SCALING SOLAR ZAMBIA PROJECT
IDC/SP/011/2015



REVISED FINAL ENVIRONMENTAL AND SOCIAL IMPACT STATEMENT

FOR THE PROPOSED NGONYE SOLAR PV PROJECT UNDER ROUND ONE (1) OF THE SCALING SOLAR ZAMBIA PROJECT

VOLUME 2

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INDUSTRIAL DEVELOPMENT CORPORATION (Z) LIMITED

ENVIRONMENTAL AND SOCIAL IMPACT STATEMENT FOR THE PROPOSED NGONYE SOLAR PV PROJECT UNDER ROUND 1 SCALING SOLAR ZAMBIA PROJECT

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REVISED FINAL ESIA REPORT

MARCH, 2017

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Abbreviations and Acronyms

Abbreviation	Definition
AMC	African Mining Consultants
ARC	Anti-reflective coating
BHs	Boreholes
DMMU	Disaster Management and Mitigation Unit
DoR	Department of Resettlement
DNI	Direct Normal Irradiation
DRC	Democratic Republic of Congo
EBRD	European Bank for Reconstruction and Development
EHS	Environment Health and Safety
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ELF	Extremely Low Frequency
EMA	Environmental Management Act
EMF	Electromagnetic Field
EP	Equator Principle
EPC	Engineering, Procurement and Constructions
EPFi	Equator Principle Financial Institution
ESIA	Environmental and Social Impact Assessment
ESIS	Environmental and Social Impact Statement
ESMP	Environmental and Social Management Plan
IDC	Industrial Development Corporation Zambia Limited
IPPs	Independent Power Producers
GHI	Global Horizontal Irradiation
GIIP	Good International Industry Practice
GTI	Global Tilted Irradiation
HIV/AIDS	Human Immuno-deficiency Virus / Acquired Immune Deficiency Syndrome
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
LCC	Lusaka City Council
LS MFEZ	Lusaka South Multi-Facility Economic Zone
LWSC	Lusaka Water and Sewerage Company
MOU	Memorandum of Understanding
MSDS	Material Safety Data Sheet
O & M	Operations and Maintenance
NHCC	National Heritage Conservation Commission
PAYE	Pay As You Earn
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
PV	Photovoltaic
RFP	Request for Proposal
RFQ	Request for Prequalification
SOE	State-Owned-Enterprise
STIs	Sexually Transmitted Infections
ToR	Terms of Reference
USSPP	Utility Scale Solar Power Plants
VAT	Value Added Tax
ZEMA	Zambia Environmental Management Agency

Executive Summary

Introduction

This document presents the Environmental and Social Impact Statement (ESIS) for the proposed Ngonye Solar PV Project under Round 1 Scaling Solar – Zambia Project (the Project). The Project has been proposed by the Industrial Development Corporation of Zambia (IDC), an investments holding company wholly owned by the Government of Zambia with registered offices at Plot F10723, Lusaka South Multi-Facility Economic Zone, Chifwema Road, New Kasama, Lusaka, Zambia. The IDC is mandated to play a catalytic role in deepening and supporting Zambia's industrialisation capacity to promote job creation and domestic wealth formation across key economic sectors.

Knight Piésold Zambia has been commissioned by IDC to prepare the ESIS for the Project based on the Terms of Reference (ToR) for the Project submitted to the Zambia Environmental Management Agency (ZEMA) on 19th March 2016. A "No Objection Letter" to proceed with the Environmental and Social Impact Assessment (ESIA) study was obtained from ZEMA on 7th April, 2016.

This ESIS has been prepared in line with the requirements of the Environmental Impact Assessment Regulations, Statutory Instrument No.28 of 1997, and in compliance with IFC Performance Standards. It takes into account public views and concerns gathered through public consultative meetings held in Lusaka in March 2016 (Scoping Meetings) and in July 2016 (Public Disclosure Meetings).

Project Background

Following the severe energy deficit and crisis in Zambia in 2015 on account of low water levels for adequate hydro power generation, His Excellency, Mr. Edgar Chagwa Lungu, President of the Republic of Zambia, in his capacity as Chairman of the Board of the Industrial Development Corporation Zambia Limited ("IDC"), directed the IDC to target the immediate development and procurement of up to 600 Mega Watts of solar PV power into the national grid as a matter of urgency and priority.

In implementing the directive, the IDC signed a memorandum of understanding ("MOU") on 20 July 2015 with the International Finance Corporation ("IFC"), the private sector arm of the World Bank Group, for advisory and technical services assistance and commenced the immediate development of two solar photo-voltaic (PV) plants operating approximately up to 50 Mega Watts each for an initial total of 100 Mega Watts out of the targeted 600 Mega Watts.

In October 2015, the IDC ran a Request for Prequalification (RFQ) for the Pre- qualification of potential Independent Power Producers (IPPs) via a transparent and competitive bidding process. During this process, a total of 48 firms applied, out of which 11 were selected as the successful bidders for the Request for Proposals (RFP) process with detailed final proposals (the bidder with the lowest tariff would be the winner).

These two Solar PV projects have been awarded to two different private developer companies for financing, construction and operation as independent power producers (IPPs) for 25 years. The two project companies will therefore operate two independent photovoltaic power plants who will obtain each one its own environmental permit. The two IPPs who have been awarded the two Solar PV Plants projects are NEOEN S.A.S. / First Solar Inc. and Enel Green Power S.p.A. The winning bidders assume majority control in the project companies and IDC will hold 20% as minority shareholder on behalf of the government.

Prior to developing the Solar PV Project, IDC is required to conduct an ESIA study in accordance with the Environmental Impact Assessment Regulations, 1997 (Statutory Instrument No. 28 of 1997), and in compliance with IFC Standards.

This document therefore presents the ESIA report for the proposed Ngonye Solar PV Project. The Ngonye Solar PV Plant will be constructed and operated by Enel Green Power S.p.A.

Project Rationale

The power deficit being experienced in the country has negatively affected homes and businesses. Therefore, the provision of up to 100 MW[1] of solar power into the national grid will contribute to reducing on-going load-shedding and will present an opportunity for the promotion of the use of sustainable renewable energy such as solar energy. The implementation of the proposed Solar PV Project is thus undoubtedly essential for improved quality and security of supply of power for domestic and industrial uses, among other benefits. The Ngonye Solar PV Plant will contribute up to 34 MW towards the initial 100 MW for Round 1 Scaling Solar Zambia Project.

Objective of the Project

The objective of the proposed Ngonye Solar PV Project is to contribute to redressing the current power deficit in Zambia by developing and installing a 34 MW Ngonye Solar PV Plant on Site 1 (Ngonye Site) whose footprint is partly within the LS MFEZ and partly on 11 ha land currently owned by the Ministry of Tourism and Arts.

Estimated Project Cost

The estimated investment cost of developing the Ngonye Solar PV Project is USD 43.40 million. Implementation of the Project has been planned to commence once approval has been granted by ZEMA.

Project Screening

The project was screened to assess potential environmental and social risks and impacts associated with the proposed Project's activities and to confirm applicable standard and national regulatory compliance requirements. The project falls under an IFC environmental and social risk Category B Classification for which environmental and social risks and impacts are estimated to be minimal, limited in scope and should be readily mitigated throughout the different stages of the project by effective implementation of an appropriate Environmental and Management Plan (ESMP). Under Zambian EIA regulations, the project requires an ESIA study prior to its implementation.

Environmental and Social Impact Assessment Methodology

The ESIA methodology adopted in carrying out the environmental and social impact study is outlined in this document. It includes the approach to environmental and social impact assessment, public consultations and identification and assessment of the impacts. The potential impacts have been assessed using standard methods of assessment and terminology. The impacts have been assessed in terms of their nature, duration, magnitude, likelihood of occurring and their overall significance.

Legal and Administrative Framework

The Ngonye Solar PV Plant Project will be implemented within the applicable Zambian Environmental and Social legislation and permitting legal and administrative framework. Some of the applicable legislations include the Environmental Management Act No.12 of 2011, Environmental Impact Assessment Regulations, 1997 (Statutory Instrument No. 28 of 1997), Statutory Instrument No. 47 of 2010, Public Health Act Cap 295, Energy Regulation Act, Cap 436, Water Resources Management Act, Cap 198, Road and Traffic Control Act, Cap 464, Local Government Act, Urban and Regional Planning Act, 2015, the Investment Act, National Heritage Conservation Commission Act, Cap 173, Zambia Wildlife Act No. 14 of 2015, Electricity Act No.15 of 1995 and Electricity Amendment Act, 2003, Occupational Health and Safety Act, 2010, Forests Act No. 4 of 2015, Employment Act CAP 268 and Workers' Compensation Act, 1999. The Project will also be implemented in compliance with the IFC's Policy on Environmental and Social Sustainability as well as the Equator Principles.

Project Overview

The project proponent for the Ngonye Solar PV Project under Round 1 Scaling Solar Zambia Project is Industrial Development Corporation. The project will be constructed and operated by Enel Green

[1] Based on site conditions and technology of choice, 80 MW is likely to be the final capacity for both Solar PV plants.

Power S.p.A. It will be operated on a 25 years Power Purchase Agreement (PPA) signed with ZESCO and consist of a 34 MW Solar PV Plant.

The design of the Ngonye Solar PV Plant on Site 1 is expected to have about 106,260 solar modules, 9 conversion units with 36 inverters to be installed at the site. The final designs will confirm the actual numbers of the components. The generated electrical energy will be transferred to an existing substation (which is currently under construction by ZESCO) via a 300 – 350 metres long 33kV underground cable, However, the installation of the underground cable is subject to change depending on final design details.

The distance between the proposed Ngonye Solar PV Plant and ZESCO substation will be less than 100 metres. This information will vary depending on the final detailed design.

The total project area at the Ngonye project site is 52 ha The area that will be developed will consist of the foundations for the conversion units, delivery cabins, Warehouse/Storage areas, Operation & Maintenance room, parking area, roads, and the PV field ground section which will have the installation of the structural posts that support the photo voltaic modules. Therefore, the effective area used for the PV system that will be developed will be less than the total available area.

The PV system for the proposed Ngonye Solar PV plant will be grid-connected with PV modules mounted on a sun tracking system.

The Ngonye Solar PV Project has been awarded to Enel Green Power S.p.A., a private company, for financing, construction and operation as an Independent Power Producers (IPPs) for 25 years. Enel Green Power will therefore operate the independent Ngonye Solar Photovoltaic power plant and will obtain its own environmental permit.

The Ngonye Solar PV Project is under Round 1 of the Scaling Solar Zambia Project. Round 2 and Round 3 of the Scaling Solar Project will follow and will be located at different sites to be identified within the country Zambia.

Project Location

The proposed and preferred Project site for the Ngonye Solar PV Plant is partly situated within the LS MFEZ and partly on an additional 11 ha piece of land owned by the Ministry of Tourism and Arts. The 11 ha land falls within the Lusaka National Park area but is outside the physical boundary fence surrounding the national park. The Ministry of Tourism has granted consent to the Ministry of Finance to hold title for the additional 11 ha of land. The Ministry of Finance will then lease the land to IDC to facilitate development of the Ngonye Solar PV Project. A letter from the Minister of Finance stating that he has no objection holding title to the land, pursuant to the Minister of Finance (Incorporation) Act, Cap 349 of the Laws of Zambia is presented in Annex 3 of the main ESIA Report for Ngonye Solar PV Project. In addition, a letter from the Ministry of Tourism and Arts to the Office of the Commissioner of Lands indicating that the Ministry of Tourism and Arts has no objection to releasing the portion of land for the Solar PV Project and that the title should be held by the Minister of Finance, pursuant to the Minister of Finance (Incorporation) Act, Cap 349 of the Laws of Zambia is presented in Annex 4 of the main ESIA Report for the same project. A copy of the Certificate of Title held by the Minister of Finance for the additional 11 hectares of land is presented in Annex 5 of this Report.

The LS MFEZ is located about 15 km to the South and East of the Lusaka Central Business District. There are no human settlements within the Project site. The project site is bordered by the Lusaka National Park to the South and some agricultural holdings to the East. The Lusaka National Park is fenced off within a wire fence. Within its fence boundary it has a 200 m buffer zone. The distance between the project site and some agricultural smallholdings located further East of the site is less than 100 metres. The site lies about 2 km South of the LS MFEZ and IDC Offices.

Main Project Activities

The construction phase of the project works will span a period of about 8-10 months. The phase will comprise ground clearance and levelling on the land at the project site, construction of the plant and staff operations maintenance building, fixing of the module footings and support structures into the

ground and mounting of modules onto the support structures within the site, digging of trenches for MV cables installation of inverters conversion units outside in one group along the module blocks and installation of cables and connection of modules to inverters and connection of delivery cabin to the substation. It is expected that approximately 100 people or more will be on site at the peak of construction activities. The workforce will be reduced to between 5 - 10 people during the operations. This number is subject to change as full sub-contracts are negotiated. During the construction phase site camp facilities will be established near the site.

The operational phase will mainly involve production of electrical energy using solar radiation and project design life is expected to extend for at least 25 years. The decommissioning phase will involve removal from site of used solar modules, associated electrical components and cabling for disposal or recycling. Site buildings will be demolished, if no alternative use for them will be agreed upon with stakeholders.

All project activities from construction phase through to decommissioning phase will be implemented with a strong focus on managing the occupational health and safety issues of the workers.

Waste Generation

The proposed project is likely to generate waste throughout its development phases. During construction phase waste from food packaging for construction workers and spoil from excavations, packaging materials (polystyrene) including cable drums, concrete, and effluent from site welfare facilities are likely to be generated. Possible waste materials to be generated during the operation phase include waste from maintenance works, failed PV units, office waste and effluent from site control room. During decommissioning phase waste will mainly be used solar modules, associated electrical components and cabling that will require removal from the site for safe disposal or recycling. Used solar modules will be sent to the manufacturers for recycling or any certified industrial recycling chain.

The centralised waste collection and treatment system for the LS MFEZ is yet to be completed and a temporary collection and disposal system will be required to be put in place by the operator until this facility is available. Designated and licensed waste disposal sites will be used for waste disposal. Mobile sanitary facilities suitable for construction sites will be used during the construction phase and waste from these facilities will be disposed of at the Sewage Treatment Plant within LS MFEZ. Any waste from the Solar PV plant that will be classified as hazardous waste will be disposed of in accordance with applicable legislations and IFC Performance Standards.

Raw materials

The sole source of energy for the project will be the sun (solar irradiance). It will be captured and converted by the solar modules to electric energy for power generation.

Water will be required during the construction phase. It will also be needed for cleaning of the solar modules and within the staff control room or office during the operation phase. The required volume of water during the operation phase will be supplied by the Lusaka South Multi-Facility Economic Zone Limited from the planned central water supply system for the zone.

As an interim measure, private off-site water supply via tankers could be used since on-site groundwater abstraction is not likely as hydrogeological study results suggest the project site has a low groundwater potential to sustain construction and operations of the Solar PV Plant. The approximate volume of water required will be confirmed based on the confirmation of the Solar PV Project Operators/Contractors and taking into account cleaning technology and local climate.

Project Alternatives

The feasible alternatives considered for this Project relate to project technology, project location and no project alternative.

Solar energy is the main source of renewable energy because of the local climate, which provides long sunshine hours (annual average of 7 hours / day). For Lusaka, the modelled average yearly sum

of direct and diffuse radiation received on horizontal plane is estimated to be 5.80 kWh/m^2. Solar PV technology, using solar energy as a raw material is, therefore, the preferred option for the proposed Solar PV Project. In addition, the selected technology is associated with very low noise levels and ease of installation.

The PV system preferred for the proposed Ngonye Solar PV Plant is the Grid-connected PV with PV modules installed on a sun-tracking system. Sun-tracking systems have more complex mounting structures associated with high cost of mounting and maintaining them but increase the average total annual irradiation.

Site selection was based on the initial desktop review of technical environmental, commercial and legal information. The LS MFEZ has been selected because it is wholly owned by IDC (LS MFEZ Limited is a subsidiary of the IDC); it has the necessary infrastructure; the fiscal incentives offered will reduce the tariffs; its proximity to the load centre for electricity; and availability of existing background data on the proposed Project site as result of on-going development works. The site is in Lusaka where the yearly average Global Horizontal Irradiation (sum of direct and diffuse radiation received on a horizontal plane) is estimated to be 5.80 kWh/m^2. This provides high potential for PV power generation.

Under the “No Project Alternative”, any potential adverse environmental and social impacts and risks associated with the project would not occur. However, the disadvantages associated with the no project scenario include increased power deficit and load shedding, lost opportunity to promote renewable energy, loss of employment opportunities for the local people who could have been employed during the construction and operation phases of the project, loss of government revenue through reduced taxes, and loss of business for suppliers and contractors.

Environmental and Social Setting of the project area

Topography

The project site has a relatively flat topography controlled by the underlying calcareous rocks of the Lusaka Limestone, which are easily weathered by mineral dissolution and leaching processes. It varies between 1315 and 1330 metres above mean sea level. The South eastern part of the site and generally the entire South to Southwest is relatively high in elevation than the north-north eastern side. The general slope at the project site is towards the northeast and this forms a general drainage direction of rainfall water surface runoff. It also slopes slightly towards the southwest.

Some sinkholes (swallow holes) and low depressions characterize the surface topography of the project site. The sinkholes have been observed on the eastern side of the immediate project site with one observed along the eastern side of the tarred road leading to the Lusaka National Park. The sinkholes (swallow holes) may be indicators of larger cavities (caverns) located below the rock/soil contact or some underground streams.

The rock outcrops and subsurface pinnacles also form the surface and subsurface features of the project site. The outcrops and rock pinnacles were noted in the project area.

Climate

The climate of the Project area is characterized by three distinct seasons: cool dry season from mid-April to August; hot and dry season from September to October; a rainy season from November to April. The area receives annual rainfall in the region of 500 mm to 1000 mm with the mean annual rainfall being in the order of 800 mm. Moderate temperatures with mean monthly temperatures ranging between about 15^{o}C in the cold season to about 30^{o}C in the hot season are experienced in the area. Prevailing easterly winds dominate the area during the dry season with fresh winds experienced in the months of July and August. Mean wind speed recorded in the area ranges from 4 km/hour to 9 km/hour. Extreme wind events in the area are associated with thunderstorms and transient, short-term “dust devils” and may reach 112 km/h. Sunlight hours per day range from 5 hours to 9 hours in August with an annual average of 7 hours per day.

Geology and Soils

Local Geology

The project area lies completely within the calcareous formation of the Lusaka Limestone and Dolomites. These rocks are part of the Chunga-Goma formations. The localized geology is an intercalation of clear white crystalline limestone, dark grey dolomitic shale and siltstone and grey dolomite. The rocks are gently folded with dips averaging 040^0 with dip directions of 058^0 (North East). There are some joints with vertical dips and geotechnical studies undertaken on site indicate the presence of one major inferred fault. Rock exposures are very prominent in the central and western sides of the project site while the eastern side is covered by thicker soil cover and only sporadic outcrops are observed.

Structural Geology

The major structural feature in the project area is the gentle dipping of the rocks, which generally dip on average $40^0/058^0$. Some localized joints are visible and the two common ones are one striking North-South with a vertical dip and the other one with a vertical dip as well but striking North East – South West.

Geotechnical aspects of the project area

The geology of the project area is predominantly calcareous, gently folded and geomorphically flat. This has implications in terms of geotechnical aspects. Some of the aspects include the following:

- The soil cover has varying thickness due to in-situ leaching. This presents a challenge in determining the stable depth for foundations.
- There are some floating rock gobbles, which could give false rock base during foundation exploration drilling.
- Presence of swallow holes is an indication of presence of larger caverns at depth or presence of underground streams. These can pose challenges in stability of surface structures in both short and long terms.
- The flat nature of the area has implications in creating an efficient drainage system within the area. The implications relate to potential pooling of rainfall runoff and flooding risks in times of heavy storm on site especially on the north-eastern part of the project site.
- The irregular subsurface weathered profile might present some serious challenges to foundation designs for heavy structures (in excess of 10 Tonnes weights).
- Uncertainties in drill logs due to irregular weathering profiles are a geotechnical challenge that requires serious consideration during foundation design and at construction stage.

The project site has karstic weathering features that include swallow holes (sink holes) and cavities. These features present a challenge to construction works on site. Suitable design and construction techniques should be considered taking into account foundation requirements for the proposed Solar PV plant. In addition, small undulating sub-surface pinnacle topography exists across the entire project area resulting in the variation of depth to the bedrock across the area.

The presence of sinkholes, cavities and rock pinnacles in the sub-surface provides significant evidence that there are problematic karstic weathering features at the project site. Therefore, the planned development should proceed with caution due to the risk posed by the karstic terrain identified on site. This risk will be required to be mitigated through suitable design and construction techniques. Detailed investigations should be carried out to understand further the site characteristics necessary for design.

The cavities noted in the diamond drilled boreholes on site were further investigated by carrying out ground penetration radar surveys. The preliminary results of the survey carried out as part detailed sub-surface mapping of the project site indicate void type of anomalies picked at depths ranging from

1.9m to 24.3m. A detailed ground penetration survey has been done to confirm the presence of void type anomalies and have been incorporated in the design of the project.

Soils

The soils at the proposed project site are ferruginous and are composed of silt, sand and gravel. The typical soil profile is composed of three layers – a humus layer followed by clayey silt sand then sand gravel (laterite). The layers are of varying thickness. Weathered rock of varying thickness controlled by the solubility of the parent rock is found below the laterite layer.

Hydrology and Hydrogeology

Surface Water

The project area also lies on the Lusaka Plateau. It lies at the watershed divide for the Chilongolo and Kafue Gorge sub catchments. The project site is divided into five sub catchments. The southern parts of the project area are drained by Sub catchments 4 and 5, which pour into the Kafue Gorge Sub catchment while runoff from the Northern and Eastern part of project area are drained by sub catchments 1, 2 and 3 that pour into the Chilongolo sub-catchment.

There are no permanent surface water features or open water courses at the Project site. The site is characterised by small valleys and depressions where rainfall runoff flows through. Most of the rainfall that is not lost through evapotranspiration drains into fissures and grikes or infiltrates through the lateritic overburden to recharge groundwater.

Surface rainfall runoff within the LS-MFEZ follows intense storms and travels for short distances until it is absorbed into the soil horizon. It flows to the North and East into the Chalimbana and Chongwe Rivers, and to the South into the Funswe and Chisuko Rivers that discharge into the Kafue and Zambezi Rivers, respectively. The base flow for these rivers is derived from the Lusaka Dolomite and discharges usually at the contact with the Cheta and Chunga Formations. There is no distinct surface drainage within several kilometres of the LS-MFEZ boundaries and any flow in these directions will be sub-surface through the soil horizon and the underlying geological structures. Surface runoff flow follows the same direction within the immediate project site.

Groundwater

The project area is located on the groundwater water divide and a recharge zone for the karst aquifer (Lusaka Dolomite Aquifer) that supplies Lusaka City zone with groundwater. It is underlain by the calcareous dolomite formation of the Lusaka Dolomite belonging to the Upper Division of the Katanga system. This geological formation (Lusaka Dolomite) has high recharge potential for groundwater. The area is also characterised by shallow groundwater tables, abundant surface karst features (karst morphology and sinkholes) that facilitates good permeability of the unsaturated zone.

Within the immediate surroundings and outside the project area, there are boreholes whose average estimated yields ranges from 0.2 l/s to 8 l/s. The long term sustainability of these yields is however not ascertained. Within the boundary of the project site, there are no existing boreholes. Available resistivity and magnetic survey data generated at surveyed areas at the project site suggests that the site is considered to be less favourable for occurrence of groundwater. The site has low groundwater potential.

The general groundwater flow direction in the project area is generally towards the northwest.

Air Quality

Dust emission

Dust monitoring undertaken around the proposed project site boundary shows that average PM10 concentrations at the site range from 6 µg/m^3 to 12.8 µg/m^3 while average PM2.5 concentrations range from 6.8 µg/m^3 to 14.0 µg/m^3 for a 24hr averaging period. The results for both PM10 and PM2.5 are all below IFC Ambient Air Quality Guidelines (50 µg/m^3 for PM10 and 25 µg/m^3 for PM2.5 for averaging period of 24hr) and the Zambian Emission Limits for Ambient Air Pollutants. The project

incremental impacts of dust are unlikely to change the background levels through the life of the project.

Sulphur Dioxide, Oxides of Nitrogen

The baseline data on gaseous air pollutants has been gathered through review of Environmental and Social Impact Assessment studies that have been conducted within the LS MFEZ. A review of JICA shows that sulphur dioxide levels ranged from 0.37 µg/m^3 to 0.43 µg/m^3 while NOx (as NO_2) was 0.21 µg/m^3.. There are currently no industries within the zone that emit sulphur emissions. Without a source of sulphur dioxide in the area the baseline concentration of gaseous air pollutants are still considered to be low as found in the baseline study done by JICA. Baseline concentrations of NOx and NO_2 are not expected to be high as there are no sources that include large fossil fuel combustion units, heavy traffic especially diesel vehicles. There are currently no operational industries likely to emit air pollutants.

Land Use

The proposed Project site partly falls within the LS MFEZ, which is Statutory Land owned by LS MFEZ Limited and partly falls within an 11 ha piece of land, which is part of the Lusaka National Park and owned by the Ministry of Tourism and Arts. The 11 ha piece of land is additional land required for the project and is physically outside the boundary fence for the National Park. The LS MFEZ, is currently zoned for industrial and commercial development. Although the LS-MFEZ certificate of title for the entire MFEZ is zoned for agricultural purposes, Statutory Instrument No.47 of 2010, which designates the area as a multi-facility economic zone overrides the zoning. The offer of land in the LS MFEZ for the purpose of developing the proposed project is attached to main ESIA Report.

The immediate project site is currently an open space with tall grass, shrubs and regenerating trees. The landscape at the site has been affected by human activities such as charcoal burning, firewood collection and farming. The southern end of the project site forms the boundary with the Lusaka National Park while a NRB Pharma Zambia, a pharmaceutical company, and LS MFEZ Offices are located on the northern end of the site. The Lusaka National Park is fenced off and within the Park boundary fence, there is a 200 metre buffer zone maintained by the Department of National Parks and Wildlife under the Ministry of Tourism and Arts.

The ZESCO substation which will facilitate the transfer of generated electrical energy from the Solar PV plant into the national grid is under construction and is located immediately to the North of the proposed project site. Other industries are also planned to be established within the economic zone. The neighbouring properties on the eastern end of the project site are smallholdings and large farms where individual farming activities such as poultry, pig rearing and crop production are practised. The neighbouring properties close to the site boundary are located within 40-100 metres while the distance between the properties and the ZESCO substation under construction at the site is over 800 metres. There are also a number of business entities and private game ranches.

Biodiversity

Flora

The immediate project site is a modified ecosystem which is characterised by some tall grass and some regrowth vegetation. The modified ecosystem resulted from previous disturbances such as shifting cultivation and charcoal production. The vegetation is mainly of regrowth nature with species of Miombo woodland dominating. The dominant species namely *Bauhinia petersiana, Diplorynchus condylocarpon, Combretum molle* and *Albizia antunesiana* are Chipya Ecological group, which is composed of species that grow in habitats where dry season fires are intense. The proposed project area is a modified habitat that is in its early stage of the woodland recovery from previous disturbances. The available baseline gathered shows that the proposed Project site does not have flora of biological importance.

Fauna

The proposed project area has a variety of fauna species namely; mammals, reptiles and avifauna. The commonest spotted mammals over the project area are Common duicker, Greater Cane Rat, Scrub hare, Cape hare, African civet, Tree Squirrel, African wild cat, African savanna hare, and Southern Giant Pouched Rat. The animals observed over the proposed project area are mainly of Least Concern (IUCN Red List Database). Reptiles observed across the project area include Flap-necked chameleon, Black-necked spitting Cobra, Nile monitor lizard, Southern African python, Twig snake, Puff adder and Spotted bush snake. The species are neither rare nor endangered. They are mainly of least concern.

The bird species observed at the site are mainly in the Least Concern or Unknown category under the IUCN Red List Database. None of the species fall under either the threatened or the endangered category.

Therefore, project site has no flora and fauna species that can be classified as rare, threatened or endemic to the area or that are of special scientific value.

Archaeology and cultural heritage

There are no known sites of archaeological, cultural or historical value near or within the vicinity of the project site. Transect walks at the site and interviews with traditional leadership in surrounding village communities of Mahopo, Shantumbu, Kakote, Mwachilenga, Chisompola and other key stakeholders at institutions in the vicinity of the project site confirmed that the proposed site does not host any known archaeological and cultural heritage resources of significance. The site was never used for culturally important activities such as burial, shrines, or any intangible heritage processes.

Noise and vibrations

Noise

Construction works and occasional traffic movement of vehicles along the tarred access roads leading to the substation and the Lusaka National Park are considered the only major sources of noise at the site. Baseline noise levels recorded at selected points along the Project site boundary ranged between 32.4 Leq dBA to 50 Leq dBA with the highest level of 50 Leq dBA recorded when there was intrusive noise from a bulldozer that was clearing land near the ZESCO substation that was under construction. The noise levels recorded around the boundary of the proposed solar plant reflect the typical values that are obtainable in a quiet place and are within the IFC Noise Levels Guideline Limits for day (70 Leq dBA) and night (70 Leq dBA) time for industrial and commercial receptors.

Vibration

Baseline vibration readings collected at identified points on and near project site beacons and receptor areas of interest show that vibration levels ranged from 0.03 to 0.20 mm/s peak. These readings were very low on and around the project site despite on-going construction activities at the ZESCO substation. Vibration-sensitive areas identified at the site are agricultural smallholdings located on the eastern boundary of the project site. The nearest buildings close to the site boundary are located within 40 – 100 metres. Off-site vibrations are therefore not anticipated to adversely affect identified vibration sensitive receptors.

Traffic and Road Infrastructure

The project site is serviced by newly constructed roads provided as part of the wider LS MFEZ development. The site is located along Chifwema Road, off Leopards Hill Road. The roads leading to the site and those within the LS-MFEZ are all tarred. Current road traffic volume on access road and internal roads are low but this is expected to increase at the peak of multiple construction and operation activities within the zone.

The surroundings of the proposed project site are well covered and served by the local radio and television network. The site has good reception for the three mobile cell networks (Airtel, MTN and CellZ).

Socio-economic conditions of the project area

The population in the immediate vicinity surrounding the LS-MFEZ includes residents of Shantumbu and Mahopo Villages, Leopards Hills, Chalala and New Kasama residents and the farming community in New Kasama bordering the eastern end of the proposed project site.

Socio-cultural and economic activities

Shantumbu Village

Shantumbu village is one of the areas whose population is considered to be in the immediate vicinity surrounding the LS MFEZ. The village is headed by a Headman and falls under the traditional leadership of Chieftainess Mukamambo Nkomeshya of the Soil people. Land within the village is under customary tenure. The village is predominantly inhabited by the Soli speaking tribe while other ethnic groups like Lenje, Tonga and Bemba are also found. The Soli people practice the 'Chikwela Makumbi" tradition ceremony held in October at Chieftainess Mukamambo Nkomeshya's palace in Chongwe. There are no people in Shantumbu Village who can be referred to as indigenous people.

A large majority of households in the village are subsistence farmers growing maize as the main crop while other crops grown are beans, sweet potatoes and groundnuts. Charcoal production and livestock is also practised. Other livelihood activities among local residents are artisanal quarrying of building material and some employment opportunities at the four quarrying and mining companies located in the area.

Shantumbu Primary School, originally established in 1958, is the only education facility in Shantumbu Village with a total pupil enrolment of 610 with 22 serving teachers. It has pupils attending Grades One to Nine classes. The pupils proceeding to Grade 10 attend senior secondary school in Lilayi, which is 4 km away or Kamwala located about 12 km away. Absenteeism is a common problem among pupils and many of them drop out of school due to long distances they have to walk to attend school.

The people in Shantumbu Village have access to basic preventive and curative services offered at Chisankane Rural Health Centre. The centre serves 22 villages with a catchment population of 9,732 people.

