing of panels) may lead to the introduction of chemical / hazardous substances (e.g. soaps, cement dust, oil spills from vehicles, etc.) into the watercourse, adversely affecting the aquatic ecosystems in the broader area.

The modification of the drainage features within the site will also lead to larger volumes of water and higher suspended sediment loading.

Although many of the impacts may occur during the construction phase the duration of the operational phase and the possibility that increased volumes and/or lower water quality would occur indicate that a moderate negative impact can be expected prior to mitigation (Table 11.5. With the implementation of the mitigation measures a low negative impact is anticipated.

Table 11.5 Decrease in water quality affecting the riparian habitat (see Section 18 for more informaiton)

Impact: Decrease in water quality affecting the riparian habitat

	Before mitigation	After mitigation
Preferred Alternative	MODERATE -	LOW -
Impact: Cumulative impact of decrease in water quality affecting the riparian habitat		
Preferred Alternative	N/A	N/A

Mitigation Measures:

- Adhere to stormwater management design measures provided in the Construction Phase;
- Stormwater infrastructure must be maintained and monitored for effectiveness with respect to controlling and minimising erosion and sedimentation of watercourses;
- No machinery must be parked overnight within 50 m of the rivers/wetlands;
- All stationary machinery must be equipped with a drip tray to retain any oil leaks;
- Any hazardous substances/waste must be stored in impermeable bunded areas or secondary containers 110% the volume of the contents within it;
- All general waste and refuse must be removed from site and disposed and windproof temporary storage area before being disposed of at a registered landfill site;
- Emergency plans must be in place in case of spillages onto bare soil or within water courses; and
- Disturbed areas should be rehabilitated and re-vegetated.

11.4 FAUNA

11.4.1 Infestation of alien faunal species

Cause and comment:
Developments that introduce domestic waste streams create suitable habitats for the introduction of alien species. Introduced urban rodent pests such as the house mouse (*Mus musculus*), house rat (*Rattus rattus*) and the Norwegian rat (*Rattus norvegicus*) are likely to occur in populated areas such as construction camps and office buildings. These species generally tend to survive alongside human habitation, and don't spread in natural areas.

The most widespread and common alien bird is the House Sparrow (*Passer domesticus*) and the Pied Crow (*Corvus albus*) which is now distributed almost worldwide and was recorded on site. The introduction of alien species will not only displace existing fauna but also create a nuisance. The long-term nature of the impact and the sensitivity of the receiving environment determine the impact to be moderate negative. This can be reduced to low negative through the application of the mitigation measures (Table 11.6).

The project area is located near an existing town and sugarcane planation. There are likely already alien fauna around and the impacts from this project are likely to be insignificant when compared to the surrounding impacts.

Table 11.6 Infestation of alien faunal species (see Section 17 for more information)

Impact: Infestation of alien faunal species		
	Before mitigation	**After mitigation**
Preferred Alternative	MODERATE -	LOW -

Impact: Cumulative infestation of alien faunal species		
Preferred Alternative	MODERATE -	LOW -

Mitigation Measures:

- The site must be checked regularly for the presence of alien invasive species. When alien invasive species are found, immediate action must be taken to remove them;
- An alien invasive management and monitoring plan must be incorporated into the ESMP;
- The ECO must create a list with accompanying photographs of possible alien invasive species that could occur on site prior to construction. This photo guide must be used to determine if any alien invasive species are present; and
- If cats are brought in to assist with any alien species control they must be logged and identifiable and all must be sterilised.

11.4.2 Collision and electrocution of birds

Cause and comment:

Bird fatalities could occur at the site through a number of mechanisms, including collision with PV panels, entanglement in perimeter fence and others. Overall the diversity of bird species on site is low, no regionally Red Listed species occur on site and the habitat on site is of low value for birds. The impact of collision with and electrocution on the overhead power line and within the substation is possible.

The project site already has a number of powerlines running along the eastern boundary of the northern and central site to the substations and from the substation through the top end of the southern site.

However, the bird species likely to be electrocuted are larger birds and more often raptors. Therefore, an impacts of moderate adverse is expected prior to mitigation (Table 11.7). Following mitigation, a low negative impact is likely.

Table 11.7 Bird collision and electrocution (see Section 17 for more information)

Impact: Bird collision and electrocution		
	Before mitigation	**After mitigation**
Preferred Alternative	MODERATE -	LOW -
Impact: Cumulative effect of Bird collision and electrocution		
Preferred Alternative	N/A	N/A

Mitigation Measures:

- The risk of electrocution of large birds on the power line pylons must be mitigated by using a bird friendly design with sufficient phase-phase and phase-earth clearance All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted; and
- A carefully considered surface water/drainage management plan must be developed for the site including attention to the use of environmentally friendly cleaning chemicals.

12 ENVIRONMENTAL IMPACTS – DECOMMISSIONING PHASE

The proposed Project is expected to operate for at least 20 years. Once the plant reaches the end of its life, the PV modules may be refurbished, or replaced to continue operations, or the facility may be closed and decommissioned. If decommissioned, all components would be removed and the site rehabilitated. Where possible all materials will be recycled, otherwise they will be disposed of in accordance with local regulations and international best practise and approximately 120 workers will be required.

13 SOCIAL ENVIRONMENT IMPACTS – CONSTRUCTION

13.1 AIR QUALITY

Cause and comment:
During the construction phase, dust generated by construction vehicles and construction activities could result in significant dust during windy conditions.

Dust emissions will arise during construction from the following activities:

- Earth moving activities and ground preparation of the Project site;
- Traffic and movement of vehicles over open ground and on unpaved roads; and
- Material stockpiles from clearance and preparation activities.
- Exposure and removal of ground stabilisation in the form of flora resulting in a source of particulate matter to be dispersed.

Dust emissions may result in nuisance issues at nearby sensitive receptors due to dust soiling and may result in increases in ambient concentrations of PM2.5 and PM10. In addition, dust emissions will arise due to traffic along unpaved roads during the construction.

The construction of the Project will take approximately 9 months and the dry season is the period within which any dust may become airborne. During the wet season (December to April) the conditions within the Project area are not conducive for dust generation. In addition, emissions associated with the activity on site will not occur consistently but are anticipated to peak during site clearance and during the delivery of the panels and mounting structures.

A reduction in ambient air quality can also arise as a result of the poor maintenance and servicing of construction plant and vehicles.

The most sensitive receptors to the change in air quality (mainly nuisance dust) will be the community adjacent to the site on the eastern side, within 150 m of the Project area boundaries Here there are dwellings, a church and a school. However, given that there is an overhead line between the earthwork area and these communities, creating a buffer together with a row

of vegetation along the M5 road, it is unlikely that the dust would be significant. In addition to this the school located across the M5 to the East of the site access road.

Construction impacts on air quality are anticipated to be short term and localised with much of the impact occurring within the project site. Therefore, a moderate negative impact is expected prior to mitigation (Table 13.1).

The reduction in air quality as a result in the increase in traffic associated with the construction phase is expected to be short term in nature and moderate in significance.

Baseline conditions were defined for both PM2.5 and PM10 during the ESIA assessment, both were found to be well below WHO recommended levels.

Following the implementation of mitigation, the significance of the impact is expected to be low negative.

Table 13.1 Decrease in Air Quality (see Section 17 for more information)

Impact: Decrease in Air Quality through increase in fugitive dust		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	LOW -
Impact: Decrease in Air Quality vehicle emissions		
All Alternatives	MODERATE -	LOW -
No-go Alternative		
	LOW -	N/A

Mitigation measures:

- Land clearance should be sequential and where ground and earthworks are undertaken the smallest possible area for working will be exposed;
- Stripping of topsoil will not be conducted earlier than required (maintain vegetation cover for as long as possible) in order to prevent the erosion (wind and water) of organic matter, clay and silt;
- During windy periods un-surfaced and un-vegetated areas must be dampened down;
- Vegetation must be retained where possible as this will reduce dust travel;
- A speed limit of 30 kph on unpaved surfaces to be enforced and the national speed limits on public roads are not to be exceeded;
- All transported materials must be covered with tarpaulins to prevent fugitive dust;
- Stockpiles stored longer than six weeks should be vegetated or covered (with sheeting, shade cloth or tarpaulin) to reduce soil loss from wind or storm water runoff;
- Stockpiles will be located as far away from receptors as possible and will be covered (with sheeting, shade cloth or tarpaulin);
- Vehicles and construction plant must be serviced regularly so as to reduce excessive vehicle emissions;
- When not in use, vehicles will be switched off, unless impractical for health and safety reasons (for example, maintenance of air conditioning); and
- Any complaints or claims emanating from dust issues must be attended to immediately and noted in the complaints register.
- Revegetation activities must be undertaken as early in the construction process as practicably possible to reduce the generation of particulate matter.

13.2 NOISE

Cause and comment:
During construction phase the main potential impacts on the acoustic environment are related to the noise from construction machinery and construction vehicles being used for the following:

- Site preparation such as vegetation clearance and minor earthworks. These activities will require heavy construction vehicles and equipment (excavators, dozers, dump trucks);
- Civil works and installation such as drilling for mounting structure frames, construction of inverter and transformer station foundations and construction of stores, workshop, and office buildings; and
- Road traffic offsite: the movement of vehicles for transport of materials and personnel on local roads and/or new access roads close to communities will also generate additional noise.

All the construction activities mentioned above have the potential to result in an overall increase in the background noise level close to the Project site with the potential to disturb occupants at the nearest receptors.

The noise during this phase will generally be of short duration over a total construction period of nine months and will be carried out during the daytime. No construction related noise is expected at night. The exact location of construction equipment has not been confirmed, but community houses/buildings within approximately 100 m from the nearest construction activities may experience a noise level of approximately 67 dB LAeq (a backhoe loader with a sound level of up to 84 dB LAeq at 10 m).

Commented [GS20]: Update with information collected during baseline survey.

A noise assessment was undertaken during the ESIA process to define a baseline, across the 5 sites tested there were average readings measuring between 42 and 49 dB. Which is to be expected in this type of per-rural setting in Malawi. The higher readings were located to the East of the site due to the M5 road.

The magnitude of the impact is considered to be slight as the period of disturbance is expected to be short term. The sensitivity of the receptors is high but they reside outside the AoI and along the M5 national road. Therefore, the significance of the impact is expected to be moderate negative before the application of mitigation (**Error! Reference source not found.**).

Following mitigation, a low negative impact is expected.

Table 13.2 Increase in Noise disturbance (see Section 17 for more information)

Impact: Increase in Noise disturbance		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	LOW -
No-go Alternative		
	LOW -	N/A

Mitigation measures:

- Maintain machines and plant equipment in good working condition and inspect regularly;
- Select equipment and vehicles in accordance with best available techniques for noise reduction;
- Minimise vehicle movements within and around the site as much as possible;
- Use screening/site hoardings to screen noise where appropriate. In this case screening along the southern boundary of the Project area South. Although, screening should be considered where local communities may raise concern; and
- Any complaints or claims regarding noise disturbance must be attended to immediately and noted in the complaints register.
- Communicate with the community prior to known high noise level activities are undertaken, such as drilling or piling.
- Ensure strict adherence to only undertaking high noise activities during day light hours by site workers.

13.3 TRAFFIC AND TRANSPORT

Cause and comment:
The informal economy in Malawi is a major component of the total economy. These informal traders operate their businesses from the points where vehicle and pedestrian traffic is highest, and this results in markets tending to be established adjacent to roads. The road route between the ports of entry are likely to be similar. In these areas, vehicles are pulling onto and off the road without using their indicators, pedestrians cross the road at random points, and children play alongside the road. The risk of accidents in these environments, especially when drivers are working to a tight delivery schedule, is increased. In addition, the sensitivity of the receptor, in this case pedestrians, is high as it could result in loss of life.

It is also anticipated that the site could become congested during peak times and does have narrow public roads. An increase in traffic as a result of the project could cause congestion on public roads in a number of ways:

- Poor timing of deliveries resulting in all deliveries arriving at once;
- Poor maintenance of vehicles resulting in break-downs on public roads;
- Delivery of abnormally sized loads at inappropriate times; and
- Overloaded vehicles moving exceptionally slowly on public roads.

The likelihood of an accident occurring is probable since the vehicles will need to pass through densely populated areas on their journey to the site. The impact will be relatively short term in nature, the communities living along the road are used to vehicles passing and the road conditions mean that speeds may be low. The severity is high because an accident could result in death. Therefore, the impact would have a significance of high negative prior to the implementation of mitigation. Similarly, the congestion on the road is likely to be short term in nature but due to the condition and width of the roads additional traffic may result in congestion and a moderate negative impact is expected.

Through the introduction of mitigation measures the residual impact is expected to be low negative for all impacts.

Table 13.3 Traffic and transport impacts (see Section 17 for more information)

Impact: Increased traffic on the risk of loss of life and serious asset damage		
	Before mitigation	**After mitigation**
All Alternatives	HIGH -	LOW -
Impact: Increased traffic on congestion on public roads		
All Alternatives	MODERATE -	LOW -
No-go Alternative		
	LOW -	N/A

Mitigation measures:

- The speed limit specified for the national roads must be strictly adhered to by the plant and contractor workforce;
- Deliveries of construction material at night should be avoided;
- All drivers must receive training for each type of vehicle including light vehicle training, heavy vehicle truck training and abnormal truck load (including low-bed and trailers) training before they are permitted to drive;
- Deliveries by heavy vehicles must, as far as possible, be scheduled to avoid the formation of convoys;
- Speed warning signage and vehicle GPS tracking devices should be installed in vehicles to discourage and monitor speeding;
- An Emergency Preparedness and Response Plan must be prepared and implemented, and must include provisions to deal with traffic accidents, particularly accidents involving personal injuries, and all drivers must be made aware of the procedures to be followed;
- Vehicles should be serviced regularly;
- The delivery of all abnormally sized loads should be planned together with the Malawian traffic authorities;
- Abnormally sized loads should be delivered at off-peak times of the day; and
- Vehicles should only be loaded to their design capacity, and not overloaded.

13.4 LANDSCAPE AND VISUAL

Cause and comment:
Construction activities may have an impact on the visual character of the landscape due to the following:

- Clearance of vegetation (in particular clearance of trees and removal of
- crops);
- Presence of large construction vehicles and equipment on site;
- Fencing of works and restrictions to site access; and
- Construction of the plant.

The construction works are considered to be short term. The presence of miombo forest on the western boundary is expected to act as a natural buffer/screen. In addition, the trees lining the eastern boundary are expected to act as a similar screen. Therefore, the significance of

the impact is expected to be moderate negative before implementation of mitigation measures (**Error! Reference source not found.**).

By implementing mitigation measures the impact can be reduced to low negative.

Table 13.4 Impact to lanscape and visual character (see Section 17 Error! Reference source not found. **for more information)**

Impact: Impact to the existing landscape and visual character		
	Before mitigation	**After mitigation**
All Alternatives	MODERATE -	LOW -
No-go Alternative		
	LOW -	N/A

Mitigation measures:

- Retain screening vegetation around the perimeter of the site as far as possible;
- Placement of stockpiles around the perimeter of the site should be considered to act as a barrier;
- Ongoing rehabilitation of cleared areas to minimise visual scarring and maintenance clearing will be kept to the absolute minimum and should not extend beyond the Project site boundary;
- Any excavated or cut and fill areas will be landscaped and allowed to revegetate;
- No debris or waste materials will be left at the work sites; and
- Appropriate directional and intensity settings will be utilised on all lighting.

13.5 HERITAGE AND CULTURAL RESOURCES

Cause and comment:
The study did not identify any archaeological receptors which will be directly impacted by the proposed project.

The study identified no buildings or structures of historical or heritage significance.

Generally, the proposed project area and its surrounds are characterised by grassland-savanna with areas of open and closed miombo woodland. There Illovo plantation is a prominent feature and small-scale subsistence farming is evident. Further away from the project area, the landscape is typical of rural Malawi with undulating hills with flatter plains in-between. This landscape stretches over many kilometres and the proposed project is unlikely to result in a significant impact on the landscape (see Section 13.4).

No graves of human burial places were noted during the site visit in January 2022.

Table 13.5 Heritage and Cultural Resources (see Section 17 for more information)

Impact: Archaeological receptors		
	Before mitigation	**After mitigation**
All Alternatives	LOW -	LOW -

Impact: Historically significant structures		
All Alternatives	LOW -	LOW -
Impact: Cultural landscape		
All Alternatives	LOW -	LOW -
Impact: Graves/human burial sites		
All Alternatives	LOW -	LOW -

Mitigation Measures:

- Human remains are usually observed when they are exposed through erosion. In some instances, packed stones or rocks may indicate the presence of informal pre-colonial burials. If any human bones are found during the course of construction work, then they should be reported to an archaeologist and work in the immediate vicinity should cease until the appropriate actions have been carried out by the archaeologist. Where human remains are part of a burial, the Department of Museums and Monuments will be engaged to dictate how to proceed. Should any unmarked human burials/remains be found during the course of construction, work in the immediate vicinity should cease and the find must immediately be reported to the archaeologist. Under no circumstances may burials be disturbed or removed until such time as necessary statutory procedures required for grave relocation have been met.

Commented [GS21]: C12 to confirm

14 Social Environment Impacts – Operation

14.1 Air Quality

Cause and comment:
Fugitive dust, vehicle and site infrastructure emissions are expected to be very low during operation. There will only be a small number of vehicles maintaining the site. Where necessary dust suppression techniques can be employed.

Therefore, impacts to air quality during operations are expected to be low negative (**Error! Reference source not found.**).

Table 14.1 Impact to air quality (see Section 18 for more information)

Impact: Reduction in air quality		
	Before mitigation	**After mitigation**
Preferred Alternative	LOW -	LOW -

14.2 Noise

Cause and comment:

Very low vehicle movement is expected during the operational phase of the project. There are no moving parts or machinery involved in the operation of a solar PV facility and therefore no significant noise disturbances are expected.

The impacts as a result of noise disturbances during operations are expected to be low negative (Table 14.2**Error! Reference source not found.**).

Table 14.2 Noise disturbance (see Section 18 for more information)

Impact: Increase in noise disturbance		
	Before mitigation	**After mitigation**
Preferred Alternative	LOW -	LOW -

14.3 TRAFFIC AND TRANSPORT

Cause and comment:
As mentioned above, very low vehicle movement is expected during the operational phase of the project. No significant deliveries are expected in any significant volume. There may be minor increase in vehicles travelling to site since there will be no accommodation on site. However, this will be limited to between 5-10 cars per day.

The impacts and risks as a result of an increase in traffic and transport are expected to be low negative (Table 14.3**Error! Reference source not found.**).

Table 14.3 Traffic and transport (see Section 18 for more information)

Impact: Increase in impact and risk from traffic and transport		
	Before mitigation	**After mitigation**
Preferred Alternative	LOW -	LOW -

14.4 LANDSCAPE AND VISUAL

Cause and comment:
Impacts during the operational phase include the colour change and a massing effect created by the PV panels covering a large area, limited early morning glare and some security lights at night. Generally, the reflection from PV systems is low intensity, similar to the impact from a body of water. Solar glare can have the potential to be hazardous to pilots (typically when panels are located near airports), motorists (when panels are located adjacent to roads), and onlookers.

There site is adjacent to the M5 national road and adjacent to the Illovo plantation. The solar panels that have been selected for the Project are designed to absorb as much solar radiation as possible and therefore solar reflection is minimised.

The potential impact will be of a long-term nature and the extent of the impact extends beyond the Project area and is regional in nature. The impact is expected to be moderate negative (Table 14.4**Error! Reference source not found.**). It is important to note that over time the visual impact will decrease as receptors become accustomed to the Project.

Table 14.4 Landacape and visual amenity (see Section 18 for more information)

Impact: Increase in impact to landscape and visual amenity		
	Before mitigation	**After mitigation**
Preferred Alternative	MODERATE -	LOW -

Mitigation Measures:

- Maintain the existing tree line along the M5;
- Consider screening with natural vegetation to the north and south of the project area;
- Rehabilitation of all disturbed areas (e.g. temporary access tracks and laydown areas) must be undertaken following construction. This must be done in such a way facilitate natural regeneration of vegetation; and
- Maintain ongoing engagement between the Project and local communities with regards to potential solar reflection impacts

14.5 Heritage and Cultural Resources

Cause and comment:
No excavations are anticipated during the operational phase. Should any cultural resources be identified during the construction phase these will be marked and either removed or "no-go" zones created.

Therefore, the impact to heritage and cultural resources is expected to be low negative (Table 14.5**Error! Reference source not found.**).

Table 14.5 Heritage and cultural resources (see Section 18 for more information)

Impact: Destruction and removal of heritage features		
	Before mitigation	**After mitigation**
Preferred Alternative	LOW -	LOW -

15 Social Environment Impacts - Decommissioning

The proposed Project is expected to operate for at least 20 years. Once the plant reaches the end of its life, the PV modules may be refurbished, or replaced to continue operations, or the facility may be closed and decommissioned. If decommissioned, all components would be removed and the site rehabilitated. Where possible all materials will be recycled, otherwise they will be disposed of in accordance with local regulations and international best practise and approximately 120 workers will be required.

16 SOCIO ECONOMIC IMPACTS – ALL PHASES

The impacts described for the socio-economic chapter are presented differently to the environmental impacts. This is due the contiguous nature of the impacts and the approach to mitigating the impacts.

16.1 LOSS OF CULTIVATED LANDS AND AGRICULTURAL LIVELIHOODS

Cause and comment:
A total of 183 cultivated plots have been identified in the proposed project development area using the recent google and drone imagery. The existence of these sites was also verified on site. The users of these lands appear to be residents of the neighbouring staff housing settlements belonging to Illovo and Dwangwe Small Cane Growers Association on the other (east) side of the M5 road. The land belongs to Illovo but is being used informally by employees and members of their households. Without mitigation, the development of the project will result in the loss of these arable lands and the crops growing on them at the time of construction. This is rated as a high negative social impact that will occur during the planning phase (Table 16.1).

As this land is leased by Illovo and is effectively private land, there is no requirement in the Malawi legal context to compensate people who are using this land informally. There are no traditional authorities responsible for land allocations in this area and no formal process for users to obtain permission to use this land. They are using it opportunistically, knowing that it belongs to Illovo and they are not entitled to use it or cut the trees down. Most of the people who are cultivating on this land are also likely to be employees or family of employees living in the neighbouring staff housing complexes, or the Dwangwa Cane Growers Association settlement, so the cultivation is supplemental to the main household income from employment and may only be used for household consumption. However, rice is usually grown as a cash crop and there is commercial demand for this crop. The extent to which Illovo is allowing, permitting and recording such informal cultivation use needs to be investigated further.

However, the IFC environmental and social standard five requires that any land user, whether formal or informal, must be compensated for their lost livelihoods, land and crops. They must be reinstated in another area or with an alternative livelihood at a similar or better quality they had prior to the project. In the case of this project, that would firstly mean finding alternative land for them to cultivate on, or to support them with developing alternative and equivalent or better livelihoods. Whether they would need to be compensated for crop losses would depend on whether the timing of the construction period and the resettlement planning process can be planned to allow people to harvest the fields and prepare new lands prior to the next season.

As Voltalia are planning to use only 60 ha of the 100 ha lease area, there is potential to relocate their fields to other parts of the project land. In addition, there is also the option for the affected people to relocate their fields to the unutilised area under the existing powerlines and adjacent to the M5 road. Parts of this area are already being cultivated but not all of it.

The existing soccer field on the proposed project area, which was developed by Illovo for the adjacent school and communities, will also be lost and must also be replaced in a suitable alternative site.

Table 16.1 Cultivated lands and agricultural livelihoods

Impact: Loss of cultivated lands and agricultural livelihoods		
	Before mitigation	**After mitigation**
Preferred Alternative	HIGH -	LOW -
No-go Alternative	N/A	N/A

Mitigation Measures:

A Livelihoods Restoration Plan (LRP) needs to be developed in consultation with the affected stakeholders that clearly identifies the displacement that will occur (to whom) and maps out a process for allocating alternative land for the affected local cultivators. This LRP needs to be developed based on a survey of the cultivators and their lands, and must be agreed on and implemented prior to construction being undertaken, and preferably before the next growing/cultivating season begins in Nov/Dec 2022.

The development of a LRP for the Voltalia project area will require the following:

1. A consultative process to identify alternative land for the soccer field and the cultivated fields with Illovo and the affected stakeholders and cultivators will be needed. This process must map out a way forward (and process for moving the croplands and soccer field), including notifying the cultivators of the need to relocate and the process and timeframe for that.
2. A survey of the cultivators in the project area will be needed to determine who is affected and to map the areas of land cultivated and types of crops grown. This data would then be used to plan and monitor the relocation and compensation process.
3. Planning the relocation process and developing the LRP and timeframe. Ideally relocation should be timed to avoid any impact on existing crops in the fields. This plan will need to be discussed with and approved by the affected persons and stakeholders, including Illovo and the Malawi Dept of Lands, prior to implementation, in order to meet IFC environmental and social standards.
4. Implementation, involving the mapping and allocating of alternative lands to the affected persons – ideally in time for them to prepare the land before the next wet season (i.e. Oct 2022).
5. Develop a grievance redress mechanism (GRM) for the relocation process that gives the affected persons an opportunity to lodge grievances, and to set up structures and processes to resolve the grievances. Ideally this should involve the appointment of one or more Community Liaison Officers, and someone more senior who would be responsible for negotiating solutions with all the relevant stakeholders. A committee with community leaders and representatives of the cultivators may also be needed to hear and resolve any more difficult grievances.
6. Management and monitoring of implementation of the relocation process to ensure that each affected cultivator obtains access to at least equivalent land to what they used previously.

7. Potential additional livelihoods restoration interventions to ensure that people are able to sustain and improve their livelihoods that could be considered for inclusion in the LRP could include:
    a. Assistance with preparing the new soccer field and providing additional infrastructure (i.e. goal posts/nets and planting shade trees around the periphery)
    b. Assistance with tilling the newly obtained lands
    c. Agricultural extension support (ie training workshops) to help farmers improve their productivity
8. If project implementation and the relocation planning is delayed, and the cultivators are not notified of the resettlement and cut-off dates, and consequently crops are cultivated in the project area in the next season, then the affected persons will need to be compensated in-kind for the crops lost – even if they don't plant crops because they are anticipating the relocation.
9. It is important therefore, to initiate the consultation, survey and planning process as soon as possible. The ideal window of opportunity for the relocation is between July and Sept 2022. Consultations, surveys and planning should be completed before then (July 2022).
10. Upon completion of the LRP implementation, Voltalia will need to commission an independent completion report on the implementation of the Livelihoods Restoration Plan, which provides the evidence that the plan (and agreed process) was implemented, grievances were resolved and people were compensated as intended in compliance with the relevant IFC environmental and social standards.

16.2 JOB CREATION

Cause and comment:
The Voltalia project will create some opportunities for local employment during the planning, construction, operational and decommissioning phases. Most of these will be created during the year-long construction phase. The construction contractors will be from Malawi and are expected to hire labour nationally and bring skilled workers in from the cities for the technical work, and hire local labour for the manual work. During the operational phase, Voltalia will employ some skilled technicians and a site manager, as well as a few security officers and around 10 maintenance and cleaning labourers. In communities where there are few employment and income generating opportunities and considerable poverty, job creation is valued as a positive benefit to the local communities and economy.

This impact is rated as a low positive impact (benefit) for the planning, operational and decommissioning phases and a moderate positive impact during the construction phase.

Table 16.2 Job creation

Impact: Possible job creation		
	Before mitigation	**After mitigation**
Preferred Alternative	LOW +	LOW +
No-go Alternative	N/A	N/A

Mitigation Measures:

Contractors must commit to hiring local labour as much as possible – to maximise local job opportunities.

16.3 ADDITIONAL POWER GENERATION AND GRID STABILITY

Cause and comment:
This solar power generation facility will generate 40 MW of power utilising 10 MW of storage that will be sold to ESCOM and be added to the national grid. This amounts to approximately 10% of Malawi's current total electricity generation capacity. The storage capacity will also help to regulate the supply of electricity. Voltalia will run the facility for 25 years, after which the contract with ESCOM could be extended or ESCOM will take over the running of the facility for another 15 years.

Given the considerable difficulties and limitations of electricity generation in Malawi, exacerbated by droughts and the recent floods, this is a significant social benefit that will contribute to the development of the Malawi economy (Table 16.3).

Table 16.3 Additional power generation and grid stability

Impact: Additional power generation and grid stability		
	Before mitigation	**After mitigation**
Preferred Alternative	MODERATE +	MODERATE +
No-go Alternative	N/A	N/A

Mitigation Measures:
Not applicable.

16.4 OCCUPATIONAL HEALTH AND SAFETY

Cause and comment:
During construction phase, failure to anticipate and take measures to avoid and minimise potential occupational health and safety risks during the construction and operation phase may result in the injury and harm of labourers, staff, surrounding residents and road users. This could be from the problematic use of or faulty equipment and machinery, as well as falls, accidents, fires, etc. Occupational risks also include the risk of sexual abuse and exploitation, sexual harassment (SEA/SH) and gender-based violence (GBV) amongst contract workers.

Based on the sensitivity of the receptors the impact is anticipated to me moderate negative prior to the implementation of mitigation measures (Table 16.4).

Table 16.4 Occupational health and safety

Impact: Increase in risks associated with occupational health and safety		
	Before mitigation	**After mitigation**
Preferred Alternative	MODERATE -	LOW -
No-go Alternative	N/A	N/A

Mitigation Measures:

- A health and safety plan in terms of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) and IFC PS 2 and 4 must be developed, adhered to and enforced by a HSE officer to ensure workers safety. This must include awareness raising and training activities, signed codes of conduct for contractors and anonymous grievance redress mechanisms to avoid and minimize the spread of communicable diseases, unwanted pregnancies and any sexual exploitation and abuse or sexual harassment (SEA/SH) and gender-based violence (GBV) incidents;
- As a general principle, all work activities undertaken by or on behalf of Voltalia must be covered by task based HSE Risks and Environmental Impacts Analyses, prepared by competent persons and considering all hazards and aspects likely to occur during the execution of the activity. The Voltalia HSE Minimum Requirements Procedure identifies the main sources of hazards in the activities of Voltalia and sets minimum requirements for mitigating their associated risks. This must be incorporated into the health and safety plan.

16.5 COMMUNITY HEALTH AND SAFETY

Cause and comment:
During all phases of the project failure to anticipate and take measures to avoid and minimse potential community health and safety risks may result in the injury and harm of surrounding residents and road users.

This is a particular risk when external workers are brought into rural communities and engage socially and professionally with local residents. There is a particular concern amongst the communities about increases in teenage pregnancies, infidelities, and the transmission of infectious diseases such as covid-19, HIV/AIDs and other STDs. Substance abuse, crime and assault incidents are other social concerns. These community health risks also include the risk of sexual abuse and exploitation, sexual harassment (SEA/SH) and gender-based violence (GBV).

This is rated as a high negative impact, that could be mitigated to a low negative impact (Table 16.5).

Table 16.5 Community health and safety

Impact: Increase in risks associated with community health and safety		
	Before mitigation	**After mitigation**
Preferred Alternative	HIGH -	LOW -
No-go Alternative	N/A	N/A

Mitigation measures:

- A Community Health and Safety Plan in terms of IFC PS 4 must be developed, adhered to and enforced by a HSE officer to ensure community safety. This must include awareness raising and training activities amongst contractors and community members, signed codes of conduct for contractors and anonymous grievance redress mechanisms to avoid and minimize the spread of communicable diseases, unwanted pregnancies and any sexual exploitation and abuse or sexual harassment (SEA/SH) and gender-based violence (GBV) incidents.
- Fence the solar farm and have security personnel present at all times to avoid trespassers entering the site to access solar panels;
- Train security personnel in safeguarding of the community in high tension situations such as community protests and community conflicts resulting in human rights abuses. This will include training the existing community policing function to provide support and engage the GVH's and TA when required;
- Establish clear and visible signage in construction areas to warn the community of any risks and hazards;
- Establish a community engagement programme to provide information about safety hazards and raise awareness of how these are being managed. This includes visits to all neighbouring communities and local schools; and
- Raise awareness to communities regarding their Grievance Mechanism to deal with community concerns and issues in a timely manner to avoid issues escalating. This will include the use of the Community Liaison Officer who will be present around the Project site pre- and during construction.

16.6 On site fire risk

Cause and comment:
Failure to plan for accidental fires during the construction and operation phase could result in potential harm to the public and/or surrounding landowners and their property (Table 16.6).

Table 16.6 Increase in risk for on-site fires

Impact: Increase in risks associated with community health and safety		
	Before mitigation	**After mitigation**
Preferred Alternative	MODERATE -	LOW -
No-go Alternative	N/A	N/A

Mitigation Measures:

- An Emergency Preparedness Plan must be in place for both the construction and operational phases and before these phases commence. This should form part of the method statement;
- Voltalia must plan for and put measures in place to prevent and deal with fires including the provision of firefighting equipment;
- During windy periods un-surfaced and un-vegetated areas must be dampened down;
- All flammable substances must be stored in dry areas which do not pose an ignition risk to the said substances;
- Smoking must not be permitted near flammable substances;

- All cooking must be done in demarcated areas that are safe in terms of runaway or uncontrolled fires;
- No open fires must be allowed on site; and
- Fire extinguishers must be available onsite.

16.7 WASTE MANAGEMENT

Cause and comment:
During the construction and operational phase, poor management of handling, disposal and storage of general and hazardous waste may lead to the pollution of the surrounding environment, including potential health risks to those on site and those communities who received the waste. See Section 4 for more details on the types of wastes anticipated.

During construction the waste generation is expected to be significantly more than during operation. However, given the sensitivities of the receptors the impact is expected to be moderate negative prior to the implementation of mitigation measures in both construction and operation. The residual impact is expected to be low negative (Table 16.7).

Table 16.7 Impacts from poor waste management

Impact: Waste management		
	Before mitigation	**After mitigation**
Preferred Alternative	MODERATE -	LOW -
No-go Alternative	N/A	N/A

Mitigation Measures:

- A waste management plan must be developed to cover all phases of the development.
- All general waste must be disposed of in bins/waste skips labelled “general waste”;
- Sufficient waste bins must be provided throughout the construction site for collecting waste;
- All general waste collected on site must be disposed of at a licensed general waste disposal site;
- All hazardous waste generated on site must be placed in a temporary impermeable bunded containment area which must be disposed of at a hazardous landfill site or be collected by the appropriate service provider;
- Proof of receipt of hazardous waste by a licenced service provider must be maintained on the site;
- Adequate sanitary facilities must be provided for construction workers and they must be properly secured to the ground;
- Maintenance of the chemical toilets should be done on a regular basis to prevent any leakages;
- Concrete and cement must take place on an impermeable surface, and dried waste concrete and cement must be disposed of with building rubble;
- No concrete mixing must take place within 30 m of any watercourse;
- Develop a robust waste handling system to avoid the creation of vermin breeding grounds.

- Establish measures through environmental controls which reduce the presence of standing water onsite during the site preparation phase;
- Ensure that working areas, such as site office areas are kept clean and free from any accumulation of wastes as well as supplied with clean potable water. This includes ensuring appropriate food preparation and monitoring measures are in place.