Water supply in the area is from boreholes and shallow wells. The school and the clinic are supplied with water from boreholes installed within their respective premises. In terms sanitation services, many households in Shantumbu Village use pit latrines.

Mahopo Village

Mahopo village has an estimated 370 households. The village character of the settlement is slowly being transformed with the construction of permanent house structures of brick and mortar with iron roofing. Livelihood and economic activities for some residents of Mahopo Village includes formal employment with the majority of them being employed as causal workers in the surrounding farms. Others are involved in trading in vegetables, eggs, chickens and other farm produce sourced from the surrounding farms, and in artisanal mining for crushed stones and slate for construction.

Mahopo Settlement is served by Mahopo Community School, which is a 1 x 3 Classroom Block School constructed with the assistance of the Japanese Embassy in Zambia. The school has a total pupil enrolment of 500 pupils in Grades One to Five with 5 teachers. Pupils proceeding to Grade 6 and above attend nearby schools in Chilenje and Kamwala South located 6km away. The school has no library facility.

Mahopo settlement has a new clinic constructed in 2016. The clinic has not been commissioned into operation.

Water supply within Mahopo Settlement is currently from 6 boreholes located within the area. With regard to sanitation services provision, new houses that are being constructed have individual toilets served by soak-aways while the older village type houses have pit latrines.

Chalala Residential Area

Chalala area is a medium cost residential area located about 6 km northwest of the proposed project site. The area is characterized by a high density of middle-income housing estates. Water supply and sanitation services are from individual boreholes and septic tanks. Livelihood activities among the residents are through formal employment in the civil service and private business enterprises. One of the Lusaka inner roads that terminate on the north-western boundary of LS MFEZ passes alongside the eastern and northern extents of Chalala Residential Area.

Leopards Hill & New Kasama Residential Areas

Leopards Hill and New Kasama residential areas are located on and around Leopards Hill Road, one of the main roads leading to the project site. The areas have mixed land use types comprising smallholding and large farms with plush residences. They are inhabited by affluent Zambians and different nationalities, mainly expatriate personnel. There are a number of business entities and large farms in these areas with notable ones being. Zambezi Private Game Reserve, Bangweulu Taxidermy, Leopards Hill Polocrosse Club, Veterinary Surgery, J Lazy J Ranch Stables & Sanctuary, Kyindu Ranch and Trees 4 Zambia.

Trading activities on stalls (locally known as *Tuntemba*) along the Chifwema Road leading to the project site is also noticeable. The stalls numbering 20 are located on a farm bordering the LS-MFEZ. Goods sold in these stalls include farm produce such as eggs, vegetables; foodstuffs such as cooking oil, sugar, bread and second-hand clothing.

Education facilities in the project area include the American International School of Lusaka (AIS), Naledi School and State Lodge Primary School. The AIS and Naledi School are private education facility located along Leopards Hill Road opposite each other while State Lodge Primary School is government education facility located about 6 km from the LS MFEZ. It is accessed by pupils from surrounding farm areas of New Kasama / Leopards Hill Road area, and the State Lodge Police Camp.

Chifwema Settlement

Chifwema Settlement falls under Kafue District and is located about 18 km from the LS-MFEZ. The population in the area is mainly involved in subsistence farming. The main food crop grown is maize. It is likely that some of the unskilled workforce will be drawn from this settlement.

The education facilities within the settlement include Nachitete and Chifwema Primary Schools. The Nachitete Community School is a single block facility located in the precincts of a mosque while Chifwema Primary School is a 1 X 2 classroom block facility with 2 staff houses. The School runs Grades One to Nine classes and has an enrolled population of 603 pupils. Water supply to the school is from a borehole and tank provided by ZAMTEL in partnership with Huawei.

Chifwema Settlement has two health centres - the Andy Health Centre at Chifwema, which is currently not operational as it has not been handed over to the Ministry of Health, which is responsible for providing staff to run the health facility. Nachitete is another health centre within the settlement.

Historical Land Use and Resettlement issues at LS MFEZ

There are no human settlements at the project site. Resettlement issues arose at the time of creating the LS MFEZ and they were handled by the Disaster Management and Mitigation Unit (DMMU), a government agency, and other government institutions. The Office of the District Commissioner was also involved and handled the resettlement of people that claimed that they were left out of the initial listing and screening exercise conducted by DMMU and other stakeholders. The issues on resettlement are briefly highlighted in this document. The proposed Ngonye Solar PV Project will not result in physical and economical displacement of people. In addition, the proposed Project is not responsible for resettlement impacts that arose during the creation of the LS MFEZ. This is because the resettlement was not as a consequence of the proposed Solar PV Project but as a result of the creation of the LS MFEZ.

Impact Assessment

The environmental and social impacts and risks that could potentially arise as a result of the proposed project have been identified based on available information. Mitigation and enhancement measures aimed at reducing potential adverse impacts and at enhancing beneficial impacts have been proposed.

The details on assessment of impacts and the significance of the impacts identifies are presented in Section 5.

Environmental Management Plan

The Environmental and Social Management Plan (ESMP) has been developed to ensure compliance with the requirements of the Zambian regulatory requirements as well as IFC Environmental and Social Sustainability policies, guidelines, standards and other requirements. The plan has incorporated mitigation measures, which have been defined in line with the predicted potential environmental and social impacts and risks. This has been done in order to avoid or minimise potential adverse environmental and social impacts and risks, and to enhance benefits arising from project development phases.

With regard to implementation of the ESMP, IDC will have senior management commitment to ensure that the level of environmental and social performance identified in the ESMP for the proposed project is achieved while the Contractor will play a central role in achieving the level of performance required during construction phase. The Contractor will implement the ESMP as part of the day to day management of the Contract and operational procedures. The Contractor will be required to report to IDC on environmental, health and safety issues pertaining to the construction and operations of the proposed Ngonye Solar PV Plant.

The ESMP includes commitments for capacity building and technology transfer to ensure consistent and acceptable environmental and social performance during the development and construction phases of the Project. The necessary skills and information required to achieve the required level of performance will be provided to local specialists by the Contractor to transfer skills and technology to the local and to build national capacity.

The Contractor will undertake environmental auditing and inspections of all its operations to ensure that environmental monitoring activities undertaken at the project site are accurate and relevant to meeting the environmental management objectives of the proposed Project. External audits will also be conducted by independent external auditors such as the Project company, ZEMA, Energy Registration Board and IFC. The environmental audits and reporting shall be conducted in compliance with IFC requirements, the project company procedures, as well as applicable Zambian environmental regulatory requirements.

A brief summary of the identified and potential impacts with their corresponding proposed mitigation measures are presented in the tables attached.

Decommissioning and Closure Plan

The project life is expected to extend for at least 25 years. The decision to decommission the Solar Plant will be influenced by economic sustainability and technological changes / advances. As these factor dictate, a specific closure concept and plan will be developed.

In general decommissioning and closure principles require that a project is decommissioned and the site rehabilitated in a socially responsible manner that reflects sound environmental management practices. The decommissioning and closure phase of a project should be implemented to achieve the following objectives: protection of public health and safety, reduction or prevention of environmental degradation, and allowing continued productive use of the project site, similar to its original use or to an acceptable alternative use.

In respect of the proposed Ngonye Solar PV Plant, the main activities during the decommissioning phase will be removal from site of used solar modules, associated electrical components and cabling

for disposal or recycling and demolition of site buildings. The solar modules will be sent to the manufacturer for recycling or any certified industrial recycling chain.

Most of the impacts associated with construction phase activities are similar to impacts associated with the decommissioning phase. The decommissioning plan will include measures to mitigate any significant adverse impacts and to enhance beneficial ones. The plan will include responsibilities and roles to manage the impacts in a sound and environmentally sustainable manner.

Conclusion

This Environmental and Social Impact Statement presents the environmental and social baseline conditions of the project area. It also presents the potential environmental and social impacts and risks that are likely to arise as a result of the propose Project. Both positive and negative impacts are presented in the document.

The measures to enhance the beneficial impacts and to avoid, reduce or remediate negative environmental and social impacts and risks have been consolidated into an Environmental and Social Management Plan included in this document. Implementation of the recommended measures will be monitored to assess their effectiveness and to adjust them where appropriate.

With the effective implementation of the proposed mitigation measures presented in the ESMP, the construction and operation of the proposed Ngonye Solar PV Project is not likely to result in adverse environmental and social impacts and risks. The project will not only contribute to redressing the power deficit current being faced by Zambia but it will also promote the use of renewable energy technologies to generate clean and sustainable energy with the subsequent creation of employment opportunities and associated multiplier effects. The project will contribute to stimulating economic growth and development in Zambia.

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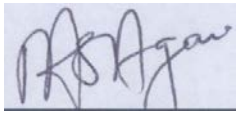
Chief Executive Officer

Industrial Development Corporation

ESIA STUDY TEAM

NAME	POSITION	SIGNATURE
Patrick Kampengele	Project Director	
Boston Katongo	ESIA Coordinator	
Mitulo Silengo	Social Specialist	
Stephen Syampungani	Ecologist	
Wilson Moono	Geologist	
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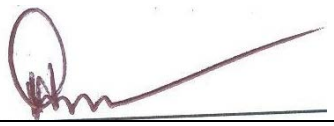
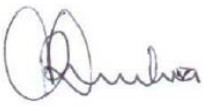
Happy Sikazwe	Hydrologist	
Joseph Siame	Power Generation and Transmission Expert	
Robam Mwenge	Vibration Expert	

Table 1: Environmental and Social Management Plan (ESMP) - Construction Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Air Quality			
Site clearing, levelling and construction of internal access roads and other construction works.	Dust generated can affect workers' health and safety on site and sensitive receptors in nearby locality and visitors to the Lusaka National Park	• Dust generation on unpaved access roads and work areas should be controlled by application of water as need arises. • Appropriate speed limits should be set to minimise dust generation from vehicles moving on unpaved site access roads. • The workers should be trained on handling construction materials and debris to reduce fugitive dust emissions. • Construction workers at risk of being exposed to significant dust emissions should be provided with adequate personal protective equipment (PPE).	Visual monitoring of dust emissions along access roads and during earthworks and construction activities. Daily safety checklist
Operation of construction equipment and machinery and transportation of solar plant components.	Exhaust emissions from the construction equipment and machinery.	• Construction equipment and vehicles used for transportation of plant equipment should be adequately maintained and inspected to minimise exhaust emissions.	Visual monitoring of exhaust emissions during earthworks and other construction activities. Vehicle maintenance records.
Archaeology and cultural heritage			
Construction activities leading to exposure, unearthing or removal of unknown subterranean and chance surface archaeological finds.	Potential damage to archaeological finds that may be exposed or unearthed (below ground archaeological deposits) during construction works	• A 'chance find' procedure will be developed and implemented to address and protect cultural heritage finds that may be discovered during the construction and operation phases of the project. • Construction activities in the immediate vicinity of the discovery shall be stopped if any archaeological or ancient prehistoric materials are chance found during construction works. • In an event that archaeological or ancient prehistoric materials are discovered, the East Central Regional Headquarters of National Heritage Conservation Commission (NHCC) should be contacted for professional advice and rescue excavations.	• At least one site inspection immediately after chance find. • Creating awareness among personnel on site about chance find procedures should the encounter archaeological or prehistoric materials.

Table 1: Environmental and Social Management Plan (ESMP) - Construction Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Construction and operations of the project.	Loss of irreplaceable heritage material (cultural and natural heritage resources) in the Project area	• In an event that irreplaceable heritage material is found, an Information Centre should be constructed in consultation with NHCC to exhibit the cultural and natural heritage, storylines and exhibition for education, research, adventure and posterity within or outside Project Area. Collection and display / exhibition of heritage artifacts and fossils	Maintenance of an information centre
Biodiversity			
Clearing of areas for installation of the scaling solar infrastructure may impact on the existing modified habitat.	Loss of vegetation (tree species) and natural habitats for small mammals, birds and insects.	• Clearing of vegetation should only be confined to areas where the solar infrastructure will be installed to minimise of loss of vegetation and wildlife habitats. • The construction workers should be provided with guides and extents of areas to be cleared and site clearing works should be monitored. • Burrowing animals likely to be noted on site during the construction and operation phases of the project will be removed and the burrows filled..	Visual inspection of clearing activities.
Community, Health Safety and Security			
Construction of the solar PV plant.	Risk of accidents involving members of the public through unauthorised access to the project site.	• The project site should be enclosed within a security perimeter and no unauthorized persons should be allowed access to the site. • Caution signs should also be placed around the site to prevent occurrence of accidents and injuries. • The community should be sensitized on the dangers of trespassing at the project site so as to avoid potential accidents that might arise from unauthorized access to the site. • Reasonable steps should be taken in the provision of security and in particular the use of force and establish appropriate conduct towards workers and affected communities. • A grievance mechanism should be put in place for the Affected Communities to express concerns about the security arrangements and acts of security personnel.	Security surveillance and community engagement to sensitize affected members of the community on their health, safety and security. Review of the chance find procedure
Lack of or inadequate good water supply and sanitation facilities on site.	Risk of water borne diseases due to lack of potable water and sanitation facilities	• Safe and clean water and good sanitation facilities should be provided to construction workers to prevent an outbreak of waterborne diseases among them which can also affect the surrounding communities. The standards range from 1 unit (toilet facility) per 15 persons to 1 unit per six persons (IFC & EBRD, 2009)	Safe and clean drinking water provided on site. Operable sanitation facilities provided on site.

Table 1: Environmental and Social Management Plan (ESMP) - Construction Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Landscape and Visual Amenity			
Clearing of vegetation and installation of solar PV modules.	Visual intrusion and disruption of the aesthetics.	• Low visual reflective solar modules with anti- reflective coating (ARC) that reduces reflectance from the solar PV modules should be used; • Low level solar module mount design system (2 - 3 metres) that will not disrupt the aesthetic view of the project /surrounding areas should be used on site: • A perimeter buffer of trees and grass vegetation along the project site boundaries should be left, where possible, to screen sensitive viewing areas such as sides of the road to the Lusaka National Park entrance gate and the area along the eastern boundary area where there are some agriculture holdings. • General cleanliness and good housekeeping at the site should promoted be at all times.	Monitoring existing vegetation screening at the site and ensuring that it is appropriately maintained without providing shades onto the solar PV modules and visual inspection of cleanliness and housekeeping.
Noise and vibration			
Construction activities (site clearance and levelling, internal roads construction), transportation of the plant components to site.	Potential noise disturbance from heavy equipment, may affect workers on site.	• Regular maintenance on all equipment, vehicles and machinery should be performed to minimise noise; • Provision of adequate PPE such as ear plugs to site workers likely to be exposed to high noise levels. • Appropriate transportation routes should be selected.	Noise monitoring during the construction (e.g. during rock blasting) using a portable noise level meter to demonstrate compliance. Daily safety checklist to ensure workers have approved PPE.
Construction works using pile drivers, earth moving and excavation equipment including blasting of rocks.	Disturbing sensitive receptors and causing structural damage arising from blasting and other construction works.	• The contractor should at all times, carry out all work in such a manner as to keep any disturbance from vibration to a minimum especially when working in close proximity to receptor areas. • Where appropriate, bored piling techniques should be considered in preference to impact piling to minimise vibration impacts. • Operators of vibrating hand-held machinery should be provided with appropriate PPE (e.g. protective gloves) and should be given suitable breaks from using such equipment to reduce the impacts of vibration.	Inspection of construction equipment. Conducting safety checks prior to operating vibrating machinery and other equipment.
Rock blasting on site to level the ground prior to installation of Solar modules and other infrastructure.	Noise disturbance and residual vibration impact arising from rock blasting on site.	• Low density blast charges should be used, if required, during rock blasting operations to minimise on noise disturbance and residual vibration impacts.	Monitoring implementation of blasting procedures including notification of nearby residences and ensure that approved low density charges are used with

Table 1: Environmental and Social Management Plan (ESMP) - Construction Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
			approved blasting permit. Record of inspections prior to rock blasting.
Occupation Health and Safety			
Occupational health and safety of workers working on site.	Reduced occupational health and safety among workers	• A Health and Safety Policy shall be developed and implemented by the contractor to guide construction and operations of the facility. • All construction activities should be conducted in accordance with provisions of the local legislation and international best practices (General EHS Guidelines: Occupational Health and Safety); • Safety rules should be enforced and complied with by workers, contractors and those coming to site: • Personal Protective Clothing (PPE) should be issued and used as required by the various classes of the workers on project site; • Barrier tapes and caution signs should be erected in all potential hazardous areas to prevent injury or loss of life among construction workers; • No unauthorized person should be allowed on site including workers without appropriate PPE.	Risks identification and implementation of management measures conducted prior to commencement works.
Construction works at the project site	Safety risk to workers and equipment caused by slippery ground during wet months.	• Resuming work immediately after rains should be avoided. Work risk analysis should be undertaken before resuming. Blast should be applied on road networks.	Permit to resume works to be implemented after a storm event and work risk analysis records.
Socio-economic			
Employment opportunities at the project site arising from construction works.	Influx of population of job seekers on site posing health and security risks and leading to unplanned housing / structures and commercial activities around the project area.	• Enforcement of relevant by-laws laid down by the respective Lusaka City Council and Kafue District Councils with the help of IDC to prevent mushrooming of unplanned structures and activities.	Security surveillance and Community Engagement to sensitize on matters relating to development of unplanned structures and activities.

Table 1: Environmental and Social Management Plan (ESMP) - Construction Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Construction sites have been known to promote risky sexual behaviour.	Risky sexual behaviour among the population leading to escalation of new STIs including HIV/AIDS in the local population and among the workforce.	• Developing an HIV/AIDS Policy by the contractor / operator to be adhered to during the construction and operation phases of the project. • Sensitization programs on preventing the spread of STIs and HIV/AIDS for project workers including contractors and suppliers. • Provision of condoms (including Female Condoms) in places where they can be easily accessed such as toilets. • Education programs on fighting stigma of those infected with HIV/AIDS	Record of sensitisation / education programmes undertaken including the number of people sensitised / trained on STI and HIV/AIDS.
Construction of the solar PV plant	Capacity building and technology transfer to local contractors, skilled manpower and unskilled workers.	• Local contractors, skilled specialists and unskilled workers should be used to benefit from technology and skills transfer during construction and operation of the solar plant. • Appropriate training should be provided to all local contractors, skilled manpower and unskilled workers to enhance expected project benefits.	Skills training for locals with assistance from local learning and construction institutions. Number of local people trained.
Construction of the solar PV plant	Employment opportunities created for both skilled and non-skilled labour and. multiplier opportunities for employment in support sectors.	• The contractor, where possible, should employ members of the local communities and local experts to maximize on the benefits of employment opportunities. The jobs for which local people qualify (including non-technical and technical) will be as much as possible be offered to the local people.	Record of employment, annual reports on IDC / Ngonye Solar PV Plant Operators.
Construction of the solar PV plant	Project contribution to the local and national economy through its multiplier effect	• Procurement of services and locally produced raw materials from local companies and local contractors during the construction phase should be done, where possible, to maximise the benefits.	Annual reports on IDC / Solar Plant Operators
Soils and geology			
Construction works at the project site	Unstable surface structure foundation caused by rock weathering.	• Detailed and *specific surface mapping,* ***geotechnical investigations for foundation design*** should be undertaken at the project site prior to installation of structures.	Survey monitoring (ground subsidence) of all installations.
Clearing of the project site to pave way for construction works.	Loss of topsoil cleared / stripped from the project site.	• The soils stripped from the project site will be stockpiled as part of soils conservation measure and will be used for remediation / rehabilitation / re-vegetation of areas that will be disturbed by construction activities.	Monitoring stockpiling of stripped topsoil at designated sites. Presence of stockpiled topsoil.

Table 1: Environmental and Social Management Plan (ESMP) - Construction Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Site clearing and movement of construction equipment on unpaved surfaces.	Fugitive dust generation impacting on the health of workers and the environment.	• Unpaved surfaces should be maintained through application of water, capping and grading to minimise fugitive dust generation. • Water bowsers should be used to spray water on unpaved access road surfaces to suppress fugitive dust emissions during construction phase.	Visual inspections of all unpaved areas.
Development of Sinkholes at the project site.	Threat to stability of Solar PV surface structures potentially resulting in damage to solar plant infrastructure.	• Detailed and specific surface mapping, *geotechnical investigations and subsurface ground penetration surveys for* ***foundation design*** should be undertaken at the project site.	Survey monitoring (ground subsidence monitoring) of all installations at the project site.
Installation of infrastructure at the project site	Stability threats to heavy surface structures due to underground caverns in base rock formation.	• Detailed and specific surface mapping, *geotechnical investigations and subsurface ground penetration surveys* ***for foundation design*** should be undertaken at the project site.	Check that all construction works are in conformance to the design specifications and layouts
Construction and operation works on site.	Risk / threat to surface structures due to formation of swallow holes and possible underground stream in subsurface rock formation.	• Detailed mapping of subsurface for foundation design and construction of effective drainage in and around project area should be undertaken.	Check all drainages structures and disturbed areas to avoid potential ponding.
Construction works and operation of the solar plant on site.	Damage to solar support structures and foundations due to soil erosion on site.	• A storm water management plan should be developed and implemented. An effective storm water drainage network should be constructed as part of the plan implementation to channel increased surface runoff to designated catchment areas. An effective drainage network will minimise soil erosion over exposed surface and will minimise the risk of erosion of the support structures and foundations. It will also reduce the risk of flooding the project site.	Check construction and effectiveness of all drainages structures on site.
Installation of infrastructure at the project site	Unstable structures caused by floating rock boulders in sub soil.	• Detailed mapping of subsurface ***for foundation design*** should be carried to identify presence of floating rock boulders and *to design appropriate foundation structures*.	Inspection of structural stability of all installations at the site (ground subsidence included).

Table 1: Environmental and Social Management Plan (ESMP) - Construction Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Site clearing and construction activities	Irregular soil profile causing foundation construction challenges and unstable foundations.	• Detailed mapping of subsurface will be carried to assess risks of soil movement (ground subsidence) prior to installation of Solar PV infrastructure. Detailed specific geotechnical investigations for design should be undertaken.	Monitoring of structures for stability in accordance with plant specifications.
Traffic and road infrastructure			
Haulage vehicles carrying materials to site have a potential to increase traffic and decrease road safety especially on access routes.	Reduced safety on public access roads and onsite due to increase in vehicle traffic (potential increase in traffic-related accidents and injuries)	• Developing and implementing a site specific Traffic Management Plan for transportation purposes during construction that the transportation service provider will adhere to. Enhancing traffic safety management within the economic zone; • Ensuring that only licensed operators and drivers use equipment and vehicles accessing the project site. • Putting up appropriate signage (road markings, road traffic signs) including speed limits and applying speed control structures; • Road safety training for workers and other stakeholders within the zone. • Separating site access routes for construction vehicles and pedestrians. • Bulk storage of materials on site to lessen constant vehicular traffic. • Employing speed calming devices. • Induction of drivers on safe conduct of vehicles on construction sites. • Providing reflective vests and coveralls for workers of site.	Undertaking weekly traffic surveillance inspections and road condition surveys. Record of inspections and number of workers trained in road safety.
Water Resources			
Clearing of vegetation and construction works at the project site.	Risk of erosion of solar PV support structures and foundations arising from increase in surface runoff during the rainy season or storm rainfall being more than infiltration into the ground.	• A storm water management plan should be developed and implemented. Storm water drainage system should be properly designed and constructed to convey surface runoff away from the project area into a catchment area, which will hold runoff and allow it to slowly infiltrate the ground. • The drainage system should also be designed and constructed to avoid erosion of support structures and foundations.	Inspection of storm water drainage network during construction and operation phases to ensure their structural integrity and capacity to convey surface runoff.

Table 1: Environmental and Social Management Plan (ESMP) - Construction Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Storage of fuels and oils on site during construction phase of the project.	Potential groundwater contamination arising from potential spillage of fuel and oils during storage and handling.	• Appropriate procedure for storage and handling of fuels and oils should be adopted to avoid spillages of fuels and oils onto the ground. Fuel tanks must be bunded to contain possible spills and to prevent the infiltration of fuel into the ground. • Secondary containment structures, made of impervious and chemically inert material and capable of containing the larger of 110 percent of the largest storage vessel should be constructed for storage of fuels, oils and other hazardous substances. All products (fuels, oils) shall be stored in a bund area that can carry 10% more than the product's capacity. • Handling, storage and disposal of hazardous substances (used transformer oils) should be carried out in accordance with the World Bank General Environmental Health and Safety Guidelines (Hazardous Materials Management) and the applicable Zambian Environmental Management (Licensing) Regulations, 2013. • Dedicated secured storage areas for fuels, oils and other hazardous materials should be provided as part of the design. All fuel will be stored above ground level. • Training on handling, storage and disposal of hazardous waste should be provided as part of the overall environmental management of the site. • Uncontrolled dumping of any toxic or hazardous waste, including used transformer oils from a couple of transformers to be installed on site should be avoided. • Uncontrolled dumping or littering of any waste within the project area and areas adjacent to the project site should be avoided.	Inspection of fuel and oils storage areas.

Table 2: Environmental and Social Management Plan (ESMP) during Operation Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Air Quality			
Regular operational works on site with the potential to generate dust.	Exposure of workers to dust potentially posing health effects to them.	• Operators at least of being exposed to significant dust emissions will be provided with adequate personal protective equipment (PPE).	Daily safety checklists to ensure workers have approved PPE.
Communication			
Operations of the solar plant	Electromagnetic field interfering with communication	• Electromagnetic compatibility (EMC) certified inverters should be used on the project to prevent electromagnetic fields interfering with communication.	A record of equipment operations checklists and testing protocols should be kept.
Community Health, Safety and Security			
Operations of the solar plant	Risks of electric shock, thermal burn, exposure to EMF and several other hazards through unauthorised personnel trespassing the site.	• Security fence should be installed around the entire facility to control access and keep out unauthorized personnel.	Inspection of the premises and installed fencing around the project site
Operation of the solar PV plant.	Risk of accidents involving members of the public through unauthorised access to the project site.	• The project site should be enclosed within a security perimeter fence and no unauthorized persons should be allowed access to the site. • Caution signs should also be placed around the site to prevent occurrence of accidents. • The community should be sensitized on the dangers of trespassing at the project site so as to avoid potential accidents that might arise from unauthorized access to the site. • Reasonable steps should be taken in the provision of security and in particular the use of force and establish appropriate conduct towards workers and affected communities. • A grievance mechanism should be put in place for the Affected Communities to express concerns about the security arrangements and acts of security personnel.	Security surveillance and community engagement to sensitize affected members of the community on their health, safety and security.

Table 2: Environmental and Social Management Plan (ESMP) during Operation Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Lack of or inadequate good water supply and sanitation facilities on site.	Risk of water borne diseases due to lack of potable water and sanitation facilities	• Safe and clean water and good sanitation facilities should be provided to workers to prevent an outbreak of waterborne diseases among them which can also affect the surrounding communities.	Safe and clean drinking water provided on site. Operable sanitation facilities provided on site.
Landscape and Visual Amenity			
Installation of solar PV modules.	Visual intrusion and disruption of the aesthetics.	• Use of low visual reflective solar modules with anti- reflective coating (ARC) that reduces reflectance from the solar PV modules; • Use of low level solar module mount design system (2 - 3 metres) that will not disrupt the aesthetic view of the project /surrounding areas: • Maintaining a perimeter buffer of trees and grass vegetation along the boundaries to screen sensitive viewing areas in the vicinity of the site.	Monitoring existing vegetation screening the site is appropriately maintained without providing shades onto the solar PV modules.
Noise and vibration			
Operations of the solar plant (electricity production) including clearing of vegetation from under and around the solar modules.	Noise disturbance arising from the operation of solar plant potentially affecting workers on site.	• Operations workers likely to be exposed to high noise levels will be provided with adequate PPE such as ear plugs.	Monitoring noise levels to ascertain level of noise generated by inverters and to check compliance with IFC Noise Levels Guidelines for industrial receptors.
Occupation Health and Safety			
Occupational health and safety of workers working on site.	Reduced occupational health and safety among workers	• A Health and Safety Policy shall be established to guide operations of the facility. • All construction activities should be conducted in accordance with provisions of the local legislation and international best practices (General EHS Guidelines: Occupational Health and Safety); • Safety rules should be enforced and complied with by workers, contractors and those coming to site; • Personal Protective Clothing (PPE) should be issued and used as required by the various classes of the workers on project site; • Barrier tapes and caution signs should be erected in all potential hazardous areas to prevent injury or loss of life among construction workers; • No unauthorized person should be allowed on site including workers without appropriate PPE	Risks identification and implementation of management measures conducted prior to commencement works.

Table 2: Environmental and Social Management Plan (ESMP) during Operation Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Occupational Health and Safety	Risks to workers health and safety during the operation and maintenance activities of the project as they are exposed to electromagnetic fields.	• Regular measurement of electrical and magnetic radiation levels and taking appropriate measures when exposure exceeds acceptable levels. • Only trained and certified workers should be allowed to install, maintain or repair electrical equipment.	Certified and approved monitoring protocols to be carried out for all electrical and magnetic radiation. Approved and authorised work permits to qualified competent persons only
Socio-economic			
Limited sources of livelihood, inadequate schools and associated facilities such as library facilities, learning facilities and teaching materials, inadequate health facilities inadequate water supply and sanitation services in identified settlements of Shantumbu, Mahopo, Chifwema and Mphande	Deteriorating social conditions in settlements in the vicinity of the project area.	Development and implementation of a Community Development Plan (CDP) with possible projects aimed at the following: • Provision of adequate schools and associated facilities (education services) such as library facilities, learning facilities, learning materials and play parks for children; • Provision of adequate water supply and sanitation services; • Provision of adequate health facilities; • Provision of titled land for settlement and farming for those settled in Mphande and assistance to restore agricultural livelihoods. • Provision of any other community help necessary to improve the living conditions in identified settlements such as sourcing unskilled / skilled labour (where available) from the settlements.	Inspecting community projects implemented. Number of community projects implemented. Titled land allocated to Mphande Settlers.
Employment opportunities at the project site arising from construction works.	Influx of population of job seekers on site posing health and security risks and leading to unplanned housing / structures and commercial activities around the project area.	• Enforcement of relevant by-laws laid down by the respective Lusaka City Council and Kafue District Councils with the help of IDC to prevent mushrooming of unplanned structures and activities.	Security surveillance and Community Engagement to sensitize the community on matters relating to development of unplanned structures and activities.

Table 2: Environmental and Social Management Plan (ESMP) during Operation Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Operations of the Solar PV Plant	Risky sexual behaviour among the population leading to escalation of new STIs including HIV/AIDS in the local population and among the workforce.	• Developing an HIV/AIDS Policy by the Developer to be adhered to during operation phase of the project. • Sensitization programs on preventing the spread of STIs and HIV/AIDS for project workers including contractors and suppliers. • Provision of condoms (including Female Condoms) in places where they can be easily accessed such as toilets. • Education programs on fighting stigma of those infected with HIV/AIDS.	Record of sensitisation / education programmes undertaken including the number of people sensitised / trained on STI and HIV/AIDS.
Operation of the Solar PV plant	Capacity building and technology transfer to local contractors, skilled manpower and unskilled workers.	• Local contractors, skilled specialists and unskilled workers should be used to benefit from technology and skills transfer during operation of the solar plant. • Appropriate training should be provided to all local contractors, skilled manpower and unskilled workers to enhance expected project benefits.	Skills training for locals with assistance from local learning and construction institutions. Number of local people trained.
Operation of the Solar PV plant	Employment opportunities created for both skilled and non-skilled labour and. multiplier opportunities for employment in support sectors.	• The contractor, where possible, should employ members of the local communities and local experts to maximize on the benefits of employment opportunities. The jobs for which local people qualify (including non-technical and technical) will be as much as possible be offered to the local people.	Record of employment, annual reports on IDC / Solar Plant Operators.
Operation of the Solar PV plant	Project contribution to the local and national economy through its multiplier effect	• Procurement of services from local contractors and locally produced raw materials during the operation phase should be done, where possible, to maximise the benefits.	Annual reports on IDC / Solar Plant Operators
Soils and geology			
Development of Sinkholes at the project site,	Threat to stability of Solar PV surface structures potentially resulting in damage to solar plant infrastructure, due to sinkholes development and underground	• Monitoring ground subsidence at the project site to identify early any sinkhole development. • potential backfilling or other methods in areas for sinkhole development	Visual inspection; Survey monitoring (ground subsidence monitoring) of all installations at the project site.