17 IMPACT SUMMARY - CONSTRUCTION PHASE

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
BIOLOGICAL ENVIRONMENT														
Soil Quality	All Alternatives	As a result of the clearing of plants and trees necessary for the implementation of the proposed project, there will be a direct loss of nutrients made available to the topsoil. This is likely to result in the interruption of the nutrient cycle and decrease the soil fertility of the area. Further degradation of the soil through compaction and erosion (wind and water) is expected.	Negative	Direct	Moderate	Study area	Long term	Probable	Reversible	Resource will be partially lost	Achievable	**MODERATE -**	• The removal of trees and plants must be limited to the absolute minimum; • Compaction as soil must be limited to areas where it is absolutely necessary; • Erosion control measures such as intercept drains and toe berms will be constructed where necessary to reduce the loss of topsoil; • Stockpiles must not exceed 1.5 m in height to maintain their viability; • Stockpiles must be covered during windy periods and during heavy rainfall; • Stockpiles stored longer than six weeks should be vegetated or covered (with sheeting, shade cloth or tarpaulin) to reduce soil loss from wind or storm water runoff; • Topsoil stripped during construction must be used to rehabilitate disturbed areas; and • All trenches/excavations must be backfilled and rehabilitated using topsoil from the stockpiles, where applicable.	**LOW -**
	No-go Alternative	There is evidence of use of the project site by Illovo and local communities. The Illovo activities include the use of sand for the maintenance of roads within their plantation and harvesting of biomass for use in their plant. Local communities use the land for crops. These activities are likely to continue under the no-go alternative.	Negative	Direct	Slight	Study area	Long term	Definite	N/A	N/A	N/A	**LOW -**	• N/A	**N/A**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Hydrology	All Alternatives	The proposed site clearance and construction activities may interrupt surface and/or subsurface flows, leading to flow concentration, change in flow pathways, flow impoundment, increased surface runoff and increased risk of erosion. Any activity that impedes or alters the natural subsurface flow in the catchment's soils could have indirect but potentially significant effects on the drainage features and wetlands.	Negative	Direct	Slight	Regional	Short term	May Occur	Reversible	Resource will be partially lost	Achievable	**LOW -**	• N/A	**LOW -**
		The results of the modelling show that the southern plot is most likely prone to flooding during heavy rainfalls. Impacts resulting from erosion are likely to be localised to watercourse crossings or where water resources are located directly downslope of construction works. Should the mentioned hydrological impacts result in scouring and gully erosion, impacts may persist for some time after the construction phase, especially if rehabilitation is not implemented.	Negative	Direct	Severe	Study area	Short term	Probable	Reversible	Resources will not be lost	Achievable	**HIGH -**	• Consideration of the option to channel water through the proposed project site, either by a closed pipe or a channel designed to accommodate the design flood. Because the flood water will flow from different directions/sources upstream of the proposed project site, a diversion of the water from these areas is necessary to ensure that the water will reach the desired inlet points.	**LOW -**
	No-go Alternative	There is evidence of use of the project site by Illovo and local communities. The Illovo activities include the use of sand for the maintenance of roads within their plantation and harvesting of biomass for use in their plant. These activities are likely to continue under the no-go alternative.	Negative	Direct	Moderate	Study area	Long term	Probable	N/A	N/A	N/A	**MODERATE -**	• N/A	**N/A**
TERRESTRIAL BIODIVERSITY AND ECOLOGY														
Loss of Closed Miombo Woodland	Preferred Alternative	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 0.57 ha of Closed Miombo Woodland	Negative	Direct	Low	Localised	Permanent	Definite	Irreversible	Resource will be completely lost.	Difficult	**LOW -**	Avoid/prevent impact: • Implement mitigation measures during planning and design phase. • Areas of high sensitivity must be avoided. • Construction activities must remain within the approved demarcated	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
		Portions of this vegetation type have already been lost due to farming activities to the east, expansion of residential areas to the west, harvesting of vegetation by local communities for building and thatching as well as from grazing of livestock.	Negative	Cumulative	Slight	Study area	Permanent	Definite	Reversible	Resource will be partially lost	Achievable	**MODERATE -**	development footprint, and no vegetation clearance is to be permitted outside of the approved development footprint. • Construction vehicles and machinery must not encroach into identified highly-sensitive, 'no-go' areas or areas outside the project footprint. • Lay down areas must not be located within any watercourses or drainage lines. • Topsoil (20 cm, where possible) must be collected and stored in an area of low sensitivity and used to rehabilitate impacted areas that are no longer required during the operational phase (e.g. laydown areas). • Only indigenous species must be used for rehabilitation. • The alien invasive management plan for the site must be implemented.	**LOW -**
	No-go Alternative	There is some evidence of harvesting of natural resources within the site. There has also been clearing and planting of woodlots in the middle of the site as well as mining for sand towards the south. These activities are likely to continue under the no-go alternative and will have a low negative impact on the remaining miombo woodland.	Negative	Direct	Moderate	Study Area	Permanent	Definite	Reversible	Resource could be partially lost	Difficult	**LOW -**	• N/A	**N/A**
Loss of Open Miombo Woodland	Preferred Alternative	Under this alternative, the clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the permanent loss of up to 2.14 ha of Open Miombo Woodland. Since this will be permanently lost, the overall significance will be moderate negative even after mitigation measures have been implemented.	Negative	Direct	Slight	Localised	Permanent	Definite	Irreversible	Resource will be completely lost.	Difficult	**LOW -**	• Refer to mitigation measures listed above for closed miombo woodland.	**LOW -**
	Cumulative Impact	Portions of this vegetation type have already been lost due to farming activities to the east, expansion of residential areas to the west, harvesting of vegetation by local communities for building and thatching as well as from grazing of livestock. The additional loss of 5 ha of closed and open miombo woodland will therefore have a moderate cumulative impact.	Negative	Direct	Moderate	Localised	Permanent	Definite	Irreversible	Resource could be partially lost	Difficult	**MODERATE-**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above.	**N/A**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
	No-Go Impact	There is some evidence of harvesting of natural resources within the site. There has also been clearing and planting of woodlots in the middle of the site as well as mining for sand towards the south. These activities are likely to continue under the no-go alternative which has a significance of Low Negative.	Negative	Direct	Moderate	Study Area	Permanent	Definite	Reversible	Resource could be partially lost	Difficult	**LOW -**	• N/A	**N/A**
Loss of Grassland-Savanna Mosaic	Preferred Alternative	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 31.16 ha of grassland-savanna mosaic. Since this vegetation type is intact and will be permanently lost, the overall significance will be moderate negative even after mitigation measures have been implemented.	Negative	Direct	Moderate	Localised	Permanent	Definite	Irreversible	Resource will be completely lost.	Difficult	**MODERATE -**	• Refer to mitigation measures listed above for closed miombo woodland.	**MODERATE -**
	Cumulative Impact	Portions of this vegetation type have already been lost due to farming activities to the east, expansion of residential areas to the west, harvesting of vegetation by local communities for building and thatching as well as from grazing of livestock. The additional loss of 35.9 ha of this vegetation type will therefore have a moderate cumulative impact.	Negative	Direct	Moderate	Local	Permanent	Definite	Irreversible	Resource could be partially lost	Difficult	**MODERATE -**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above.	**N/A**
	No-Go Impact	There is some evidence of harvesting of natural resources within the site. There has also been clearing and planting of woodlots in the middle of the site as well as mining for sand towards the south. These activities are likely to continue under the no-go alternative which has a significance of Low Negative.	Negative	Direct	Moderate	Study Area	Permanent	Definite	Reversible	Resource could be partially lost	Difficult	**LOW -**	• N/A	**N/A**
Loss of Plant Species of Conservation Concern	All Alternatives	Only one species (*Pterocarpus angolensis*) was identified as a SCC due its status of Vulnerable on the National Red List. Although the permanent loss of this plant species of conservation concern within the site may occur, it is relatively widespread and the loss will not impact this specie's survival at this stage.	Negative	Direct	Moderate	Localised	Permanent	Definite	Irreversible	Resource will be partially lost.	Achievable	**MODERATE -**	• A botanical walkthrough of the site, by an experienced botanist with knowledge of the SCC that has been identified as occurring within the site, must be undertaken. Where there are groupings of this species, this area must be marked as a no-go area and the placement of infrastructure must avoid this area. • Where there are single individuals with no other individuals within a 50m radius, these may be removed. The wood from these individuals must be given to local communities as it is a valuable resource.	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Disruption of Ecosystem Function and Process	Cumulative Impact	The additive effect associated with the cumulative loss of *Pterocarpus angolensis* will be of moderate significance.	Negative	Direct	Moderate	Regional	Permanent	Definite	Irreversible	Resource could be partially lost	Difficult	**MODERATE -**	If the powerline is positioned to avoid direct impacts on this vegetation type, the cumulative impact will be low.	**N/A**
	No-Go Impact	As per the above, under the no-go alternative the vegetation will remain unchanged and the current impacts are therefore negligible.	N/A									**NEGLIGIBLE**	• N/A	**N/A**
	Preferred Alternative	Approximately 60 ha of near natural and transformed vegetation will be replaced by solar panels resulting in the loss of this natural ecological corridor that runs from the north to the south between the sugar plantations to the east and the residential area to the west.	Negative	Direct	Moderate	Study Area	Permanent	Definite	Irreversible	Resource could be partially lost	Difficult	**MODERATE -**	• Rehabilitate laydown areas. • Use existing access roads and upgrade these where necessary. • Where feasible, situate new powerlines adjacent to existing ones. • Faunal species are important for the dispersal of seeds and their movement must therefore not be inhibited. As such it is recommended that an ecological corridor through an area of natural vegetation is included to ensure the continued movement of species from north to south between the existing sugar plantation and residential area. It is recommended that the Closed Miombo Woodland, which forms a natural corridor is used. • Avoid locating panels in riparian areas as these provide natural ecological corridors.	**MODERATE -**
	Cumulative Impact	There is already a fair amount of habitat fragmentation as a result of the surrounding land-uses. The additive affect associated with the loss of natural vegetation will be of moderate significance.	Negative	Direct	Moderate	Study Area	Permanent	Definite	Irreversible	Resource could be partially lost	Difficult	**MODERATE -**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. However, it is imperative that the applicant implement the mitigation measures listed above.	**N/A**
	No-Go Impact	Under the no go alternative, habitat fragmentation has already occurred and will continue to do so. However, this will be at a significantly smaller scale than the direct impact.	Negative	Direct	Slight	Localised	Permanent	Definite	Reversible	Resource could be partially lost	Difficult	**LOW -**	• N/A	**N/A**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Establishment of Alien Plant Species	All Alternatives	Disturbance to habitats often results in the infestation of alien species and displacement of indigenous vegetation unless these are controlled. There are already two species of Eucalyptus on site as well as Gmelina. Should this happen the impact will be of high significance. However, this impact is easily mitigated trough the implementation of an alien invasive management and monitoring plan.	Negative	Direct	Severe	Study Area	Permanent	Definite	Irreversible	Resource could be partially lost	Achievable	**HIGH -**	• The site must be checked regularly for the presence of alien invasive species. • An alien invasive management and monitoring plan must be incorporated into the ESMP. • The ECO must create a list with accompanying photographs of possible alien invasive species that could occur on site prior to construction. This photo guide must be used to determine if any alien invasive species are present.	**LOW -**
	Cumulative Impact	There is already evidence of alien species on site. These are mostly being grown within woodlots but there is the risk that they could escape into the natural environment if not controlled. The clearing of vegetation for the construction of the solar PV plant could result in the disturbance of the seedbank and establishment of alien species outside of the controlled woodlots. The additive impact will be of moderate significance.	Negative	Direct	Moderate	Study Area	Permanent	Definite	Irreversible	Resource could be partially lost	Difficult	**MODERATE -**	It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. • However, it is imperative that the applicant implement the mitigation measures listed above.	**N/A**
	No-Go Impact	Under the no-go alternative, the infestation of alien species is likely to be controlled and kept within woodlots.	Negative	Direct	Slight	Localised	Permanent	Definite	Reversible	Resource could be partially lost	Difficult	**LOW -**	• N/A	**N/A**
Loss of ecosystem services provided by the plant communities identified in the study area	Preferred Alternative	Loss of ecosystems services through the removal of vegetation communities will result in the loss of ecosystem services provided by each vegetation type. This is relevant since the local communities are reliant on these areas as a source of food and medication, for construction materials and fuel wood and as a source of income through activities such as charcoal production. These species, however, are fairly widespread and are also found outside of the footprint of the proposed project area.	Negative	Direct	Moderate	Study Area	Medium term	Probable	Reversible	Resource may be partially lost	Easily Achievable	**MODERATE -**	• Allow local communities the opportunity to harvest plants prior to the start of the construction phase activities.	**MODERATE -**
		The cumulative loss of natural resources as a result of development occurring in the area will mean that communities reliant on the project site for ecosystem services will need to look further afield and possibly travel longer distances to find what they need. Given that there is development on either side of the project site this impact will be of moderate significance.	Negative	Direct	Moderate	Study Area	Medium term	Probable	Reversible	Resource may be partially lost	Easily Achievable	**MODERATE -**		**N/A**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
	No-go Alternative	The use of ecosystem services provided by the plant communities is likely to continue should the proposed project not proceed. This will have a low negative impact on the site, with habitats continuing to degrade.	Negative	Direct	Slight	Study Area	Long term	Probable	Reversible	Resource may be partially lost	Achievable	**LOW -**	• N/A	**N/A**
Direct ecosystem modification or destruction / loss impacts Alteration of water quality Water pollution	Preferred Alternative	During the construction phase, vegetation clearance and earthworks, including excavation and infilling, may result in the partial loss of the wetland to the west of the existing ESCOM substation.	Negative	Direct	Moderate	Study area	Long term	Definite	Irreversible	Resource may be lost	Difficult	**MODERATE -**	• The wetland buffers should be demarcated, and no activities should be allowed to occur within these buffers. • Construction materials must not be stored within the moderate sensitivity	**MODERATE -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
		During the construction phase, the clearance of vegetation and compaction of soil may result in increased run-off and erosion resulting in elevated levels of sediment entering the system. This could result in significant water quality concerns which in-turn may compromise the aquatic habitat.	Negative	Indirect	Moderate	Study area	Medium term	Probable	Reversible	Resource may be partially lost	Achievable	**MODERATE -**	areas. • Stockpiles must not be stored within the moderate sensitivity areas. • Construction activities should be undertaken during the driest part of the year, to the extent possible, to minimize erosion and downstream sedimentation due to excavation, etc. • Appropriate stormwater structures must be implemented during construction to control run-off and minimize erosion. • Vegetation clearing must be kept a minimum and only to the site footprint. • Erosion controls and sediment trapping measures must be put in place. • Stockpiles must be monitored for erosion and mobilisation of materials towards watercourses. • Stockpiles must not exceed 1.5 m in height. Stockpiles must be covered during windy periods. • Disturbed areas must be monitored for erosion channels and these must be rehabilitated. • All trenches/excavations must be backfilled and all disturbed areas backfilled, compacted and revegetated, where applicable.	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
		During the construction phase, accidental spillages of wet concrete and chemical / hazardous substances may result in soil and groundwater contamination, adversely affecting the aquatic ecosystems in the broader area.	Negative	Indirect	Moderate	Study area	Short term	Possible	Reversible	Resource may be partially lost	Achievable	**MODERATE -**	• No concrete mixing must take place within 30 m of any watercourse. • No machinery must be parked overnight within 50 m of the rivers/wetlands. • All stationary machinery must be equipped with a drip tray to retain any oil leaks. • Chemicals used for construction must be stored safely on bunded surfaces in the construction site camp. • No ablution facilities must be located within 50 m of any river or wetland system. • Chemical toilets must be regularly maintained/ serviced to prevent ground or surface water pollution. • Any hazardous substances/waste must be stored in impermeable bunded areas or secondary containers 110% the volume of the contents within it. • All general waste and refuse must be removed from site and disposed and windproof temporary storage area before being disposed of at a registered landfill site. • Emergency plans must be in place in case of spillages onto bare soil or within water courses.	**LOW -**
	No-go Alternative	The current wetlands and aquatic resources are used by the local communities for a number of functions. They use the wetlands for the growing of rice, a cash crop. Additional uses include for washing of clothes and watering livestock.	Negative	Direct	Moderate	Study Area	Long term	Definite	N/A	N/A	N/A	**MODERATE -**	• N/A	**N/A**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Loss of extent of faunal habitat (feeding, breeding, shelter and roosting sites) resulting in a reduction in species diversity	Preferred Alternative	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 0.57 ha of Closed Miombo Woodland, 2.14 ha of open miombo woodland and 35.9ha of grassland-Savanna mosaic. These all provide important habitat for a range of faunal species. The loss of extent of faunal habitat will result in the loss of feeding, breeding, shelter and roosting sites for faunal species and the impact associated with this loss, will be a reduction in species diversity. However, to place this impact in context, it should be noted that the habitat that will be lost is directly adjacent to large plantations of sugar cane along the eastern border and there is already likely to be a lower species diversity due to existing habitat fragmentation and edge effects. The further loss of habitat will result in faunal species being displaced to the east, north and south. This impact is difficult to mitigate since the loss of extent of faunal habitat will be long term and as such the impact significance remains the same even after mitigation.	Negative	Direct	Moderate	Study Area	Long term	Probable	Irreversible	Resource may be partially lost	Difficult	**MODERATE -**	• Construction vehicles and machinery must not encroach into identified 'no-go' areas or areas outside the project footprint; • Where feasible Closed Miombo Woodland as identified in the Botanical report, should be avoided as it provides important refugia for faunal species in the area; • Lay down areas must not be located within any watercourses or drainage lines; • Employees must be prohibited from making open fires during the construction phase; • Employees must be prohibited from poaching wild animals within or adjacent to the site; • The development footprint of the proposed solar PV plant and associated infrastructure (roads and laydown areas) must be demarcated to prevent any encroachment of construction or operational activities into surrounding natural areas; • Edges of roads, sidewalks and any elevated area must not have steep sides and must have a gentle slope; • Any fencing required must be wildlife permeable especially at strategic places such as along drainage lines or other areas of dense vegetation. This allows for small and medium sized animals to move between their natural habitat unencumbered. If electrified strands are to be use, there are to be no strands within 30 cm of the ground. As an example, if a tortoise touches this strand it automatically retreats into its shell and does not move because it senses danger, and the repeated shocks eventually kill it (Arnot & Moteno, 2017); and • Create additional faunal micro habitats e.g. rocky outcrops, corridors of shrubbery, stumperies	**MODERATE -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
		Portions of faunal habitat have already been lost due to farming activities to the east, expansion of residential areas to the west, harvesting of vegetation by local communities for building and thatching as well as from grazing of livestock. The additional loss of faunal habitat will therefore have a moderate cumulative impact.	Negative	Cumulative	Moderate	Local	Permanent	Definite	Irreversible	Resource could be partially lost	Difficult	**MODERATE -**	• It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. • However, it is imperative that the applicant implement the mitigation measures listed above.	N/A
	No-go Alternative	There is some evidence of harvesting of natural resources within the site. There has also been clearing and planting of woodlots in the middle of the site as well as mining for sand towards the south. These activities are likely to continue under the no-go alternative and will have a low negative impact on the remaining faunal habitat.	Negative	Direct	Moderate	Study area	Medium term	Probable	N/A	N/A	N/A	**LOW -**	N/A	**N/A**
Impact on faunal species of conservation concern	Preferred Alternative	The SCC that possibly occur on the project area include bat species which may utilise the woodland/forest habitat for shelter as well as the nearby buildings and forage over the wetland and grassland. It is possible that the terrapin and occasionally otters may utilise the river channels and wetland areas. Migrant species may utilise habitats on the project area but not exclusively and raptors may nest on existing powerlines and well-established trees in the woodland/riparian forest. The blue swallow was confirmed on the northern site in the savanna habitat trees.	Negative	Direct, Indirect	Moderate	Localised	Long term	May occur	Irreversible	Resource could be partially lost	Achievable	**MODERATE -**	• All clearing activities must deploy search and rescue teams in-front of clearing machinery to assist in relocating slower moving faunal species e.g. tortoises. • Search and rescue deployed ahead of clearance, including diurnal active searches (during spring to early autumn if feasible). • Intact habitat patches where these species are known to occur (rocky outcrops and hillsides) should be buffered from disturbance taking into account connectivity to other similar habitat, or at least habitats that these species will utilise for migration and dispersal purposes. • The minimum buffer requirement is 30 m. However, a 100 m buffer is recommended for high impact activities.	**LOW -**
	No-go alternative	Disturbance will probably continue should the proposed project not proceed. This will have a low negative impact on the site, with habitats continuing to degrade.	Negative	Direct	Slight	Study area	Medium term	Probable	N/A	N/A	N/A	**LOW -**	N/A	**N/A**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Faunal mortalities as a result of construction activities including road collisions	Preferred Alternative	The movement of heavy machinery and an increased number of vehicles during the construction phase may result in the accidental mortality of faunal species, specifically fossorial species and slow-moving species.	Negative	Direct	Moderate	Study Area	Short Term	Definite	Reversible	Resource could be partially lost	Achievable	**MODERATE -**	• Staff and contractors' vehicles must comply with speed limits of 40km/hr • Project must start and be completed within the minimum timeframe. i.e. may not be started and left incomplete; • ECO to walk ahead of clearing construction machinery and move slow moving species e.g. tortoises out of harms way and into suitable neighbouring habitat; • Any faunal species that may die as a result of construction must be recorded (photographed, gps co-ordinates) and if somewhat intact preserved and donated to a Malawian University equipped to preserve the remains; • Any faunal species observed onsite must be recorded (photographed, gps co-ordinates); and • Staff and contractors are not permitted to capture, collect or eat any faunal species onsite	**LOW -**
		There are no similar construction activities in the area and as such there is unlikely to be a cumulative impact.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**N/A**		**N/A**
	No-go Alternative	Under the no go alternative, faunal mortality from construction activities will not occur.	Negative	Direct	Slight	Localised	Permanent	Definite	Reversible	Resource could be partially lost	Difficult	**LOW -**	N/A	N/A
Increased Human-animal conflict	All Alternatives	There are existing troops of baboons and monkeys which may cause damage to equipment and may raid any living quarters and waste disposal sites.	Negative	Indirect	Slight	Study Area	Long term	Probable	Reversible	Resource may be partially lost	Achievable	**MODERATE -**	• Refuse should be isolate to one area; • Consider separating organic refuse out and store in baboon proof bins. • All refuse bins must be baboon proof; • Project related staff must not feed wildlife. Include in the Code of Conduct; • Project employees must be made aware of the risks associated with encountering potentially dangerous animals (venomous snakes and baboons); and • If a snake is encountered development staff and residents are to contact the designated snake handler for removal and relocation.	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
SOCIAL ENVIRONMENT														
Air quality	All Alternatives	During the construction phase, dust generated by construction vehicles and construction activities could result in significant dust during windy conditions.	Negative	Direct	Moderate	Study area	Short-term	Definite	Reversible	Resource will not be lost	Achievable	**MODERATE -**	• Land clearance should be sequential and where ground and earthworks are undertaken the smallest possible area for working will be exposed;	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
		During the construction phase poor maintenance and servicing of construction plant and vehicles may result in an increase in vehicle emissions in the areas.	Negative	Indirect	Moderate	Study area	Short-term	Probable	Reversible	Resource will not be lost	Achievable	**MODERATE -**	• Stripping of topsoil will not be conducted earlier than required (maintain vegetation cover for as long as possible) in order to prevent the erosion (wind and water) of organic matter, clay and silt; • During windy periods un-surfaced and un-vegetated areas must be dampened down; • Vegetation must be retained where possible as this will reduce dust travel; • A speed limit of 30 kph on unpaved surfaces to be enforced and the national speed limits on public roads are not to be exceeded; • All transported materials must be covered with tarpaulins to prevent fugitive dust; • Stockpiles stored longer than six weeks should be vegetated or covered (with sheeting, shade cloth or tarpaulin) to reduce soil loss from wind or storm water runoff; • Stockpiles will be located as far away from receptors as possible and will be covered (with sheeting, shade cloth or tarpaulin); • Vehicles and construction plant must be serviced regularly so as to reduce excessive vehicle emissions; • When not in use, vehicles will be switched off, unless impractical for health and safety reasons (for example, maintenance of air conditioning); and • Any complaints or claims emanating from dust issues must be attended to immediately and noted in the complaints register.	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
	No-go Alternative	There is some evidence of some use of the site by Illovo through clearing and sand "mining". These activities are likely to continue under the no-go alternative.	Negative	Indirect	Slight	Study area	Long-term	Probable	N/A	N/A	N/A	**LOW -**	• N/A	**N/A**
Noise disturbance	All Alternatives	During construction phase the main potential impacts on the acoustic environment are related to the noise from construction machinery and construction vehicles being used for the following: • Site preparation such as vegetation clearance and minor earthworks. These activities will require heavy construction vehicles and equipment (excavators, dozers, dump trucks); • Civil works and installation such as drilling for mounting structure frames, construction of inverter and transformer station foundations and construction of stores, workshop, and office buildings; and • Road traffic offsite: the movement of vehicles for transport of materials and personnel on local roads and/or new access roads close to communities will also generate additional noise.	Negative	Indirect	Moderate	Study area	Short term	Probable	Reversible	Resource will not be lost	Achievable	**MODERATE -**	• Maintain machines and plant equipment in good working condition and inspect regularly; • Select equipment and vehicles in accordance with best available techniques for noise reduction; • Minimise vehicle movements within and around the site as much as possible; • Use screening/site hoardings to screen noise where appropriate; and • Any complaints or claims regarding noise disturbance must be attended to immediately and noted in the complaints register.	**LOW -**
	No-go Alternative	There is some evidence of some use of the site by Illovo through clearing and sand "mining". These activities are likely to continue under the no-go alternative.	Negative	Indirect	Slight	Study area	Long term	Probable	N/A	N/A	N/A	**LOW -**	• N/A	**N/A**
Traffic and Transport	All Alternatives	The key regional road is the M5 that runs adjacent to the proposed project site. The road is single lane and is in disrepair in many places. There are frequent heavy goods vehicles that use the route carrying tobacco, maize, and sugar. The road passes through trading centres, where pedestrians, cyclists, and traders also use the road. The addition of project traffic increases the risk of road accidents.	Negative	Direct	Severe	International	Short term	May occur	Reversible	Resource will not be lost	Easily achievable	**HIGH -**	• The speed limit specified for the national roads must be strictly adhered to by the plant and contractor workforce; • Deliveries of construction material at night should be avoided; • All drivers must receive training for each type of vehicle including light vehicle training, heavy vehicle	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
		An increase in traffic as a result of the project could cause congestion on public roads.	Negative	Direct	Moderate	International	Short term	May occur	Reversible	Resource will not be lost	Easily achievable	**MODERATE -**	truck training and abnormal truck load (including low-bed and trailers) training before they are permitted to drive; • Deliveries by heavy vehicles must, as far as possible, be scheduled to avoid the formation of convoys; • Speed warning signage and vehicle GPS tracking devices should be installed in vehicles to discourage and monitor speeding; • An Emergency Preparedness and Response Plan must be prepared and implemented, and must include provisions to deal with traffic accidents, particularly accidents involving personal injuries, and all drivers must be made aware of the procedures to be followed; • Vehicles should be serviced regularly; • The delivery of all abnormally sized loads should be planned together with the Malawian traffic authorities; • Abnormally sized loads should be delivered at off-peak times of the day; and • Vehicles should only be loaded to their design capacity, and not overloaded.	**LOW -**
	No-go Alternative	There is some evidence of some use of the local roads by Illovo vehicles. These activities are likely to continue under the no-go alternative.	Negative	Direct	Slight	Study area	Long term	May occur	N/A	N/A	N/A	**LOW -**	• N/A	**N/A**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Landscape and visual character	All Alternatives	Construction activities may have an impact on the visual character of the landscape due to the following: • Clearance of vegetation (in particular clearance of trees and removal of • crops); • Presence of large construction vehicles and equipment on site; • Fencing of works and restrictions to site access; and • Construction of the plant.	Negative	Direct/Indirect	Moderate	Study area	Short term	Probable	Reversable	Resource will not be lost	Achievable	**MODERATE -**	• Retain screening vegetation around the perimeter of the site as far as possible; • Placement of stockpiles around the perimeter of the site should be considered to act as a barrier; • Ongoing rehabilitation of cleared areas to minimise visual scarring and maintenance clearing will be kept to the absolute minimum and should not extend beyond the Project site boundary; • Any excavated or cut and fill areas will be landscaped and allowed to revegetate; • No debris or waste materials will be left at the work sites; and • Appropriate directional and intensity settings will be utilised on all lighting.	**LOW -**
	No-go Alternative	There is evidence of use of the project site by Illovo and local communities. The Illovo activities include the use of sand for the maintenance of roads within their plantation and harvesting of biomass for use in their plant. Local communities use the land for crops. These activities are likely to continue under the no-go alternative.	Negative	Direct/indirect	Slight	Study area	Long term	May occur	N/A	N/A	N/A	**LOW -**	• N/A	**N/A**
Loss of archaeological features	All Alternatives	The study identified 5 areas within the site that contained heritage features. Given the nature of the construction activities it is anticipated that these will be disturbed.	Negative	Direct	Moderate	Study area	Permanent	Probable	Irreversible	Resource may be partially lost	Achievable	**MODERATE -**	An Archaeological Chance Find Procedure, in line with the IFC Performance Standards, needs to be developed.	**MODERATE -**
Loss of historically significant building and structures	All Alternatives	The study identified no buildings or structures of historical or heritage significance.	Negative	Direct	Slight	Study area	Permanent	Unlikely	Irreversible	Resource will not be lost	Achievable	**LOW -**	• N/A	**LOW -**
Alternation of cultural landscape	All Alternatives	Generally, the proposed project area and its surrounds are characterised by open fields and farmlands. Further away from the project area, the landscape is typical of rural Malawi with undulating hills with flatter plains in-between. This landscape stretches over many kilometres and the proposed project is unlikely to result in a significant impact on the landscape.	Negative	Direct	Moderate	Study area	Permanent	Probable	Irreversible	Resource may be partially lost	Achievable	**MODERATE -**	An Archaeological Chance Find Procedure, in line with the IFC Performance Standards, needs to be developed.	**MODERATE -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Disturbance to graves/human burial sites	Preferred Alternative	No graves of human burial places were noted during the site investigation.	Negative	Direct	Slight	Study area	Short Term	Unlikely	Irreversible	Resource will not be lost	Achievable	**LOW -**	Human remains are usually observed when they are exposed through erosion. In some instances, packed stones or rocks may indicate the presence of informal pre-colonial burials. If any human bones are found during the course of construction work, then they should be reported to an archaeologist and work in the immediate vicinity should cease until the appropriate actions have been carried out by the archaeologist. Where human remains are part of a burial, they would need to be exhumed under a permit. Should any unmarked human burials/remains be found during the course of construction, work in the immediate vicinity should cease and the find must immediately be reported to the archaeologist. Under no circumstances may burials be disturbed or removed until such time as necessary statutory procedures required for grave relocation have been met.	**LOW -**
SOCIO ECONOMIC IMPACTS														
Loss of cultivated lands (informal) and agricultural livelihoods	All Alternatives	During the planning and design phase, PAPs who are informally cultivating in the proposed project area will lose access to their existing cultivated lands in the proposed project area. The loss of such cultivated land would have negative livelihood impacts for the cultivators who are members of Illovo and DSGA staff households who live adjacent to the project area, as well as residents of neighbouring Mowe community.	Negative	Direct	Severe	Localized	Long term	Definite	Reversible	Resource will not be lost	Achievable	**HIGH -**	A Livelihoods Restoration Plan (LRP) needs to be developed in consultation with the affected stakeholders that clearly identifies the displacement that will occur and maps out a process for allocating alternative land for the affected local cultivators. This LRP needs to be developed based on a survey of the cultivators and their lands, and must be agreed on and implemented prior to construction being undertaken, and preferably before the next growing/cultivating season begins in Nov/Dec 2022.	**LOW -**
Job creation	All Alternatives	During the planning and design phase, there will be some temporary job opportunities associated with planning and design of the proposed solar park.	Positive	Direct	Slight	Localized	Short-term	Definite	N/A	Resource will not be lost	Easily Achievable	**LOW +**	N/A	**LOW +**

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POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Additional power and grid stability	All Alternatives	This solar power generation facility will generate 40 MW of power and provide an additional 10 MW of storage that will be sold to Escom and be added to the national grid. This amounts to 10% of Malawi's total electricity generation capacity. The storage capacity will also help to regulate the supply of electricity. Voltalia will run the facility for 25 years, after which the contract with ESCOM could be extended or Escom will take over the running of the facility for another 15 years.	Positive	Direct/Indirect	Moderate	Regional	Long term	Probable	N/A	N/A	N/A	MODERATE +	N/A	MODERATE +
Occupational Health and Safety	All Alternatives	During construction phase, failure to anticipate and take measures to avoid and minimise potential occupational health and safety risks during the construction and operation phase may result in the injury and harm of labourers, staff, surrounding residents and road users. This could be from the problematic use of or faulty equipment and machinery, as well as falls, accidents, fires, etc. Occupational risks also include the risk of sexual abuse and exploitation, sexual harassment (SEA/SH) and gender-based violence (GBV) amongst contract workers.	Negative	Direct, Indirect	Moderate	Study area	Short-term	Possible	Irreversible	Resource will be lost	Achievable	MODERATE -	• A health and safety plan in terms of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) must be drawn up by and HSE officer prior to construction to ensure workers safety. • Fence the solar farm and have security personnel present at all times to avoid trespassers entering the site to access solar panels; • Train security personnel in safeguarding of the community in high tension situations such as community protests and community conflicts resulting in human rights abuses. This will include training the existing community policing function to provide support and engage the GVH's and TA when required; • Project Security will comply with Malawian laws and regulations as well as the requirements of the Voluntary Principles for Security and Human Rights. The security will include, among other things, selection of personnel based on a careful background screening, and monitoring of performance; • Implement security measures to minimise safety risks and the possibility of theft in construction camps, storage areas etc; and • Establish a community engagement programme to provide information about safety hazards and raise awareness of how these are being managed.	LOW -

Community Health and Safety	All Alternatives	During all phases of the project failure to anticipate and take measures to avoid and minimse potential community health and safety risks may result in the injury and harm of surrounding residents and road users. This is a particular risk when external workers are brought into rural communities and engage socially and professionally with local residents. There is a particular concern amongst the communities about increases in teenage pregnancies, infidelities, and the transmission of infectious diseases such as covid-19, HIV/AIDs and other STDs. Substance abuse, crime and assault incidents are other social concerns. These community health risks also include the risk of sexual abuse and exploitation, sexual harassment (SEA/SH) and gender-based violence (GBV).	Negative	Direct, Indirect	Moderate	Study area	Short-term	Possible	Irreversible	Resource will be lost	Achievable	**MODERATE -**	• A Community Health and Safety Plan in terms of IFC PS 4 must be developed, adhered to and enforced by a HSE officer to ensure community safety. This must include awareness raising and training activities amongst contractors and community members, signed codes of conduct for contractors and anonymous grievance redress mechanisms to avoid and minimize the spread of communicable diseases, unwanted pregnancies and any sexual exploitation and abuse or sexual harassment (SEA/SH) and gender-based violence (GBV) incidents. • Fence the solar farm and have security personnel present at all times to avoid trespassers entering the site to access solar panels; • Train security personnel in safeguarding of the community in high tension situations such as community protests and community conflicts resulting in human rights abuses. This will include training the existing community policing function to provide support and engage the GVH's and TA when required; • Establish clear and visible signage in construction areas to warn the community of any risks and hazards; • Establish a community engagement programme to provide information about safety hazards and raise awareness of how these are being managed. This includes visits to all neighbouring communities and local schools; and • Raise awareness to communities regarding their Grievance Mechanism to deal with community concerns and issues in a timely manner to avoid issues escalating. This will include the use of the Community Liaison Officer who will be present around the Project site pre- and during construction.	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
On-site fire risk	All Alternatives	During the planning and design phase, failure to plan for accidental fires during the construction and operation phase could result in potential harm to the public and/or surrounding landowners and their property.	Negative	Direct	Moderate	Study area	Medium-term	Possible	Irreversible	Resource will be lost	Easily Achievable	**MODERATE -**	• An Emergency Preparedness Plan must be in place for both the construction and operational phases and before these phases commence. This should form part of the method statement; • Voltalia must plan for and put measures in place to prevent and deal with fires including the provision of firefighting equipment; • During windy periods un-surfaced and un-vegetated areas must be dampened down; • All flammable substances must be stored in dry areas which do not pose an ignition risk to the said substances; • Smoking must not be permitted near flammable substances; • All cooking must be done in demarcated areas that are safe in terms of runaway or uncontrolled fires; • No open fires must be allowed on site; and • Fire extinguishers must be available onsite.	**LOW -**

Waste Management	All Alternatives	During the construction and operational phase, poor management of handling, disposal and storage of general and hazardous waste may lead to the pollution of the surrounding environment, including potential health risks to those on site and those communities who received the waste.	Negative	Direct	Moderate	Regional	Long term	Possible	Reversible	Resource will not be lost	Easily Achievable	**MODERATE -**	• A waste management plan must be developed to cover all phases of the development. • All general waste must be disposed of in bins/waste skips labelled “general waste”; • Sufficient waste bins must be provided throughout the construction site for collecting waste; • All general waste collected on site must be disposed of at a licensed general waste disposal site; • All hazardous waste generated on site must be placed in a temporary impermeable bunded containment area which must be disposed of at a hazardous landfill site or be collected by the appropriate service provider; • Proof of receipt of hazardous waste by a licenced service provider must be maintained on the site; • Adequate sanitary facilities must be provided for construction workers and they must be properly secured to the ground; • Maintenance of the chemical toilets should be done on a regular basis to prevent any leakages; • Concrete and cement must take place on an impermeable surface, and dried waste concrete and cement must be disposed of with building rubble; • No concrete mixing must take place within 30 m of any watercourse; • Develop a robust waste handling system to avoid the creation of vermin breeding grounds. • Establish measures through environmental controls which reduce the presence of standing water onsite during the site preparation phase; • Ensure that working areas, such as site office areas are kept clean and free from any accumulation of wastes as well as supplied with clean potable water. This includes ensuring appropriate food preparation and monitoring measures are in place.	**LOW -**