Table 2: Environmental and Social Management Plan (ESMP) during Operation Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
	caverns in base rock formation.		
Operation of the solar plant on site.	Damage to solar support structures and foundations due to soil erosion on site.	• An effective storm water drainage network should be maintained to channel increased surface runoff to designated catchment areas. An effective drainage network will minimise soil erosion over exposed surface and will minimise the risk of erosion of the support structures and foundations. It will also reduce the risk of flooding the project site.	Monitor effectiveness of all drainages structures on site.
Operations of the solar power plant.	Risk / threat to electrical equipment due to potential flooding / poor drainage at the project site.	• An effective storm water drainage network should be constructed in and around the project area to avoid flooding. • Conduits for electrical installations should be appropriately constructed to avoid flooding them.	Monitoring storm water drainage system and electrical installations.
Water Resources			
Operation of the Solar PV plant at the project site.	Risk of erosion of solar PV support structures and foundations arising from increase in surface runoff during the rainy season or storm rainfall being more than infiltration into the ground.	• A storm water management plan should be developed and implemented. • An effective storm water drainage network should be constructed in and around the project area to avoid flooding. • Storm water drainage system should be inspected regularly to ensure that the system conveys surface runoff away from the project area into a catchment area, which will hold runoff and allow it to slowly infiltrate the ground. • The drainage system should also be designed and constructed to avoid erosion of support structures and foundations.	Inspection of storm water drainage network operation phases to ensure their structural stability and capacity to convey surface runoff.
Conversion of the existing vegetation cover to bare or impervious surface at the project site	Flood risks arising from increased surface runoff and reduced infiltration into the groundwater regime with potential to cause damage to solar plant infrastructure (especially electrical equipment) mounted on or close to ground	• Storm water drainage system should be properly designed and constructed to convey surface runoff away from the project area into a catchment area that will hold runoff and allow it to slowly infiltrate into the ground. This will also contribute to recharging of the groundwater aquifer. • Where appropriate, upstands should be erected for installation of electrical equipment to avoid flooding.	Inspection of storm water drainage network during construction and operation phases to ensure their structural integrity and capacity to convey surface runoff.

Table 2: Environmental and Social Management Plan (ESMP) during Operation Phase			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
	level.		
Conversion of existing vegetation cover to bare or impervious surface at the project site.	Reduced recharge of groundwater aquifer.	• Storm water drainage system should be properly designed and constructed to convey clean surface runoff away from the project area into a catchment area from where runoff will be held and allowed to slowly filter into the ground. This will also contribute to recharging of the groundwater aquifer.	Inspection of the storm water system.
Storage and handling of fuels and oils on site during operations phase.	Potential groundwater contamination onsite arising from spillage of fuels and oils onto the ground during operations phase.	• Handling, storage and disposal of hazardous substances (used transformer oils and others) should be carried out in accordance with the World Bank General Environmental Health and Safety Guidelines, Zambian Environmental Management (Licensing) Regulations, 2013 including Material Safety Data sheets (MSDS). • Appropriate designed bunded storage areas with impervious lining should be constructed and maintained. • Separate storage areas should be provided for all hazardous substances / products and they must be labelled with proper identification of its hazardous properties. • Training on handling, storage and disposal of hazardous waste should be provided to relevant workers on site as part of the overall environmental management of the site.	• Inspection of fuel and oils storage areas to monitor or ensure their integrity. • Inspections and update of materials storage bays and inventory. • Record of training schedules for trained personnel. • Record inspection of fuels and oils storage areas including hazardous waste storage areas.
Storage and handling of fuels and oils including handling of hazardous waste on site during operational phase.	Potential contamination of groundwater from spillage of fuels, oils contamination	• Uncontrolled dumping or littering of any waste within the project area and areas adjacent to the project site should be avoided. • Uncontrolled dumping of any toxic or hazardous waste, including used oils from transformers should be avoided. • Specific dumping locations for litter and any other waste should be provided on site with adequate protective lining. • Collection, storage and removal of all toxic and hazardous waste should be documented and handled by competent staff.	• Inspection of dumping sites within the site to ensure correct labelling and usage.

Table 3: Environmental and Social Management Plan during Decommissioning Phase (all the aspects and mitigation measures similar construction phase)			
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Monitoring Action and parameters**
Air Quality			
Demolition of site buildings at decommissioning and restoration of the site.	Potential health effects on workers involved in demolition of site buildings and removal of site infrastructure arising from dust generation.	Workers who will be involved in carrying out decommissioning works should be provided with adequate PPE such as dust masks.	Daily safety checklists to ensure workers have approved PPE.
Noise and vibration			
Removal from site of used solar modules, demolition of site buildings and restoration of the site.	Noise disturbance associated with decommissioning activities may potentially affect workers on site.	Workers likely to be exposed to high noise levels should be provided with adequate PPE such as ear plugs. Decommissioning works should be done during day time to reduce on exposing the surrounding community to any potential noise disturbance.	Daily safety checklists during decommissioning works.

1 INTRODUCTION

This document presents the Environmental and Social Impact Statement (ESIS) for the proposed Ngonye Solar PV Project under Round 1 Scaling Solar – Zambia Project (the Project). The Project has been proposed by the Industrial Development Corporation of Zambia (IDC), an investments holding company wholly owned by the Government of Zambia with registered offices at Plot F10723, Lusaka South Multi-Facility Economic Zone, Chifwema Road, New Kasama, Lusaka, Zambia. The IDC is mandated to play a catalytic role in deepening and supporting Zambia's industrialisation capacity to promote job creation and domestic wealth formation across key economic sectors.

Knight Piésold Zambia has been commissioned by IDC to prepare the ESIS for the Project. The ESIS is based on the Terms of Reference (ToR) for the Project submitted to the Zambia Environmental Management Agency (ZEMA) on 19th March 2016 and to which a "No Objection Letter" to proceed with the environmental and social impact assessment (ESIA) study was obtained on 7th April, 2016. The ToR (Appendix A) set forth the scope of the ESIA study and the approach that was used to conduct the study and to prepare the ESIS for the project.

This ESIS has been prepared in line with the requirements of the Environmental Impact Assessment Regulations, Statutory Instrument No.28 of 1997, and in compliance with International Finance Corporation (IFC) Performance Standards. It takes into account public views and concerns gathered through public consultative meetings (scoping meetings) held in Lusaka on 11th and 12th March 2016 at Nakatindi Hall and Cooperative College Conference Hall respectively as part of the preparation of the ToR for the ESIA study for the Project. It also takes into account public views and concerns obtained through public disclosure meetings held in Lusaka on 8th and 9th July 2016 at the same venues. The public disclosure meetings were held in accordance with the requirements of the Environmental Impact Assessment Regulations, 1997 as part of public consultation on preparing the Final Draft ESIS.

1.1 Project Background

Following the severe energy deficit and crisis in Zambia in 2015 on account of low water levels for adequate hydro power generation, His Excellency, Mr. Edgar Chagwa Lungu, President of the Republic of Zambia, in his capacity as Chairman of the Board of the Industrial Development Corporation Zambia Limited ("IDC"), directed the IDC to target the immediate development and procurement of up to 600 Mega Watts of solar PV power into the national grid as a matter of urgency and priority.

In implementing the directive, the IDC signed a memorandum of understanding ("MOU") on 20 July 2015 with the International Finance Corporation ("IFC"), the private sector arm of the World Bank Group, for advisory and technical services assistance and commenced the immediate development of two solar photo-voltaic (PV) plants of up to 50 Mega Watts each for an initial total of 100 Mega Watts out of the targeted 600 Mega Watts.

IDC has engaged the IFC, a member of the World Bank Group, as its lead transaction advisor. With IFC's support, IDC has adopted the World Bank Group's 'Scaling Solar Initiative' as the fastest and most transparent procurement process to meet the President's directive. Scaling Solar is an open, competitive and transparent approach that facilitates the rapid development of privately-owned, utility-scale solar PV projects in sub-Saharan Africa. It is capable of immediate implementation and offers a 'one-stop-shop' package of advisory services, contracts, financing, guarantees and insurance, enabling governments and utilities to procure solar power transparently and at the lowest possible cost. Scaling Solar is based on the principle of tariff minimization and uses a competitive auction bidding process to determine the lowest tariff and consequently the winning bid to develop the allocated amount of solar PV power at a given location.

IDC intends to commence Round 1 of the 600 MW Solar power programme, which consists of two Solar PV plants – one plant will be operating up to approximately 50 MW while the other one will be operating approximately up to 34 MW. The proposed plants are the Bangweulu Solar PV Plant and the Ngonye Solar PV Plant. The proposed Round 1 Scaling Solar PV Project is to redress the current power deficit in Zambia by developing and installing the two Solar PV Plants within the Lusaka South Multi-Facility Economic Zone (LS MFEZ), about 15 km to the South and East of the Lusaka Central Business District. These two Solar PV projects have already been awarded to two different private developer companies for financing, construction and operation of respectively 34 and 54 MW peak power plants. The overall Round 1 Scaling Solar Project at the LS MFEZ will cover a total footprint of 100 ha of land, which represents about 4.8% of the total area covered by the LS MFEZ.

In October 2015, the IDC ran a Request for Prequalification (RFQ) for the Pre- qualification of potential Independent Power Producers (IPPs) via a transparent and competitive bidding process. During this process, a total of 48 firms applied, out of which 11 were selected as the successful bidders for the Request for Proposals (RFP) process with detailed final proposals (the bidder with the lowest tariff would be the winner).

These two Solar PV projects have been awarded to two different private developer companies for financing, construction and operation as Independent Power Producers (IPPs) for 25 years. The two project companies will therefore operate two independent photovoltaic power plants and will each obtain its own environmental permit. The two IPPs who have been awarded the two Solar PV Plants projects are NEOEN S.A.S. / First Solar Inc. and Enel Green Power S.p.A. The winning bidders assume majority control in the project companies and IDC will hold 20% as minority shareholder on behalf of the government.

This ESIS document has therefore been prepared as part of environmental permitting (approval process) for the proposed construction and operation of the Ngonye Solar PV Project by Enel Green Power S.p.A. The project will be implemented in compliance with the Environmental Management Act No.12 of 2011 read together with the Environmental Impact Assessment Regulations, Statutory Instrument No. 28 of 1997, and in compliance with IFC Performance Standards, Guidelines and Policies.

1.2 Overview on Industrial Development Corporation of Zambia

IDC is an investment company wholly owned by the Zambian government. It was incorporated in early 2014. The mandate of IDC is to play a catalytic role in deepening and supporting Zambia's industrialisation capacity to promote job creation and domestic wealth formation across key economic sectors. It plays its role through evaluation, pricing and lowering the investment risk profile by serving as co-investor alongside private sector investors.

IDC facilitates provision and raising of long term finance for projects. Simultaneously, IDC serves as an investment holding company for State-Owned Enterprises (SOEs) and new investments that ultimately generate earnings for the proposed Zambia Sovereign Wealth Fund.

IDC is an active shareholder and investor focused on a broad spectrum of sectors including agriculture, forestry, manufacturing, financial services, mining, energy, telecommunications, logistics, medical, education, tourism, real estate and media.

IDC will develop the proposed Project and will hold all the operating approvals for the Project. Table 1.1 presents IDC contact details, current company board of directors and other relevant details. The Ngonye Solar PV Plant will be constructed and operated by Enel Green S.p.A. Enel Green Power will assume majority control and IDC will hold 20% as minority shareholder on behalf of the government.

The Ngonye power plant will operate at up to 34 MW and will cover a maximum footprint of about 52 ha. The design of the Ngonye Solar PV Plant is expected to have about 106,260 solar modules, 9 conversion units with 36 inverters to be installed at the proposed site. The final design will confirm the actual numbers of the components. The generated electrical energy will be transferred to an existing substation (which is currently under construction by ZESCO) via a 300 – 350 metres long 33kV underground cable. However, the installation of the underground cable is subject to change depending on final design details.

The investment cost is estimated at US $ 43.40 million, not including neither the development nor the financing cost.

1.3 Track Record of Enel Green Power

Enel Green Power is the Enel Group company entirely dedicated to the development and management of energy generation from renewable sources at a global level, with a presence in Europe, the American continent and Africa.

With an energy generation capacity from water, sun wind and the Earth's heat of more than 32 billion kWh in 2014 – meeting the needs of more than 11 million households and avoiding the emission of over 17 million tonnes of CO2 – EGP is a global leader.

The Company's installed capacity exceeds 9,800 MW, with a range of sources that includes wind, solar, hydroelectric, geothermal and biomass.

EGP operates some 740 plants in 15 countries, in Europe, the American continent and Africa. This geographical diversification allows it to maximise the strategic growth options, while minimising regulatory and country risk.

The Company is consolidating its presence in North America, with wind energy projects under construction for over 400 MW and in Latin America, particularly in Brazil, where over the last few months it won wind and solar photovoltaic supply contracts for additional 548MW.

In South Africa, in 2013 and 2015 Enel Green Power won solar photovoltaic and wind energy supply contracts totalling 938MW, within a renewable energy public tender launched by the South African government.

In 2015, EGP entered the renewable energy market in Turkey, where it won a solar photovoltaic supply contract for around 20MW.

In Italy the Company is also present in every technology, with an absolute leadership in geothermal energy – one of the main geothermal poles in the world is the one of Larderello and Monte Amiata in Tuscany – and a strong presence in hydroelectric and wind power.

Enel Green Power is also engaged in manufacturing solar PV panels, in Catania, Sicily, where it has built the largest factory in Italy of multi-junction thin-film panels.

Enel Green Power is a founding member of RES4MED- Renewable Energy Solutions for the Mediterranean, the association established in 2012 for the promotion of renewable energy in the Mediterranean and of the electricity infrastructure required for their transportation.

Appendix I in Volume 3 of the ESIA Report includes a summary the Enel Green Power S.p.A.'s track record and the Company Profile.

Table 1.1: Name and Details of the Project Developer	
Name of Project Developer	Industrial Development Corporation
Address and contact details	**Industrial Development Corporation (Zambia) Limited** Lusaka South Multi-Facility Economic Zone (LSMFEZ) Plot F10723, Chifwema Road, New Kasama, P.O. Box 37232, Lusaka, Zambia Tel: +260 211 843568 or +260 211 843567 or +260 211 234684 Email: info@idc.co.zm
Ownership	100% Government of Zambia
Chief Executive Officer - IDC	Andrew Chipwende
Company Board of Directors	• Board Chairperson - His Excellency the President of the Republic of Zambia • [3] Cabinet Ministers of Finance, Commerce Trade and Industry, and Agriculture; • [2] civil servants, • the Secretary to the Treasury • Permanent Secretary for Commerce Trade and Industry; • [7] private sector members • [3] Executive Directors of the IDC as ex-officio members.

1.4 Project Rationale

The power deficit Zambia is experiencing has negatively affected homes and businesses in the City of Lusaka and the whole country in general. The domestic and social life of the local population is negatively affected while hours of operations for local businesses have reduced. The provision of additional 100 MW[2] solar power into the national grid will reduce on-going load-shedding situation and will help to facilitate uninterrupted power supply for domestic use as well as increased hours of operation for local businesses. It will also present an opportunity for promotion of the use sustainable renewable energy in the form of solar energy.

Therefore, implementation of the proposed Ngonye Solar PV Project is undoubtedly very important for improved quality and security of supply of power for domestic and industrial uses, among other benefits. The Ngonye Solar PV Plant will contribute up to 34 MW towards the initial 100 MW for Round 1 Scaling Solar Zambia Project.

1.5 Project Screening

The project was screened by IFC as part of the initial stage in the ESIA Process (WSP| Parsons Brinckerhoff and World Bank Group, 2015). It was screened to assess potential environmental and social risks and impacts associated with the proposed Project's activities and to confirm applicable standard and national regulatory compliance requirements.

The preliminary consultation carried out by WSP | Parsons with ZEMA confirmed that the Scaling Solar Zambia Project will require an ESIA Study as per provisions in the Environmental

[2] Based on site conditions and technology of choice, 80 MW is likely to be the final total capacity for both Solar PV plants.

Impact Assessment (EIA) Regulations 3(1) of Statutory Instrument No. 28 of 1997 and the Environmental Management Act No.12 of 2011.

Further screening of the scope of project activities against IFC international standards (environmental and social review process) suggested that the project falls under an environmental and social risk Category B Classification. This category is due to the fact that the anticipated environmental and social risks and impacts are estimated to be minimal, limited in scope and should be readily mitigated throughout the different stages of the project by the effective implementation of an appropriate Environmental and Social Management Plan (ESMP) (WSP | Parsons, 2015).

The creation of LS MFEZ for development of industries and other establishments also involved undertaking environmental and social impact assessment studies. The zone has been subjected to these studies. Management plans have been developed and are being implemented as part of developing the zone. The project site is therefore located within the LS MFEZ area that has already been subjected to a number of environmental and social impact assessment studies.

1.6 Objective of the Project

The objective of the proposed Ngonye Solar PV Project is to contribute to redressing the current power deficit in Zambia by developing and installing a 34 MW Solar Power Plant. The estimated investment cost of developing the Project is USD 43.40 million. Implementation of the Project has been planned to commence once approval has been granted by ZEMA. The construction and operations of the Ngonye Solar PV plant will be carried out by Enel Green Power S.p.A., who has been selected as preferred bidders through a competitive bidding process for the construction and operation of the Ngonye Solar PV Plant on Site 1. The company will have environmental approvals based on the ESIA Report for the proposed project site covering Site 1 (Ngonye Site).

1.7 Environmental and social impacts

The key potential environmental and social impacts that may potentially arise as a result of implementation of the proposed Project and to be assessed in this Environmental and Social Impact Statement document relate to the following:

- Noise and Vibration;
- Air Quality;
- Biodiversity;
- Water Resources;
- Socio-economic;
- Soils and geology;
- Land Use Impacts;
- Landscape and visual amenity;
- Waste Management and hazardous substances;
- Electrical and magnetic field;
- Aviation and communication;
- Archaeology and Cultural Heritage;

- Deforestation and Climate Change; and
- Occupational Health and Safety.

Table 1.1 lists a summary of the potential sources of environmental and social impacts relating to the proposed Project. The list is based on the review of available baseline data, Initial Scoping Report by World Bank Group and WSP | Parson Brinkerhoff, public comments and concerns raised by stakeholders at public consultation meetings held in Lusaka at Nakatindi Hall and Co-operative College. The relevant concerns raised by stakeholder have been addressed in respective sections of this document. The concerns raised by stakeholders during the full Scoping Meetings held in March 2016 as part of preparation of the draft Terms of Reference are presented in Appendix A of Volume 3 (Figures and Appendices) of ESIA Report. The Appendix includes a list of participants at the respective meetings. The concerns have been included in the Scope of the assessment.

Further public comments raised at the time of public disclosure meetings for the Draft Environmental and Social Impact Assessment Report held on 8th and 9th July 2016 at Nakatindi Hall (Lusaka Civic Centre) and Cooperative College Hall respectively have been taken into account. The minutes of the public disclosure meetings including Attendance Registers are presented in Appendix A-1 of Volume 3 of the ESIA Report. Key issues raised at the meetings are summarised in Section 8 of this document.

Table 1.1 : Potential Sources of Environmental and Social Impacts		
Parameter	**Potential Source**	**Issue raised by Stakeholders**
Noise and Vibration	Construction activities such as earthworks, site excavations, breaking out of rock either by blasting or use of compressors leading to noise pollution and vibration which can negatively impact on sensitive receptors.	√
Air Quality	Dust generation during construction activities such as earthworks, site excavations, blasting and during vehicular movements locally affecting ambient air quality.	
Biodiversity	Clearing of site vegetation during constructions works destroying any species of flora or fauna that could be classified as endemic to the area or of special scientific value.	√
Water Resources	Site activities such as blasting during construction causing potential damage to water resource; Poor handling of waste / hazardous substances potentially leading to groundwater pollution.	√
Socio-economic	Construction and operational phases of the project leading to both positive and negative social impacts: • Boost of local and national economy; • Creation of employment; • Increased public revenue; • Capacity building and knowledge transfer; • Increase in local prostitution and HIV/AIDS; • Local crime; • Pressures on local services; • etc.	√
Soils and geology	Clearing of existing site vegetation and scarifying of topsoil together with compaction during site preparation and levelling reducing the ground's ability to retain water and subsequently potentially increasing surface run-off during periods of rainfall and leading to soil erosion especially in exposed places were sub soils will be destabilised by construction activities.	
Land Use Impacts	Process of land acquisition by LS MFEZ and change of land use from a wildlife park for an 11 ha additional land in the Lusaka National Park to development of a solar farm.	
Landscape and visual amenity	Visual impact during day-to-day operation of the project facilities will be associated with the Solar PV modules, inverters and transformers.	
Waste Management and hazardous substances	Generation of waste through maintenance activities on the site.	√
Electrical and magnetic field	Harm arising from potential sources such as electrocution, fire from electrical sources and exposure to site derived dust.	√
Aviation and communication	Solar modules impacting on aviation and communication.	
Traffic and road infrastructure	Increase in construction related traffic in the local area travelling to and from the project site leading to additional burden on existing road traffic (congestion and vehicle safety).	√

Table 1.1 : Potential Sources of Environmental and Social Impacts		
Parameter	**Potential Source**	**Issue raised by Stakeholders**
Archaeology and Cultural Heritage	Construction activities damaging archaeological and cultural heritage sites.	
Deforestation and Climate Change	Clearing of vegetation on site contributing to deforestation and climate change.	√
Occupational Health and Safety	Potential risk to the occupational health and safety of workers and personnel during construction and operational activities. Such activities and procedures include: Movement of machinery around the site; Vehicular safety on site; Blasting or rock breaking; Work in dusty environment; Work in trenches and shallow excavations; Storage and handling of hazardous substances / wastes on site including fuel and oil; and Safe handling of electrical equipment.	√

1.8 Environmental and Social Impact Statement (ESIS)

This Environmental and Social Impact Statement presents the findings of the environmental and social impact assessment study for the proposed Project. The assessment was carried out in compliance with the Zambian Environmental Management Act No.12 of 2011 and its subsidiary legislation, the Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997. The assessment was also carried out in compliance with IFC Performance Standards and guidelines.

This ESIS is aimed at ensuring that potential environmental and social impacts associated with the construction, operation and decommissioning of the proposed Project are identified and appropriately assessed. In additions, it aims at identifying appropriate mitigation measures for identified significant impacts.

It presents information on the proposed Ngonye Solar PV Project and the results of technical specialist assessments. It comprises three Volumes:

- **Volume 1** is a Non-Technical Summary, which presents and highlights the main issues pertinent to the decision-making process on the Project in a non-technical language readily understood by decision-makers and other stakeholders.
- **Volume 2** (this document) presents the details on the proposed Project and the findings of ESIA study.
- **Volume 3** contains all relevant technical baseline information (Figures / Technical Data and other specialist information used for the ESIA study), which have been referenced within the body of the ESIS.

This volume (Volume 2) is structured as follows:

4 Environmental and Social Baseline Conditions

5 Impact Assessment

6 Environmental and Social Management Plan (ESMP)

7 Decommissioning and Closure Plan

8 Public Consultation

9 Conclusion

10 References

11 Declaration of Authenticity

1.9 Methodology

1.9.1 Approach to Assessment

An assessment of the environmental and social impacts and risks associated with the Ngonye Solar PV Project under Round 1 of the overall Scaling Solar Zambia Project was undertaken as part of the ESIA process. The assessment has addressed potential impacts and risks from construction, operation and decommissioning phases of the Project. The potential receptors of impacts have been identified based on baseline data and surveys undertaken data, with an assessment of the significance of potential impacts on these receptors.

The general approach to the assessment included review of previous studies and data to gather environmental and social baseline data, which is necessary to attain a pre-project record of the existing environmental and social conditions against which any future impacts can be predicted. The previous studies included the environmental and social impact studies undertaken during the creation of the LS MFEZ and other developments within the MFEZ. The reviewed reports have been referenced accordingly.

In addition, the baseline field surveys of the area of direct land take by the proposed Project and of immediate surrounding areas were conducted. The baseline surveys were used to collect current site specific data and to supplement secondary data gathered during desk study of the previous studies including on-going ones. Communities likely to be potentially affected were consulted. The field surveys provided an updated understanding of the prevailing baseline environmental and social conditions of the project area. The baseline data was used to assess the potential impacts on the physical, biological, human and wider environment, within the project's area of influence.

Specific technical specialist studies were carried out based on the approach presented herein. Each technical section of this ESIS presents the specific methodology adopted to conduct each technical study detailing the site setting, likely impacts and proposed mitigation measures.

1.9.2 Stakeholder Consultations

Stakeholder consultations were conducted as part of the ESIA Study. The details on consultations conducted are presented in Section 8 of this document.

1.9.3 Impact Identification, Assessment and Mitigation Measures

The potential environmental and social impacts of the proposed Project have been predicted and evaluated based on the analysis of the Project components and the environmental and social baseline conditions of the project area. The prediction and evaluation of impacts have been undertaken in accordance with current international best practice in impact assessment

and cover positive/beneficial and negative/adverse impacts, long term and short term impacts, direct, indirect and induced impacts, and cumulative impacts of the proposed Project. The definitions of some of the terms that have been used to characterise the impacts are given in Table 1.2.

Table 1.2: Impact assessment terminology	
Term	**Definition**
Beneficial / Positive Impact	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Adverse / Negative Impact	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct Impacts	Impacts that arise directly from activities that form an integral part of the Project (e.g. new infrastructure).
Indirect Impacts	Impacts that arise indirectly from activities not explicitly forming part of the Project (e.g. noise changes due to changes in road or rail traffic resulting from the operation of the Project).
Secondary Impacts	Secondary or induced impacts caused by a change in the Project environment (e.g. employment opportunities created by the supply chain requirements).
Cumulative Impacts	Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

The significance of the impacts have been evaluated taking into account the magnitude, extent, duration, frequency, reversibility, and probability of occurrence of changes in environmental and social conditions, sensitivity and ability to adapt (resilience) of affected resources and receptors. The definition of the impact characteristics above and their designation are presented in Table 1.3.

Table 1.3: Definition of Impact Characteristics		
Characteristic	**Definition**	**Designation**
Duration	The time period over which a resource / receptor is affected	• **Temporary –** impacts are predicted to be of short duration and intermittent / occasional. • **Short-term –** impacts are predicted to last to last only during the construction phase. • **Long-term –** impacts that will continue for the life of the project (25-30 years), but ceases when the project stops. • **Permanent** – impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the life of the project – i.e. irreversible).

Table 1.3: Definition of Impact Characteristics		
Characteristic	**Definition**	**Designation**
Extent	The reach of the impact (i.e. physical distance an impact will extend).	• **On-site** – impacts that are limited to the boundaries of the project site. • **Local** – impacts that are limited to the project site and adjacent properties. • **Regional** – impacts that are experienced at a regional scale, e.g. District or Province. • **National** – impacts that are experienced at a national scale. • **Trans-boundary/International** – impacts that are experienced at an international scale, e.g. extinction of species resulting in global loss.
Frequency	Measure of the constancy or periodicity of the impact.	1 - **Periodic** 2 - **Once off**

The definitions of term used to describe the likelihood of the impacts occurring are presented in the table below.

Table 1.4: Definitions of likelihood (Likelihood that the impact will occur)	
Likelihood	**Definition**
Unlikely	The impact is unlikely to occur.
Possible	The impact is likely to occur under most conditions.
Likely / Certain	The impact will occur.

Assessment of Impacts

The sources of impacts associated with the proposed Project are linked to the Solar Project components and their associated activities. The ESIA has identified and determined the significant impacts of the Project through construction, operation, and decommissioning where appropriate. The determination and assessment of the impacts is based on the following criteria:

- Magnitude: to what extent environmental resources are going to be affected;
- Extent: how much area will adversely or positively be affected by the project;
- Significance: what value in terms of costs and benefits does society place on the resources and the different impacts affecting the resource (s); and

- Special sensitivity: which impacts are significant in the specific local economic, social and ecological setting.

The significance of the impacts is considered to reflect the relationship between the two factors:

- the magnitude of the impact or impact magnitude (i.e. the actual change taking place to the environment); and
- the sensitivity of the affected resource or receptor.

Impact Magnitude

The magnitude of an impact is a measure of change from baseline conditions. It describes the degree of change that the impact is likely to impart upon the resource / receptor. This measure of change can be described in terms of its:

- Extent: spatial extent (e.g. area impacted) or population extent (e.g. proportion of the population/ community affected) of an impact;
- Duration: how long the impact will interact with the receiving environment. In this context short term, long term and permanent refers to construction, operation and post-operational phases respectively);
- Frequency: how often the impact will occur (periodic or once off); and
- Reversibility: how long before impacts on receptors cease to be evident.

The above characteristics collectively describe the nature, physical extent, and temporal condition of the impact.

Impact magnitude in this assessment has been described using a qualitative scale of negligible, low, medium and high for each of the magnitude characteristics.

Criteria for each impact magnitude category (i.e. negligible, low, moderate and high ranking criteria) have been be developed as appropriate for each discipline of the ESIA study and are presented in the technical reports.

Receptor / Resource Sensitivity

Receptor / resource sensitivity is the degree to which a particular receptor is more or less susceptible to a given impact. Resilience and value are taken into account when assessing receptor sensitivity. Resilience of the receptor describes the ability of a receptor to withstand adverse impacts while value of the receptor takes into consideration its quality and its importance as represented, for example, by its conservation status, its cultural importance and / or its economic value.

In this assessment, receptor sensitivity has been described using a qualitative category scale of low, medium, and high for each of the sensitivity characteristics, resilience and value. The criteria for receptor sensitivity (i.e. low, medium and high) have been developed for each discipline and have been summarised in the ESIA Report and described in the Technical Reports.

International best practice requires that significant effects should be determined by consideration of the following:

- Sensitivity of the resource or receptor (rated as high, medium and low) by considering the importance of the receiving environment (international, national, regional, district and

local), rarity of the receiving environment, benefits or services provided by the environmental resources and perception of the resource or receptor); and

- Severity of the impact, measured by the importance of the consequences of change (high, medium, low, negligible) by considering inter alia magnitude, duration, intensity, likelihood, frequency and reversibility of the change.

Sensitivity of the resource or receptor and the severity of the impact will be taken into consideration when determining the significance of the impacts.

Impact Significance Matrix

Impact magnitude and receptor sensitivity have been used to assess the significance of the impacts according to the Impact Significance Matrix presented in Table 1.5.

Table 1.5: Impact Significance Matrix

		Resource Sensitivity (Vulnerability and Value)		
		High	**Medium**	**Low**
Impact Magnitude (extent, frequency, duration, reversibility)	**High**	Major	Moderate	Moderate
	Medium	Major	Moderate	Minor
	Low	Moderate	Minor	Minor
	Negligible	Minor	Negligible	Negligible

The significance of the impacts has been classified as major, moderate, minor or negligible; either beneficial (positive) or adverse (negative) and the following impact significance terminology have been applied:

- Major beneficial or adverse impact – where the Project would cause a significant improvement of or deterioration to the existing environment;
- Moderate beneficial or adverse impact – where the Project would cause a noticeable improvement of or deterioration to the existing environment;
- Minor positive or negative impact – where the Project would cause a barely perceptible improvement of or deterioration to the existing environment; and
- Negligible – no discernible improvement of or deterioration to the existing environment.

Residual Impacts

The determination of the significance of residual environmental impacts involves value judgements and expert interpretation. The significance of residual impacts has been determined by reference to impact criteria for each assessment discipline. These criteria have used a common approach of classifying impacts according to whether they are major, moderate or minor impacts considered to be adverse, negligible or beneficial. Where it was not be possible to quantify the impacts, qualitative assessments have been conducted based on available knowledge and professional judgment.