18 IMPACT SUMMARY - OPERATIONAL PHASE

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
BIOLOGICAL ENVIRONMENT														
Soil Quality	Preferred Alternative	The impacts to the soil quality are likely to take place during construction. No earthworks are expected during the operational phase. There is a risk of erosion during heavy rainfall events in areas that have not been rehabilitated.	Negative	Direct	Slight	Study area	Long term	May occur	Reversible	Resource will be partially lost	Achievable	**LOW -**	N/A	**LOW -**
Hydrology	Preferred Alternative	Given that many of the deviations and changes will occur during the construction phase the impacts during operation are associated with the modified hydrology scenario and mostly concerned around the management of stormwater. The results show that the southern plot is most likely prone to flooding during heavy rainfall. It is anticipated that the project will need to design and install appropriate infrastructure to accommodate the increased runoff volumes as a result of the panels increasing the hardstand area. The stormwater management plan needs to ensure that the volume of water exiting the site is controlled and does not cause downstream impacts.	Negative	Direct	Moderate	Study area	Long term	May Occur	Reversible	Resource will be partially lost	Achievable	**MODERATE -**	• Consideration of the option to channel water through the proposed project site, either by a closed pipe or a channel designed to accommodate the design flood. Because the flood water will flow from different directions/sources upstream of the proposed project site, a diversion of the water from these areas is necessary to ensure that the water will reach the desired inlet points; • The development of a stormwater management plan that aims to: ○ Reduce the volume and runoff speed as a result of the project; ○ Manage the quality of the water discharging to water resources outside the project area.	**LOW -**
		A high volume of stormwater has the potential to reduce the water quality through increase sediment loading and any pollutants from the site.	Negative	Direct	Moderate	Study area	Long term	Probable	Reversible	Resources will not be lost	Achievable	**MODERATE -**		**LOW -**
TERRESTRIAL BIODIVERSITY AND ECOLOGY														
Infestation of Alien Plant Species	Preferred Alternative	If laydown areas and roads are not rehabilitated, these disturbed areas can become places for alien invasive species to become established and if left unmitigated these species can spread and establish themselves in intact vegetation resulting in the displacement of indigenous species.	Negative	Direct	Severe	Study Area	Permanent	Definite	Irreversible	Resource could be partially lost	Achievable	**HIGH -**	• The site must be checked regularly for the presence of alien invasive species. When alien invasive species are found, immediate action must be taken to remove them.	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
		The cumulative impact is likely to be of moderate significance.	Negative	Direct	Moderate	Study Area	Permanent	Definite	Irreversible	Resource could be partially lost	Difficult	**MODERATE -**	• An alien invasive management and monitoring plan must be incorporated into the ESMP. • The ECO must create a list with accompanying photographs of possible alien invasive species that could occur on site prior to construction. This photo guide must be used to determine if any alien invasive species are present. • It is difficult to implement mitigation measures specific to the cumulative impacts as the applicant only has jurisdiction over their development and not over other developments or farming activities in the area. • However, it is imperative that the applicant implement the mitigation measures listed above.	**N/A**
Changes in species composition	Preferred Alternative	The shading effect of the panels results in a change in species composition. For example, it may favour more herbs and possibly “weeds” or ruderals.	Negative	Direct	Slight	Localised	Permanent	Definite	Reversible	Resource could be partially lost	Difficult	**LOW -**	Ensure that “weeds” or ruderals do not move into natural habitat.	**LOW -**
		Since there are no existing solar PV plants in the area, the cumulative impact is negligible.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**N/A**		**N/A**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Aquatic/riparian habitat	Preferred Alternative	During the operational phase, routine maintenance (e.g. the washing and servicing of panels) may lead to the introduction of chemical / hazardous substances (e.g. soaps, cement dust, oil spills from vehicles, etc.) into the watercourse and/or soil, adversely affecting the aquatic ecosystems in the broader area. The modification of the drainage features within the site will also lead to larger volumes of water and higher suspended sediment loading.	Negative	Direct	Moderate	Study Area	Long term	Probable	Irreversible	Resource may be partially lost	Difficult	**MODERATE -**	• Adhere to stormwater management design measures provided in the Construction Phase; • Stormwater infrastructure must be maintained and monitored for effectiveness with respect to controlling and minimising erosion and sedimentation of watercourses; • No machinery must be parked overnight within 50 m of the rivers/wetlands; • All stationary machinery must be equipped with a drip tray to retain any oil leaks; • Any hazardous substances/waste must be stored in impermeable bunded areas or secondary containers 110% the volume of the contents within it; • All general waste and refuse must be removed from site and disposed and windproof temporary storage area before being disposed of at a registered landfill site; • Emergency plans must be in place in case of spillages onto bare soil or within water courses; and • Disturbed areas should be rehabilitated and re-vegetated.	**LOW -**
		Since there are no other developments in the area, the cumulative impact is negligible.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**N/A -**	N/A	**N/A**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Infestation of alien faunal species	Preferred Alternative	Developments that introduce domestic waste streams create suitable habitats for the introduction of alien species. Introduced urban rodent pests such as the house mouse (*Mus musculus*), house rat (*Rattus rattus*) and the Norwegian rat (*Rattus norvegicus*) are likely to occur in populated areas such as construction camps and office buildings. These species generally tend to survive alongside human habitation, and don't spread in natural areas. The most widespread and common alien bird is the House Sparrow (*Passer domesticus*) and the Pied Crow (*Corvus albus*) which is now distributed almost worldwide and was recorded on site.	Negative	Direct	Moderate	Study Area	Long Term	Definite	Reversible	Resource could be partially lost	Achievable	**MODERATE -**	• The site must be checked regularly for the presence of alien invasive species. When alien invasive species are found, immediate action must be taken to remove them; • An alien invasive management and monitoring plan must be incorporated into the ESMP; • The ECO must create a list with accompanying photographs of possible alien invasive species that could occur on site prior to construction. This photo guide must be used to determine if any alien invasive species are present; and • If cats are brought in to assist with any alien species control they must be logged and identifiable and all must be sterilised.	**LOW -**
		There are no similar construction activities in the area and as such there is unlikely to be a cumulative impact.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**N/A**		**N/A**
Collision and electrocution of birds	Preferred Alternative	Bird fatalities could occur at the site through a number of mechanisms, including collision with PV panels, entanglement in perimeter fence and others. Overall the diversity of bird species on site is low, no regionally Red Listed species occur on site and the habitat on site is of low value for birds. The impact of collision with and electrocution on the overhead power line and within the substation is possible.	Negative	Direct	Moderate	Study Area	Long term	May occur	Reversible	Resource may be partially lost	Achievable	**MODERATE -**	• The risk of electrocution of large birds on the power line pylons must be mitigated by using a bird friendly design with sufficient phase-phase and phase-earth clearance All staff, vehicle and machinery activities should be strictly controlled at all times so as to ensure that the absolute minimum of surface area is impacted; and • A carefully considered surface water/drainage management plan must be developed for the site including attention to the use of environmentally friendly cleaning chemicals	**LOW -**
		The project site already has a number of powerlines running along the eastern boundary of the northern and central site to the substations and from the substation through the top end of the southern site.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**N/A**	N/A	**N/A**
SOCIAL ENVIRONMENT														
Air quality	Preferred Alternative	Fugitive dust, vehicle and site infrastructure emissions are expected to be very low during operation. There will only be a small number of vehicles maintaining the site. Where necessary dust suppression techniques can be employed.	Negative	Direct	Slight	Study area	Long term	May occur	Reversible	Resource will not be lost	Achievable	**LOW -**	N/A	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Noise disturbance	Preferred Alternative	Very low vehicle movement is expected during the operational phase of the project. There are no moving parts or machinery involved in the operation of a solar PV facility and therefore no significant noise disturbances are expected.	Negative	Direct	Slight	Study area	Long term	May occur	Reversible	Resource will not be lost	Achievable	**LOW -**	N/A	**LOW -**
Traffic and Transport	Preferred Alternative	As mentioned above, very low vehicle movement is expected during the operational phase of the project. No significant deliveries are expected in any significant volume. There may be minor increase in vehicles travelling to site since there will be no accommodation on site. However, this will be limited to between 5-10 cars per day.	Negative	Direct	Slight	Study area	Long term	May occur	Reversible	Resource will not be lost	Easily achievable	**LOW -**	N/A	**LOW -**
Landscape and visual character	Preferred Alternative	Impacts during the operational phase include the colour change and a massing effect created by the PV panels covering a large area, limited early morning glare and some security lights at night. Generally, the reflection from PV systems is low intensity, similar to the impact from a body of water. Solar glare can have the potential to be hazardous to pilots (typically when panels are located near airports), motorists (when panels are located adjacent to roads), and onlookers. There site is adjacent to the M5 national road and adjacent to the Illovo plantation. The solar panels that have been selected for the Project are designed to absorb as much solar radiation as possible and therefore solar reflection is minimised.	Negative	Direct/Indirect	Moderate	Study area	Long term	Probable	Reversable	Resource will not be lost	Achievable	**MODERATE -**	• Maintain the existing tree line along the M5; • Consider screening with natural vegetation to the north and south of the project area; • Rehabilitation of all disturbed areas (e.g. temporary access tracks and laydown areas) must be undertaken following construction. This must be done in such a way facilitate natural regeneration of vegetation; and Maintain ongoing engagement between the Project and local communities with regards to potential solar reflection impacts.	**LOW -**
Loss of heritage and cultural resources	Preferred Alternative	No excavations are anticipated during the operational phase. Should any cultural resources be identified during the construction phase these will be marked and either removed or "no-go" zones created.	Negative	Direct/Indirect	Slight	Study area	Long term	Unlikely	N/A	N/A	N/A	**LOW -**	N/A	**LOW -**
SOCIO ECONOMIC ENVIORNMENT														

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Job creation	All Alternatives	During the planning and design phase, there will be some temporary job opportunities associated with planning and design of the proposed solar park.	Positive	Direct	Slight	Localized	Short-term	Definite	N/A	Resource will not be lost	Easily Achievable	LOW +	N/A	LOW +
Additional power and grid stability	All Alternatives	This solar power generation facility will generate 40 MW of power and provide an additional 10 MW of storage that will be sold to Escom and be added to the national grid. This amounts to 10% of Malawi's total electricity generation capacity. The storage capacity will also help to regulate the supply of electricity. Voltalia will run the facility for 25 years, after which the contract with ESCOM could be extended or Escom will take over the running of the facility for another 15 years.	Positive	Direct/Indirect	Moderate	Regional	Long term	Probable	N/A	N/A	N/A	MODERATE +	N/A	MODERATE +

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
Occupational Health and Safety	All Alternatives	During construction phase, failure to anticipate and take measures to avoid and minimise potential occupational health and safety risks during the construction and operation phase may result in the injury and harm of labourers, staff, surrounding residents and road users. This could be from the problematic use of or faulty equipment and machinery, as well as falls, accidents, fires, etc. Occupational risks also include the risk of sexual abuse and exploitation, sexual harassment (SEA/SH) and gender-based violence (GBV) amongst contract workers.	Negative	Direct, Indirect	Moderate	Study area	Short-term	Possible	Irreversible	Resource will be lost	Achievable	**MODERATE -**	• A health and safety plan in terms of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) must be drawn up by and HSE officer prior to construction to ensure workers safety. • Fence the solar farm and have security personnel present at all times to avoid trespassers entering the site to access solar panels; • Train security personnel in safeguarding of the community in high tension situations such as community protests and community conflicts resulting in human rights abuses. This will include training the existing community policing function to provide support and engage the GVH's and TA when required; • Project Security will comply with Malawian laws and regulations as well as the requirements of the Voluntary Principles for Security and Human Rights. The security will include, among other things, selection of personnel based on a careful background screening, and monitoring of performance; • Implement security measures to minimise safety risks and the possibility of theft in construction camps, storage areas etc; and • Establish a community engagement programme to provide information about safety hazards and raise awareness of how these are being managed.	**LOW -**

Community Health and Safety	All Alternatives	During all phases of the project failure to anticipate and take measures to avoid and minimse potential community health and safety risks may result in the injury and harm of surrounding residents and road users. This is a particular risk when external workers are brought into rural communities and engage socially and professionally with local residents. There is a particular concern amongst the communities about increases in teenage pregnancies, infidelities, and the transmission of infectious diseases such as covid-19, HIV/AIDs and other STDs. Substance abuse, crime and assault incidents are other social concerns. These community health risks also include the risk of sexual abuse and exploitation, sexual harassment (SEA/SH) and gender-based violence (GBV).	Negative	Direct, Indirect	Moderate	Study area	Short-term	Possible	Irreversible	Resource will be lost	Achievable	**MODERATE -**	• A Community Health and Safety Plan in terms of IFC PS 4 must be developed, adhered to and enforced by a HSE officer to ensure community safety. This must include awareness raising and training activities amongst contractors and community members, signed codes of conduct for contractors and anonymous grievance redress mechanisms to avoid and minimize the spread of communicable diseases, unwanted pregnancies and any sexual exploitation and abuse or sexual harassment (SEA/SH) and gender-based violence (GBV) incidents. • Fence the solar farm and have security personnel present at all times to avoid trespassers entering the site to access solar panels; • Train security personnel in safeguarding of the community in high tension situations such as community protests and community conflicts resulting in human rights abuses. This will include training the existing community policing function to provide support and engage the GVH's and TA when required; • Establish clear and visible signage in construction areas to warn the community of any risks and hazards; • Establish a community engagement programme to provide information about safety hazards and raise awareness of how these are being managed. This includes visits to all neighbouring communities and local schools; and • Raise awareness to communities regarding their Grievance Mechanism to deal with community concerns and issues in a timely manner to avoid issues escalating. This will include the use of the Community Liaison Officer who will be present around the Project site pre- and during construction.	**LOW -**

POTENTIAL ISSUE	ALTERNATIVES	SOURCE OF ISSUE	NATURE	TYPE	CONSEQUENCE	EXTENT	DURATION	PROBABILITY	REVERSIBILITY	IRREPLACEABLE LOSS	MITIGATION POTENTIAL	SIGNIFICANCE WITHOUT MITIGATION	MITIGATION MEASURES	SIGNIFICANCE WITH MITIGATION
On-site fire risk	All Alternatives	During the planning and design phase, failure to plan for accidental fires during the construction and operation phase could result in potential harm to the public and/or surrounding landowners and their property.	Negative	Direct	Moderate	Study area	Medium-term	Possible	Irreversible	Resource will be lost	Easily Achievable	**MODERATE -**	• An Emergency Preparedness Plan must be in place for both the construction and operational phases and before these phases commence. This should form part of the method statement; • Voltalia must plan for and put measures in place to prevent and deal with fires including the provision of firefighting equipment; • During windy periods un-surfaced and un-vegetated areas must be dampened down; • All flammable substances must be stored in dry areas which do not pose an ignition risk to the said substances; • Smoking must not be permitted near flammable substances; • All cooking must be done in demarcated areas that are safe in terms of runaway or uncontrolled fires; • No open fires must be allowed on site; and • Fire extinguishers must be available onsite.	**LOW -**

Waste Management	All Alternatives	During the construction and operational phase, poor management of handling, disposal and storage of general and hazardous waste may lead to the pollution of the surrounding environment, including potential health risks to those on site and those communities who received the waste.	Negative	Direct	Moderate	Regional	Long term	Possible	Reversible	Resource will not be lost	Easily Achievable	**MODERATE -**	• A waste management plan must be developed to cover all phases of the development. • All general waste must be disposed of in bins/waste skips labelled “general waste”; • Sufficient waste bins must be provided throughout the construction site for collecting waste; • All general waste collected on site must be disposed of at a licensed general waste disposal site; • All hazardous waste generated on site must be placed in a temporary impermeable bunded containment area which must be disposed of at a hazardous landfill site or be collected by the appropriate service provider; • Proof of receipt of hazardous waste by a licenced service provider must be maintained on the site; • Adequate sanitary facilities must be provided for construction workers and they must be properly secured to the ground; • Maintenance of the chemical toilets should be done on a regular basis to prevent any leakages; • Concrete and cement must take place on an impermeable surface, and dried waste concrete and cement must be disposed of with building rubble; • No concrete mixing must take place within 30 m of any watercourse; • Develop a robust waste handling system to avoid the creation of vermin breeding grounds. • Establish measures through environmental controls which reduce the presence of standing water onsite during the site preparation phase; • Ensure that working areas, such as site office areas are kept clean and free from any accumulation of wastes as well as supplied with clean potable water. This includes ensuring appropriate food preparation and monitoring measures are in place.	**LOW -**

19 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

This section outlines the proposed organisational structures and other activities that will be required to implement the ESMP. The generic key management positions to manage the ESMP are discussed below. The actual titles used for each position may change once the project is implemented, but the responsibilities will remain unchanged.

Voltalia will establish procedures to monitor and measure the effectiveness of the ESMP as well as compliance with any related legal and/or contractual obligations and regulatory requirements and applicable standards related to environmental and social performance.

Where the authorities or another third party has responsibility for managing specific risks and impacts through implementation of various mitigation measures, Voltalia will collaborate with them in establishing and monitoring the implementation and effectiveness of such mitigation measures. Where appropriate, Voltalia will consider involving representatives from affected communities to participate in monitoring activities.

Ultimately, the Proponent will be responsible for ensuring full compliance of contractors and employees with the requirements of this ESMP.

19.1 ROLES AND RESPONSIBILITIES

19.1.1 Proponent

The proponent is the responsible entity for monitoring the implementation of the ESMP and compliance with the authorisation. They are also responsibly for:

- Ensuring that sufficient resources are made available to implement the ESMP; and
- Periodically reviewing the effectiveness of the plan and arranging for revisions where necessary and in accordance with applicable legislation.

19.1.2 Environmental, Health, Safety and Security Manager

- Ensuring the implementation of and compliance with this plan as well as relevant legislation and standards;
- Maintaining ongoing liaison with relevant national and provincial government agencies and regulatory authorities;
- Reviewing and approving E&S management procedures relating to the construction phase of the project, in conjunction with the Contractor;
- Continuously reviewing the effectiveness of the measures described in this plan, as informed by regular reviews and monitoring reports;
- Ensuring that the project grievance mechanism is efficient and effective;
- Maintaining and managing the environmental monitoring programme; and

- Recommending and/or developing corrective actions in the event of significant non-compliance with the requirements of the ESMP.

19.1.3 Construction Environmental Site Officer

- Monitor and maintain associated records (including photographic evidence) of contractor performance with respect to compliance with this ESMP;
- Assisting the EHSS Manager to develop management procedures;
- Ensuring that all new contractor personnel coming onto site attend the environmental awareness training courses;
- Reviewing the results of monitoring programmes; and
- This person must have the relevant tertiary education (occupational health and safety or environmental management) and a minimum of 2 years relevant experience.

19.1.4 Construction Community Liaison Officer

All communication with the local community required in the implementation of this ESMP will be managed by the Community Liaison Officer. The engagement with communities will be informed by a Stakeholder Engagement Plan and include:

- Identify issues or areas of concern that may have been overlooked or under-emphasised and suggest ameliorative and/or mitigation measures;
- Assist in identifying development opportunities that can enhance productivity, sustainability and viable economic opportunities in the vicinity of the project site;
- Hold regular meetings with the affected communities to explain the LRP process, and advise about progress; and
- Monitor the project area to prevent any illegal encroachers.

19.1.5 Contractor

The successful contractor must:

- Be responsible for the finalisation of the ESMP in terms of methodologies which are required to be implemented to achieve the environmental specifications contained herein, and the relevant requirements contained any environmental authorisations, licences and permits;
- Be responsible for the overall implementation of the ESMP in accordance with the requirements of the Proponent;
- Ensure that all third parties who carry out all or part of the contractor's obligations under the contract comply with the requirements of this ESMP; and
- Ordering disciplinary proceedings against persons not complying with management procedures, including the removal of offenders from site.

19.2 Training and Awareness Programmes

All personnel involved in the construction and operation of the project will undergo a training and awareness programme on environmental management prior to commencing activities. The range of topics that are covered by the EHS Induction Training includes but is not limited to:

- Environment, Health, Safety & Community policy;
- Environmental Objectives and Targets;
- Organisational structure and responsibilities;
- Aspects of routine or day-to-day operational activities, which can have environmental impacts;
- Environmental hazards, which could arise from non-routine situations and corrective actions;
- The importance of Environmental Hazard Incident reporting and completion of appropriate reports;
- Road safety and vehicle-related rules;
- Alcohol and drugs;
- Waste management;
- Hazardous chemicals and hydrocarbon management;
- Emergency preparedness and response;
- Land management and wildlife;
- Channels of communication for discussing and reporting environmental issues;
- Documentation systems so that appropriate records of environmental matters are maintained; and
- Responsibilities under the applicable legislation.

Information will be transferred in an appropriate manner. Training courses will take language and cultural and education levels into consideration. Employees will be trained to ensure that they have the right skills and competencies to undertake their particular activities in a manner that is safe, conforms to the requirements of the ESMP and which minimises occupational, community and environmental risks and impacts.

19.3 Emergency Preparedness

An overarching Plan must be developed for Voltalia's Project and include major incident scenarios as they relate to the construction, operations and associated activities. In addition, specific response procedures must be contained in the various SOP's such spill events etc.

All staff and contractors will adhere to Voltalia's incident management procedure to ensure that there will be an appropriate response to unexpected or accidental actions or incidents that could result in environmental, health or safety impacts during the life of the project. Such activities may include, inter alia:

- Accidental discharges to water and land;
- Accidental exposure of employees to hazardous substances;
- Accidental fires;
- Accidental spillage of hazardous substances; and
- Specific environmental and ecosystem effects from accidental releases or incidents.

19.4 Checking and Monitoring

The effectiveness of mitigation measures, procedures and structures aimed at minimising E&S risks and impacts and enhancing benefits of the project will be assessed regularly through the

E&S monitoring programme.

Checking and monitoring includes four key activities:

- Defining objectives and targets;
- Monitoring selected E&S quality variables as defined in the objectives and targets;
- On-going inspections and continuous improvement of general state of the operations; and
- Internal audits to assess the robustness of the ESMP and SOPs or to focus on a particular performance issue.

Where performance fails to meet the standards specified in the monitoring programme or the ESMP, remedial measures will need to be implemented and the effectiveness of these assessed through subsequent monitoring. Details of this monitoring programme have been included in this ESMP.

19.5 Performance Objectives and Targets

E&S performance objectives and targets (measurable indicators) against which the performance of the project can be measured and monitored will be developed as part of ESMP and SOPs. These objectives and targets must be clearly defined and incorporated, where appropriate, as contractual obligations that have to be fulfilled by third parties. The latter is of particular relevance during the design and construction phases of the project. In so doing, Voltalia will be better able to manage its Health, Safety and Environmental risks and obligations. Objectives and targets will be reviewed on a regular basis. In cases where objectives and targets are not met, new and revised method statements indicating proposed corrective measures will be developed and approved.

19.6 Ongoing Inspections and Continuous Improvement

On-going inspection and continuous improvement will form a key component of the ESMP as this document will be regularly reviewed and updated. Research on certain aspects will be undertaken to refine environmental management and to ensure that the levels of environmental protection outlined in this ESMP are achieved.

Owing to the transient nature of the construction phase, the greatest source of information will be obtained through on-going visual inspection. At the same time some potential impacts are difficult to monitor quantitatively, such as soil erosion and waste management. An on-going, but pragmatic inspection regime will be developed that allows for potential E&S non-conformances to be identified proactively so that mitigation can be quickly and effectively implemented.

19.7 Internal Audits

Audits of the environmental performance of the project will be undertaken by Voltalia. The purpose of the audits will be to:

- Assess compliance with the conditions of the Environmental Permit, and
- Determine if the objectives and targets outlined in the ESMPr are being met.

The findings of internal and informal environmental reviews will be recorded and items requiring action will be identified. The implementation of these actions will be assessed in the following audit.

Where the monitoring data and the inspection reports highlight problems, the internal audit can be used to ascertain the source of the problem and to define action to prevent its recurrence. The three key areas for audit are operating efficiencies of facilities, project procedures and their implementation, and Contractor's E&S performance.

19.8 Incident Reporting, Non-Compliance and Corrective Action

19.8.1 Incident Documentation and Reporting

Voltalia and its contractors must employ the same incident documentation and reporting procedure.

19.8.2 Non-compliance

The ESMPr is deemed not to have been complied with when:

- There is evidence of contravention of the recommendations in the document, its environmental specifications or the developed Method Statements or Procedures;
- If Proponent activities take place outside the legal boundaries of the project area;
- Environmental damage ensues due to negligence;
- Personnel fail to comply with corrective or other instructions that have been issued as corrective measures; and
- Personnel fail to respond adequately to complaints from the public or Malawian authorities.

19.8.3 Corrective Action

There are several mechanisms for implementing corrective action and they include verbal instructions, written instructions and contract notices.

Verbal instructions are likely to be the most frequently used form of corrective action and are given in response to minor transgressions that are evident during routine site inspections. Verbal instructions are also used to create further awareness amongst employees and contractors, as often the transgressions are a function of a lack of awareness.

Written instructions will be given following an audit. The written instructions will indicate the source or sources of the deviations from desired performance and proposed solutions to those deviations. The implementation of these solutions can also be assessed in a follow-up audit and further written instructions issued if required. All written instructions will be centrally logged to ensure that there is an auditable record of such instructions and how they were responded to.

A **contract notice** is a more extreme form of written notice because it reflects the transgression as a potential breach of contract. If there is not an adequate response to a

contract notice then the next step can be to have the contractor or employee removed from the site and the contract cancelled. Contracts will be drafted with this in mind.

19.8.4 Management Review

The process of management review is in keeping with the principle of continual improvement. As such, Voltalia will develop a management review procedure to ensure that the company defines and maintains a documented process and agenda for periodic review the continuing suitability, adequacy and effectiveness of the ESMP. The management review, which will be conducted at least annually, will include a review of internal and external audit reports as well as the cost estimates for implementation of the ESMP. The purpose of the review is to critically examine the effectiveness of the ESMP and its implementation and to decide on potential modifications as and when necessary.

19.8.5 Financial Resources

Voltalia will be responsible for ensuring that sufficient financial resources are made available for the effective implementation of the requirements of this ESMP throughout the life of the project. Where applicable, Voltalia will need to ensure that all contractors are aware of their obligations in terms of this ESMP and that they have made appropriate financial provisions to ensure full compliance.

19.8.6 External Environmental Auditing and Verification

Audits of the E&S performance of the project will be undertaken regularly by an independent party to verify compliance with the requirements of the ESMP. During the construction phase, such independent audits will be conducted quarterly and then annually during the operational phase. In this regard, Voltalia will ensure that the independent audit team are provided with all relevant documentation (including a copy of the ESMP) and that, as far as practical, they address recommended actions emerging from the independent audits within a reasonable period of time.
The independent E&S auditor will be responsible for the following:

- A preliminary review of all relevant documentation provided by Voltalia. This will enable the auditor to assess the applicability of the instruments currently in place and to identify and review any other instruments not explicitly noted previously.
- Compilation of the audit findings in the form of an audit report that describes all incidences of compliance, partial compliance or non-compliance against the reference framework with an assessment of the significance of degree of non-compliance and the potential risks to the project.
- As non-compliances are identified the external auditor will progressively prepare a Draft Action Plan, which will describe the actions and activities required to remedy or address any deficiencies identified.

19.9 Record Keeping and Document Control

The Contractor and the Environmental Site Officer (ESO) will monitor the contractor's adherence to the approved impact prevention procedures. The ESO must document the nature and magnitude of the non-compliance in a designated register, the action taken to

discontinue the non-compliance, the action taken to mitigate its effects and the results of the actions. These reports must be made available to the authorities when requested.

The Contractor must ensure that an electronic filing system identifying all documentation related to the ESMP is established. A list of reports likely to be generated during all phases of the project is provided below, and all applicable documentation must be included in the environmental filing system catalogue or document retrieval index:

- Environmental and Social Management Programme;
- Final design documents and diagrams issued to and by the Contractor;
- All communications detailing changes of design/scope that may have environmental implications;
- Complaints register;
- Medical reports;
- Incident and accident reports;
- Emergency preparedness and response plans;
- Copies of all relevant environmental legislation;
- All relevant permits; and
- All method statements from the Contractor for all phases of the project.

The Contractor must be responsible for establishing a procedure for electronic or hard copy document control. The document control procedure must comply with the following requirements:

- Documents must be identifiable by organisation, division, function, activity and contact person;
- Every document must identify the personnel and their positions, who drafted and compiled the document, who reviewed and recommended approval, and who finally approved the document for distribution; and
- All documents must be dated, provided with a revision number and reference number, filed systematically.

20 EFFECTS OF THE PROJECT ON GLOBAL CLIMATE CHANGE

20.1 INTRODUCTION

Climate and weather are very closely intertwined. While weather refers to short term variations of the state of the atmosphere (including changes in air temperature, cloudiness, precipitation and wind), according to Battan (1974), climate is the long term manifestations of the weather. In general the climate of a region will be described in terms of the average temperature, precipitation, atmospheric humidity and wind velocity over periods of approximately 30 years. Climatologists are confident that over the past century, the global average surface temperature has increased by about half a degree Celsius (IPCC, 1995a).

According to the Intergovernmental Panel on Climate Change (IPCC), climate change refers to any change in climate over time, whether due to natural variability or as a result of anthropogenic activity. Climate change is thus a long-term change in the statistical distribution of weather patterns over long periods of time. Fluctuations in the weather patterns in periods shorter than a few decades, such as El Niño, do not represent climate change. This definition differs slightly from that in the UN Framework Convention on Climate Change (UNFCCC) where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (IPCC Summary for Policymakers, 2007). The change in climate is generally attributed to the change in the atmospheric gaseous composition and this could be enhanced by anthropogenic sources of greenhouse gases (GHG). The increased concentrations of GHG (including water vapour, carbon dioxide, methane, nitrous oxide, and ozone) produce global warming that affects long-term climate, with potential impacts, both negative and positive, on humanity in the foreseeable future (ibid, 2007).

Climate change is one of the most important environmental issues facing humankind. Concern over the anthropogenic factors relates to the increase in atmospheric CO_2 and its equivalents due to emissions mainly from fossil fuel combustion and the removal of vegetation due to land use change. Understanding the potential impacts of climate change on natural ecosystems is essential in order to manage the environment to minimize the negative consequences of climate change and maximize the opportunities that it may offer.

According to the IPCC (2022) report, GHG emissions continued to rise to 2019, although the growth of global GHG emissions has slowed over the past decade. Delivering the updated Nationally Determined Contributions (NDCs) to 2030 would turn this into decline, but the implied global emissions by 2030, still exceed pathways consistent with 1.5°C by a large margin and are near the upper end of the range of modelled pathways that likely limit warming to 2°C or below. The report concludes that there will be more frequent extreme climate events.

Climate change may affect natural ecosystems in a variety of ways. In the short term, it can alter the mixture of plant species in land ecosystems such as grasslands while over the long

term, climate change has the potential to dramatically alter the geographic distribution of major vegetation types. Climate change can also potentially alter global ecosystem processes, including the cycling of carbon, nitrogen, phosphorus, and sulphur. All of the climate change-induced alterations of natural ecosystems affect the services that these ecosystems provide to humans. However, not all impacts related to climate change are negative and adverse. While droughts, floods and sea level rise can be frequent and significant in some places, other areas such as the sub-arctic, may experience an increase in crop yields due to the fertilising effects of CO_2 and longer growing seasons. This may however have a negative effect on natural resources, ultimately resulting in infrastructure damage and extinction of indigenous life forms with slow adaptation rates.

Globally, the implementation of a low-carbon economy is proposed as a means to avoid catastrophic climate change. This will involve stabilizing greenhouse gas concentrations in the atmosphere by reducing emissions of GHGs from energy production and use, transport, buildings, industry, land use, and human settlements. Furthermore, it will be necessary to find ways to decouple greenhouse gas emissions from the growth of economies and population (IPCC, 2013).

Malawi is a developing (non-Annex 1) country in terms of the Kyoto protocol and therefore has no obligation to report its greenhouse gas (GHG) emissions under the protocol. The projects operational phase GHG emissions have been estimated using internationally published emission factors.

The manifestations of climate change on Malawi are likely to be:

- Higher temperatures;
- Altered rainfall patterns; and
- More frequent or intense extreme weather events such as heat-waves, droughts and storms.

20.2 Climate Change Related Impact of The Proposed Project

It is important to clearly distinguish between two aspects of climate change with respect to the project:

- The contribution (or impact) of the level of project GHG emissions (mostly CO_2) to overall the global increase in atmospheric GHGs, that are causing climate change; and
- The ability of the project owners and developers to respond to the physical risks and impacts associated with the manifestations of climate change, such as increased temperatures, flooding, etc.

In addition to these two aspects, this sections also considers direct (e.g. increased temperatures can decrease efficiency of the solar PV technology, etc.) and indirect impacts (community related impacts such as water scarcity, etc).

20.3 CONTRIBUTION TO CLIMATE CHANGE

The proposed project may contribute directly to climate change through consumption of non-renewable energy sources (hydrocarbons) and associated CO2 emissions and indirectly through reduction of local carbon stock (deforestation activities). This are discussed individually below.

Energy Consumption

The consumption of fossil fuels, directly as fuel, may contribute to climate change. Sources of GHGs at the project include the liberation of CO_2 during fossil fuel combustion.

A summary of all direct GHG emissions from the Project (using default IPCC emission factors) is given in Table 6.5a & b (expressed as tonne CO_2 equivalent or tCO_{2eq}). CO_{2eq} is a term for describing different GHG in a common unit. For any quantity and type of GHG, CO2eq signifies the amount of CO_2 which would have the equivalent global warming impact. A quantity of GHG can be expressed as CO_{2eq} by multiplying the amount of the GHG by its global warming potential (GWP). For example, if 1 kg of methane is emitted, this can be expressed as 23 kg of CO_{2eq} (1 kg CH4 * 23 = 23 kg CO_{2eq}).

Carbon sequestration loss, due to removal of grassland vegetation, will occur over the plant area (approximately 60 ha). Aerial photography suggests that some of this transformation has already occurred. Carbon losses due to land clearing and emissions from the mineral soil of the cleared area were estimated for the plant area according to the IPCC (2006) Reference Manual for Land Use Change and Forestry. It is assumed that the cleared material, especially woody material, will be removed off-site and used by the local community for household use. Potential emissions from the burning of this material were not quantified.

Table 6.5a: GHG emissions resulting from the Project during construction

Emission source	Quantity	Units	Emission factor	Emission rate (tCO_{2eq}/a)	Emission factor source
Diesel fuel use	50 000	litres/a GJ/a	0.0741 tonnes CO_{2eq}/ GJ fuel	148	(IPCC, 2006)
Land use change	60	ha	140 t dry matter per ha grassland	8 400	(first year only) (IPCC, 2006)
Mineral soil emissions	60	ha	180 t carbon per ha (to 30 cm depth); base factor for abandoned soils (0.5) (based on twenty year period)	10 800	(IPCC, 2006)
			Total	19 348	(first year only)

Table 6.5b: GHG emissions resulting from the Project during operation (i.e. 25 year life cycle)

Emission source	Quantity	Units	Emission factor	Emission rate (tCO_{2eq}/a)	Emission factor source
Diesel fuel use	5 000	litres/a GJ/a	0.0741 tonnes CO_{2eq}/ GJ fuel	18	(IPCC, 2006)
			Total	444 (18 x 25 years)	

The largest source of GHG emissions at the project is likely to be the change in land use, due to size of the area that needs to be cleared for the project (vegetation and soils). The IFC Sustainability Framework (Version 2) requires reporting of GHG emissions above the threshold of 25 000 tCO2eq/a. Based on the calculations above the project is unlikely to exceed the IFC's threshold during the construction phase and would therefore not be regarded as a significant contribution to CO_2 emissions.

During operation the emissions are expected to be as low as 444 tCO2eq/a. If the construction contribution was spread out over the 25-year operational phase then the emissions would range from 1 669.92 to 2 501.92 tCO2eq/a. This is relatively low compared to other sources of energy that may have been used as an alternative.

20.3.1 Loss of Carbon Stock

In addition to its direct importance for the maintenance of ecological systems and provision of food, material for housing, medicine and energy, vegetation can act as an important carbon sink. If cleared vegetation is either burned or allowed to decompose, the carbon stored within the plant material will be released as carbon dioxide, thereby eliminating any future carbon storage potential of these plants while at the same time, releasing additional carbon dioxide to the atmosphere. The primary actions required to mitigate for the disruption of the natural habitat have been described in detail in Chapter 11 of this report. The following mitigation measures will be implemented by Voltalia to mitigate against the climate change impacts of the loss of habitat:

- As far as possible, minimise clearing of forested areas which are in a mature or climax state;
- Educate employees about conservation of vegetation resources (in the hope that unsustainable harvesting is decreased);
- Maintain vegetation in drainage lines and wetland areas to reduce loss of soil by erosion in the event of increased rainfall; and
- Prepare a detailed rehabilitation strategy that takes into consideration the likely impacts of climate change. This could include selection of more drought-tolerant species.

20.4 Exacerbation Of Climate Change Impacts

20.4.1 Increase in temperature reducing the effectiveness of the PV panels

Photovoltaics that produce electricity are affected by their operating temperature, which is primarily a product of the ambient air temperature as well as the level of sunlight. Higher temperatures result in reduced efficiency. Since climate change would result in increased temperatures the direct impact to the project is that of reduced efficiency.

20.4.2 Reduced availability of water

The findings of the climate change predictions are that Malawi will experience longer drier

periods and that there may be a delay in the start of the wet season. This will have a direct influence on the project as it requires water to maintain the efficiency of the panels. This reduction in efficiency would reduce the ability of the facility to deliver energy to the grid.

It is also possible that local communities, in particular those that rely on natural water resources for their water supply may experience challenges with access to water during dry periods.

Even if abstraction of water for use by the development does not result in significantly reduced access to water by communities during dry periods, the project could result in a reduction of the quality of water that is available. This would then also exacerbate the climate change-related challenges associated with water availability during prolonged dry seasons.

20.4.3 Loss of ecosystem goods and services

Change in climate may result in the change of vegetation types and abundance of fauna and flora. The biophysical environment, of which various vegetation types are a key component, has been shown to be of great importance to local human and animal communities, particularly in rural areas where these resources provide a measure of insurance in times of hardship. For example, in times of drought and associated failure of crops, communities may become highly reliant on local ecosystems for food. The loss of vegetation as well as ecosystem services currently provided within the project area (estimated to be about 8 ha) is unlikely to further increase use and pressure on the natural resources of the surrounding area to sustain local communities.

20.4.4 Reduced food security

The predicted change in rainfall, temperature and length of dry periods is expected to impact negatively on food security of the area. These factors may also contribute to greater erosion of topsoil with subsequent reduction in availability of arable land. The vulnerability of water supplies to climate change translates to the vulnerability of growing crops and the production of food in those areas without access to formalised irrigation schemes. The yield and survival of food crops may also be reduced. The proposed development may exacerbate this risk of food insecurity through:

- Conversion of existing agricultural land for the project; and
- Loss of natural habitat for wild food plants and fauna.

Mitigation measures aimed at reduction of soil erosion, loss of vegetation and food security have been addressed elsewhere in this report. In line with recommendations by Arndt et al (2010), the developer will investigate opportunities to improve food security to those communities affected.