For consistence in expressing the outcomes of the various studies that have been undertaken as part of the ESIA, and thereby enable comparison between impacts upon different environmental components, the following terminology have been used in the ESIA to define residual impacts:

- **Adverse** detrimental or negative impacts to an environmental resource or receptor;
- **Negligible** imperceptible impacts to an environmental resource or receptor; or
- **Beneficial** advantageous or positive impact to an environmental resource or receptor.

The significance of identified residual impacts has been assessed against the impact significance matrix presented above (Table 1.5).

Cumulative Impacts

Cumulative impacts likely to arise from all other industrial activities within the zone at the peak of operation have been considered and are presented in each technical section of this document. The IFC definition of cumulative impacts has been to characterize all the impacts identified as such (cumulative impacts).

Mitigation

Appropriate mitigation measures have been recommended for potential significant impacts and are included in the Environmental and Social Management Plan (ESMP) for the proposed Project. These include measures to prevent or reduce impacts where possible, and where impacts are unavoidable, to remedy them. In addition, options for enhancing benefits from the project have also been identified and have been included in the ESMP.

Appraisal of Project Alternatives

Project alternatives along with the 'without project or no project' alternative have been considered as part of project alternatives appraisal process. An analysis of the options, in relation to technology, project location and availability of existing background information, was undertaken to come up with optimal project design and location that would prevent and minimise significant adverse environmental and social impacts as well as enhance beneficial impacts.

2 LEGAL AND ADMINISTRATIVE FRAMEWORK

This section outlines the legal framework and international requirements within which the Project will be implemented. It outlines the applicable national environmental and social legislation and permitting requirements and international standards typically adopted by lenders who could provide funding for this project.

2.1 Relevant Regulations

The Ngonye Solar PV Project will be implemented within the applicable Zambian Environmental and Social legislation and permitting legal and administrative framework. It will also be implemented in compliance with the IFC's Policy on Environmental and Social Sustainability, which includes IFC Performance Standards and Environment Health and Safety (EHS) Guidelines.

Where host country regulations differ from the levels and measures presented in the international standards such as the IFC's Environmental Health and Safety (EHS) Guidelines, projects funded by international lenders are expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific assessment. This justification should demonstrate that the choice of alternate performance levels is still protective of human health and the environment.

Where the Zambian regulations differ from the levels and measures presented in IFC EHS guidelines, the concept outlined above will be applied for this Project.

2.2 Applicable National Legislation

Environmental Management Act, 2011

The Zambian Environmental Management Act (EMA), 2011 is the superior Act on matters relating to environmental protection and management. Its superiority is outlined in Section 3 of the Act. The Act sets out a framework for Environmental Impact Assessments (EIA's) and mandates ZEMA to do all such things as are necessary to ensure the sustainable management of natural resources and the protection of the environment, and the prevention and control of pollution.

The EMA outlines principles governing environmental management and provides for, among other things, Environmental Impact Assessment and regulations relating to environmental assessments. The Act has also spelt out offences relating to failure to prepare and submit an EIA report for projects that require such reports.

The projects that require preparation of EIA reports must be approved by ZEMA prior to implementation. Section 29 of the Act specifically states that "a person shall not undertake any project that may have an effect on the environment without the written approval of the Agency, and except in accordance with any conditions imposed in that approval".

The Environmental Impact Assessment Regulations, 1997 (Statutory Instrument No. 28 of 1997) specifies the requirements for an EIA and it also set out in its Second Schedule projects for which EIAs are applicable. It provides specific guidelines for conducting environmental impact assessments and for evaluation of environmental impact statements. The regulations

require project developers undertaking projects that may have significant effect on the environment to conduct environmental impact assessment prior to obtaining written approval from ZEMA on implementation of the project. Regulation 3 of the Instrument specifically states that "A developer shall not implement a project for which a project brief or an environmental impact statement is required under these Regulations, unless the project brief or an environmental impact assessment has been concluded in accordance with these Regulations.

Relevance: The project represents activities which will be subjected to mandatory EIA as per requirements of the Environmental Management Act No 12 (2011) read together with the Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997.

Compliance: The developer will obtain all necessary approvals and permits as stipulated under the Act. The new development will be carried out in accordance with the EIA procedures laid out in the Environmental Impact Assessment Regulations enforced by ZEMA.

Other pieces of legislation that are equally relevant to proposed Project implementation are summarised in the table below.

Table 2.1: Summary of Legislation relevant to implementation of proposed Project			
Legislation	**Summary**	**Relevance to the project**	**Compliance**
Statutory Instrument No. 47 of 2010	The Lusaka South Multi Facility Economic Zone (LS-MFEZ) was declared as a Multi Facility Economic Zone (MFEZ) under this statutory instrument.	It provides secure land tenure under statutory law and validates all developmental activities enclosed within the LS MFEZ area.	The developer(s) will need to obtain legal rights and follow all stipulated procedures for the establishment of this project within the LS MFEZ. A change of land use application will also be required to allow the implementation of the project on what is partly a national park area owned by the Ministry of Tourism and Arts.
Public Health Act, Cap 295	The Act provides for and regulates all matters connected with public health in the country under the local authority of each district as the enforcement agency.	For the proposed development, this will cover such matters as waste management and the standards and public and occupational health risks of exposure to the waste.	All necessary licenses and permits will be obtained in accordance with the Act.
Energy Regulation Act, Cap 436	In conjunction with ZEMA the Energy Regulation Board formulates measures to minimise the environmental impact of the production and supply of energy and the production, transportation, conversion, storage and use of fuels and enforces such measures by the attachment of the appropriate conditions to licenses held by the undertaking.	A license from the Energy Regulation Board of Zambia (ERB) will be required prior to commencement of the operation phase of the project.	The design, construction and operation of the plant will comply with the standards of the Act.
Water Resources Management Act, Cap 198	This Act repeals and replaces the Water Act, 1949; and provides for matters connected with, or incidental to, the following; • The establishment of the Water Resources Management Authority	The developer will put in place measures to ensure protection against pollution and conservation of water resources on the site. A permit may be required prior to abstraction if groundwater is abstraction if	The developer will put in place measures to ensure protection against pollution and conservation of water resources on the site. A permit may be required prior to abstraction if groundwater is abstraction if sourced for water related activities on site.

Table 2.1: Summary of Legislation relevant to implementation of proposed Project			
Legislation	**Summary**	**Relevance to the project**	**Compliance**
	and definition of its functions and powers. • The establishment of the pollution of public water as an offence.	sourced for water related activities on site.	
Road and Traffic Control Act, Cap 464	The Roads and Traffic Control Act, provides for the control of traffic, and for the regulation of storm water disposal structures.	Deliveries of materials especially for the construction phase will result in a considerable amount of additional traffic on local roads and present on site.	**S**igns and directions to control traffic movement to ensure a safe environment both in proximity to and within the site will be put in place. The developer will make sure that there are designated routes to and from and within the site, built to national and international specifications and standards. The ESIA shall include an assessment of traffic impacts, and also, shall inform the development of Construction and Operational Traffic Management Plans.
Local Government Act, Cap 281	The Act was enacted in 1991 following the repeal of the Local Administration Act of 1981. It provides for the functions of local authorities including the implementation of environmental protection and natural resources management.	The Kafue District authorities have jurisdiction over the LS MFEZ.	The developer will obtain all necessary licenses and permits required for the project development.
The Urban and Regional Planning Act, 2015 Laws of Zambia	The Act provides for the appointment of planning authorities whose main responsibilities are the preparation, approval and revocation of development plans. It also provides for the control of development and subdivision of land.	The site falls within the LS MFEZ zone and is subject to an allocation and change of land use.	Approval for plans will be sought by the developer including the change of land use application and land lease for the project site.

Table 2.1: Summary of Legislation relevant to implementation of proposed Project			
Legislation	**Summary**	**Relevance to the project**	**Compliance**
The Investment Act	Passed in 1993, the act provides a legal framework for investment in Zambia. The Act relates to environment indirectly by providing incentives for tree planting, soil and water conservation activities. The Act further recognizes the role of other agencies including those responsible for environmental protection in authorizing specific projects.	The developer requires various licences which relate to this Act.	The developer will ensure all relevant licences are obtained.
Environmental Management (Licensing) Regulations, 2013	The regulations provide for licensing requirements for air emissions, discharge of effluents and wastewaters into the environment, hazardous waste management (storage, transportation, pre-treatment, disposal, labelling and packaging, importation, exportation, etc.), among other provisions. The regulations set out guidelines and limits where applicable and general provisions relating to personal protective equipment, etc.	The project will be generating hazardous waste during its operation life. Such waste will include failed Solar PV units.	The developer of the project will comply with the provision of the regulations by disposing hazardous waste as prescribed.
National Heritage and Conservation Commission Act, 1989	The Act provides for the conservation of ancient, cultural and natural heritage, relics and objects of aesthetic, historical, prehistoric, archaeological or scientific interest by preservation, restoration, rehabilitation, reconstruction, adaptive use and good management. The Commission also provides regulations for archaeological excavation and export of relics. If a	Any new discoveries of items of historical or archaeological interest during implementation of the project shall be handled in accordance with the provisions of the NHCC Act and the required procedures for the reporting of such discoveries shall be followed.	Implementation of the proposed project shall take into account the provisions of the Act as it is a legal requirement under the NHCC Act that any development with potential to disturb a heritage site be subjected to an assessment.

Table 2.1: Summary of Legislation relevant to implementation of proposed Project			
Legislation	**Summary**	**Relevance to the project**	**Compliance**
	development is unable to proceed without affecting an item of heritage, permission must be sought from the NHCC as outlined in Section 35 and 36 of the National Heritage Conservation Commission Act.		
Electricity Act No.15 of 1995 and Electricity Amendment Act, 2003	The Act provides for the regulation of generation, transmission, distribution and supply of electricity.	The project will establish Solar PV Plant and will be generating electricity from solar energy. The electricity will be transferred into the national grid. The generation of electricity for this particular project will be regulated as provided for in the Act.	The project developer will establish and operate the Solar PV Plant in accordance with the regulations made under the Electricity Act and will comply with any requirements by the relevant authorities such as preparation of the Environmental Impact Statement and obtaining a license prior to project implementation.
Occupational Health and Safety Act, 2010	This Act provides for the establishment of health and safety committees at workplaces and for the health, safety and welfare of persons at work. It further provides for, among other provisions, the protection of persons, other than persons at work, against risks to health or safety arising from, or in connection with, the activities of persons at work.	The project will employ people during its development phases (construction, operation and decommissioning phases). Other persons other than persons at work might be exposed to environment at the project site. The health, safety and welfare of all persons at work places at the project site should be taken into account.	The project developer shall comply with the Act by ensuring, so far as is reasonably practicable, the health, safety and welfare of all the employees. It shall place and maintain employees in an occupational environment adapted to meet the employees' welfare as required under the Act. The developer shall further provide, among other provisions, systems of work that are safe and without any risks to human health as required under the Act.

Table 2.1: Summary of Legislation relevant to implementation of proposed Project			
Legislation	**Summary**	**Relevance to the project**	**Compliance**
Forests Act No. 4 of 2015	The Act provides for the conservation and use of forests and trees for the sustainable management of forests ecosystems and biological diversity. It also provides for, among other provisions, the implementation of international agreements such as United Nations Framework Convention on Climate Change, Convention on International Trade in Endangered Species of Wild Flora and Fauna, the Convention on Wetlands of International Importance, especially as Water Fowl Habitat, the Convention on Biological Diversity, the Convention to Combat Desertification in those Countries experiencing Serious Drought and/or Desertification and any other relevant international agreement to which Zambia is a party.	The project will include clearing vegetation at the project site to pave way for construction of the Solar PV Plant.	The project developer will comply with the provisions of the Act by avoiding indiscriminate removal, felling or cutting of trees outside the project site footprint.
Employment Act CAP 268	The Act provides for legislation relating to the employment of persons and the engagement of persons on contracts of service. In addition, the Act provides for the form of and enforcement of contracts of service, and protection of wages of employees, among other provisions.	The project developer will employ persons during the construction, operation and decommissioning of the Solar PV Plant.	The project developer will comply with the provisions of the Act by ensuring that all persons required for the construction and operations of the Ngonye Solar PV Plant are employed in compliance with the provisions of the Employment Act.

Table 2.1: Summary of Legislation relevant to implementation of proposed Project			
Legislation	**Summary**	**Relevance to the project**	**Compliance**
Workers' Compensation Act, 1999	The Act provides for the establishment and administration of the Workers Compensation Fund for the compensation of workers for disabilities suffered or diseases contracted during the course of employment. It also provides for the payment of compensation to dependants of workers who die as a result of accidents or diseases; among other provisions. The Act requires eligible employers to register with the Workers Compensation Fund Control Board within fourteen days of commencing business activities, among other requirements.	The workers who will be employed by the project developer, should they be suffer disabilities or contract diseases or die during the course of employment, will be entitled to the payment of compensation in respect of total disablement, permanent disablement and death.	The project developer will comply with the provisions of the Act by registering with the Workers Compensation Fund Control Board and complying with any requirements as provided for in the Act.
Zambia Wildlife Act No.14 of 2015	The Act provides for, among other provisions, the establish the Wildlife Management Licensing Committee; establishment, control and management of National Parks, bird and wildlife sanctuaries and for the conservation and enhancement of wildlife eco-systems, biological diversity and objects of aesthetic, pre-historic, historical, geological, archeological and scientific interest in National Parks; promotion of opportunities for the equitable and sustainable use of the special qualities of public wildlife estates; development and implementation of management plans.	The project site is partly located on an 11 ha piece of land (additional land for the project) which is within the Lusaka National Park. Though the additional land is physically located outside the park boundary fence and is not currently used a national park, the land is gazetted as a national park and it is owned by the Ministry of Tourism and Arts.	The project developer has engaged the Ministry of Tourism and Arts to ensure compliance with the provisions of the Zambia Wildlife Act. Section 15 of the Wildlife Act prohibits the granting of title in a national park. However, Section 16(1)(b) of the Act provides an exception to this, where such grant is consistent with the Wildlife Act. The Ministry of Tourism and Arts is in agreement to grant consent to the Minister of Finance to hold the Additional Land (See Annex 3 and 4 for letters of on objection from the Ministry of Tourism and Arts and Ministry of Finance concerning the use of additional land for Solar PV project development, and Annex 5 for a copy of the Certificate of Title held by the Minister of Finance for the additional 11 ha of land. The Minister of Finance will then lease the additional

Table 2.1: Summary of Legislation relevant to implementation of proposed Project			
Legislation	**Summary**	**Relevance to the project**	**Compliance**
			Land to IDC to facilitate development of the Ngonye Solar PV Plant. Further engagement of the Department of National parks and Wildlife has confirmed that there will be no adverse effect on the National Park since the land falls outside the physical boundary of park.

2.3 International Conventions and Agreements

Table 2.2 summarises international conventions and agreements to which the Zambian Government is a party and which are applicable to the project. The agreements and protocols impose obligations on Zambia to address issues or topics included in these documents.

Table 2.2: International Conventions relevant to the Project

Convention	Relevance
United Nations Framework Convention on Climate Change (UNFCCC) ratified in 1992	The convention aims at stabilizing of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The proposed Project will use clean and renewable energy with insignificant contribution to global greenhouse gases.
Convention on Biological Diversity (ratified in 1993)	The objectives the Zambia's National Biodiversity Action Plans include, ensuring the conservation of a full range of Zambia's natural ecosystems through a network of protected areas, development and implementation of strategies for conservation of biodiversity, sustainable use and management of biological resources. Biological resources of significant conservation value that will be identified during Project implementation will be conserved and protected.
Convention Concerning the Protection of World Heritage (1972)	The Convention aims at ensuring the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage. Cultural and natural heritage sites that may be identified during implementation of the proposed Project will be protected and conserved in accordance with the provisions of the Convention to which Zambia is party to.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989)	The Convention is the most comprehensive global environmental treaty on hazardous and other wastes. It aims at protecting human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes.

2.4 International Standards

This ESIS makes due reference to internationally recognised standards in order to establish a transparent regulatory framework for the Project which is in line with both national requirements and the international lenders requirements.

Therefore, whilst complying with national legislations, IDC will also comply with additional international lender requirements (EPs, IFC Performance Standards and EHS Guidelines) in the implementation of the proposed Project. The social and environmental impact assessments that have been carried out for the Project also involved public consultation with interested and affected parties, formulation of environmental and social management plans and mechanisms for redress of grievances associated with the Project.

The IFC Performance Standards and EHS Guidelines relevant to the Project are briefly outlined in the subsections that follow.

2.4.1 International Finance Corporation Performance Standards

The IFC's Sustainability Framework and Performance Standards define clients' roles and responsibilities for managing their projects and the requirements for receiving and retaining IFC support. A summary of the performance standards and requirements relevant to this Project is provided below.

The IFC PS' on Environmental and Social Sustainability, which were published in January 2012, are recognised as being the most comprehensive standards available to international finance institutions working within the private sector. The principles provide a framework for an accepted international approach to the management of social and environmental issues. The eight IFC PS are:

- **IFC Performance Standard 1:** Assessment and Management of Environmental and Social Risks and Impacts: Establishes requirements for social and environmental performance management throughout the life of a project through initial baseline studies and identification of risks and impacts, establishment of management programmes that describe mitigation and performance improvement measures and actions to address identified risks and impacts, stakeholder engagement and application of management system to monitor and improve performance.
- **IFC Performance Standard 2:** Labour and Working Conditions: Highlights the need for workers' rights regarding income generation, employment creation, relationship management, commitment to staff, retention and staff benefits. It identifies and outlines the need to provide workers with a safe and healthy working environment. This Performance Standard is guided by international conventions.
- **IFC Performance Standard 3: Resource Efficiency and Pollution Prevention**: Defines an approach to pollution prevention and abatement in line with current internationally disseminated technologies and good practice. It deals with ambient and cumulative considerations, resource conservation and energy efficiency, hazardous materials and waste management, pesticide use and management, and emergency preparedness and response provisions.
- **IFC Performance Standard 4: Community Health, Safety and Security**: Specifies requirements for mitigating any potential for community exposure to risks and impacts arising from equipment accidents, structural failures and releases of hazardous materials. In addition, communities may be affected by impacts on their natural resources, exposure to diseases, and the use of security personnel.
- **IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement**: Outlines a policy to avoid or minimise involuntary physical resettlement as a consequence of the project. Where it is unavoidable, it requires suitable measures to mitigate adverse impacts on affected stakeholders, including appropriate compensation for any economic displacement such as loss of subsistence or commercial livelihood.
- **IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources**: Sets out an approach to protect and conserve biodiversity, including habitats, species and communities, ecosystem diversity, and genes and genomes, all of which have potential social, economic, cultural and scientific importance.
- **IFC Performance Standard 7: Indigenous Peoples**: Recognises that Indigenous Peoples can be marginalized and vulnerable (such as, if their lands and resources are

encroached upon by or significantly degraded by a Project). Their languages, cultures, religions, spiritual beliefs, and institutions may also be under threat.

- **IFC Performance Standard 8: Cultural Heritage**: Aims to protect irreplaceable cultural heritage and to provide guidance for protecting cultural heritage throughout a Project's life cycle.

2.4.2 World Bank Environmental, Health and Safety Guidelines

The World Bank EHS Guidelines (30 April, 2007) are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP), as defined in IFC's PS3 on Resource Efficiency and Pollution Prevention. The World Bank EHS industry-specific guidelines that would be relevant and applicable to the proposed Project include the *EHS Guideline for Electric Power Transmission and Distribution (2007).*

The EHS Guidelines contain the performance levels and measures that are normally acceptable to IFC and are generally considered to be achievable in new facilities at reasonable costs by existing technology. For IFC-financed projects, application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets with an appropriate timetable for achieving them. The environmental assessment process may recommend alternative (higher or lower) levels or measures, which, if acceptable to IFC, become project- or site-specific requirements.

2.4.3 Equator Principles (EPs)

The Equator Principles (EPs) are a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing. They are currently in their third iteration (EPIII) since they were launched in June 2003. The EPIII has ten principles and are adopted voluntarily by international financial institutions to ensure that projects financed by these institutions are developed in a manner that is socially responsible and reflect sound environmental management practices. They are intended to provide a minimum standard for due diligence to support responsible risk decision-making.

The EPs are based on and implemented in accordance with World Bank Group's International Finance Corporation (IFC) Performance Standards on Social and Environmental Sustainability and the IFC Environmental Health and Safety (EHS) Guidelines. The IFC standards and guidelines define both a robust approach to managing risks and impacts, and determine good international industry practice for significant project components.

The application of EPIII is global. They are applicable to all industry sectors and to the four financial products listed below:

- **Project Finance Advisory Services** where the total Project capital costs are US$10 million or more;
- **Project Finance** with total Project capital costs of US$10 million or more;
- **Project-Related Corporate Loans** (including Export Finance in the form of Buyer Credit) where all four of the following criteria are met: (i) the majority of the loan is related to a single Project over which the client has Effective Operational Control (either direct or indirect); (ii) the total aggregate loan amount is at least US$100 million; (iii) the Equator Principles Financial Institution 's (EPFI) individual commitment (before syndication or sell down) is at least US$50 million; and, (iv) the loan tenor is at least two years; and,

- **Bridge Loans** with a tenor of less than two years that are intended to be re-financed by Project Finance or a Project-Related Corporate Loan that is anticipated to meet the relevant criteria described above.

Whilst there are countries that are deemed to have suitable domestic legislative requirements, termed *Designated Countries*, for which the EPs are not applicable; Zambia is *not* listed as a Designated Country, and as such, an EPFI who forms part of the project development would apply EP requirements to the Scaling Solar Zambia Project.

Therefore, EPs will also be considered in implementing the overall Project.

3 THE PROJECT

3.1 Project Proponent

The project proponent for the Ngonye Solar PV Project is the Industrial Development Corporation Zambia Limited and will initially hold project operating approvals and authorisations before transfer to the operating company, which is one of the Special Purpose Vehicles (SPVs) that IDC has incorporated. The project will be constructed and operated by Enel Green Power S.p.A. the preferred Independent Power Producer (IPP) who has been awarded the Contract to finance, construct and operate the Ngonye Solar PV power plant will operate up to 34 MW on a 25 year Power Purchase Agreement signed with ZESCO. The IPP will be issued with an environmental permit (decision letter) based on this ESIA Report for the project site. Enel Green Power S.p.A will install the Ngonye Solar PV Plant on Site 1. Site 1 is shown on Figures 3.1 and 3.2.

The Ngonye Power Plant will operate at up to 34 MW and will cover a maximum footprint area of about 52 ha. The design of the plant will require about 106,260 solar modules, 9 conversion units with 36 inverters.

The proposed PV system will be connected to the grid and the electrical energy will be transferred to an existing substation (which is currently under construction by ZESCO) via a 300 - 350 metres long 33kV underground cable. However, the installation of the underground cable is subject to change depending on final design details. The Investment cost for the Project is estimated at US $ 43.40 million.

3.2 Project Overview

Zambia is dependent on hydropower resources and is currently facing a power generation deficit of 560 MW due to changing weather patterns (low rain). This has resulted in frequent power outages negatively impacting on homes and business. In an attempt to redress the power deficit, IDC with the assistance of the IFC as Transaction Advisor and the Zambian Government, intends to develop within the LS MFEZ, one of the two Solar Photovoltaic (PV) Power Plants, namely the Ngonye Solar PV Plant operating up to 34 MW. The solar plant will be operated by Enel Green Power S.p.A.

The proposed Ngonye Solar PV Project is under Round 1 of the 600 MW Scaling Solar Project. Round 2 and Round 3 of the Scaling Solar Zambia Project will follow and will be located at different sites to be identified within the country Zambia.

3.3 Proposed Project Location

The proposed and preferred Project site for the Ngonye Solar Plant is partly situated within the LS MFEZ and partly on an 11 ha piece of land (additional land for the project) that forms part of the Lusaka National Park owned by the Ministry of Tourism and Arts. The piece of land is physically outside the park fence boundary and is currently not used as a park. The Ministry of Tourism and Arts has granted consent to the Ministry of Finance to hold the addition land in line with the provisions of the Zambia Wildlife Act No. 14 of 2015. The Ministry of Finance will in turn lease the additional land to IDC to facilitate development of the Ngonye Solar PV Project. A letter from the Minister of Finance stating that he has no objection holding title to the land, pursuant to the Minister of Finance (Incorporation) Act, Cap 349 of the Laws of Zambia is presented in Annex 3. In addition, a letter from the Ministry of Tourism and Arts to the Office of the Commissioner of Lands indicating that the Ministry of

Tourism and Arts has no objection to releasing the portion of land for the Solar PV Project and that the title should be held by the Minister of Finance, pursuant to the Minister of Finance (Incorporation) Act, Cap 349 of the Laws of Zambia is presented in Annex 4. A copy of the Certificate of Title held by the Minister of Finance for the additional 11 hectares of land is presented in Annex 5 of this Report. Figure 3.2b shows the Ngonye Project Site Layout Boundary.

The LS MFEZ is located about 15 km to the South and East of the Lusaka Central Business District. There are no human settlements within the Project site since the site was cleared by the Government as part of LS MFEZ development process. The site is bordered by the Lusaka National Park to the South and some agricultural smallholdings to the East. The National Park has a fence around its boundary. Within the park boundary, there is 200 metre buffer zone created by the National Parks and Wildlife Department under the Ministry of Tourism and Arts.

The Ngonye Site lies about 2 km South of the LS MFEZ and IDC Offices. The Bangweulu Site lies to the North of Ngonye Site. The site was selected, among other alternatives, based on the relative ease of acquisition of land for the project within the LS MFEZ and the availability of existing background information as a result of on-going development works within the economic zone.

The area of influence of the proposed Project extends to surrounding communities who are likely to benefit from the power supply and also the job opportunities that may arise during the construction and operational phases of the project. These communities include Mahopo and Shantumbu Villages, Leopards Hills, Chalala and New Kasama residents and the farming community in New Kasama bordering the eastern end of the proposed project site.

Figures 3.1a and 3.1b below show the location of the proposed site within the LS MFEZ. The geographical coordinates that give the general location and layout of the site are given in Table 3.1 below. Figure 3.2a shows the satellite image of the proposed Ngonye Solar PV Project Site while Figure 3.2b shows the Ngonye Project Site Boundary. The project site boundary and infrastructure in the vicinity of the site – classified as PV SITE 2 - are also shown on Figure 3.2c.

Table 3.1: Geographical Coordinates of the Ngonye Solar PV Plant Project Site		
No	**X**	**Y**
1A	651714.63	8283954.55
1B	652639.73	8284392.85
1C	652707.12	8284179.76
1D	652728.16	8284107.28
1E	652791.83	8283960.55
1F	653010.27	8283961.86
1G	652967.14	8284046.75
1H	653142.90	8284135.71
1I	653118.23	8284184.45
1J	653193.03	8284219.85
1K	653182.23	8284242.45
1L	653212.94	8284257.05
1M	653224.13	8284233.55
1N	653304.93	8284271.85
1O	654037.53	8284271.85
1P	654034.53	8283967.35
1AA	652716.50	8284147.40
1BB	652715.81	8284184.72
1CC	652726.16	8284258.00
1DD	652727.66	8284303.94
1EE	652725.10	8284358.54
1FF	652723.84	8284370.16
1GG	652715.59	8284428.78

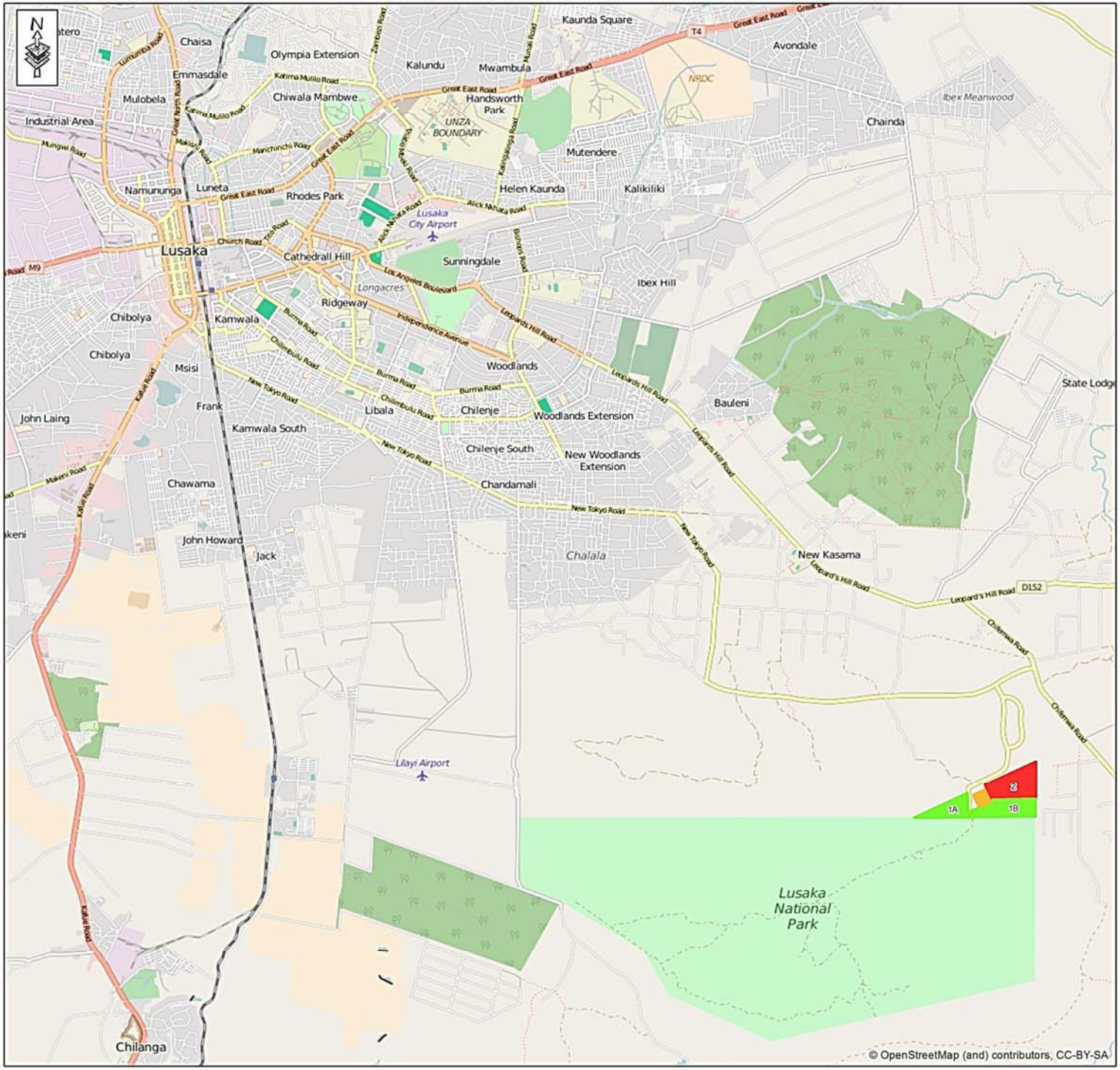


Figure 3.1a: Location of the Proposed Ngonye Solar PV Project (Site 1)

Legend:

SITES

- Site 1
- Site 2
- ZESCO

Projection: UTM 35South on WGS84

0 0.75 1.5 3 4.5 6 Kilometers

Proposed LS-MFEZ Solar PV Sites Project Location

Knight Piésold CONSULTING

302-00332-01	June 2016

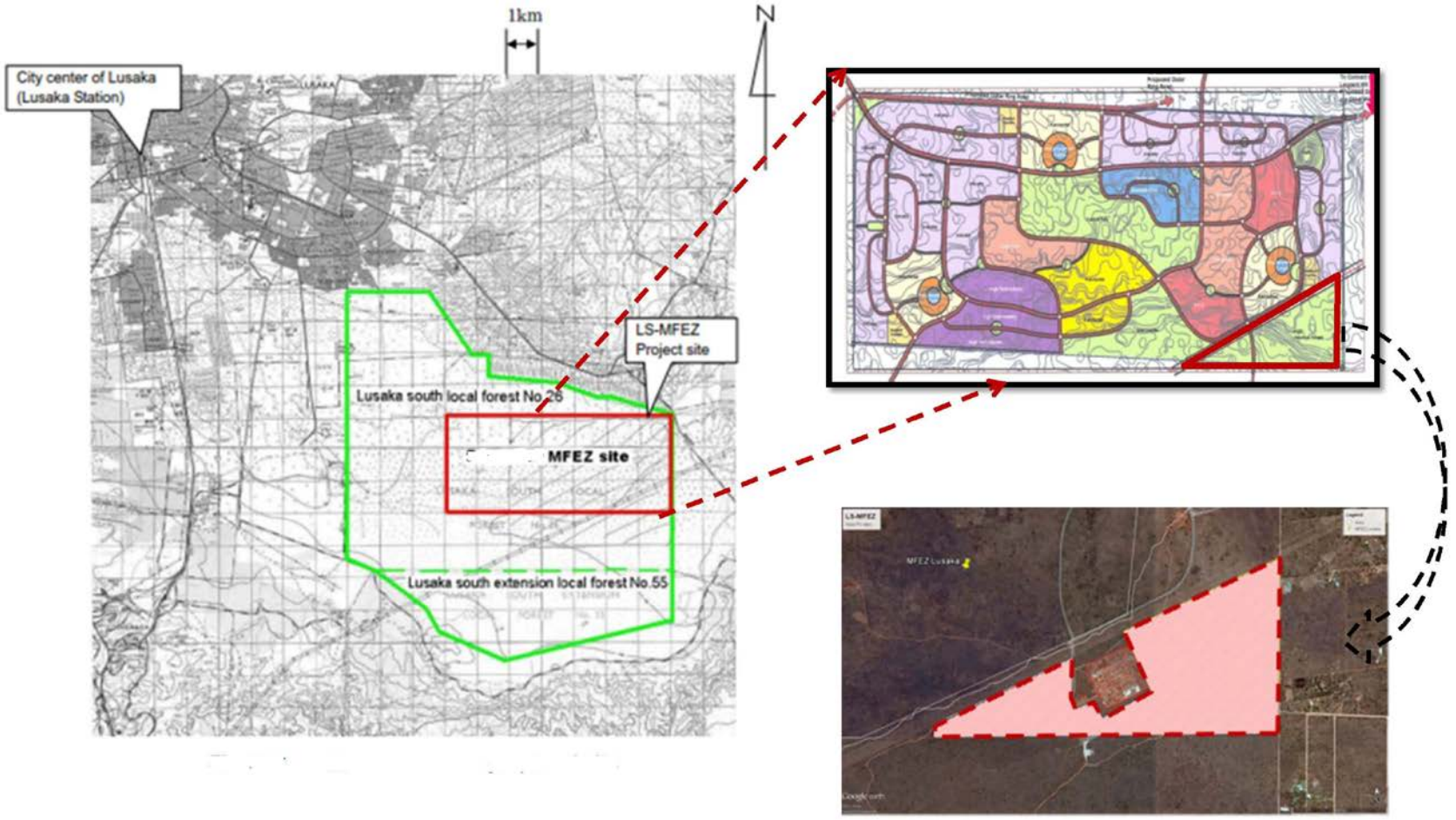


Figure 3.1b: Location of the Round 1 Scaling Solar Project Site within the LS MFEZ

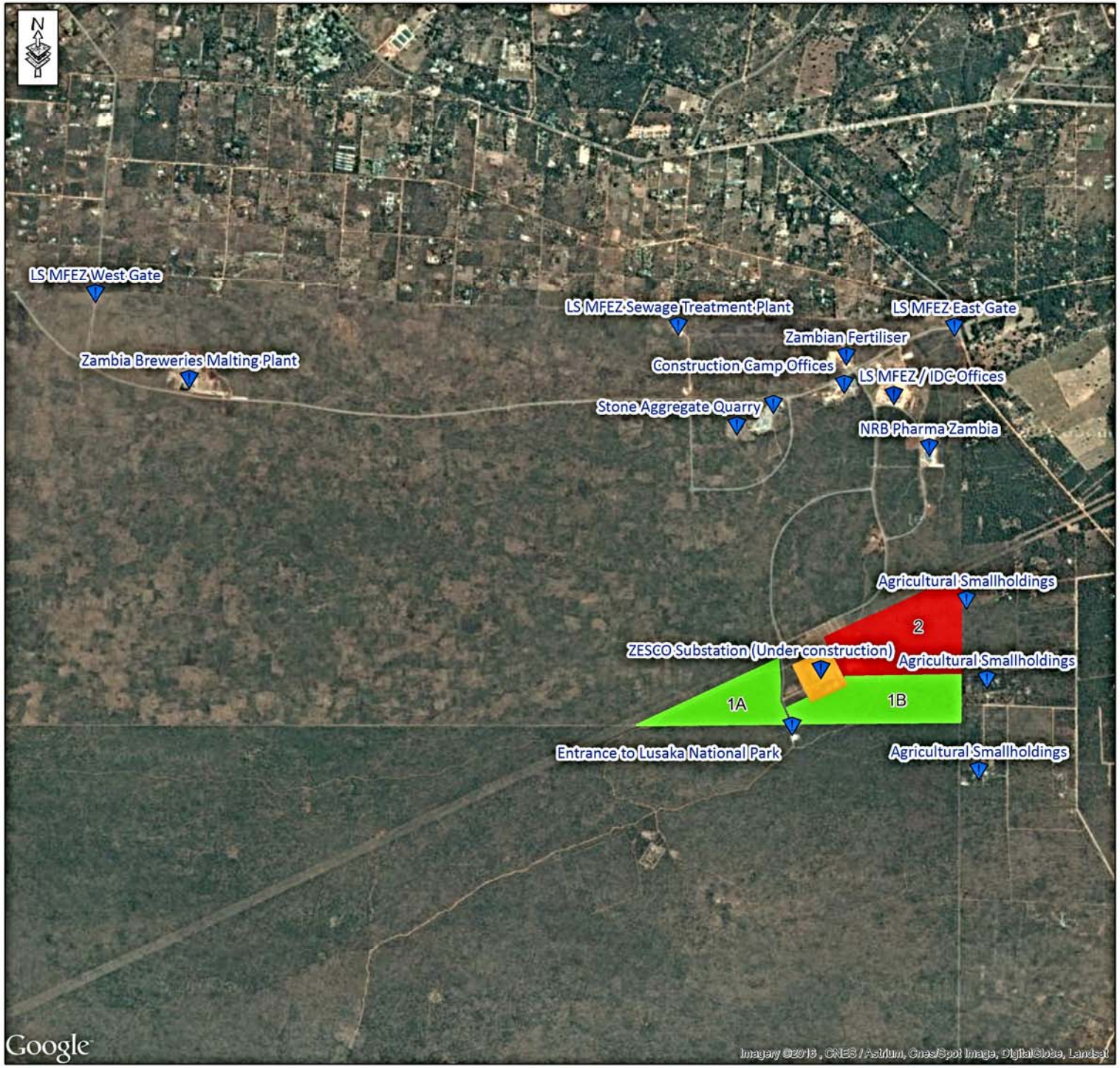


Figure 3.2a: Satellite image of the Proposed Ngonye Solar PV Project site (Site 1A/1B shaded green) showing existing facilities

Legend:

Other Facilities

SITES

Site 1

Site 2

ZESCO

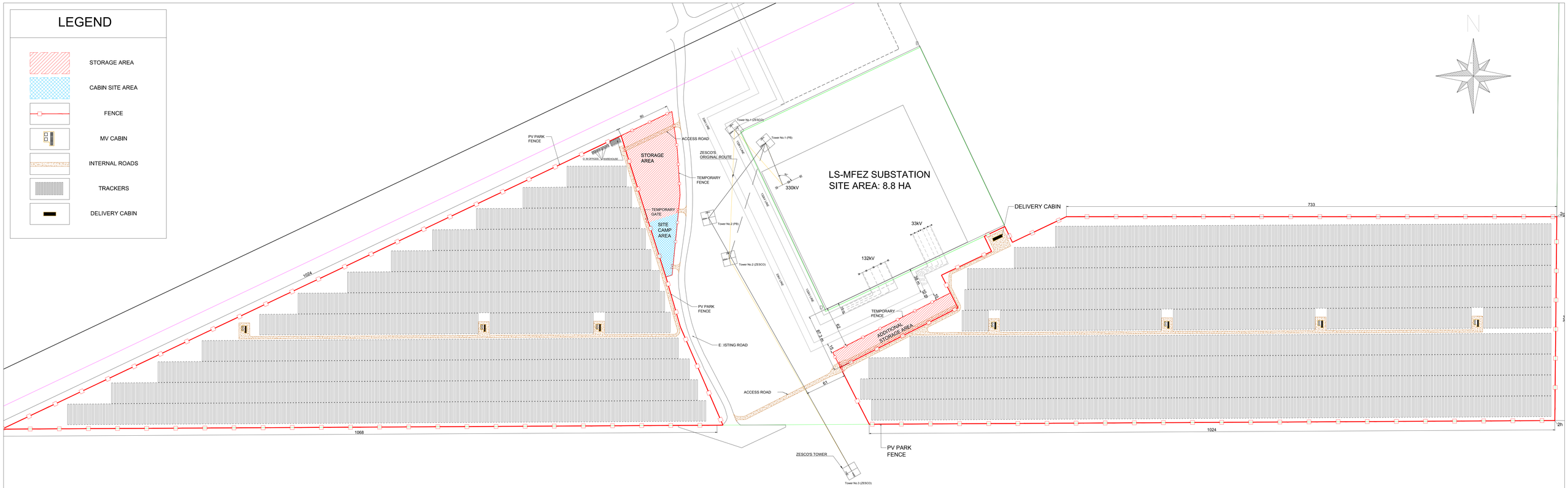
Projection: UTM 35South on WGS84

0 250 500 1 000 1 500 2 000 Meters

Proposed LS-MFEZ Solar PV Sites Other Facilities

Knight Piésold CONSULTING

302-00332-01	June 2016



CAMP GENERAL LAYOUT SCALE 1:2000

TerniEnergia S.p.A.
Sede legale in Nera Montoro - 05035 Narni (TR) - ITALY

LAYOUT OF THE PROPOSED NGONYE SOLAR PV PROJECT

E□ECUTIVE PROJECT

REV. REV.	DATA DATE	DESCRIZIONE DESCRIPTION	PREPARATO PREPARED	CONTROLLATO CHECKED	APPROVATO APPROVED
1	31/03/2017	emission	Simone Contessa	Matteo Mantini	Ing. Franco Diomedi
0	29/03/2017	emission	Simone Contessa	Matteo Mantini	Ing. Franco Diomedi

VALIDO PER IMPIANTI / ISSUE FOR PLANT

REV. 00 - EMISSIONE / REV. 00 - ISSUED

DATA DATE	PREPARATO PREPARED	CONTROLLATO CHECKED	APPROVATO APPROVED

PROGETTO / PROJECT: Mosi - oa - Tunya

NOME FILE / FILE NAME:

CLASSIF./CLASSIFICATION | RIFERIMENTO / ARCHIVED ID

FORMATO/FORMAT: A0 | SCALA/SCALE: various

SCALA PLOTT / PLOT SCALE: 1 = 1 | TAVOLA / SHEET: 1 / 1

Enel Green Power

ENGINEERING & CONSTRUCTION

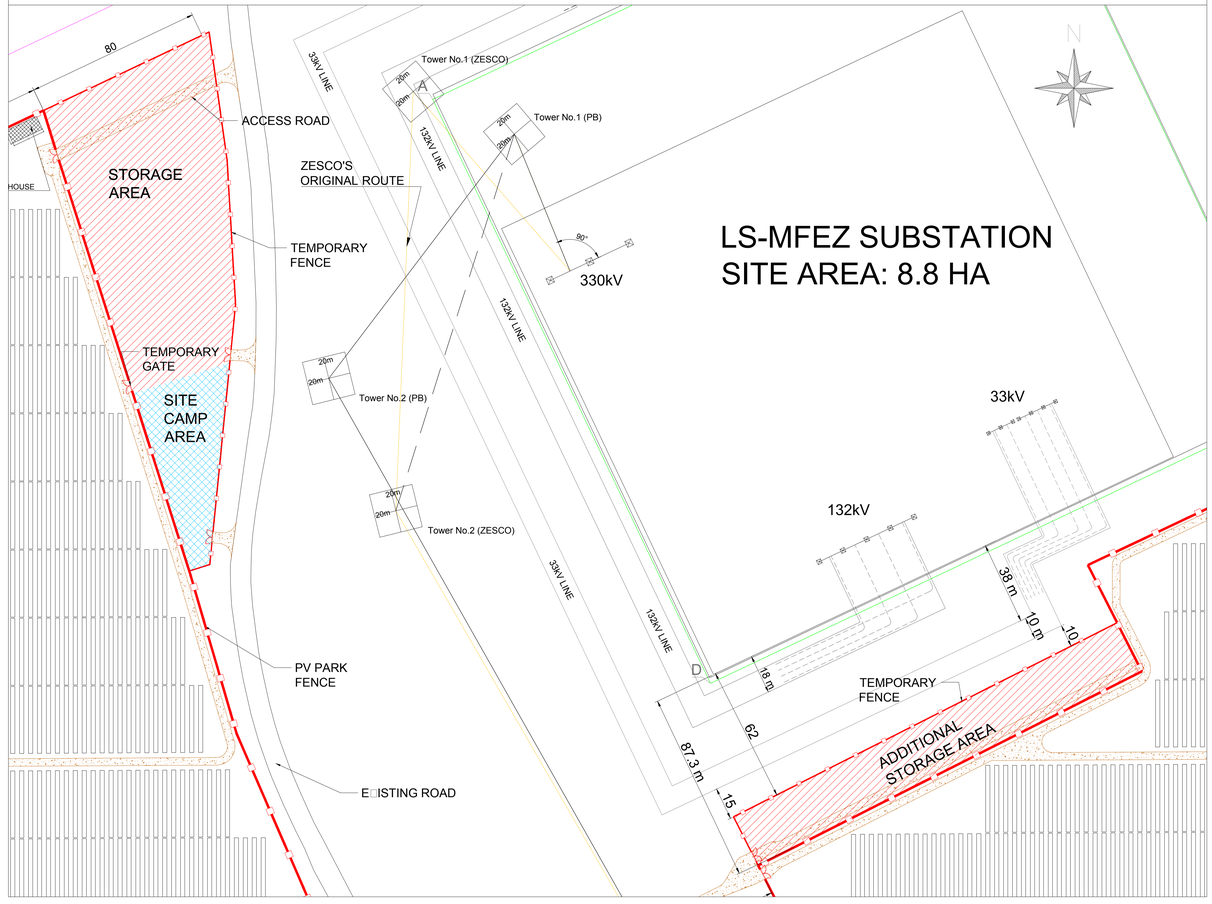
ENGINEERING

TITOLO / TITLE: **Construction Camp - Architectural Layout & Construction Details**

CODICE / CODE

TIPO DOC.	RIFERIM. ELAB.	PAESE COUNTRY	EDIFICIO	IMPIANTO PLANT							SISTEMA SYSTEM	PROGRESSIVO PROGRESSIVE			REVISIONE REVISION
D	2	7	Z	M	P	8	9	6	0	8	0	0	1	6	8	0	0

SITE CAMP LAYOUT SCALE 1:1000



TYPICAL SUPPORTING STRUCTURES SCALE 1:20

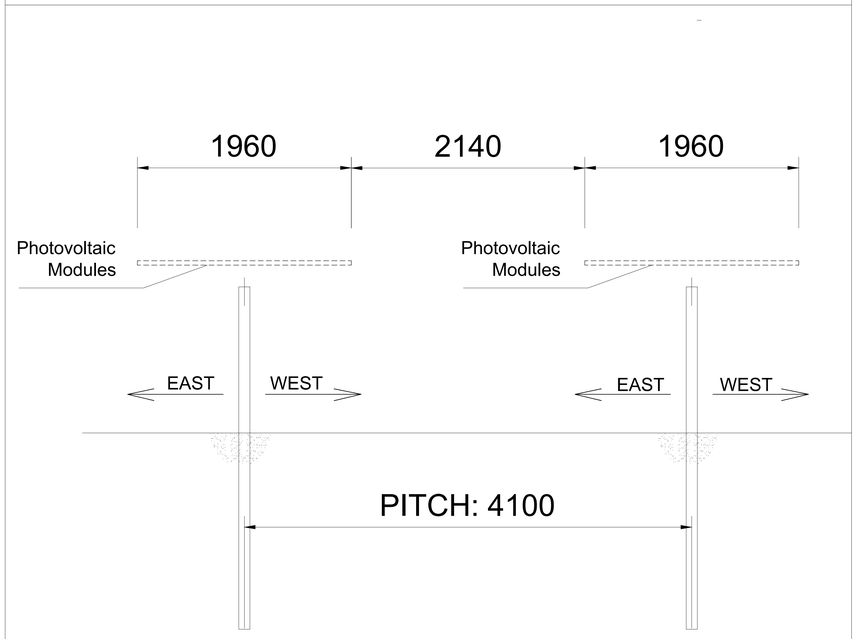


Figure 3.2b: Ngonye Project Site Layout Boundary

Figure 3.2c: Ngonye Solar PV Project Site and Infrastructure in the vicinity of the site - classified as PV SITE 2.

Legend

- Solar PV Site Boundary
- ZESCO SS Fence
- Existing Fence
- Existing Road
- 330 kV OHL
- 11 kV OHL
- ZESCO 330 kV Route
- PB 330 kV Route
- 132 kV Underground Cable
- 132 kV OHL
- 33 kV Underground Cable
- 33 kV OHL
- Back-up area

Coordinates UTM 27 (Arc1950 UTM 35S)

No	X	Y
1A	651714.63	8283954.55
1B	652639.73	8284392.85
1C	652707.12	8284179.76
1D	652728.16	8284107.28
1E	652791.83	8283960.55
1F	653010.27	8283961.86
1G	652967.14	8284046.75
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1BB	652715.81	8284184.72
1CC	652726.16	8284258.00
1DD	652727.66	8284303.94
1EE	652725.10	8284358.54
1FF	652723.84	8284370.16
1GG	652715.59	8284428.78

No	X	Y
2A	653055.54	8284589.62
2B	654045.20	8285058.22
2C	654037.53	8284271.85
2D	653304.93	8284271.85
2E	653224.13	8284233.55

No	X	Y
4A	651935.00	8284059.02
4B	652764.83	8284022.78
4C	652984.18	8284013.20

Rev	Date	Description	By	Chk	App

PARSONS BRINCKERHOFF
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Newcastle upon Tyne NE4 7YQ
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Client:
INDUSTRIAL DEVELOPMENT CORPORATION

Site/Project:
LUSAKA MFEZ

Title:
SITE LAYOUT AND INFRASTRUCTURE

Drawn: RH		Checked: LS	
Designed: RH		Approved: LS	
Date: 28/02/2017	Scale: 1:7500 A1	Sheet: 1 OF 1	
Project Number:	Drawing Number:	Revision:	
62105071	D01	9	

3.4 Project Description

The Ngonye Solar PV Project will operate on a 25 years Power Purchase Agreement signed with ZESCO and will consist of one Solar PV Plant that will be operating up to 34 MW. The project will cover a footprint of 52 ha of land. The design for the Solar PV Plant will require about 106,260 solar modules, 9 conversion units with 36 inverters. The final design will confirm the actual numbers of the components. The generated electrical energy will be transferred to an existing substation (which is currently under construction by ZESCO) via a 33kV underground cable. The distance between the proposed Solar PV Plant and ZESCO substation will be less than 100 metres. This information will vary depending on the final detailed design. The proposed Ngonye Solar PV Plant at Site will have a footprint of 52 ha.

The area that will be developed will consist of the foundations for the conversion units, delivery cabins, Warehouse/Storage areas, Operation & Maintenance room, parking area, roads, and the PV field ground section which will have the installation of the structural posts that support the photo voltaic modules. Therefore, the effective area used for the PV system that will be developed will be less than the total available area.

The PV system for the proposed Ngonye Solar PV plant will be a Grid-connected PV with PV modules mounted on sun tracking systems.

Solar energy will be used to generate electrical energy. The local climate provides long sunshine hours with an annual average of 7 hours per day and modelled average yearly Global Horizontal Irradiation[3] (GHI) shows that the GHI for Lusaka is 5.80 kWh/m^2 (IFC, 2014), which is considered to provide high potential for solar power generation. The generated electrical energy will be transferred to an existing ZESCO substation, which is currently under construction.

The project will use commercially available Solar PV cell technologies. The technologies are grouped into two broad categories (IFC, 2014). These categories are:

- Crystalline (c-Si); and
- Thin-film (IFC, 2015).

The crystalline silicon cells, which are further divided into mono-crystalline (mono-c-Si) or multi-crystalline (multi-c-Si), are known to provide high efficiency modules (IFC, 2015). Of the two types of crystalline cells, mono-crystalline are known to be more efficient and expensive than multi-crystalline cells, which are generally less efficient and less costly.

The thin-film cells are also divided into three main types, which are Cadmium Telluride (CdTe), Copper Indium (Gallium) Di-Selenide (CIGS/CIS), and Amorphous Silicon (a-Si). The thin-film PV cells are relatively cheaper than the crystalline cells but they are less efficient.

With regard to PV systems, the project will use grid-connected PV power plant. The power plant will be built on open space, where solar PV modules will be mounted on a sun-tracking system. The project design will take into account issues of landscape, potential visual intrusion and solar reflection in the design criteria to minimise negative impacts. Figure 3.4 shows the schematic drawing showing an overview of a grid-connected Solar PV plant.

[3] Global Horizontal Irradiation is the sum of direct and diffuse radiation received on a horizontal plane. GHI is a reference radiation for the comparison of climatic zones; it is also essential parameter for calculation of radiation on a tilted plane.

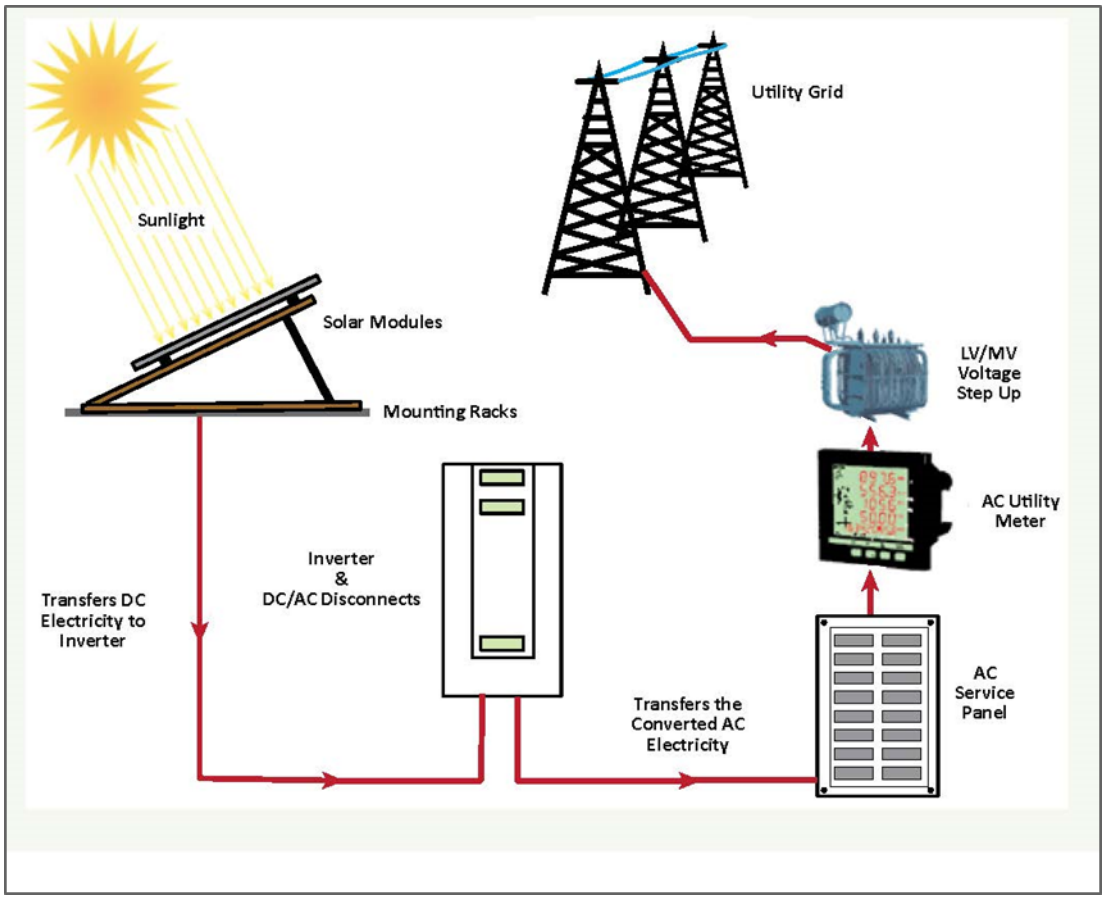


Figure 3.4: Overview of a grid-connected Solar PV Plant (Source: IFC, 2015)

Typical Installation of Solar Modules

3.5 Main Project Activities

All project activities from construction phase through to decommissioning phase will be implemented with a strong focus on managing the occupational health and safety issues of the workers. The project developer / Contractor should ensure that all reasonable precautions are carried out to protect the health and safety of the workers during all the project phases. The protective and preventive measures that will be required to be implemented should take into account the following, in order of their priority (IFC, 2007):

- Elimination of the hazard by removing the activity from the work process;
- Controlling the hazard at its source through use of engineering controls;
- Minimizing the hazard through design of safe work systems and administrative or institutional control measures;
- Providing appropriate personal protective equipment incorporating training, use and maintenance of PPE.

Work risk assessments should be undertaken prior to carrying out the works as a way of identifying occupation hazards, assessing risks and developing appropriate risk-reduction measures to protect the health and safety of the workers.

The main activities that will be carried out as part of project development and that must incorporate occupational health and safety measures during implementation are outlined in the subsections below.

3.5.1 Construction Phase

It is anticipated that the construction phase of the project works will last between 8-10 months. The construction phase related works will comprise:

a) Site clearance and levelling of the proposed project site area located within LS MFEZ to create a geotechnically suitable development platform for the installation of the PV modules, footings and other supporting structures.

b) Transportation of the plant components to site.

c) Construction of a small control building for storage and maintenance equipment and as well as welfare facilities.

d) Storage of modules, inverters and transformers and their associated parts.

e) Fixing of the module footings and support structures into the ground and mounting of modules onto the support structures within the site.

f) Digging of trenches for MV cables.

g) Installation of conversion units outside of the modules along the module blocks.

h) Installation of cables and connection of modules to the inverters and connection of delivery cabin to the substation under construction by ZESCO. The connections to the inverters and transformers within the substation will be via 33kV underground cables within trenches of approximately 0.9 metres below ground level.

i) Internal roads will be constructed as part of the project development works. In addition, temporary and site camp facilities (office, laydown/storage area, parking) will be established during the construction phase. During the operations phases temporary facilities will be removed and only permanent infrastructure will remain. The permanent infrastructure will also contain the conversion unit containers (that house solar inverters).

It is expected that approximately 100 people or more will be on site for at the peak of construction activities. The workforce will be reduced to 5 – 10 people during operations. This number is subject to change as full sub-contracts are negotiated.

3.5.2 Operational Phase

The operational phase of project development will comprise the following:

- Supervision of the electricity production — functioning of modules, inverters and transformers.
- monitoring/correcting production fluctuation, and managing system instability.
- Regular cleaning of the modules by trained local personnel using either water or dry cleaning.
- Clearing of vegetation from under and around the modules to allow maintenance and operation at full capacity.
- Maintenance of modules and spare parts including inverters, transformers and transfer cables to the substation.
- Office management and maintenance of the welfare facilities.
- Implementing activities aimed at avoiding and minimizing risks and impacts on community health, safety and security. This will include implementing security measures such as erecting a security fence to avoid trespassing, theft of company property, which includes cables, solar modules, etc.

  The operation phase of the project is expected to extend for at least 25 years. During this phase it is estimated that about 5 - 10 people will be employed. The number is subject to change based on negotiations for full sub-contracts.

3.5.3 Decommission Phase

The project design life is expected to extend for at least 25 years, following which it will be decommissioned. The main activity during the decommissioning phase is the removal from site of used solar modules, associated electrical components and cabling for disposal or recycling and demolition of site buildings. The solar modules will be sent to the manufacturer for recycling or any certified industrial recycling chain. The buildings may not be demolished if alternative use for them is agreed upon with other stakeholders.

The site will need to be restored to near pre-project conditions by rehabilitating the site.

3.6 Waste Generation and Management

Currently, there are few developments within the LS MFEZ such that waste generation on site is considered to be minimal. The Zambian Breweries Malting Plant, NRB Pharma Zambia Limited, Zambian Fertiliser and ZESCO substation are still under construction. NRB Pharma

Zambia and the ZESCO substation have reached advanced stages and will soon be commissioned. Other companies such as TPN Tippers, ZICTA, Lunzua Water, Alliance Pharmaceuticals, Rowland Tobacco will soon start construction works within the Zone. Currently the main type of waste being generated from these construction sites is construction rubble and waste packaging materials. Some construction rubble is being used to backfill borrow areas.

Waste from welfare facilities at the LS MFEZ Offices is directed to a new Sewage Treatment Plant constructed within the zone. The plant has a capacity of 3000 Litres and it is not yet commissioned. The plant will be expanded to cater for projected increase in sewage from welfare facilities at the peak of operations of the LS MFEZ. Construction of septic tanks within the Zone is not allowed. This has not been allowed to prevent pollution of groundwater in the Lusaka Dolomite Aquifer, a major source of water supply for most parts of Lusaka.

Solid waste, which is projected to increase once the zone is fully developed and operational, will be disposed of at landfill site to be situated on a 33 ha piece of land approximately 26 km from the LS MFEZ. The planned landfill to be developed by LS MFEZ Limited will be mechanized. All solid waste from the zone will be disposed of at the Landfill.

Construction Phase

Waste materials likely to be generated during the construction phase of the project development works include spoil from excavations, packaging materials (polystyrene) including cable drums, concrete, and effluent from site welfare facilities. Spoil from excavation works and non-recyclable solid waste including waste from food packaging for the workers will be disposed of at designated and licensed waste disposal sites. Mobile sanitary facilities will be used during the construction phase and waste from these facilities will be disposed of at the Sewage Treatment Plant. No septic tanks will be constructed at the project site.

Operation Phase

Possible waste materials to be generated during the operation phase include waste from maintenance works, failed PV units, office waste and effluent from site control rooms. No chemicals will be used in the system, or derived from the process. Non-recyclable solid waste such as some packaging materials, some office waste will be disposed of at designated and licensed waste disposal sites.

Any waste from the Solar PV plant that will be classified as hazardous waste will be disposed of in accordance with applicable legislations and IFC Performance Standards. The project developer will consider sourcing solar PV modules from reputable companies with a voluntary take back and recycling programme for end-of-life modules and who will take responsibility for PV modules throughout the life of the project. This will facilitate the collection and transportation of failed PV modules back to the manufacturer for recycling or any certified industrial recycling chain.

Small quantities of oils and fuels (mainly diesel up to a maximum of 30 cubic metres) will be stored at the project site during the construction and operation phases of the project. This includes transformer oils for a couple of small transformers that will be installed on site. The maintenance of transformers at the ZESCO substation will be the responsibility of ZESCO.

Maintenance activities on the site are not expected to generate significant quantities of waste. It is proposed that all liquid and solid waste generated by the operational site will be

discharged to or taken to a centralised waste collection and treatment system that will be provided within the LS MFEZ. This will treat and dispose of the waste according to national standards. Hazardous waste, such as but not limited to used oils and used solar modules, will be managed in accordance with the applicable national requirements and World Bank EHS Guidelines. Considering the nature and operations of the proposed project, minimal waste is expected to be generated at the project site.

The centralised waste collection and treatment system is yet to be completed and a temporary collection and disposal system will be required to be put in place by the operator until this facility is available. The temporary facilities will include mobile and temporary toilets suitable for construction sites.