20.4.5 Health Impacts

It has been predicted that climate change will influence the prevalence of certain diseases and susceptibility of local communities to disease may be increased as a result of reduced food availability and subsequent reduction in immunity as well as a loss of access to medicinal

plants. Certain vectors may be able to extend their ranges and changes to climate may influence vector populations. Change to rainfall patterns (such as shorter periods of more intense rainfall) may provide additional breeding areas (such as temporary puddles / ponds) for vectors such as mosquitos (which transmit malaria). In the event of climate change impacting on rainfall patterns, the proponent will take measures to assist with food security and access to medical plants, and ensure that the project does not further contribute to the increase in numbers of disease vectors. Potential mitigation measures could include:

- Take steps to improve awareness of vector-borne health risks amongst employees and local communities;
- Implement pest management measures for the facility that includes vectors for disease;
- As part of the Community Health and Safety Management Programme, consider engaging with and assisting relevant authorities to develop and implement malaria reduction programmes in local communities;
- Implement necessary procedures to minimise the presence of stagnant water on the site;
- Through consultation with local communities, establish an inventory of key ethnobotanical resources in the area of the project site and, as far as practical, develop a nursery for cultivation of these species (such as medicinal plants); and
- Take reasonable efforts to rescue key ethnobotanical species from the project area and proposed access road.

20.5 CONCLUSION

Based on various studies on the likely climate change scenarios for Malawi and the associated biophysical and socio-economic impacts, it is likely that rainfall will become more variable with prolonged drier periods. The direct contribution of the proposed solar PV operation to global climate change is expected to be limited. The impacts on local communities that rely on natural resources are limited in extent. However, the developer will implement various mitigation measures aimed at reducing the impact to the surrounding communities through the development of an LRP.

21 PUBLIC CONSULTATION: STAKEHOLDER ENGAGEMENT

21.1 INTRODUCTION

The Public Participation Process (PPP) involves consultation with the wider public. The process facilitates the dissemination of information about the project and identification of indirectly and directly Interested and Affected Parties (I&APs).

It is vital that all I&APs are not only aware of the project and its possible negative implications, but also understand the project and its potential benefits to their communities and surrounding environment. Failure to ensure this could cause disputes and disagreements between communities, the developer and government authorities and lead to the disruption of established social structures.

As part of this process, public consultation meetings are organized where all I&APs are invited and thus have an opportunity to express and record their concerns, expectations and comments relating to the proposed project and environmental authorization process.

21.2 NATIONAL AND INTERNATIONAL REQUIREMENTS

This section provides details of national legislative requirements and international best practice standards, namely the International Finance Corporation (IFC) Performance Standards and Equator Principles.

21.2.1 National Requirements

The main stakeholder engagement requirements for development projects are detailed in the Environmental Management Act, 1996 (1). It states that an Environment Impact Assessment (EIS) should be developed in accordance with the requirements set out in the Act. The requirements include the following engagement activities:

"The EIA shall be open for public inspection provided that no except for the purposes of civil proceedings brought under this Act or under any written relating to the protection and management of the environment or the conservation or sustainable utilization of natural resources.

The Director shall invite written or oral comments from the public thereon, and where necessary may—

- *Conduct public hearings at such place or places as the Director deems necessary for purposes of assessing public opinion thereon;*

- *Require the developer to redesign the project or to do such other thing as the Director considers desirable taking into account all the relevant environmental concerns highlighted in the environmental impact assessment report, any comments made by the public and the need to achieve the objectives of this Act…"*

Additionally, following legislation in Table 21.1 below applies in relation to land acquisition, which includes notices to be placed in the *Gazette*.

Table 21.1 Land acquisition requirements and PPP

Land Act (2016): The Act is the principal act with respect to land administration and management in Malawi and for all matters relating to land such as land tenure, land transfer, land use and compensation. The Act vests all land in the Republic in perpetuity. The Act has two categories of land, which are public land and private land. Section 7 (2) classifies Public land as Government land and unallocated customary land while Section 7(3) classifies private land as freehold, leasehold or customary estate.
Electricity Act (2004): Notice needs to be published in the Gazette or in a paper in general circulation. Notices should include the nature of the work and the name and location of the project. Notice will also be provided to the affected person.
Land Acquisition Act (2016): The Lands Acquisition (Amendment) Act 2016 empowers the Minister to acquire land in the interest of Malawians.
The Customary Land Act (2016): Customary land is the land occupied and used by members of a community who live under customary law. Customary land, however, is not communal land. Most customary land is divided into pieces allocated for the use of individuals and their families. Rights to this land are usually well defined, often for exclusive use and transmissible. In the case that the Minister intends to transfer customary land for public interest, this is announced in the Gazette and sent to the land committee containing the details of the land to be transferred. Contradictory to the Land Acquisition Act, the Minister shall give 90 days' notice for the transfer. However, it should be noted that the land acquired for the Project was private land and therefore this requirement does not apply.

Other requirements that need to be observed by the Project are grounded in the Constitution of Republic of Malawi (1995) which focuses on human rights and participation of various groups in society such as women, children and the disabled that may be vulnerable to Project impacts. As such vulnerable groups will require specific measures to ensure they are included in stakeholder engagement activities.

21.2.2 International Requirements

This section outlines international best practice requirements stipulated by the IFC and Equator Principles to align stakeholder engagement activities with International Finance Institution (IFI) requirements.

The IFC defines the objective of stakeholder engagement as being *"the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts".*

The IFC Performance Standards include specific guidance on conducting stakeholder engagement both during the planning phase as well as throughout the project lifecycle. Stakeholder engagement requirements are contained in Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts, as summarised in Table 21.2.

Table 21.2 Performance Standards and PPP

IFC PS1: Assessment and Management of Environmental and Social Risks and Impacts: Stakeholder engagement is an on-going process that requires stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and on-going reporting to Affected Stakeholders. **Disclosure of relevant project information**: Provide affected stakeholders with access to relevant information on: (i) the purpose, nature, and scale of the project; (ii) the duration of proposed project activities; (iii) any risks to and potential impacts on such stakeholders and relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism. **Informed Consultation and Participation (ICP)**: ICP involves a deep exchange of views and information to inform process decision-making and understand the views of the affected stakeholders on matters that affect them directly, including proposed mitigation measures, the sharing of development benefits and opportunities, and implementation issues. All consultation should be documented and stakeholders should be informed about how their concerns have been considered. **External Communications**: Implement and maintain a procedure for external communications that includes methods to receive and track communications from the public, assess the issues raised and determine how to address them, provide and document responses and adjust the management program. Additionally, clients are encouraged to make publicly available periodic reports on their environmental and social sustainability. **Grievance Mechanism for Affected Stakeholders**: Establish a grievance mechanism to receive and facilitate resolution of affected stakeholders' concerns and grievances about the client's environmental and social performance. **On-going Reporting to Affected Stakeholders**: Provide periodic reports to the affected stakeholders that describes project progress, on-going risk to or impacts on affected stakeholders, and issues related to the consultation process or grievance mechanism. Consultation and disclosure must continue throughout the life cycle (construction and operation phase) of the project.

21.3 Stakeholder / Interested and Affected Party Identification

A stakeholder is defined in the IFC Performance Standards as:

"Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interests, the academic community, or other businesses".

The purpose of the stakeholder identification process is therefore to establish which organisations and individuals, including vulnerable groups, may be directly or indirectly affected (positively or negatively) by the Project or have an interest in it.

Stakeholder identification takes into account:

- The expected AoI of the Project, that is the geographical area over which it may cause impacts (both positive and negative) over its lifetime, and therefore the localities within which people and businesses could be affected; and
- The nature of the impacts that could arise and therefore the types of government bodies, Nongovernmental Organisations (NGOs), academic and research institutions and other bodies that may have an interest in these issues.

The aim of stakeholder mapping is to understand the stakeholders' needs and expectations for engagement and consultation in order to tailor engagement to each type of stakeholder. Stakeholders should be categorised and mapped according to their influence, impact and influence on the Project.

A list of stakeholders identified to date based on the above methodology, is provided in Table 21.3). This list will be updated as the Project progresses, with a comprehensive list included in an Appendix in the Draft ESIA report

Table 21.3 Preliminary list of Project stakeholders

Stakeholder Category	Stakeholder Name	Connection to the Project
National Regulators	MEPA	GoM ESIA Regulatory Authority
Government	Ministry of Energy, Including the Alternative Energy Division (AED)	Responsible for national level energy policy, and renewable grid integration.
	Malawi Energy Regulatory Authority (MERA)	Energy Regulatory Body
	Department of Forestry and Natural Resources	Responsible for national forestry resource management.
	Department of Water Resources	Responsible for national water resource management.
	Ministry of Lands	Responsible for compensation and land tenure management.

Stakeholder Category	Stakeholder Name	Connection to the Project
	Ministry of Agriculture, Irrigation, and Water	Responsible for agricultural production and management.
	Department of Museums and Monuments	Responsible for monitoring cultural heritage conservation.
	Department of National Parks and Wildlife	Responsible for monitoring wildlife, and the nearby Nhkotakota Reserve
	Ministry of Gender, Children, Disability, and Social Welfare	Responsible for monitoring social welfare, and vulnerable groups.
District Level Government	Nkhotakota District Council, District Commissioner (DC)	Head of Nkhotakota district
	District Environmental Sub-Committee (DESC)	Responsible for managing environmental decision making in the district.
	Nkhotakota Regional Lands Office	Responsible for land rights in the district, and will be involved in assessing property values if compensation is required.
	Nkhotakota Regional Forestry Office	Responsible for managing forest resources, and clearance permits in the district.
	Nkhotakota District Environmental Officer	Responsible for managing district level environmental compliance.
	Nkhotakota District Labour Office	Responsible for labour disputes and data collection in the district.
	Nkhotakota District Medical Officer	Key source of district level data and understanding on health.
Community Level	Representing the Traditional Authority (TA), Senior Group Village heads (SGVH), Group Village Heads (GVH), and Village Heads (VH). • Communities are: • Kasasa; • Majiga; • Mowe; • DCGL Village.	Traditional leadership for the project area.
	Community members affected by the project.	Local community members impacted by the project or

Stakeholder Category	Stakeholder Name	Connection to the Project
		who have useful insight into proposed activities.
NGO	African Parks (Nkhotakota Wildlife Reserve)	International conservation non-profit with local engagement.
	WESM	Coordinating Wildlife, Environmental activities in Nkhotakota
	Foundation for Community and Capacity Development (FOCCAD)	Malawian NGO engaged with health and inclusiveness issues, based in Nkhotakota.
Civil Society Groups	Civil Society Organizations	Groups who may be impacted by the project or could benefit from mitigation/enhancement measures.
Commerce and Industry	Energy Generation Company Malawi (EGENCO)	Company formed when ESCOM was unbundled responsible for the generation of the majority of Malawi's electricity.
	Electricity Supply Corporation of Malawi (ESCOM)	Responsible for the national transmission and distribution of electricity in Malawi.
	Illovo	Local business
	Kasasa Sports Club	Local business

21.4 STAKEHOLDER ENGAGEMENT ACTIVITIES

This Section outlines stakeholder engagement activities that have been carried out to date in support of the Project, and the process required for the ESIA. In order to avoid stakeholder fatigue there are two main stages of engagement that form the ESIA process. These include engaging on the scoping stage, which incorporates feedback already captured. Further engagement will be undertaken on the draft ESIA (disclosure), which will include consultation on the impacts and associated mitigation identified.

It is anticipated that the list of stakeholders contained within will develop throughout the ESIA process, so this plan will be fluid in nature. Initial engagement was undertaken (Scoping Phase) to introduce the project to key stakeholders. From here other stakeholders were identified and issues and concerns raised. Every stakeholder was given clear channels of communication to the consultants and project developers to ensure they were able to communicate concerns and queries. A key consideration here is the availability of the Illovo CLO who is very familiar with these communities – many of them are employees of Illovo.

A number of techniques were (and will be) utilised in the engagement process which have been outlined in the table below with the likely target stakeholders (Table 21.4).

Table 21.4 Engagement techniques for targeting stakeholders

	Stakeholder					
	National Regulators	Government Level	District Level	Community Level	NGOs	Industry
Phone/Direct Consultation	*	*	*	*	*	*
Key Informant Interviews	*	*	*	*	*	*
Focus Group Discussions				*	*	
Public Meetings			*	*	*	*

The stakeholder engagement process has been impacted by the Covid 19 pandemic as the it has been a requirement to increase the number of phone consultations, and reduce the number of face to face interviews. In addition, it has been required to ensure that the group meetings have been only held when strictly necessary and ensuring that precautions are in place to limit possible transmission.

Throughout the ESIA process, the current GoM directives on Covid 19 were adhered to, for example limiting the number of participants, ensuring masks are worn at all times, ensuring social distancing is adhered to.

21.4.1 Initial Engagement

Initial engagement involved meeting Regional and District Lands Officers to gather information on the land acquisition process in Malawi, and in relation to the Project.

During the past months/years several meetings have taken place with several government departments, mainly with the objective of raising awareness for the importance of this project and presenting updated status of the project development. Some recent examples are presented below:

- 1/03/2022 – Meeting Illovo Management, being this the latest of several meetings held to provide an update on the developments on site and discuss the future engagements with the community on site, and future cooperation concerning community issues;
- 28/02/2022 – Meeting with PML, being this the latest of several meetings held to provide an update on the project development and conclude on the project documents;
- 24/2/2022 – Meeting with Minister of Energy and Principal Secretary, being this one the latest of several meetings held with different cabinet Ministers to provide an update on the development of the project;
- 2/02/2022 – Meeting at Ministry of Finance, being this the latest of several meetings held to provide an update on the project development;
- 2/02/2022 - Meeting at European Union delegation in Lilongwe, being this the latest of several meetings held to provide an update on the project development;

- 24/11/2021 – Meeting with ESCOM, being this the latest of several meetings held to provide an update on the project development and conclude on the project documents;
- 27/10/2021 – Meeting with Ministry of Lands, being this the latest of several meetings held to provide an update on the project development and get information on the procedure for valuation and compensation at Dwangwa Site; and
- 8/09/2021 – Introductory Meeting with District Commissioner to present the project and request for advice on the way forward.

Several ongoing meetings with MITC have been held as this entity is providing continuous support on local engagement.

21.4.2 Scoping Consultation

As part of the data gathering process for baseline Social Impact Assessment, communities and stakeholders were provided with an overview of the Project and asked for any information on how the land was used, whether they foresee any impacts associated with the project and how the project would impact their them.

Stakeholder engagement was carried out between the 25th – 28th January 2022. During this time meetings were held with national, district, and local level stakeholders. On some occasions these meetings were building on from engagement that has already been undertaken in support of the Project.
Engagement materials developed for this stage of engagement included the following:

- A background information document (BID) in English and Chichewa to provide a high-level overview of the Project. The BID included maps of the proposed area, illustrating the project footprint, the ESIA and land acquisition process, comment on the potential impacts and provided contact details for comments/grievances to be submitted; and
- A technical presentation for the government, NGOs, and other stakeholders.

All meetings were documented, including meeting registration, photos and meeting minutes (see Appendix C). Additionally, feedback on the meeting process was gathered where appropriate using meeting feedback forms and verbally.

Many of the stakeholders met during the social surveys reported that they were encouraged to see a project of this nature in their area. By having a project like this near them provides opportunities for employment, business ventures and the potential for secure power. However, there were a number of concerns over the influx of workers, the potential for an increase in abuse of vulnerable groups and the spread of disease.

A summary of the key issues raised is provided in Table 21.5 below. This feedback has informed the initial scoping of potential impacts that have been considered in the ESIA.

Table 21.5 Project feedback and perceptions

Theme	Perceptions
Job creation / economic improvements	• Opportunities for the younger members of the community to get jobs, even if it's only during construction.

Economic displacement	• It might be that they need to move their crops. But their understanding with Illovo is that they would need to move should they be required to.
Environmental impacts	• Removal of vegetation and trees. • The flow of water and erosion must be considered in the construction and operational phases of the project. • The integrity of the soil is also important
Safety and security	• School children must not be allowed to enter the site because of the large machinery and electrical danger. • Vehicles accessing the site opposite the school is a concern. • Vandalism on the infrastructure may occur the project area must be secure.
Waste (solid and liquid)	• It will be important to identify suitable disposal facilities for solid waste, since there is nothing suitable near Dwangwa. • The liquid waste must be controlled to ensure it does not lead to environmental and health issues. • Hazardous waste, broken panels and batteries needs to be clearly dealt with in this project.
Gender – female	• Risk for girls to be enticed by male workers. • Females engaging in sex work to support income generation. • Marriage breakdowns from polygamy or marital affairs with the workforce and aspiration for improved living standards. • Violence against women needs to be considered through the grievance mechanism.
Health	• Increased spread of HIV resulting from influx of workforce. • Sensitisation is required in schools and in communities regarding sexual health, involving hey decision makers and community leaders. • Unwanted pregnancies, breaking up of families.
Positive comments	• The project will contribute to improving the livelihoods of the community and many benefits. • Opportunities to provide communities with electricity must be explored.

21.4.3 National and District Level Engagement

Using the materials described above the Project team arranged and met with the key government departments that play a role in the Project, for approvals or to provide feedback to feed into the ESIA.

A summary of the engagement and photos of the meetings are provided in Appendix C & D.

21.4.4 Community Level Engagement

In addition to national and district meetings, meetings were also held with communities covering a number of villages surrounding the proposed project and lease areas:

Village	Date of meeting	No. of representatives	No. of community

			members
Kasasa	26th January 2022	23	
Majiga			
Mowe			
DCGA Village			

Commented [GS23]: Rob – do we know what the population of the villages are?

The purpose of the meetings was to provide a more in-depth description of the Project, explain the ESIA process, explain some of the key impacts identified during the scoping process and gather feedback to feed into the ESIA. The engagement also involved undertaking focus group discussions and key informant interviews were undertaken to gather gender and topic related information. A full list of meetings is provided in Appendix C.

21.4.5 ESIA Consultation

This will be populated following the disclosure of the Draft EIR.

22 CONCLUSIONS AND RECOMMENDATIONS

22.1 CONCLUSIONS

Voltalia, a global renewable energy producer and independent power producer (IPP), intend to construct a 40 MWAC solar photovoltaic (PV) power plant near Dwangwa town in, Nkhotakota district, Central Malawi. The Dwangwa Solar PV power plant will comprise of photovoltaic solar panels that cover an area of approximately 60 ha. Additional infrastructure on site will include a security guardhouse, an operations and maintenance building, internal gravel roads, a single circuit 132kV powerline and a substation. The overall Project investment cost across all phases of the Project is approximately USD 60,951,442.

CES was appointed by Voltalia to undertake an EIA in line with the requirements of the Malawian laws (including the Environment Management Act (1996)) and regulations as well as the requirements of international finance institutions (IFI). On the basis of the initial design a Project Brief was submitted by Voltalia to the Environmental Affairs Department (EAD) now the Malawi Environmental Protection Authority (MEPA) on the 29 June 2021. Following a review of the Project Brief, in line with the EMA, it was confirmed by the MEPA on 30 July 2021 that the Project required a detailed Environmental Social Impact Assessment (EIA).

A Scoping Report was prepared in February 2022. The purpose of the Scoping Report was to identify the potential interactions between the Project related activities and the existing environmental and social resources/receptors and to prioritise the scope of work for the ESIA assessment. Formal stakeholder engagement was undertaken with Government Departments and project affected communities.

The Scoping Report identified a number of potential impacts that required further assessment in the ESIA stage:

- Job creation / economic improvements

- Economic displacement
- Environmental impacts (loss of sensitive vegetation – miombo woodland)
- Site and community health, safety and security
- Waste (solid and liquid)
- Gender based sensitivities – HIV, pregnancies, GBV

In line with IFC requirements this Environmental and Social Impact Assessment (ESIA) has been prepared to identify impacts anticipated during the construction, operation and decommissioning phases of the project.

It is important to note that the project layout has been modified to accommodate those impacts which were deemed to be significant. The main changes were to avoid the development within the closed miombo woodland to the west of the site and the exclusion of the wetland/rice paddy west of the ESCOM substation and the irrigation channel on the eastern side of the site, adjacent to the M5.

The impacts identified as part of the ESIA have been summarised in Table 22.1 and Table 22.2 below.

Table 22.1 Summary of the significance of impacts for the construction phase

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Soil Quality	Reduction of soil quality as a result of the clearing of plants and trees including the incorrect stockpiling methodology.	MODERATE -	LOW -
Hydrology	The proposed site clearance and construction activities may interrupt surface and/or subsurface flows, leading to flow concentration, change in flow pathways, flow impoundment, increased surface runoff and increased risk of erosion.	LOW -	LOW -
	The results of the modelling show that the southern plot is most likely prone to flooding during heavy rainfalls.	HIGH -	LOW -
Vegetation	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 0.57 ha of Closed Miombo Woodland	LOW -	LOW -
	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the permanent loss of up to 2.14 ha of Open Miombo Woodland.	LOW -	LOW -
	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 31.16 ha of grassland-savanna mosaic.	MODERATE -	MODERATE -
	Only one species (*Pterocarpus angolensis*) was identified as a SCC due its status of Vulnerable on the National Red List.	MODERATE -	LOW -
Ecosystem Function and Process	Approximately 60 ha of near natural and transformed vegetation will be replaced by solar panels resulting in the loss of this natural ecological corridor that runs from the north to the south between the sugar plantations to the east and the residential area to the west.	MODERATE -	MODERATE -
Alien Plant Species	Disturbance to habitats often results in the infestation of alien species and displacement of indigenous vegetation unless these are controlled.	HIGH -	LOW -
Ecosystem services	Loss of ecosystems services through the removal of vegetation communities will result in the loss of ecosystem services provided by each vegetation type.	MODERATE -	MODERATE -
Water Quality	During the construction phase, vegetation clearance and earthworks, including excavation and infilling, may result in the partial loss of the wetland to the west of the existing ESCOM substation.	MODERATE -	MODERATE -
	During the construction phase, the clearance of vegetation and compaction of soil may result in increased run-off and erosion resulting in elevated levels of sediment entering the system. This could result in significant water quality concerns which in-turn may compromise the aquatic habitat.	MODERATE -	LOW -
	During the construction phase, accidental spillages of wet concrete and chemical / hazardous substances may result in soil and groundwater contamination, adversely affecting the aquatic ecosystems in the broader area.	MODERATE -	LOW -

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Fauna	The clearing of land for the construction of the solar PV plant, powerline, access roads and substation will result in the loss of up to 0.57 ha of Closed Miombo Woodland, 2.14 ha of open miombo woodland and 35.9ha of grassland- Savanna mosaic. These all provide important habitat for a range of faunal species.	**MODERATE -**	**MODERATE -**
	The SCC that possibly occur on the project area include bat species which may utilise the woodland/forest habitat for shelter as well as the nearby buildings and forage over the wetland and grassland. It is possible that the terrapin and occasionally otters may utilise the river channels and wetland areas. Migrant species may utilise habitats on the project area but not exclusively and raptors may nest on existing powerlines and well-established trees in the woodland/riparian forest. The blue swallow was confirmed on the northern site in the savanna habitat trees.	**MODERATE -**	**LOW -**
	The movement of heavy machinery and an increased number of vehicles during the construction phase may result in the accidental mortality of faunal species, specifically fossorial species and slow-moving species.	**MODERATE -**	**LOW -**
	There are existing troops of baboons and monkeys which may cause damage to equipment and may raid any living quarters and waste disposal sites.	**MODERATE -**	**LOW -**
Air quality	During the construction phase, dust generated by construction vehicles and construction activities could result in significant dust during windy conditions.	**MODERATE -**	**LOW -**
	During the construction phase poor maintenance and servicing of construction plant and vehicles may result in an increase in vehicle emissions in the areas.	**MODERATE -**	**LOW -**
Noise	During construction phase the main potential impacts on the acoustic environment are related to the noise from construction machinery and construction vehicles being used for the following: • Site preparation such as vegetation clearance and minor earthworks. These activities will require heavy construction vehicles and equipment (excavators, dozers, dump trucks); • Civil works and installation such as drilling for mounting structure frames, construction of inverter and transformer station foundations and construction of stores, workshop, and office buildings; and • Road traffic offsite: the movement of vehicles for transport of materials and personnel on local roads and/or new access roads close to communities will also generate additional noise.	**MODERATE -**	**LOW -**
Traffic and Transport	The key regional road is the M5 that runs adjacent to the proposed project site. The road is single lane and is in disrepair in many places. There are frequent heavy goods vehicles that use the route carrying tobacco, maize, and sugar. The road passes through trading centres, where pedestrians, cyclists, and traders also use the road. The addition of project traffic increases the risk of road accidents.	**HIGH -**	**LOW -**
	An increase in traffic as a result of the project could cause congestion on public roads.	**MODERATE -**	**LOW -**

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Landscape and visual character	Construction activities may have an impact on the visual character of the landscape due to the following: • Clearance of vegetation (in particular clearance of trees and removal of crops); • Presence of large construction vehicles and equipment on site; • Fencing of works and restrictions to site access; and • Construction of the plant.	MODERATE -	LOW -
Heritage features	The study identified 5 areas within the site that contained heritage features. Given the nature of the construction activities it is anticipated that these will be disturbed.	MODERATE -	MODERATE -
	The study identified no buildings or structures of historical or heritage significance.	LOW -	LOW -
	No graves of human burial places were noted within the project site.	LOW -	LOW -
Socio-economic	Community members who are informally cultivating in the proposed project area will lose access to their existing cultivated lands in the proposed project area. The loss of such cultivated land would have negative livelihood impacts for the cultivators who are members of Illovo and DSGA staff households who live adjacent to the project area, as well as residents of neighbouring Mowe community.	HIGH -	LOW -
	During the construction phase there will be some temporary job opportunities associated the proposed solar facility.	LOW +	LOW +
	This solar power generation facility will generate 40 MW of power and provide an additional 10 MW of storage that will be sold to ESCOM and be added to the national grid.	MODERATE +	MODERATE +
	During construction phase, failure to anticipate and take measures to avoid and minimise potential occupational health and safety risks during the construction and operation phase may result in the injury and harm of labourers, staff, surrounding residents and road users.	MODERATE -	LOW -
	During all phases of the project failure to anticipate and take measures to avoid and minimse potential community health and safety risks may result in the injury and harm of surrounding residents and road users. This is a particular risk when external workers are brought into rural communities and engage socially and professionally with local residents. Substance abuse, crime and assault incidents are other social concerns. These community health risks also include the risk of sexual abuse and exploitation, sexual harassment (SEA/SH) and gender-based violence (GBV).	MODERATE -	LOW -
	Failure to plan for accidental fires during the construction and operation phase could result in potential harm to the public and/or surrounding landowners and their property.	MODERATE -	LOW -

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
	During the construction and operational phase, poor management of handling, disposal and storage of general and hazardous waste may lead to the pollution of the surrounding environment, including potential health risks to those on site and those communities who received the waste.	**MODERATE -**	**LOW -**

Table 22.2 Summary of the significance of impacts for the operational phase

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Soil Quality	The impacts to the soil quality are likely to take place during construction. No earthworks are expected during the operational phase.	**LOW -**	**LOW -**
Hydrology	Given that many of the deviations and changes will occur during the construction phase the impacts during operation are associated with the modified hydrology scenario and mostly concerned around the management of stormwater. The results show that the southern plot is most likely prone to flooding during heavy rainfall. It is anticipated that the project will need to design and install appropriate infrastructure to accommodate the increased runoff volumes as a result of the panels increasing the hardstand area. The stormwater management plan needs to ensure that the volume of water exiting the site is controlled and does not cause downstream impacts.	**MODERATE -**	**LOW -**
	A high volume of stormwater has the potential to reduce the water quality through increase sediment loading and any pollutants from the site.	**MODERATE -**	**LOW -**
Alien Plant Species	If laydown areas and roads are not rehabilitated, these disturbed areas can become places for alien invasive species to become established and if left unmitigated these species can spread and establish themselves in intact vegetation resulting in the displacement of indigenous species.	**HIGH -**	**LOW -**
	The shading effect of the panels results in a change in species composition. For example, it may favour more herbs and possibly “weeds” or ruderals.	**LOW -**	**LOW -**
Water Quality	During the operational phase, routine maintenance (e.g. the washing and servicing of panels) may lead to the introduction of chemical / hazardous substances (e.g. soaps, cement dust, oil spills from vehicles, etc.) into the watercourse and/or soil, adversely affecting the aquatic ecosystems in the broader area. The modification of the drainage features within the site will also lead to larger volumes of water and higher suspended sediment loading.	**MODERATE -**	**LOW -**

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
Alien faunal species	Developments that introduce domestic waste streams create suitable habitats for the introduction of alien species. Introduced urban rodent pests such as the house mouse (*Mus musculus*), house rat (*Rattus rattus*) and the Norwegian rat (*Rattus norvegicus*) are likely to occur in populated areas such as construction camps and office buildings. These species generally tend to survive alongside human habitation, and don't spread in natural areas. The most widespread and common alien bird is the House Sparrow (*Passer domesticus*) and the Pied Crow (*Corvus albus*) which is now distributed almost worldwide and was recorded on site.	**MODERATE -**	**LOW -**
Avifauna	Bird fatalities could occur at the site through a number of mechanisms, including collision with PV panels, entanglement in perimeter fence and others. The impact of collision with and electrocution on the overhead power line and within the substation is possible.	**MODERATE -**	**LOW -**
Air quality	Fugitive dust, vehicle and site infrastructure emissions are expected to be very low during operation.	**LOW -**	**LOW -**
Noise disturbance	Very low vehicle movement is expected during the operational phase of the project. There are no moving parts or machinery involved in the operation of a solar PV facility.	**LOW -**	**LOW -**
Traffic and Transport	Very low vehicle movement is expected during the operational phase of the project.	**LOW -**	**LOW -**
Landscape and visual character	Impacts during the operational phase include the colour change and a massing effect created by the PV panels covering a large area, limited early morning glare and some security lights at night. Generally, the reflection from PV systems is low intensity, similar to the impact from a body of water. There site is adjacent to the M5 national road and adjacent to the Illovo plantation. The solar panels that have been selected for the Project are designed to absorb as much solar radiation as possible and therefore solar reflection is minimised.	**MODERATE -**	**LOW -**
Heritage and cultural resources	No excavations are anticipated during the operational phase. Should any cultural resources be identified during the construction phase these will be marked and either removed or "no-go" zones created.	**LOW -**	**LOW -**
Socio-economic	During the operational phase, there will be some temporary job opportunities associated with planning and design of the proposed solar park.	**LOW +**	**LOW +**
	This solar power generation facility will generate 40 MW of power and provide an additional 10 MW of storage that will be sold to ESCOM and be added to the national grid.	**MODERATE +**	**MODERATE +**

POTENTIAL ISSUE	SOURCE OF ISSUE	SIGNIFICANCE WITHOUT MITIGATION	SIGNIFICANCE WITH MITIGATION
	During construction phase, failure to anticipate and take measures to avoid and minimise potential occupational health and safety risks during the construction and operation phase may result in the injury and harm of labourers, staff, surrounding residents and road users. This could be from the problematic use of or faulty equipment and machinery, as well as falls, accidents, fires, etc.	**MODERATE -**	**LOW -**
	During all phases of the project failure to anticipate and take measures to avoid and minimse potential community health and safety risks may result in the injury and harm of surrounding residents and road users. This is a particular risk when external workers are brought into rural communities and engage socially and professionally with local residents. Community health risks also include the risk of sexual abuse and exploitation, sexual harassment (SEA/SH) and gender-based violence (GBV).	**MODERATE -**	**LOW -**
	During the operational phase, failure to plan for accidental fires during the construction and operation phase could result in potential harm to the public and/or surrounding landowners and their property.	**MODERATE -**	**LOW -**
	During operational phase, poor management of handling, disposal and storage of general and hazardous waste may lead to the pollution of the surrounding environment, including potential health risks to those on site and those communities who received the waste.	**MODERATE -**	**LOW -**

22.1.1 Biophysical Environment

The construction phase of the project will have the most significant impact on the project area through the site preparation activities, the construction of the mounting structures and supporting infrastructure, and the transport of materials to site.

In addition, the modification of the hydrology of the area is anticipated to result in localised flooding in the southern portion of the site and an appropriate design of stormwater management needs to be considered.

The project infrastructure will result in the loss of approximately 0.57 ha of Closed Miombo Woodland, 2.14 ha of Open Miombo Woodland and 31.16 ha Grassland-Savanna Mosaic. Impacts associated with this development include the following:

- Loss of vegetation communities, biodiversity and species of conservation concern will occur as a result of direct clearing during construction and indirect clearing as a result of the displacement of farmlands. The loss of vegetation in these instances is difficult to mitigate and as such are typically high by their very nature.
- Impacts associated with habitat fragmentation, edge effects and the infestation of alien invasive species are easy to mitigate and are thus not considered to be a concern at this specific site.
- Reduction in water quality as a result of increased erosion and runoff.

The project area is on the eastern extent of any remaining natural habitat. Across the M5 to Lake Malawi vast tracks of sugar cane have been planted. The habitat available within the project area is important for faunal species, particularly the rocky outcrops and rice paddies. The northern lease area is mostly intact. As one moves towards the south, the habitats are more disturbed due to agricultural practices and existing ESOM infrastructure (substation and overhead lines). The southern lease area is considered to be degraded due to sand mining, woodlot and community use of the land. The habitat available in the project area is not unique and occurs west and south of the project area.

22.1.2 Social Environment

As with the biophysical environment, the main impacts will occur during the construction phase of the project. Key impacts will be associated with:

- The stripping of the vegetation creating dust nuisance and noise;
- The diversion of drainage features and unconsolidated surfaces leading to erosion and poorer water quality;
- Potential disturbance and accident risk through higher traffic volume surrounding the project site; and
- The generation and management of waste which could lead to contamination of terrestrial and aquatic environments both on the site and at the receiving site.

While many of these impacts are considered to be moderate, the application of well known and easily implementable mitigation measures can reduce these impacts to low significance. Further information on mitigation measures is contained with the ESMP (Appendix 9).

22.1.3 Socio-economic

Social impacts are likely to be both positive and negative.

All phases of the project are likely to result in job creation for those communities immediately adjacent to the site. In addition, the local community will benefit from being able to provide goods and services to workers on site.

Negative impacts may arise through:

- The limitation of access to the site and ecosystem services which the local communities make use of;
- The use of the land for crops will result in economic displacement; and
- Community health and safety due to the influx of workers and the perceived opportunities that the project brings can impact vulnerable groups.

As there is only economic resettlement, a Livelihood Restoration Plan (LRP) will be developed in parallel with the ESIA. The plan will set out the extent and scale of displacement impacts, engagement related to land acquisition, eligibility and entitlements for affected persons and the implementation, monitoring and evaluation requirements.

In addition, mitigation and preventive measures have been included within the ESMP which will minimise the potential negative impacts and the residual risk remains of moderate or minor significance. Positive impacts are expected from the creation of local employment opportunities during the construction phase, capacity building and economic development as well as long term local employment opportunities through on the job training and capacity development. Enhancement measures have been proposed to maximise the potential positive benefits. The generation of electricity will have a significant positive impact on Malawi.

22.2 RECOMMENDATIONS

The significant impacts associated with the construction, operation and decommissioning of the site can all be reduced to low negative with the implementation of suitable mitigation measures.

An LRP has been recommended and together with the ESMP and Voltalia's commitment to IFC Standards the execution of the project is not expected to deviate from what has been reported.

The proponent is committed to working with the local community and authorities during the construction and operation of the Project and will maintain open dialogue as part of their ongoing stakeholder engagement activities.

The project has the ability to deliver a significant contribution to the power availability and grid stability in the area and therefore, together with acceptable environmental and social impacts, it is recommended the Project continue as planned.

23 REFERENCE LIST

Brown, P and Young, A. 1965. Physical Environment of central Malawi, with special reference to soils and agriculture.

Barstow, M. & Timberlake, J. 2018. *Pterocarpus angolensis*. *The IUCN Red List of Threatened Species* 2018: e.T33190A67802808. https://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T33190A67802808.en. Downloaded on 11 June 2021.

Intergovernmental Panel on Climate Change. 2021. IPCC Sixth Assessment Report (AR6). November 2021. 2913pp

McNicol, Iain & Ryan, Casey & Williams, Mathew. (2015). How resilient are African woodlands to disturbance from shifting cultivation? Ecological Applications. 150407011925001. 10.1890/14-2165.1.

Mojeremane, Witness. (2016). A review of *Pterocarpus angolensis* DC. (Mukwa) and important and threatened timber species of the miombo woodlands. Research Journal of Forestry. 10. 10.3923/rjf.2016.

Nkhotakota District Council Socio-Economic Profile 2017-2022

Vetter, Susanne. (2009). Drought, change and resilience in South Africa's arid and semi-arid rangelands. South African Journal of Science. 105. 10.1590/S0038-23532009000100017.

World Weather Online. https://www.worldweatheronline.com/dwangwa-weather-averages/nkhotakota/mw.aspx
Accessed: 4 June 2021

APPENDIX 1: MEPA TOR

APPENDIX 2: ECOLGICAL SPECIALIST REPORT

APPENDIX 3: FAUNAL SPECIALIST REPORT

APPENDIX 4: HERITAGE SPECAILIST REPORT

APPENDIX 5: FLOOD RISK REPORT

APPENDIX 6: AIR AND NOISE IMPACT REPORT

APPENDIX 7: STAKEHOLDER ENGAGEMENT – ISSUES AND RESPONSE TRAIL

APPENDIX 8: STAKEHOLDER ENGAGEMENT PHOTOGRAPHS

Village Head Group meeting

DESC meeting

Local business meeting

Informal engagement with community members

APPENDIX 9: ENVIRONMENTAL AND SOCIAL MANAGEMENT PROGRAMME (ESMP)