Decommissioning Phase

At the end of life of the project estimated to extend to at least 25 years, used solar modules, associated electrical components and cabling will be the main waste types. These will require removal from the site for safe disposal or recycling. Site buildings will need to be demolished if there will be no agreed alternative use for them and the site will need to be restored to near pre-project conditions.

A detailed project decommissioning plan will be developed and will be continually updated. The plan will be implemented to ensure safe removal and disposal of all project components at their end of life or which are no longer required for the continuous use at the project.

3.7 Raw Material and other Resources required during production

The sole source of energy for the project will be the sun (solar irradiance). It will be captured and converted by the solar modules to electric energy for power generation.

No cooling water will be required for the operation phase of the project. However, water will be needed for cleaning of the modules and within the staff control room or office. Wet cleaning with water will mainly be carried out during the dry season since during the rainy season, the solar modules will be cleaned by the natural cleaning effect of rainwater. The required volume of water for cleaning of the solar modules and other operations at the site will be supplied by the Lusaka South Multi-Facility Economic Zone Limited from the planned central water supply system for the zone. The water supply line that current extends near the ZESCO substation will be extended to the Ngonye Solar PV Plant project site.

LS MFEZ will supply water to the site from boreholes installed within the zone. Four boreholes are currently operational. No.1 borehole has a yield of 25 litres per second (l/s) while No.2 Borehole has a yield of 12 l/s. No.3 Borehole is combination of two boreholes and has a total yield of 12 l/s (one borehole has a yield of 5 l/s while the other one has a yield of 7 l/s giving a total of 12 l/s). The chlorination and testing of groundwater abstracted from boreholes as well as and maintenance of the boreholes is currently being done by Lusaka Water and Sewerage Company (LWSC).

As an interim measure, an alternative source like private off-site supply via tankers could be used. On-site groundwater abstraction has been ruled out because of low groundwater potential at the site. The hydrogeological study undertaken at the site suggests that the conditions in the surveyed areas at the site are less favourable for the occurrence of groundwater (AMC, 2015b). In general, the available data suggests a low groundwater potential at the project site to sustain construction and operations of the Ngonye Solar PV Plant. Therefore, water supply during the construction phase of the project will be from a

private off-site supply via tankers. The approximate volume of water required will be confirmed based on the confirmation of the Solar PV Project operators / contractors. The volume of water required is, however, dependent on available cleaning technologies and the local climate (degree of soiling of modules, rainfall). Solar PV projects are considered as low water consumption projects. It is estimated that approximately 1.6 litres of water per m^2 of PV modules is required (IFC, 2015). The proposed project will cover an area of 52 ha (520,000 m^2). Therefore, water requirements for cleaning of modules for the proposed project would be less than 0.8 million litres as this estimation assumes that the PV modules will cover the whole project footprint.

3.8 Project Alternatives

The feasible alternatives considered for this Project relate to project technology, project location and the "no action" or "no project alternative".

Wind and Solar Energy are the main sources of renewable energy. Wind energy is generated from wind turbines. The wind speeds in Zambia are generally considered to be very low to enable sustainable use of wind energy on a large scale (ZDA, 2014). Wind speeds of between 0.1 to 3.5 metres per second with an annual average of 2.5 metres per second have been recorded (ZDA, 2014). Wind speeds within this range are very low for electricity generation but most suitable for water pumping for household use and irrigation purposes.

Solar energy is the other source of renewable energy. The local climate provides long sunshine hours with an annual average of 7 hours per day. The modelled average yearly Global Horizontal Irradiation (GHI) and Global Tilt Irradiation[4] (GTI) for Lusaka are 5.80 and 6.10 kWh/m^2 respectively while the average yearly Direct Normal Irradiance[5] (DNI) are 5.48 kWh/m^2 (IFC, 2014). Therefore, solar energy is preferred resource for solar power generation.

3.8.1 Project Alternatives on Technology

The solar power generation technologies considered include the photovoltaic (PV) flat plate technologies, which use GHI and GTI, and the Concentrating Photovoltaic (CPV) and the Solar Thermal Power Plants (also referred to as Concentrating Solar Power (CSP) plants), which use DNI (IFC, 2014). The GHI and the GTI are the solar resources used for assessment of PV technology while DNI is a solar resource for CSP and CPV technologies. DNI is involved in thermal (concentrating solar power, CSP) and photovoltaic concentration technologies (concentrated photovoltaic, CPV).

Solar modelling results show that Zambia has very high potential for PV power generation (IFC, 2014). For the proposed Solar Plant at LS MFEZ, solar PV technology is therefore the preferred option because of the local climate. In addition, the selected technology is associated with very low noise levels and ease of installation.

With regard to PV systems, the grid-connected PV power plants and the off-grid and mini-grids system are relevant to Zambia (IFC, 2014). The grid-connected power plants are built

[4] Global Tilted Irradiation represents global irradiation that is received by surface of PV modules optimally tilted to maximise yearly energy yield (IFC, 2014).
[5] Direct Normal Irradiance is the direct solar radiation from the solar disk and the region closest to the sun (circumsolar disk of 5° centred on the sun). DNI is component that is involved in thermal (concentrating solar power, CSP) and photovoltaic concentration technology (concentrated photovoltaic, CPV) (IFC, 2014).

on open space, where solar PV modules are either mounted in fixed position or on sun-trackers. The grid-connected system can also be mounted on roofs or facades of buildings.

A grid-connected PV system mounted at fixed position with an optimum inclination (tilt) has basic, simple, low-cost fixed mounting structures. The structures have long life in terms of performance and can be maintained at low cost as compared to sun-tracking systems, which have more complex mounting structures associated with high cost of mounting and maintaining them.

The off-grid and mini-grid systems are not connected to centralised grid system and typically meant to provide isolated communities with electricity while roof mounted PV systems are in most cases small to medium with solar energy output ranging up to hundreds of kilowatts.

The PV system for the proposed Ngonye Solar PV Plant will be the Grid-connected PV power plant with PV modules mounted on a sun-tracking system.

3.8.2 Project Location

Site selection was based on the initial desktop review of technical environmental, commercial and legal information. The LS MFEZ has been selected because of the following reasons:

- It is wholly owned by IDC (LS MFEZ Limited is a subsidiary of the IDC);
- It has the necessary infrastructure;
- The fiscal incentives offered will reduce the tariffs;
- Its proximity to the load centre for electricity.

In addition, a number of environmental and social assessments have also been carried out within and around the site. Therefore, there is already existing background data on the proposed Project site as result of on-going development works.

The selected site is in Lusaka where the yearly average Global Horizontal Irradiation[6] is estimated to be 5.80 kWh/m^2. This provides high potential for PV power generation.

3.8.3 "No Action" or "No Project alternative"

Under the "No Project Alternative", any potential adverse environmental and social impacts associated with the project would not occur. However, the preliminary assessment indicates that the disadvantages with the no project scenario include the following:

- Increased power deficit and load shedding;
- Lost opportunity to promote renewable energy;
- Loss of employment opportunities for the local people who could have been employed during the construction and operation phase of the project;
- Loss of government revenue through reduced taxes, and
- Loss of business for suppliers and contractors.

[6] Irradiation expressed in MJ/ m2 or Wh/m2 it indicates the amount of incident solar energy per unit area during a lapse of time (hour, day, month, etc.). Irradiance indicates power (instant energy) per second incident on a surface of 1 m2 (unit: W/ m2).

4 ENVIRONMENTAL AND SOCIAL SETTING

The environmental and social baseline conditions of the project area against which the potential environmental and social impacts have been assessed are presented in this section. The baseline conditions described in this document are based on field surveys undertaken at the project site as well as review of relevant documents and reports specific to the project area.

4.1 Topography

LS MFEZ

The terrain within LS-MFEZ is relatively flat, apart from the localised high ground in the east and south-east, and is thus potentially ideal for industrial and commercial development. The highest topography in the broader LS-MFEZ area is in the North-east at an altitude of 1323m amsl. The topography then falls off to the east and to the south-west and west. There is a secondary ridge of higher ground in the north-western part of the area. The lowest point in the LS-MFEZ is in the south-west at approximately 1270 m, indicating an average gradient of approximately 1:120.

The entire LS-MFEZ lies within a single landscape unit of subdued terrain formed on an underlying dolomitic geological sequence, with no appreciable surface drainage. However, localised natural sinkholes occur in the area.

Project Site

The topography of the immediate project site varies between 1315 and 1330 metres above mean sea level. The South eastern part of the site and generally the entire South to Southwest is relatively high in elevation than the north-north eastern side. The highest elevation contour in the south is at +1327m above sea level (ASL) while the northern lower contour is at 1316m ASL. This represents on average a slope of 0.733%. The general slope at the project site is towards the northeast and this forms a general drainage direction of rainfall water surface runoff. It also slopes slightly towards the southwest. Figure 4.1 shows the topographic map of the project site showing the general sloping trends of the project area (AMC, 2015c). The site has a relatively flat topography controlled by the underlying calcareous rocks of the Lusaka Limestone, which are easily weathered by mineral dissolution and leaching processes.

Some sink holes (swallow holes) and low depressions, like some areas within the broader LS-MFEZ, characterize the surface topography of the project site. Some sink holes have been observed on the eastern side of the immediate project site (see Figure 4.1) with one observed along the eastern side of the tarred road leading to the Lusaka South National Park, some 100 m North of the entrance (Gate) to the Park. The sinkholes at the project site are generally localized areas of lower ground that allow water to pool during rainy seasons hence cause dissolution of limestone and subsequent leaching of dissolved minerals and subsequent sucking of the water down and open up into underground cavities. The sinkholes (swallow holes) may be indicators of larger cavities (caverns) located below the rock/soil contact or some underground streams.

The rock outcrops and subsurface pinnacles also form the surface and subsurface features of the project site. The outcrops and rock pinnacles were noted in the project area.

4.2 Climate

The climate of the Project area is characterized by three distinct seasons: cool dry season from mid-April to August; hot and dry season from September to October; a rainy season from November to April. The project area receives annual rainfall in the region of 500 mm to 1000 mm with the mean annual rainfall being in the order of 800 mm.

The temperatures experienced within the project area are moderate with the mean monthly temperatures ranging between about 15°C in the cold season to about 30°C in the hot season. The area is dominated by prevailing easterly winds during the dry season with fresh winds experienced in the months of July and August. The mean wind speed recorded in the area ranges from 4 km/hour to 9 km/hour (DH Engineering, 2014). Extreme wind events are associated with thunderstorms and transient, short-term "dust devils" and may reach 112 km/h (ZEMA, 2014). Winds from the south-east are also experienced during the dry months while westerly winds are experienced in the wet months. Sunlight hours per day range from 5 hours to 9 hours in August with an annual average of 7 hours per day.

A review of climatic data for Lusaka reported in the Strategic Environmental Assessment Report (Draft) for the LS MFEZ shows that average annual evaporation is 1946 mm while annual rainfall is 837 mm spread out between September and March. The highest rainfall is recorded in January and February. Within the broader Lusaka, rainfall is increasingly localised. The sunshine hours within a year range from 5.2 hours to 9.5 hours. The average total sunshine hours in a year is estimated at 2827 hours (ZEMA, 2014). Table 4.1 presents summarised climate data for Lusaka.

Table 4.1: Summarised Climate Data for Lusaka

Parameter	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Av. Temp (oC)	21.6	21.3	21.1	20.4	18.4	16.7	16.0	18.4	21.3	21.4	23.9	21.8	
Sunshine (hrs)	5.7	5.2	7.3	8.4	9.1	8.6	8.7	9.4	9.5	9.3	6.7	5.6	2827
Wind speed (kph)	4.5	4.9	5.6	6.4	6.2	6.7	7.9	8.0	8.8	7.9	5.9	4.5	
P evaporation (mm)	164	137	164	150	136	117	130	164	201	236	183	164	1946
Rainfall (mm)	218	196	106	21	4	0	0	0	5	15	91	186	837

Source: ZEMA, 2014 (LS MFEZ Strategic Environmental Assessment Draft Report).

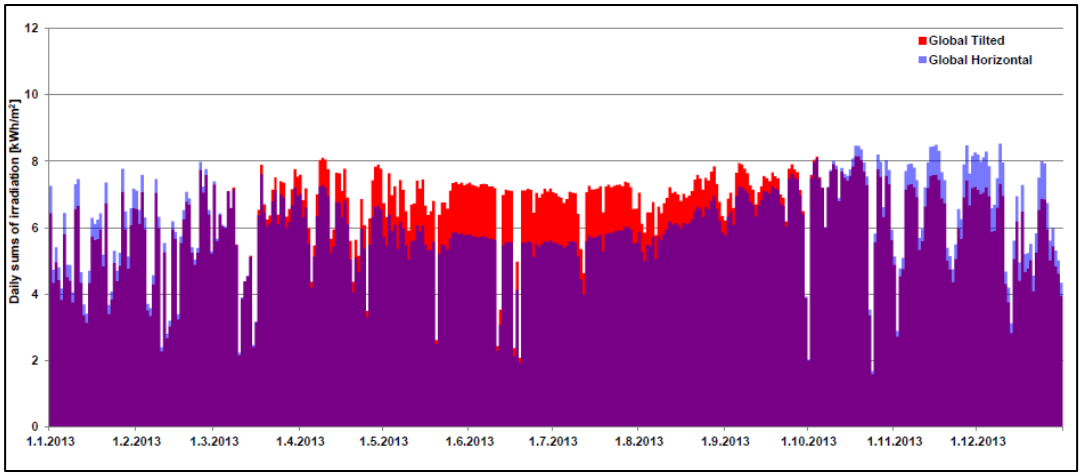
The Solar Resource Mapping for Zambia Report indicates that "In Zambia, the average daily sums of specific PV power production from a reference system vary between 4.5 kWh/kWp (equals to yearly sum of about 1640 kWh/kWp) and 5.1 kWh/kWp (about 1860 kWh/kWp yearly) with extreme values in Western Province and South-east of Luapula Province, where the values are higher than 5.1 kWh/kWp. This positions Zambia to regions with very high potential for PV power generation" (IFC, 2015).

Table 4.2 shows the relative gain of GTI to GHI while the Figure below shows daily values of GTI and GHI for Lusaka in the year.

Table 4.2: Relative gain of daily GTI to GHI in Lusaka

Site	Average daily sum of irradiation [kWh/m^2]												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Global Horizontal	5.51	5.52	5.57	5.69	5.41	4.93	5.12	5.95	6.77	7.01	6.40	5.75	5.80
Global Tilted	5.02	5.27	5.70	6.36	6.53	6.15	6.26	6.82	7.17	6.86	5.88	5.15	6.10
Global Tilted vs. Horizontal [%]	**-9**	**-5**	**2**	**12**	**21**	**25**	**22**	**15**	**6**	**-2**	**-8**	**-10**	**5**

Source: IFC, 2014 – Solar Modelling Report on Solar Resource Mapping in Zambia



Daily values of GHI and GTI for Lusaka, year 2013

Source: IFC, 2014 – Solar Modelling Report on Solar Resource Mapping in Zambia

4.3 Soils and Geology

Regional Geology

The geology of Lusaka is primarily composed of the upper Katanga sequence rock formations. This is comprised of intrusive granites and sandstones to the north east and calcareous rocks mainly Limestones and Dolomites within the Lusaka City Centre and to the East and South extending to Shimabala area in Kafue. The Lusaka limestones and dolomites form part of the major Chunga - Goma formation that curves around Chunga area to Chisamba North of the City of Lusaka (Appendix C).

The southern part of Lusaka is underlain by geological formation characterized by an extensive band of calcareous rocks of Katanga age constituting the Lusaka Dolomite Formation, comprising limestone and dolomite marble (DH Engineering, 2014). The Lusaka Dolomite Formation lies unconformably over the Cheta Formation (of earlier Katanga age), generally consisting of kyanite bearing schist, phyllite and quartzite.

Local Geology

The project area lies completely within the calcareous formation of the Lusaka limestone and Dolomites. These rocks are part of the Chunga - Goma formations. The localized geology is an intercalation of clear white crystalline limestone, dark grey dolomitic shale and siltstone and grey dolomite. The rocks are gently folded with dips averaging 40^0 with dip directions of 058^0 (North East). There are some joints with vertical dips and a review of a geotechnical report AMC indicates the presence of one major inferred fault (AMC, 2015d). Rock exposures are very prominent in the central and western sides of the project site while the eastern side is covered by thicker soil cover and only sporadic outcrops were observed at the site.

The geological mapping of the project site indicates that there are three types Limestone classification at the project site (AMC, 2015d):

ROCK TYPE 1: Low to moderate purity, fine to medium grained, selectively laminated to massive, white to brown in colour with a characteristic gnarled “twisted” structure. This rock type occurs in the extreme western part of the area and is called gnarled Dolomitic Limestone.

ROCK TYPE 2: High to moderate purity, medium to coarse grained, thinly laminated to locally crystal-line grey in colour and occurs in the central part of the area wrapping up to the north east and is called grey limestone.

ROCK TYPE 3: Moderate to high purity, medium grained, selectively thinly laminated to locally massive white dolomite occurring in the central to the south-east part of the area and is called dolomite.

The localized variation of rock units within the project area is summarized in the Figure 4.4 and Figure 4.5.

Structural Geology

There are no major structural features in the area. The major structural feature is the gentle dipping of the rocks, which generally dip on average $40^0/058^0$. Some localized joints are visible. The two common localized joints are one striking North-South with a vertical dip and the other one with a vertical dip as well but striking North East –South West (Appendix C).

Geotechnical aspects of the project area

The geology of the project area is predominantly calcareous, gently folded and geomorphically flat. This has implications in terms of geotechnical aspects. Some of the aspects include the following:

- The soil cover has varying thickness due to in-situ leaching. This presents a challenge in determining the stable depth for foundations.
- There are some floating rock gobbles and this could give false rock base during foundation exploration drilling.
- Presence of swallow holes is an indication of presence of larger caverns at depth or presence of underground streams. These can pose problems in stability of surface structures in both short and long terms (see Photo 4.1).

- The flat nature of the area has implications in creating an efficient drainage system within the area. This could have severe implications during once off storms (one in 10, 20, 50 and 100 years storms) such as risk of flooding. A review of hydrological study conducted at the project site shows that the risk of pooling and flooding is low on some sub-basins of the project site (northern, central, south-western parts of the project site) because concentrated flood flows on the larger part of the project site are outside the site (AMC, 2015b). High peak flows will not be at the project site but further downstream of the project area. The likelihood of flooding occurring on these areas is low. All the sub basins at the project site are well drained and flood flows through them are very small with an exception of the sub basin on the eastern part of the site. The extreme end of eastern part of the project site has natural flood ways running from the south towards the north and their outlet is outside the project site. Figure 4.2b shows the possible flood lines and sub basins draining of the project site. Potential flooding of this part of the site is possible under heavy storm rainfall. Adequate drainage system will be required to be installed to effectively and quickly channel peak flows from the project site into the planned LS MFEZ internal catchment areas and ponds system. The drainage system for the proposed Solar PV Project will be integrated into the plans for the LS MFEZ drainage system, which includes internal catchment areas and pond systems. The Solar PV Project will not, however, have full responsibility for the LS MFEZ internal catchment areas and pond systems.

- The irregular subsurface weathered profile might present some serious challenges to foundation designs for heavy structures (in excess of 10 Tonnes weights).

- Uncertainties in drill logs due to irregular weathering profiles are a geotechnical challenge that requires serious consideration during foundation design and at construction stage (Photo 4.2).

A review of the Surface Geological Mapping and the Geotechnical Investigation reports on the project site prepared by AMC indicate that there are two sinkholes that have been mapped through surface mapping (AMC, 2015d, 2015e). Both sinkholes are located within the grey limestone at the project site. At point (0653946, 8283806); there is a cluster of 4 sinkholes covering an area of 30 metres by 22 metres wide and average downward slump of approximately 1.5m while at point (0653824, 8284107); there is another sinkhole which is 5m long by 3m wide with a downward slump of 1.5m to 2 m (AMC, 2015d, 2015e). Cavities at the project site have also been logged from 5 drilled diamond core (AMC, 2015e).

In addition, small undulating sub-surface pinnacle topography exists across the entire project area resulting in the variation of depth to the bedrock across the area.

The presence of sinkholes, cavities and rock pinnacles in the sub-surface provides significant evidence that there are problematic karstic weathering features at the project site. The surface geological mapping report indicates that there is a probability that the karstic weathering features can be a threat to construction at the project site, hence their sub-surface signature will have to be investigated further (AMC, 2015d).

The geological mapping report recommends that the planned development should proceed with caution due to the risk posed by the karstic terrain identified on site. This risk will be required to be mitigated through suitable design and construction techniques. Detailed investigations should be carried out to understand further the site characteristics necessary for design. The requirements for foundations of the proposed Solar PV plant should be assessed in light of the findings of the Surface geological mapping report as well as the Geotechnical Investigations Report.

In addition, the reports recommended that cavities noted in the diamond drilled boreholes on site should be investigated further as their lateral and vertical extent and distribution were not known yet. The preliminary results of the ground penetration survey carried out as part detailed sub-surface mapping of the project site indicate void type of anomalies picked at depths ranging from 1.9m to 24.3m (Dynamic Design Ground Penetration Radar Survey Progress Report B, March 2015). A detailed ground penetration survey has been done to confirm the presence of void type anomalies and have been incorporated in the design of the project.

Photo 4.1: A swallow hole on the road side near the gate to Lusaka South National Park

Photo 4.2: Uncertainties in drilling profiles, heavy weathering after fresh rock (AMC, 2015e)

The project site has karstic weathering features that include swallow holes (sink holes) and cavities. These features present a challenge to construction works on site. Suitable design and construction techniques should be considered taking into account foundation requirements for the proposed Solar PV plant.

Soils

The soils at the proposed project site are ferruginous and are composed of silt, sand and gravel. The typical soil profile is composed of three layers – a humus layer followed by clayey silt sand then sand gravel (laterite). The layers are of varying thickness. Weathered rock of varying thickness controlled by the solubility of the parent rock is found below the laterite layer. The typical soil profile found at the site is shown in the photo below.

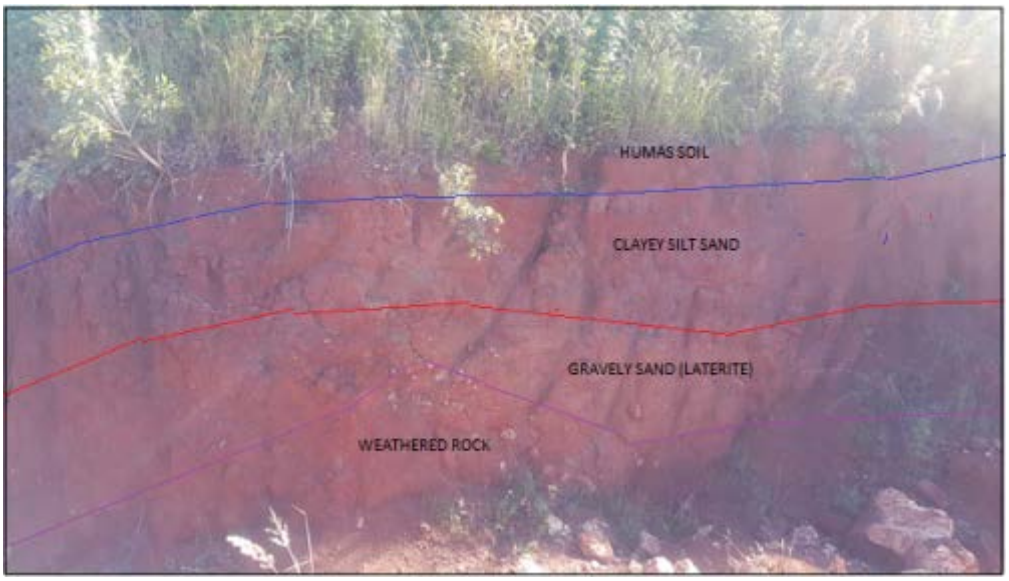


Photo 4.3: Typical soil profile (in the burrow pit)

The project area is generally flat and this has direct implications on the weathering process of the rocks and the resulting soil cover. Because the area is generally flat, water tends to pond and percolate down through the limestone, hence dissolving the rocks through leaching process. This results in in-situ type of soil composed primarily of resistant minerals such as quartz and other silicates.

The rock formation is an intercalation of various rock layers or bands. The weathering pattern or depth for each rock type varies. This leads to varying soil depths and some gobbles are seen in burrow pit exposure (See Photo 4.4). The exposures in a burrow pit are located on the northern side of the project area. The exposures show varying soil depth and rock boulders floating in soil mass. The pit is located about 1 km to the north of the Ngonye Project site. There are also some swallow holes, which are also referred to as sinkholes in the AMC Surface Geological Mapping report (AMC, 2015d). This is due to varying presence of silicate minerals and degree of metamorphism and weathering and subsequent leaching.

Photo 4.4: Exposures in a burrow pit on the northern side of the project area showing varying soil depth and rock boulders floating in soil mass. The pit is located about 1 km the north of the Ngonye project site.

4.4 Hydrology and hydrogeology

Surface Water

The City of Lusaka lies on fairly flat topography known as the Lusaka Plateau. The plateau forms the watershed between rivers and streams that flow westwards to join Mwembeshi River, a tributary of Kafue River. It also forms a watershed between streams that flow southwards to join the Kafue River and streams that flow eastward into Chongwe River, like the Chalimbana Stream (AMC, 2015b).

The project area also lies on the Lusaka Plateau. It lies at the watershed divide for the Chilongolo and Kafue Gorge sub catchments. Figure 4.2 shows the drainage and the hydrology of Lusaka and the project area. The project site is divided into five sub catchments as shown in the Figure 4.2. The southern parts of the project area are drained by Sub catchments 4 and 5, which pour into the Kafue Gorge Sub-Catchment while runoff from the Northern and Eastern part of project area are drained by sub catchments 1, 2 and 3 that pour into the Chilongolo sub-catchment (AMC, 2015b).

The Chilongolo sub catchment drains the project area and parts of Lusaka into Chilongolo River, which flows southwards towards Kafue Flats. The southern parts of the project area are drained directly into Kafue Gorge Catchment.

There are no permanent surface water features or open water courses at the Project site. The site is characterised by small valleys and depressions where rainfall runoff flows through. Most of the rainfall that is not lost through evapotranspiration drains into fissures and grikes or infiltrates through the lateritic overburden to recharge groundwater (Roland

Bäumle & Jack Nkhoma, 2008). A detailed description of the hydrology of the project site is presented in Appendix B.

Surface rainfall runoff within the LS-MFEZ follows intense storms. It travels for short distances until it is absorbed into the soil horizon (ZEMA, 2014). As the LS MFEZ is developed with the planned industrial, commercial and residential infrastructure, the conditions will be altered. Within the zone, there are two main directions of surface runoff around LS-MFEZ. Surface runoff flows to the north and east into the Chalimbana and Chongwe Rivers, and to the south into the Funswe and Chisuko Rivers that discharge into the Kafue and Zambezi Rivers, respectively. The base flow for these rivers is derived from the Lusaka Dolomite and discharges usually at the contact with the Cheta and Chunga Formations (ZEMA, 2014). There is no distinct surface drainage within several kilometres of the LS-MFEZ boundaries and any flow in these directions will be sub-surface through the soil horizon and the underlying geological structures (ZEMA, 2014).

Within the immediate project site, surface runoff flow is in the same direction, i.e. towards the north and east and towards the south.

Groundwater

The project area is underlain by the calcareous dolomite formation of the Lusaka Dolomite belonging to the Upper Division of the Katanga system. This geological formation (Lusaka Dolomite) has high recharge potential for groundwater. The area is also characterised by shallow groundwater tables, abundant surface karst features (karst morphology and sinkholes) that facilitates good permeability of the unsaturated zone. In addition, the area has no surface drainage system indicating that considerable portion of rainfall infiltrates the ground and directly recharges the groundwater (Bäumle & Nkhoma, 2008).

The project area is located on the groundwater water divide and a recharge zone for the karst aquifer (Lusaka Dolomite Aquifer) that supplies Lusaka city zone with groundwater. The aquifer is the source of approximately 50% of all Lusaka Water and Sewerage Company (LWSC) bulk water. It directly supplies a large number of agricultural, business and residential holdings around the western, northern and eastern margins of the LSMFEZ. In addition, the Lusaka Dolomite Aquifer and its adjacent formation is an important source of base flow for streams and rivers that drain off the Lusaka plateau (Chongwe, Chilongolo, Chalimbana Rivers, etc.).

Within the immediate surroundings and outside the project area, there are boreholes whose average estimated yields ranges from 0.2 l/s to 8 l/s. The long term sustainability of these yields is however not ascertained (AMC, 2015a). Figure 4.3 shows the location of boreholes in the project area.

Within the boundary of the project site, there are no existing boreholes. Available resistivity and magnetic survey data generated at surveyed areas at the project site suggests that the site is considered to be less favourable for occurrence of groundwater (AMC, 2015a). Two existing boreholes (BHs) at ZESCO substation being built in this area have shown an average groundwater yield of only 0.4l/sec. This is inadequate given the estimated demand by the project operation at 432 m^3/day. It has been assumed that a water source capable of yielding at least 5l/s of water would be sufficient for the intended purposes. This source could be from surface water or groundwater supply. Detailed exploratory drilling can be undertaken at the project site to ascertain the low groundwater potential that has been suggested or interpreted to be associated with the immediate project site surroundings.

The general groundwater flow direction in the area is towards the northwest. The flow directions and groundwater contour were derived from 126 observation points made in November 2008 (Roland Bäumle & Jack Nkhoma, 2008). Groundwater recharge rates in the south-eastern limb of the Lusaka Dolomite are estimated to be 250 to 300 mm/annum or about 30% of mean rainfall and higher than the average in the Lusaka region, estimated at 160 to 200mm/year (ZEMA, 2014).

Groundwater Quality

The Lusaka Water and Sewerage Company (LWSC) periodically monitors nine water quality parameters for total and faecal coliforms, conductivity, pH, alkalinity, total hardness, calcium hardness, chlorides and turbidity. A review of the average data generated from sampling boreholes between 2008 and 2013 shows that "very little of the Lusaka Aquifer is free of anthropogenic contamination, principally through entry to the groundwater of raw sewage, agricultural products, wastewater, cemetery contamination, or hydrocarbons effluent and leakage" (ZEMA, 2014). The quality of groundwater sampled during the period shows varying degrees of contamination arising from human activities.

A summary of previous studies reviewed is presented in Table 4.3.

Table 4.3: A summary of previous studies reviewed.

No.	Study Theme	Report ID NO.	Objective/Scope	Study findings
1	Geotechnical Investigation	DD201527C		• Presence of karstic weathering features (Sinkholes and cavities) as major sources of groundwater recharge could be interfered with during the construction phase and thereby leading to reduction in groundwater recharge and areas.
2	Water Resources	DD201527D	• Assess and identify adequate source of water for the proposed Construction site. • Conduct a field study to identify potential sources of water to supply the project both construction and operation phases.	• A reconnaissance visit to the project area further confirmed that the project area is located on a water divide with no permanent surface water sources within the vicinity of the project area. • The results of the resistivity and magnetic surveying suggest conditions in the surveyed areas to be less favourable for the occurrence of groundwater. • Although, the presence of Lusaka Dolomite (the most important aquifer) in the project area tend to suggest that groundwater could be the most reliable water source, the available information on groundwater are not adequate to permit any quantitative assessments of the water resources at the project site. • The results of the resistivity and magnetic surveying suggest conditions in the

Table 4.3: A summary of previous studies reviewed.				
No.	**Study Theme**	**Report ID NO.**	**Objective/Scope**	**Study findings**
				surveyed areas to be less favourable for the occurrence of groundwater. • Information collected from the field show that the borehole yield in the north of the project area is better than in the project area; yields from borehole drilled on the ZESCO project site located within the project area is in the order of 0.4l/sec sufficient only for domestic use.
	Hydrology Study	DD201527E	• Identify areas at risk of flooding and provide estimation of flood flows and flood levels; • Identify and quantify of adequate sources of water for the project both at construction and operation phases.	• Converting vegetal cover to bare or impervious surface in the project area as a result of construction activity is bound to increase surface runoff by as much 150% and thereby reducing groundwater recharge tremendously. This will increase the risk of flooding the project area. To overcome this situation, properly designed storm water drainage system will have to be constructed to convey the surface runoff away from the project area. • The Solar plant project area lies on groundwater divide and a groundwater recharge zone for the karst aquifer supplying 50% of Lusaka city's water. There is therefore need to protect this area from activities which have the potential to interfere with the quantity and quality characteristic of this resource

Source: African Mining Consultants Assessment Report -Solar PV Energy Project, 2015

4.5 Air Quality

Bush and scrub burning is common around the project area and are considered as the current main sources of air pollutants especially during dry and windy conditions between July and September. These conditions can contribute to on-site generation of dust emission that can potentially reduce the ambient air quality. Currently there are no operational industries within the LS MFEZ emitting air pollutants. A quarry and a stone crushing plant that were operational during the construction of bituminous (tarred) roads within the LS MFEZ, and which could have been considered as potential sources of dust emissions and other air pollutants, are no longer operational. A review of the air quality monitoring results recently generated during the ESIA Study for the Zambia Breweries Malting Plant located within the LS MFEZ indicates that the ambient air is generally clean with no air pollutants such as sulphur dioxide, carbon monoxide, oxides of nitrogen (DH, 2014).

Zambian Fertilizer Company, located approximately 2 km North of the proposed project site is currently under construction while NRB Pharma Zambia, a pharmaceutical industry located about 2 km North of the site, is almost complete but not yet commissioned. A ZESCO substation, which is under construction, is located immediately to the North of the project site. Other industrial developments have been earmarked to be established in the Zone but no construction works have been started. The southern end of the site is bounded by the Lusaka National Park while the eastern end shares the boundary will some agricultural smallholdings.

PM10 and PM2.5 Dust Particles Baseline

Baseline dust monitoring was undertaken by Knight Piésold Consulting in April 2016 at the project site as part of the environmental impact assessment for the proposed Scaling Solar Project. Baseline PM10 and PM2.5 levels were monitored using TDI AM 510 dust sampler at points (A1, B and G3) located along the proposed solar plant boundaries as shown in Figure 4.6. A detailed methodology of the dust monitoring exercise is presented in Appendix D (Air and Noise Monitoring Report). There were no major activities at the project site at the time of dust monitoring except for construction works at the ZESCO substation and land clearing outside the northern perimeter fence of the substation. Table 4.4 shows the PM10 and PM2.5 monitoring results.

Table 4.4: Dust Monitoring Results along the Proposed Solar Project site boundary

Sampling Point	Coordinates		Sampling Date	*PM_{10} µg/m³ (24 hr)	*$PM_{2.5}$ µg/m³ (24 hr)
	Easting	Northing			
A1	651888	8283766	21/04/2016	9.2	11.2
			22/04/2016	10.8	12.4
			23/04/2016	12.8	14.0
B	654038	8284802	21/04/2016	9.6	9.6
			22/04/2016	9.2	10.8
			23/04/2016	12.4	14.0
G3	654027	8283699	20/04/2016	6.0	6.8
			21/04/2016	10.0	8.8
			22/04/2016	12.0	12.0
Environmental Management (Licensing) Regulations 2013 (Emission Limits for Ambient Air Pollutants)				70	15
Reference Time				24 hr	12 Months
IFC Guidelines Values				50	25
IFC Reference Time				24hr	24hr

* PM10 and PM2.5 data obtained was converted to 24 hour reference times by using Environmental Protection Agency (EPA) guidelines (EPA, 1992)[7]. Methodology is presented in Appendix D.

[7]EPA, 1992. Screening Procedures for Estimating the Air Quality Impact of Stationery Sources" (Section 4.2 page 4-15)

The indicative field results show that average PM10 concentrations range from 6 µg/m^3 to 12.8 µg/m^3 while average PM2.5 concentrations range from 6.8 µg/m^3 to 14.0 µg/m^3. For both PM10 and PM2.5, all the results are below IFC and Zambia Ambient Air Quality guidelines shown in Table 4.4 and Table 4.5 respectively. The IFC Ambient Air guidelines are set out to give threshold levels that protect public health and safety. The guidelines of relevance are to do with particulate emission from project activities, which in this case can be emissions from construction activities and movement of vehicles along access roads. The Environmental Management (Licensing) Regulations, 2013, Statutory Instrument No 112 of 2013 provides the emission limits for ambient air pollutants (see Table 4.6) that are aimed at protecting human health, animal or plant life and the environment.

The results of the baseline dust monitoring show that dust levels of PM10 and PM2.5 are below the IFC ambient air guideline limits and Zambian emission limits for ambient air pollutants. The project incremental impacts of dust are unlikely to change the background levels through the life of the project.

Table 4.5: IFC Ambient Air Guidelines for gases and particulate matter				
	SO_2 µg/m3	PM10 µg/m3	PM2.5 µg/m3	Nitrogen Dioxide µg/m3
Hourly				200
Daily (24 Hr)	125	50	25	
Annual	20	20	10	40

TABLE 4.6: Emission Limits for Ambient Air Pollutants			
PARAMETER	**REFERENCE TIME**		**GUIDELINE LIMIT**
1. Sulphur dioxide (SO2)	10 minutes		500µg/m3
	1hour		350µg/m3
2.0 Sulphur dioxide (SO2) in combination with Total Suspended Particles TSP and PM10	SO2	24 hour	125µg/m3
		6 months	50µg/m3
	TSP	24 hour	120µg/m3
		6 months	50µg/m3
	PM10	24 hours	70µg/m3
3.0 Respirable particulate matter PM10 *2	PM10	24 hours	70µg/m3
Respirable particulate matter PM2.5 *3	PM2.5	12 Months	15µg/m3
Oxides of nitrogen (NO_X) as nitrogen dioxide (NO_2)	1 hour		400 µg/m3
	24 hours		150µg/m3
5. Carbon monoxide (CO)	15 minutes		100 mg/m3
	30 minutes		60 mg/m3
	1 hour		30 mg/m3
	8 hours		10 mg/m3
6. Ambient Lead (Pb)	3 months		1.5 µg/m3
	12 months		1.0 µg/m3
7. Dust fall	30 days	Residential and light commercial areas	250mg/m2/day
		Residential and light commercial areas	500mg/m2/day
8 Ozone	8hours		120 µg/m3

*1) Total suspended particles (TSP) are particles with diameter less than 45 micrometers (µm).
*2) Respirable particles (PM10) are particles with diameter less than 10 micrometers (µm).
*3) Respirable particles (PM2.5) are particles with diameter less than 2.5 micrometers (µm).
NOTE: Reference times are the 98th percentile averaging times.

Source: Extracted from Zambian Environmental Management (Licensing) Regulations, 2013.

Sulphur Dioxide, Oxides of Nitrogen and Carbon Monoxide Baseline

The baseline data on gaseous air pollutants has been gathered through review of Environmental and Social Impact Assessment (ESIA) studies that have been conducted within the LS MFEZ. Within the zone there are no industries that emit sulphur emissions. Sulphur dioxide emissions usually come from industrial operations. Mobile sources can emit sulphur dioxide through exhaust fumes if the fuel contains sulphur. Without a source of sulphur dioxide in the area the baseline concentration of gaseous air pollutants are still considered to be low as found in the baseline study done by JICA. Baseline concentrations of NOx and NO_2 are not expected to be high as there no sources that include combustion large fossil fuel combustion units, heavy traffic especially diesel vehicles.

Table 4.7: Table Baseline Air Quality Conditions Tested in Mid-September 2008

Sampling time	SO2 µg/m3	NOx as NO2 µg/m3	PM10 *1 µg/m3	TSP*2 µg/m3	Pb µg/m3
08.00-11.20	0.37	NE	11.2	60	0.002
11.00-13.20	NE	0.21	18.8	50	0.001
13.00-16.30	0.43	NE	12.7	30	0.001
Zambian Guideline Limits	350 (1hr Average) 125 (24hr Average)	400 (1hr Average) 150 (24hr average)	70 (24hr average)	120 (24hr average)	1.5 (3 month average)
EU Air Quality Standards		200 (1hr average) 40 (1yr average)	50 (24hr average)		

*1 Particles between 2.5 and 10 microns in diameter.
*2 Now superseded by PM10 and PM2.5 measurements

Source: ZEMA, 2014 - LS MFEZ Strategic Environmental Assessment Draft Report - based on JICA 2009: The Study on Master Plan of Lusaka South Multi-Facility Economic Zone, Table E.1

Note that results above were reported under SI 141 of 1996 (The Environmental Protection and Pollution Control Act of 1990) which stipulated the ambient guideline limits for ambient air pollutants - gases and dust. SI 141 has since been replaced by SI 112 of the Environmental Licensing Regulations of 2013. The new regulations SI 112 has included PM2.5 particles which were not in the repealed SI 141. Table 4.5 shows the emission limits for ambient air pollutants included in the new regulations.

A review of the air quality monitoring results generated during the ESIA Study for the Zambia Breweries Malting Plant located within the LS MFEZ (Environmental Impact Statement for the Proposed Malting Plant in LS MFEZ done in July 2014 by DH Engineering Consultants) indicates that the ambient air values were below detection limits for CO, SO_2 and NOx. Draeger tubes were used for sampling the gases. The reported results show that the SO_2

was below 500 µg/m^3, the 10 minute guideline limit, CO was below the 100mg/m^3, the 15 minute guideline value and the NOx was less than the 400 µg/m^3 , the 1 hour guideline value.

Table 4.6 in the JICA study shows that the values for SO_2 was less than 1 µg/m^3 compared to guideline value of 350 µg/m^3 and Nitrogen dioxide was less than 1 µg/m^3 compared to guideline value of 400 µg/m^3

Conclusion

The baseline air quality based on the dust sampling for PM10 and PM2.5, which was conducted in April 2016 as reported under the dust baseline, and the gases measurements, which were done by JICA and by DH Engineering at the LS MFEZ as reported above, indicates that PM10, PM2.5, CO, NOx, and SO_2 are all within the IFC guideline limits and Zambian Emission Limits for Ambient Air Pollutants.

4.6 Land Use

The LS MFEZ is located in what was Local Forest Reserve No. 26. The area was declared a Forest Reserve in the 1942. The vegetation in the area was principally that of Miombo Woodland and some Munga woodland vegetation type. The area provided habitat to wildlife including large wildlife mammals and birds (ZEMA, 2014).

The area has over the years been progressively deforested by local people through firewood collection, charcoal production and small-scale farming with most significant changes occurring in the mid-1990s (ZEMA, 2014). Some of the local people encroached on the Forest Reserve as way back as 1974 and settled there in dwellings mainly constructed of either mud bricks or poles with grass thatched roofs. The other local people who were dependent on the Forest Reserve in terms of farming and other livelihood activities were not staying within the reserve land but were coming from the nearby townships such as Bauleni, Chilenje, Chawama, etc. (DMMU, 2012).

Farming was the major source of livelihood for the local people settled in the Forest Reserve as well as for others that came from nearby townships. Other sources of livelihood activities included casual labour or piece work done in surrounding farms, petty trading (sell of groceries and other small commodities), stone crushing and skilled trade artisanship (DMMU, 2012).

Therefore, before the establishment of LS MFEZ, Local Forest No. 26 was important for the surrounding communities and households of Shantumbu and Mahopo as they derived natural resources were they depended on from the Forest. These natural resources included cropland, firewood, charcoal production and other non-timber forest resources.

The LS MFEZ area was degazetted as a Local Forest Reserve in October 2007 (Forests Act CAP 199 Statutory Instrument No. 82 of 2007) and was declared as a Multi-Facility Economic Zone in 2010 (Statutory Instrument No. 47 of 2010 of the Zambia Development Act No.11 of 2006).

The proposed Ngonye Project site partly falls within the LS MFEZ, which is *Statutory Land* owned by LS MFEZ Limited and is partly within a 11 ha piece of land, which is within the Lusaka National Park owned by the Ministry of Tourism and Arts. The LS MFEZ was designated for setting up of different types of industries and establishments. Although the LS-MFEZ certificate of title for the entire MFEZ is zoned for agricultural purposes, Statutory Instrument No.47 of 2010, which designates the area as a multi-facility economic zone overrides the zoning. The offer of land to Industrial Development Corporation Zambia in the

LS MFEZ for the purpose of developing the proposed project is attached to the main ESIA Report.

The other part of the project site, about 11 ha of additional land for the project, is physically located outside the National Park fence boundary and is not currently being used as a wildlife park. The Ministry of Tourism and Arts has granted consent to the Ministry of Finance to hold the additional land. The Ministry of Finance will in turn lease the additional land to IDC to facilitate development of the Ngonye Solar PV Project (See Annex 3 and 4 for letters of on objection from the Ministry of Tourism and Arts and the Ministry of Finance concerning the use of additional land for Solar PV project development). A copy of the Certificate of Title held by the Minister of Finance for the additional 11 hectares of land is presented in Annex 5 of this Report. Figure 3.1b shows the location of the project in relation to the LS MFEZ boundaries.

The site is currently an open space with tall grass, shrubs and regenerating scattered trees. The landscape at the site has been affected by human activities such as charcoal burning, firewood collection and farming. There is a ZESCO substation under construction in situated towards the northern end of proposed project site. The substation will facilitate the transfer of generated electrical energy from the solar plant into the national grid. Therefore, the substation will not be demolished.

The southern end of the project site forms the boundary with the Lusaka National Park while NRB Pharma Zambia, a pharmaceutical company, and LS MFEZ Offices are located on the northern end of the site, approximately 2 km from the project site boundary on the Northern end. Within the Lusaka National Park boundary fence, there is a 200 metres buffer zone created and maintained by the Department of National Parks and Wildlife under the Ministry of Tourism and Arts.

Other industries have been planned to be established within the Zone. The Lusaka National Park is a protected area and is securely fenced with security checks provided by National Parks and Wildlife Department security personnel.

The neighbouring properties on the eastern end of the project site are smallholdings and large farms where individual farming activities such as poultry, pig rearing and crop production are practised. The properties are located within 40-100 metres from the site boundary while the distance between the properties and the ZESCO substation under construction ranges from 0.8 km to 1.0 km. The smallholdings are not likely to be relocated as a result of the proposed project development. There also a number of business entities and private game ranches. Other activities being undertaken in the vicinity of the project site include small-scale quarrying for limestone / dolomite and collection of firewood and charcoal burning.

4.7 Biodiversity

A review of previous flora and fauna studies carried out within the broader LS MFEZ area was undertaken to establish flora and fauna baseline conditions in the project area (AMC, 2015b; LSMEFZ, 2014; Bäumle & Nkhoma, 2008; DH, 2014; WSP | Parsons Brinkerhoff, 2015). Secondary data gathered through the review of the above cited documents was supplemented with data from site specific flora and fauna assessment conducted by Knight Piesold Zambia in April 2015. This subsection highlights the baseline flora and fauna conditions at the project site based on the actual site assessment and review of the available literature. The data from the assessment was analyzed to generate the following fauna and

flora information: (a) number of species per family (b) Importance value (c) IUCN status, etc.).

The focus of survey was on plant and terrestrial fauna species composition as there are no surface streams or surface water features at the project site.

The methodology used to assess flora and fauna at the project site involved a combination of techniques namely-

(i) Pacing to establish 20 m radius plots for each selected sampling point for surveying flora component

(ii) Recording of the following attributes a) species b) stem/trunk diameters c) number of individual stems and c) herbaceous plants in each plot;

(iii) Conducting transect walks across the project site to observe either fauna, or any trails or foot prints or nests or sound or any other mark that may guide in identification of the fauna species of the project area;

(iv) Consultation with local community members/agencies familiar with the place and fauna species of the area.

From the diameters at breast height (dbh) collected, individual species Importance Value[8], were calculated as follows:

Importance value (IV) = [Relative frequency[9] (RF) + Relative density[10] (RD) +Relative basal areas (RBA)

Flora

Miombo woodland vegetation initially dominated the LS MFEZ area. The vegetation was dominated by *Brachystegia boehmii*. It has, however, been reduced to open savannah vegetation characterized by tall grass and sparse trees due to human activities, which include farming and logging. The common vegetation species within the broader project area include *Julbernadia globiflora, Albizia antunesiana, Olax obtusifolia* and *Ochna pulchra* (DH, 2014; ZEMA, 2014).

A site specific flora survey carried out by Knight Piesold Zambia in April 2016 at the site revealed that the proposed project area is a modified ecosystem which is characterised with some tall grass and some regrowth vegetation arising from previous disturbances such as shifting cultivation and charcoal production. The vegetation is mainly of regrowth nature with species of Miombo woodland dominating. The observed largest merchantable diameter at breast height in the proposed project area is 12.5 cm.

A total of 19 families were recorded on the project site. The genera and species observed over the project area were 31 and 37, respectively. Among the families observed over the project area is Fabaceae, which had the highest (9) number of species, while the other families like Leguminaceae, Rhamnaceae, Rubiaceae and Malvaceae recorded the lowest number of species (see Figure 4.7).

[8] Importance value (IV) is the sum of the Relative density, Relative frequency and Relative basal area divide by 3.
[9] Relative frequency (RF) is the number of plots in which species is present per total number of plots recorded. Relative basal area (RBA) is the basal area of a species in a community per total basal area of all species.
[10] Relative density (RD) is the number of stems recorded for species per number of stems recorded for all species.

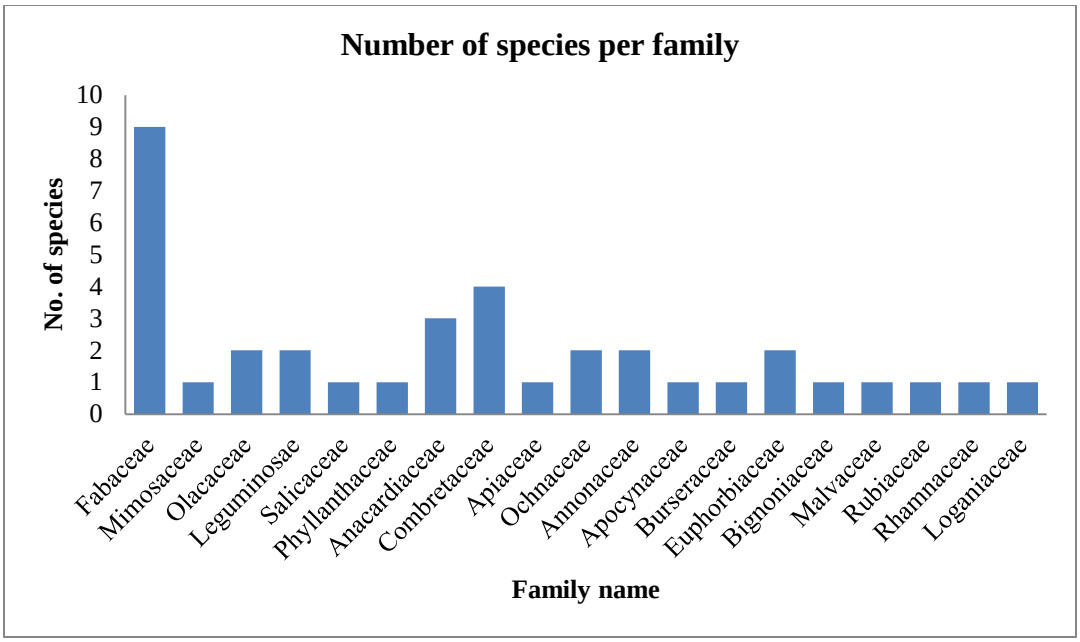


Figure 4.7: Number of Species per family.

Relative density, relative frequency and relative dominance varied among species. *Diplorynchus condylocarpon* had the highest relative density (7.53%) followed by *Bauhinia petersiana* (7.11%). In terms of Importance Value, *Diplorynchus condylocarpon* dominated (5.36%) the proposed project area, followed by *Combretum molle* (5.16%) whilst the *Flacourtia indica* (0.58%) has the lowest Importance value (see Table 4.8). The Importance value indicates the overall dominance of plant species over the study area. As such the higher the Importance Values, the more dominant the plant species is in terms of relative basal area, relative frequency and relative density. In this case, *Diplorhynchus condylocarpon* has higher relative basal area, relative frequency and relative density combined compared to *Flacourtia indica.* In terms of management, this information provides background information regarding the status of each species on the proposed site.

The observed species and families are typical of Miombo woodland species although the dominant species are the Miombo woodland canopy species. The dominant species namely *Bauhinia petersiana, Diplorynchus condylocarpon, Combretum molle* and *Albizia antunesiana* are Chipya Ecological group. These Chipya Ecological species, according to Lawton (1978), belong to the ecological group which is composed of species that grow in habitats where dry season fires are intense. This is because the proposed project area is a modified habitat that is in its early stage of the woodland recovery from previous disturbances. The available baseline gathered shows that the proposed Project site does not have flora of biological importance.

Table 4.8: Species dominance and composition over the proposed project area				
Species	**Relative Density**	**Relative Frequency**	**Relative Dominance**	**Importance Value**
Bauhinia petersiana	7.11	6.38	1.58	**5.02**
Dichrostachs cinerea	0.84	2.13	1.25	1.41
Julbernadia globiflora	3.77	2.13	1.16	2.35
Ximenia americana	1.67	3.19	1.89	2.25
Pericopsis angolensis	0.42	1.06	0.32	0.60
Flacourtia indica	0.42	1.06	0.27	0.58
Pseudolachnostylis maprouneifolia	0.84	2.13	1.72	1.56
Ozoroa reticulata	5.02	4.26	2.36	3.88
Combretum zeyheri	0.84	1.06	0.36	0.75
Steganotaenia araliacea	3.77	3.19	2.29	3.08
Combretum molle	7.11	6.38	1.98	**5.16**
Brachystegia spiciformis	2.09	1.06	3.84	2.33
Albizia antunesiana	5.02	5.32	2.93	**4.42**
Ochna pulchra	2.93	5.32	1.75	3.33
Julbernadia paniculata	0.42	1.06	3.11	1.53
Lannea discolor	1.67	3.19	2.19	2.35
Hexalobus monopetalus	1.26	1.06	2.03	1.45
Terminalia sericea	2.51	3.19	3.24	2.98
Diplorynchus condylocarpon	7.53	6.38	2.18	**5.36**
Commiphora mollis	1.26	1.06	7.73	3.35
Friesodielsia obovata	1.67	1.06	1.57	1.44
Rhus longipes	2.93	4.26	2.98	3.39
Ochna spp	0.84	2.13	3.23	2.07
Brachystegia utilis	4.18	3.19	1.10	2.82
Bridelia macrantha	0.42	1.06	1.66	1.05

Table 4.8: Species dominance and composition over the proposed project area				
Species	**Relative Density**	**Relative Frequency**	**Relative Dominance**	**Importance Value**
Burkea africana	3.35	4.26	2.50	3.37
Swartzia madagascariensis	3.77	4.26	4.37	4.13
Hymenocardia acida	5.02	3.19	2.61	3.61
Markhamia obtusifolia	0.84	1.06	5.11	2.34
Sterculia quinqueloba	0.84	2.13	5.11	2.69
Canthium spp	0.42	1.06	6.18	2.56
Brachystegia boehmii	0.84	1.06	1.96	1.29
Brachystegia longifolia	7.11	4.26	2.39	4.58
Combretum collinum	4.18	2.13	3.90	3.40
Zizyphus abbysinica	5.86	2.13	3.89	3.96
Strychnos spinosa	0.42	1.06	5.11	2.20
Olax obtusifolia	0.84	1.06	2.16	1.35

Photo 4.5: Typical vegetation found at the project site.

Photo 4.6: Tall grass, shrubs and scattered regenerating tress found on site

Fauna species

The reviewed data also indicates that cobras, black mambas, puff adders and common lizards are some of the terrestrial fauna of the local area and the project site (ZEMA, 2014; DH, 2014; WSP | Parsons Brinkerhoff, 2015). In terms of small mammals found in the area,

the common ones are bush mice and rabbits whilst insects such as ants and termites dominate the area. The proposed Project site borders the Lusaka Game Park on its southern end.

A site specific survey of the project site undertaken by Knight Piesold Zambia in April 2016 also confirmed that proposed project area has a variety of fauna species namely; mammals, reptiles and avifauna. The commonest spotted mammals over the project area are shown in Table 4.9. The animals observed over the proposed project area are mainly of Least Concern (IUCN Red List Database).

Table 4.9: Mammals occasionally sighted around the project area/open areas

Common name	Scientific name	IUCN Status
Common duicker	*Sylvicapra grimmia*	Least concern
Greater Cane Rat	*Thryonomys swinderianus*	Least concern
Scrub hare	*Lepus saxatilis*	Least concern
Cape hare	*Lepus capensis*	Least concern
African civet	*Civettictis civetta*	Least concern
Tree Squirrel	*Paraxerus cepapi*	Least concern
African wild cat	*Felis lybica*	unknown
African savanna hare	*Lepus microtis*	Least concern
Southern Giant Pouched Rat	*Cricetomys ansorgei*	Least concern

Photo 4.7: Droppings of a common duicker observed on site

Photo 4.8: Mould of burrowing mammal (mole) found on site

Photo 4.9: One of the insects found onsite on the tarred Access Road to Lusaka National Park

Photo 4.10: Birds are also found on site

Reptiles are also observed across the project area (Table 4.10), although most of the observed species are neither rare nor endangered. They are mainly of least concern.

Table 4.10: Common reptiles around the project site

Common Name	Scientific Name	IUCN Status
Flap-necked chameleon	*Chameoleo dilepis*	Least concern
Black-necked spitting Cobra	*Naja nigricollis*	Least concern
Nile monitor lizard	*Varanus niloticus*	Least concern
Southern African python	*Python natalensis*	Unknown
Twig snake	*Thelotornis capensis capensis*	Unknown
Puff adder	*Bitis orientans*	Unknown
Spotted bush snake	*Philothamnus semivariegatus*	Unknown

The site specific survey undertaken by Knight Piesold Zambia in April 2016 also confirmed that the proposed project area is rich in avifauna. A number of bird species are sited over the project area. In terms of the IUCN status, the observed species fall mainly in either the Least Concern category or the unknown category (Table 4.11). None of the species fall under either the threatened or the endangered category.

Table 4.11: Common avifauna species sighted around the project area		
Common name	**Scientific name**	**IUCN Status**
African scops- owl	*Otus senegalensis*	Least concern
Southern white faced owl	*Ptilopsis granti*	Least concern
Pied cuckoo	*Clamator jacobinus*	Least concern
Great spotted cuckoo	*Clamator glandarius*	Least concern
Common cuckoo	*Cuculus canorus*	Least concern
Lesser cuckoo	*Cuculus poliocephalus*	Least concern
Black coucal	*Centrapus grillii*	Unknown
Giant Kingfisher	*Ceryle maxima*	Unknown
Barteleur Eagle	*Terathiopius ecaudatus*	Unknown
Lilac breasted Roller	*Coracias caudate*	Unknown
Redbilled Teal	*Anas erythrohyncha*	Unknown
Cape Turtle Dove	*Streptpelia capicola*	Unknown
African Skimmer	*Rhynchops flavirostris*	Unknown
Red billed quelea	*Quelea quelea*	Least concern

The review of previous ecological reports cited above and site specific flora and fauna surveys conducted by Knight Piesold Zambia have revealed that there are no flora and fauna species that can be classified as rare, threatened or endemic to the area or that are of special scientific values.

The project site provides habitat to flora and fauna species identified at the project site. It is also considered as part of the recharge area for the Lusaka Dolomite Aquifer, an important source for groundwater supply for the City of Lusaka.

4.8 Archaeology and Cultural Heritage

Literature review, oral interviews and field transect techniques were used to carry out an archaeological / cultural heritage impact assessment of the project area. The methods were

used to investigate, identify and collect information of outstanding cultural heritage. Detailed description of the methods is presented in Appendix F.

A review of the previous data indicated that there are no known sites of archaeological, cultural or historical value near or within the vicinity of the project site. A site specific survey of the proposed project site for the Solar Project revealed that the area was part of protected Forest Reserve No. 26 and was surrounded by the Soli People. The Soli people are a Bantu speaking group which established their presence in the area following the period of historic migrations from Kola region, present Democratic Republic of Congo (DRC).

The Solar PV project site is within the LS MFEZ and bordered by Lusaka National Park on the southerly part. Beyond the National Park there are Mahopo, Shantumbu, Kakote, Mwachilenga, Chisompola Soli village communities. The project area is also in marginal proximity with the farms adjacent and beyond the Lusaka National Park to the south easterly direction. The inhabitants of these areas are mainly subsistence farmers and small scale business people. They also provide semi and unskilled labor. These people are peasant farmers. They grow a variety of crops which include cassava, maize, sweet potatoes, and bananas, among others. Gardening is another economic activity practiced by a few village communities within and around the project area.

The village communities are also involved in animal domestication. The animals kept include dogs and chickens. They too keep fowls, thus chickens, ducks.

However, it is important to indicate that both animal and plant husbandry practiced by the village communities of the project area is done at subsistence level rather than commercial.

Survey Characterization

Transects were made by a team of two pacers using pathways made by a geotechnical team along which their Ground Penetrating Radar Survey equipment, was being pulled. The distance between the pathways was between 3 to 5 metres apart. This increased the visibility against the tall grass and general vegetation. This mode of operation was maintained in examining the entire Project area for archaeological and cultural heritage sites.

Cleared pathways by the geo technical team

Opened up e*arth crust points within and around the project site examined for possible archaeological artifacts*

	
Opened up *earth crust points within and around the project site examined for possible archaeological artifacts*	Opened up e*arth crust points within and around the project site examined for possible archaeological artifacts*

As part of the archaeological and cultural heritage survey, geo technical test pits and artisanal slate mining openings were also given thorough strata examination to ascertain possible presence of ancient or recent archaeological remains. Other areas of exposed underground surfaces within and around the project site were examined for archaeological debitage. Transects were conducted in a mixture of parallel and intermittent zigzag movements.

Oral interviews were held with the traditional leadership in Soli village communities including Headman Shantumbu and other village leader, Headman Mwachilenga, Headman Chisompola and other traditional leaders in Mahopo and Kakote communities. Further oral interviews were held with the Representative of Her Royal Highness, Chieftainess Nkomesha Mukamambo II and who is also the Chairperson of the Soli annual traditional ceremony, Chakwela Makumbi, He is also Headman Kapuka. The interviews with the traditional leadership indicated and reiterated that the Scaling Solar Zambia project area was a Forest Reserve before it was degazetted for alternative use. The traditional leadership explained that the area is void of aspects cultural heritage of significance as it was never used for culturally important activities such as burial, shrines, or any intangible heritage processes. They unanimously indicted that villages surrounding the area had individual burial sites and that the project site was never settled on as it was a Forest reserve protected area, part of which later was turned into the Lusaka National Park. The local leadership in Shantumbu Village, however, indicated that the project site area was at times, with permission from the Forestry Department, accessible for specific activities such as firewood collection, grass and slate stone artisanal mining.

Other interviews conducted at Shantumbu Health Post whose catchment area stretches from Chifwema Village to Shantumbu also indicated that the proposed project site, in what used to be a Forest Reserve, was never used for cultural activities such as a burial site, shrines or any intangible heritage processes.

Further interviews with school authorities at Shantumbu Primary School and with National Parks and Wildlife Department Officers at Lusaka National Park revealed that the project area does not have any known archaeological or cultural sites of any heritage significance.

Therefore, the archaeological and cultural heritage survey conducted at the site shows that the project area did not host any archaeological and cultural heritage resources of

significance. The Representative of Her Royal Highness, Chieftainess Nkomesha Mukamambo II, Headman Kapuka confirmed that the site for the proposed Scaling Solar project was devoid of heritage resources of irreplaceable value to the Soli people. The Representative mentioned that some of the most important heritage sites for the Soli people as the Ancestral Ash Fire situated in Katuba area, and the historic caves situated in Nkomesha area. Both of them are not located at the project site.

4.9 Noise and Vibration

4.9.1 Noise

The project site is located within the periphery of the Lusaka City away from arterial roads, industries and dense residential areas. It is located within the LS MFEZ at the south eastern end of the zone. Currently, construction works associated with rock blasting at the ZESCO substation located at the centre of the site are the only major sources of noise. In addition, occasional traffic movement of vehicles along the tarred access roads leading to the substation and the Lusaka National Park are to a limited extent considered as sources of noise.

The areas within and around the project site considered as sensitive receptors include agricultural smallholdings located immediately to the East of the project site, the Lusaka National Park located immediately to the South of the site, NRB Pharma and LS MFEZ / IDC Offices located approximately over a kilometre to the North of the Project site. There are no hospitals, clinics and schools that could be considered as highly sensitive.

Baseline noise levels were monitored at selected points along the Project site boundary. Table 4.12 shows the noise levels recorded. Detailed methodology on noise level monitoring is presented in Appendix D. The noise levels recorded ranged between 32.4 Leq dBA to 50 Leq dBA. The highest level of 50 Leq dBA was recorded when there was intrusive noise from a bulldozer that was clearing land near the ZESCO substation under construction. Occasional traffic movements along the access roads leading to ZESCO substation and the Lusaka National Game Park entrance contributed to fluctuations in noise levels at the project site.

Intermittent blasting of rocks at the ZESCO substation construction site was also a source of noise. However, noise levels arising from any rock blasting incident at the substation was not recorded at the time of noise level monitoring at the project site.

The noise levels recorded around the boundary of the proposed Solar PV plant site reflect the typical values that are obtainable in a quiet place. An exception to this observation is when there is intrusive noise from nearby quarry operations especially during crushing operations and occasional noise from construction activities at ZESCO Substation. The quarry is not within the project site or even within the LS MFEZ. It will therefore not have impact on the Solar PV project. Most operational quarries in the broader project area outside of the LS MFEZ but considered to be relatively near to the site are located in Shantumbu Area, which is approximately 5-7 km south of the project site.

The noise levels measured at the proposed project site boundary are within with the IFC Noise levels guideline limits for day and night time levels. The project area is a relatively an isolated place and no major activities take place in the night. The day time results indicate that results in this area will be lower as there is still no active population and settlement near the project area. Offsite measurements in areas where there was more community activity

(Victory Bible Church, Woodlands Ash Lodge) did indicate that the noise levels even in current residential areas are below the IFC night time guideline limit.

There area to the North and West of the proposed site will be developed into an industrial park and residential areas. With further developments within the LS MFEZ, it is anticipated that noise levels in the area could be higher than the current background levels due to the cumulative impact from all other industrial activities within the zone at the peak of operation.

Table 4.12: Noise Level Monitoring at the Project Site						
Noise level Sampling Points	**Eastings**	**Northings**	**Date**	**Time**	**Day Time Leq dB(A)**	**Night Time Leq dBA**
A1	651888.00 mE	8283766.00 mS	21/4/2016	13:30	38.5	-
			22/4/2016	08:15	42.5	-
			23/4/2016	10:15	32.6	-
B	654038.00 mE	8284802.00 mS	22/4/2016	09:56	32.4	-
			22/4/2016	09:56	32.4	-
			23/4/2016	10:00	33.0	-
G3	654024.00 mE	8283681.00 mS	20/4/2016	17:15	34.9	-
			21/4/2016	11:30	35.3	-
			22/4/2016	12:17	30.4	-
ZESCO Substation (Bulldozer Working)	653176 mE	8292919 mS	22/4//2016		50	-
Victory Bible Church	0644894 mE	8290938 mS	21/4/2016	06:00	60	45
Woodlands Ash Guest House	643359 mE	8292919 mS	22/4/2016	05:00	38	38

Table 4.13: IFC Noise Level Guidelines		
	One Hour Leq (dBA)	
Receptor	**Daytime 07-22hrs**	**Night time 22-07hrs**
Residential; Institutional, educational	55	45
Industrial and Commercial	70	70

4.9.2 Vibration

Construction activity can result in ground vibrations of varying degrees depending on the type of construction method used. The construction equipment used at the site can cause ground vibration which spread through the ground and reduce with distance.

Sensitive areas such as buildings in close proximity to the construction site can respond to ground vibrations with varying results. The vibrations can be perceptible in varying degrees in buildings very close to the construction site. Old fragile buildings of historical significance can easily be damaged as a result of ground vibrations caused by construction equipment.

There are no old buildings of historical significance at the project site. The only sensitive areas identified that are close to the project site and that can be considered as vibration-sensitive areas are agricultural smallholdings located on the eastern boundary of the project site. The nearest buildings close to the site boundary are located within 40 – 100 metres.

As part of the study, baseline vibration readings were collected using a dataPAC 1500 vibration measuring instrument with an accelerometer mounted on the steel rod drilled into the ground. The vibration readings were collected at identified points on or near project site beacons and receptor areas of interest. Onsite calibration of the measuring equipment was performed using standard signal calibrators prior to collection of data. Table 4.13 below shows the baseline vibration readings recorded.

The readings in mm/s peak show that vibration levels ranged from 0.03 to 0.20 mm/s peak. This data shows that the baseline vibration levels were very low on and around the project site despite on-going construction activities at the ZESCO substation. Off-site vibrations are therefore not anticipated.

Table 4.14: Baseline Ground Vibration Readings Recorded				
Site	**Measurement Location**	**Coordinates**		**Baseline Vibration Reading in mm/s peak**
		Eastings	**Northings**	
Site 1A	A1	651888.00	8283766.00	0.07
Site 1A	B1	652699.00	8284152.00	0.09
Site 2	B	654038.00	8284802.00	0.03
Site 1B	P2	654037.00	8283979.00	0.16
Site 1B	G3	654024.00	8283681.00	0.2
Site 1B	A3	652798.00	8283728.00	0.04
Site 1B	D3	653223.00	8283927.00	0.08
Site 1B	P1	653198.00	8283991.00	0.04
ZESCO Substation	Z1	652810.72	8284108.75	0.04
ZESCO Substation	Z2	653080.04	8284238.60	-
ZESCO Substation	Z3	653206.00	8283967.00	-
Site 1A	E1	652775.00	8283687.00	0.03
Site 1A	C1	652717.00	8283835.00	0.08
Site 1A	D1	652738.00	8283728.00	0.06
Main Gate	NRB Pharma Zambia Ltd	653768.50	8285837.33	0.09
Main Gate	LS-MFEZ Offices	653545.83	8286124.10	0.15
East Gate	Lusaka National Park Gate	652789.02	8283645.56	0.05

4.10 Traffic and Road Infrastructure

The Project site is located on Chifwema Road, which is off Leopards Hill Road. Tarred access roads have been constructed as part of the LS MFEZ development. Traffic volume on the access roads and internal roads of the project area (LS MFEZ) are currently low. However, traffic volume is expected to increase at the peak of multiple construction and operation activities within the zone.

Transportation of material to site is expected to increase traffic volume on the road.

Communication

The surroundings of the study area are well covered and served by the local radio and television network. The site has good reception for the three mobile cell networks (Airtel, MTN and CellZ).

Typical Tarred Road within the LS MFEZ.

4.11 Socio-economic conditions of the Project Area

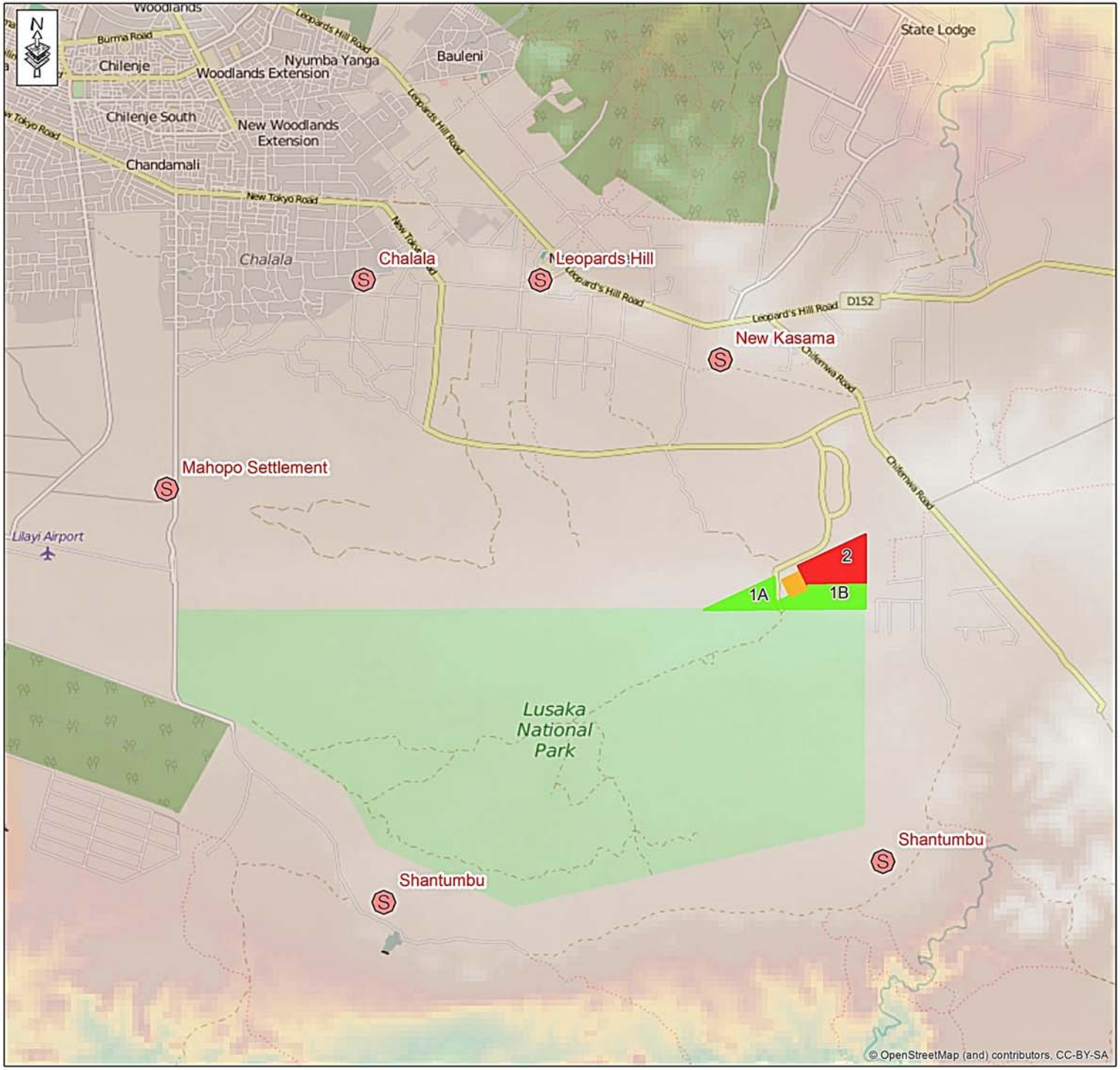
Baseline data collection for the social impact assessment involved desktop review of relevant documents including review of information on the project area. It also involved stakeholder mapping, key informant interviews and public consultations.

Public consultations were held in March 2016 as part of the overall ESIA process. Identified stakeholders were also directly engaged during the social baseline surveys to collect primary data undertaken in April 2016. The survey included a site visit to Mphande Forest Resettlement Area where some people previously living and farming in the LS MFEZ area, when it was still gazetted as a forest reserve, have been resettled.

Key informant interviews were also held with key local community members encountered during the baseline survey.

The scope of the social impact assessment included areas in the vicinity surrounding the LS MFEZ. These are Mahopo and Shantumbu Villages, Leopards Hills, Chalala and New Kasama residents and the farming community in New Kasama bordering the eastern end of the proposed project site. Figure 4.8 shows the indicative location of some areas.

This subsection presents a summary of the socio-economic baseline conditions of the project area. Appendix G includes the social impact assessment report. The report also covers a review of resettlement process implemented at Mphande Forest 320 Resettlement area during the time of creating the LS MFEZ.



Legend:

- Settlements

SITES

- Site 1
- Site 2
- ZESCO

Projection: UTM 35South on WGS84

0 500 1 000 2 000 3 000 4 000 Meters

Proposed LS-MFEZ Solar PV Sites Surrounding Settlements

Knight Piésold CONSULTING

302-00332-01	June 2016

Figure 4.8: Location of Mahopo, Shantumbu, Chalala, New Kasama and other areas in the vicinity of the project sites.

4.11.1 Current land use of the LS MFEZ

The LS-MFEZ has a total area of 2100 hectares that has been zoned into industrial, commercial, research and development, and housing. It is a public sector development that has been set up to promote manufacturing and to promote export activities, technological development and wealth creation. There are currently few industries and infrastructure under development / construction within the zone.

4.11.2 Population and Area of Influence of the proposed project

The population in the immediate vicinity surrounding the LS-MFEZ includes residents of Mahopo and Shantumbu Villages, Leopards Hills, Chalala and New Kasama residents and the farming community in New Kasama bordering the eastern end of the proposed project site. The population is not known currently as there are no readily available official census data on the surrounding communities.

The area of influence of the proposed Scaling Solar Project extends to these surrounding communities who are likely to benefit from the power supply and also the job opportunities that may arise during the construction and operational phases of the project. Households in Leopards Hill, New Kasama and Chalala residential areas are connected to the national grid while a number of households in Mahopo and Shantumbu Villages have limited access to electricity. All the households with ZESCO power supply have access to electricity through connection to the national grid. The benefits the surrounding communities and businesses/facilities connected to the national grid will derive from the proposed Scaling Solar PV project will be associated with reduced load shedding during peak hours and stable supply of electricity.

4.11.3 Socio-economic and culture

Shantumbu Village

Shantumbu village falls under the traditional leadership of Chieftainess Mukamambo Nkomeshya of the Soil people. It is located about 5-7 km to the South and Southwest of the project site. Many people from Shantumbu village used Forest No. 26 to farm and produce charcoal for sale. The village is divided into 11 Zones with each Zone being headed a Headman. Zone 10 is centrally located and has an estimated population of 480 people. It is headed by Headman Shantumbu. Land within the village is under customary tenure.

The village is predominantly inhabited by the Soli speaking tribe, one of the many ethnic groups found in Zambia. Other tribal groups found in the village are Lenje, Tonga and Bemba. The Soli people practice the ‘Chikwela Makumbi” tradition ceremony. It is an important cultural activity by the Soli held in October to pray for rain. The ceremony is held at Chieftainess Mukambo Nkomeshya’s palace in Chongwe. There are no people in Shantumbu Village referred to as indigenous people. Different ethnic groups are found in the village.

A large majority of households in the village are subsistence farmers growing maize as the main crop in fields surrounding their villages. Other crops grown are beans, sweet potatoes and groundnuts. Some people are involved in charcoal production. Livestock such as cattle, goats, pigs and chickens are also reared.

Currently quarrying and mining for construction material is done on a large scale in Shantumbu by 4 companies quarrying for construction material used for road construction and block making. These are Avic, Joint Mining Limited, Skyways and Luhlang Stone Mining Company Limited. The companies employ people mainly from other settlements in Lusaka such as Bauleni, Chazanga, Chilenje, Chipata Compound and Chilanga. Artisanal quarrying of building material is also common among the local residents as a source of livelihood. Slate is sold for K130 per tonne whereas crushed stones are sold at K50 per tonne.

The only education facility in Shantumbu Village is Shantumbu Primary, which was originally established in 1958 as mission school. The school has pupils attending Grades One to Nine classes. The school has electricity and water, which is supplied directly from a borehole. There is no overhead storage tank. In terms enrolment, Shantumbu Primary has total of 610 pupils enrolled with 22 serving teachers. The school fee charged per pupil is K520 per year.

The pupils proceeding to Grade 10 attend senior secondary school either in Lilayi which is about 4 kilometres away or Kamwala, located about 12 kilometres away. As many parents whose children progress to Grade 10 cannot afford boarding fees, many children dropout of school. Absenteeism is a common problem among pupils. This is mainly due to long distances that pupils have to walk to attend school. The dropout rate for girls is estimated to be 70% due to teenage pregnancies and early marriages. The pass rates are low. For example, in 2015 the progression rate from Grade 9 to Grade 10 was 42%.

Shantumbu Primary School

Chisankane RHC Shantumbu

Health Facilities

The people in Shantumbu Village have access to basic preventive and curative services offered at Chisankane Rural Health Centre. The health services offered are shown in Table 4.14 below. A total head count of people serviced from the health centre in 2015 was 8,342 people (Source: Chisankane Rural Health Centre, 2015). The catchment population increased to 9,732 people from 22 villages in 2016.

Table 4.14: Health Services Offered	
Health Service	**Frequency**
1. Out-patient care	Daily
2. Deliveries	Daily
3. Ante-natal Care	Tuesdays 1st Booking & Thursdays Re-attendance
4. Family Planning	Fridays
5. Voluntary Counselling and Testing	Monday – Friday
6. Growth Monitoring and Nutrition	Mondays
7. Youth Friendly Services	Monday – Friday
8. Anti-Retroviral Treatment	Wednesdays
9. Tuberculosis	Daily

Source: Chisankane RHC, 2016

Water Supply and Sanitation

Water supply is from boreholes and shallow wells. The school and the clinic are supplied with water from boreholes installed within their respective premises. Some households have either boreholes or shallow wells from where draw their potable water. In terms sanitation services, many households in Shantumbu Village use pit latrines.

Mahopo Village

Mahopo village derives its name from the settlement's past history of selling piles of firewood (Mahopo) along the Shantumbu Road to the surrounding residents of Chilenje, Kamwala, Libala and Woodlands. It is located about 9 km to the west of the project site. The village has an estimated 370 households. The village character of the settlement is slowly being transformed with the construction of permanent house structures of brick and mortar with iron roofing. The settlement is becoming a true extension of Chalala.

For livelihood and economic activities, some residents of Mahopo Village are engaged in formal employment. The majority of the people are employed as causal workers in the surrounding farms while others are involved in trading in vegetables, eggs, chickens and other farm produce sourced from the surrounding farms. Artisanal mining for crushed stones and slate for construction is also an important economic activity in the area.

Education Facilities - Mahopo

Mahopo Settlement is served by Mahopo Community School. The school is a 1 X 3 Classroom Block constructed with the assistance of the Japanese Embassy in Zambia. The school was officially handed over to the Community on 11 December 2015. It has 500 pupils enrolled in Grades One to Five. Pupils proceeding to Grade 6 and above will attend nearby schools in Chilenje and Kamwala South located 6km away. The School currently has 5 teachers, 3 of whom are female. There is no library facility at the School.

Health Facilities - Mahopo

Mahopo settlement has a new clinic constructed in 2016. The clinic has not been commissioned into operation.

Mahopo Community School

Mahopo Health Centre

Water Supply and Sanitation at Mahopo Settlement

Water supply within Mahopo Settlement is currently from 6 boreholes located within the area. From a total number of 6 boreholes within the settlement, two are located at Mahopo Community School and Mahopo Clinic respectively. With regard to sanitation services provision, new houses that are being constructed have individual toilets served by soak-aways while the older village type houses have pit latrines.

Chalala Residential Area

Chalala area is a medium cost residential area. It is a conurbation of Kamwala South. It is located about 6 km to the Northwest of the proposed project site. The area is characterized by a high density of middle-income housing estates. The residential plots are not serviced by municipal water supply and sanitation. Individual boreholes and septic tanks are a common phenomenon. Most of the residents are employed in the civil service. Others manage private business enterprises.

One of the Lusaka inner roads that terminate on the north-western boundary of LS MFEZ passes alongside the eastern and northern extents of Chalala Residential Area. Potential increase in traffic during the construction phase of the project can potentially bring up issues of road safety to the residents.

Leopards Hill & New Kasama Residential Areas

Leopards Hill and New Kasama residential areas are located on and around Leopards Hill Road, one of the main roads leading to the project site. The nearest residential houses are located about 2 km North of the project site while the nearest agricultural holdings in New Kasama are located within a kilometre. These areas have mixed land use types and comprise smallholding and large farms with plush residences. They are inhabited by affluent Zambians and different nationalities, mainly expatriate personnel.

There are a number of business entities and large farms in these areas. The notable ones among these include Zambezi Private Game Reserve, Bangweulu Taxidermy, Leopards Hill Polocrosse Club, Veterinary Surgery, J Lazy J Ranch Stables & Sanctuary, Kyindu Ranch and Trees 4 Zambia.

Bangweulu Taxidermy

Zambezi Private Game Reserve

There are also noticeable trading activities on stalls (locally known as *Tuntemba*) along the Chifwema Road which leads to the project site. These stalls numbering 20 are located on a farm bordering the LS-MFEZ. The traders construct these stalls and pay K50 rent per month to the farm owner. Goods sold in these stalls include farm produce such as eggs, vegetables; foodstuffs such as cooking oil, sugar, bread and second-hand clothing.

Tuntemba on Chifewema Road leading to LS-MFEZ.

Tuntemba on Chifewema Road leading to LS-MFEZ.

Education Facilities and associations in Leopards Hills and New Kasama Residential Areas

American International School

The American International School of Lusaka (AIS) located on Leopards Hill is an elite private education facility. It caters for children of expatriates and wealthy Zambian nationals who can afford to pay as much as $6500 per term. The school is organized into two sections, namely, Primary (3 – 10 years) and Secondary (11 – 18 years). The Secondary Grades are based on the International Baccalaureate Middle Years program.

State Lodge Primary School

The State Lodge Primary School is a government education facility. It is accessed by pupils from surrounding farm areas of New Kasama / Leopards Hill Road area, and the State Lodge Police Camp. It is located north of the LS MFEZ about 6 km from the economic zone.

Naledi School

Naledi is a private school, situated along Leopard Hill Road, Opposite the American International School of Lusaka. It is both boarding and day school for both sexes. It is currently running from Grade 1 to 10. Naledi is a Christian school founded and run on Adventist Principles.

Leopards Hill Neighbourhood Watch Association

The Leopards Hill Neighbourhood Watch (LHNWA) is a community initiative that operates in the area in collaboration with the Zambia Police Service. LHNWA was formed and legally registered in the 1990's as a community response to a sharp upsurge in violent crime in the neighbourhood. The Association was formed with the sole purpose of deterring violent crime. It is a rapid, armed response and follow-up service. Membership is drawn from the surrounding farms of New Kasama/Leopards Hill area. The association's catchment area stretches from Trotover area to nearly 8 km down Chifwema Road, and around 10 km down Leopards Hill to the Palabana area.

Chifwema Settlement

Chifwema Settlement falls under Kafue District and is located about 18 km from the LS-MFEZ. The population in the area is mainly involved in subsistence farming. The main food crop grown is maize. It is likely that some of the unskilled workforce will be drawn from this settlement.

The education facilities within the settlement include Nachitete and Chifwema Primary Schools. The Nachitete Community School is a single block facility located in the precincts of a mosque. Chifwema Primary School, which started as a Community School but was taken over by the Zambian Government in 2014, is a 1 X 2 classroom block facility with 2 staff houses. The head teacher bemoaned the inadequacy of learning facilities and teaching materials. The School runs Grades One to Nine classes and has an enrolled population of 603 pupils. Water supply to the school is from a borehole and tank provided by ZAMTEL in partnership with Huawei.

	
Nachitete Community School behind Mosque	Chifwema Primary School

Health Facilities

The area has two health centres within Chifwema Settlement. There is the Andy Health Centre at Chifwema constructed in 2010 by Bread & Water for Africa in collaboration with Kabwata Orphanage and Transit Centre. The Health Centre is currently not operational, as it has not been handed over to the Ministry of Health, which is responsible for providing staff to run the health facility. There is also another Health Centre at Nachitete.

	
Addy Health Centre at Chifwema	Health Centre at Nachitete

The social baseline conditions of Shantumbu, Mahopo and Chifwema settlements indicate that the areas have limited sources of livelihood activities, inadequate schools and associated facilities such as library facilities, learning facilities and teaching materials, inadequate health facilities inadequate water supply and sanitation services.

Prior to establishment of the LS MFEZ, the local communities in Shantumbu and Mahopo settlements derived some ecosystem services from the Forest. These are cropland, firewood, charcoal production and other non-timber forest resources. The establishment of the LS MFEZ precluded the communities from accessing these ecosystem services they had

greatly relied on for their livelihoods. These negative impacts of dislocation of livelihood activities in Local Forest Reserve 26 and the subsequent resettlement of some households were identified in the Strategic Environmental Assessment that was conducted for the LS MFEZ by ZEMA (ZEMA, 2014). The Disaster Management and Mitigation Unit was engaged in collaboration with other stakeholders to compile a register of those that were affected by the displacement and resettlement and compensation was paid accordingly.

Therefore, the Solar PV project is not responsible for the negative social impacts arising from the resettlement that took place when the LS MFEZ was being established. This is because the resettlement impacts were not as a consequence of the proposed Solar PV Project but as a result of the creation of the LS MFEZ.

There are no human settlements within the actual project footprint for the proposed Solar PV project. The project site is within the LS MFEZ area, which is already fenced. Access to the LS MFEZ is controlled through security gates and the surrounding communities do not use the project site to access ecosystem services or natural resources they were dependent on. Therefore, the project will not affect communities' and households' access to ecosystem services and natural resources and it will not result in loss of access to pasture, fruit trees, medicinal plants, fiber, firewood, and other non-timber forest resources, croplands, fallow lands, etc.

4.12 Resettlement Issues relating to LS MFEZ

Historical land use relating to the current LS MFEZ area is outlined in Section 4.6 of this report. The LS MFEZ area was part of Local Forest Reserve No. 26 prior to being declared a Multi-Facility Economic Zone in 2010. The resettlement issues for people who were living and farming in Forest No. 26 are outlined in the subsections that follow.

Resettlement Issues

There were two categories of people resettled as a result of the establishment of the Lusaka South Multi-Facility Economic Zone (MFEZ). The first category concerned those that were resettled after the listing and screening facilitated by a number of stakeholders coordinated by the Disaster Management and Mitigation Unit (DMMU). The second category concerned people that claimed through the District Commissioner's Office that they were left out of the initial listing and screening exercise conducted by DMMU and other stakeholders.

Because of the two categories of people, two separate resettlement processes have been followed. The resettlement of the first category of people (Resettlement 1) was handled by DMMU while the resettlement of the second category of people (Resettlement 2) was handled by the Office of the District Commissioner. The resettlement timeline is presented in Table 4.15.

4.12.1 Resettlement 1:

The listing and screening exercise for those living and farming in Forest No. 26 was undertaken by DMMU in 2012 (DMMU, 2012) with the participation of the following:

- Office of the President – Special Division;
- Department of Resettlement (DoR);
- Ministry of Lands- Survey Department;
- Ministry of Agriculture and Livestock;

- Department of Forestry;
- Lusaka City Council(LCC);
- Civic Forum on Housing and Habitat.

Representatives / leaders from political groups, farmer associations that were based in the forest area and other groups that had a presence in the area were also involved in the survey and assessment of the area.

The listing and screening exercise for affected people that were living and farming in Forest No. 26 was undertaken by carrying out surveys in the area to determine:

- Population, Household Size and Composition of the affected people;
- Demographics of the Population living in the forestry;
- Livelihoods of the affected people;
- Origin of the People and Reasons for Settling in Forestry No. 26;
- Asset Base of the People living in the area (livestock, farming implements and other assets);
- Farming fields owned; and
- Housing Structures and other infrastructure.

The listing and screening exercise was also carried out to recommend to government the way forward for the affected people (DMMU, 2012).

The resettlement assessment report prepared by DMMU indicates that out of the 962 households only 247 households (1221 people) resided and farmed in the forest area. These people lived in houses that were made from mud and pole with most of them having grass thatched roofs. The people started settling in the forest as early as 1974. Some were seasonal farmers who only had fields where they grew crops mainly maize. These seasonal farmers came from nearby compounds such as Bauleni, Chilenje and as far as Kalingalinga, Mtendere and Chawama Township.

The resettlement assessment report recommended the following measures:

Option 1: *Those people who are willing to be resettled in any land that the government would find.*

These would be resettled following the relocation plan. In the relocation plan, the following issues would be considered:

Short term

- *Land Identification* - This would determine the size of the land per household to be allocated. The Department of Resettlement would spearhead this:
- *Provision of Tentage* – The people to be resettled would require tentage before they built their own housing units. A total of 488 tents would be required for a population of 1221 people.

- *Provision of agricultural inputs for farming for the first farming season.* Since the peoples' livelihood would be disturbed the government would consider provision of agricultural inputs for households to be resettled for the next farming season (2012/13 season).

Medium to Long term

- *Planned settlement* - The people to be relocated would be resettled in a planned settlement that should have:
    - Access Roads
    - Clean Drinking Water
    - Health Services
    - Education Services

Option 2

Those who were living in the forest and had not opted to be resettled by government be compensated with cash according to the Budget for Relocation plan and summary cost estimates for the Settlers of Forestry 26.

- Compensating for structures would not arise as most of the units were made from mud and pole with most of them having grass thatched roofs.
- Compensating the people that farm in the area but did not live there be based on valuation of the seasonal maize crop based on the value of the standing crop at harvest, determined by the average current market price of maize.
- Sensitization meetings be conducted in the area to prepare people for relocation. This would be done in conjunction with the NGO that the community had been working with.

Of all the 247 households affected by the displacements from MFEZ, only 32 households chose to be resettled. Subsequently DMMU resettled 15 households in Kanchibiya Resettlement Scheme in Mpika District in Muchinga Province. These households were allocated 5 hectares of land. The other 15 households were taken to Milenge District in Luapula Province and resettled in Milambo Resettlement Scheme. These were allocated 10 hectares of land. The remaining 2 households taken to Lukulu District in Western Province were resettled in Dongwe Resettlement Scheme and were allocated 25 hectares. These households were repatriated on 16 October 2013.

In addition to cash compensation for their crops, the resettled households were given tents for temporal shelter food (1 x 50kg beans, 5 kg packet of salt and 20 litre of cooking oil) to last them 7 months. One bag of mealie meal was to be given to them for three months up to December 2013 thereafter maize grain was going to be provided to last them up to April 2014. They were also provided with farming inputs to assist them to re-establish their farming livelihoods. These inputs were provided according to the guidelines of the Farmer Input Support Programme - 2 x 50kg bags of D-Compound, 2 x 50kg bags of Urea, 1 x 10kg bag of Maize seed and 1 x 5kg bag of Sugar Beans.

The remaining 215 households who lived and farmed in Forest 26 and had not opted for resettlements were paid cash compensation. This compensation was based on the valuation of the seasonal maize crop at harvest determined by the average market maize price.

An additional 20 households who claimed they had been missed by the initial listing and screening were also resettled in Kanchibiya Resettlement Scheme in Mpika on 5 hectare land. This group was repatriated on 27 July 2014. Each household was given one-off provision of tents for temporal shelter, 2 x 50kg of mealie meal, 1 x 50 kg bag of beans, 5 kg packet of salt and 20 litres of cooking oil.

The remaining 715 households who only farmed in Forest 26 but lived in other parts of Lusaka such as, Bauleni, Mtendere and Chilenje were not compensated for fear of opening up more claims to prospective speculators.

4.12.2 Resettlement 2

The table below presents the resettlement timeline.

Table 4.15: Resettlement Timeline

Year	Activity
2010	Lusaka South Multi-Facility Economic Zone established by Statutory Instrument No. 47 of 2010
2010	Lusaka City Council engaged by the Zambia Development Agency to conduct a survey of people living or farming in Forest 26 and identifies 649 people
2012	DMMU Screening exercise identifies 247 households living and farming in the MFEZ area to be resettled and/or compensated
2013	32 households repatriated to Kanchibiya, Milenge and Dongwe Resettlement Schemes by DMMU.
2013/14	An additional 295 households request the Office of the District Commissioner to consider resettling them stating they were also affected by establishment of Lusaka South MFEZ.
2014	Additional 20 households resettled in Kanchibiya Resettlement Scheme by DMMU
2015	2,000 hectares of the Mphande Forest 320 degazatted to pave way for resettlement
2015	Relocation of 295 households to Mphande Forest carried out from 28 November to 31 November through Office of District Commissioner.
2016	On 8 April 2016, the 295 households provided with 8 IRB Iron Sheets and 1 x 50kg bag of maize

Mphande Forest 320 Resettlement Area

The Mphande Forest 320 was encroached in the late 1970s. It was a camp for charcoal producers from Kafue and Chipapa for over 20 years. Over the years the local population

has been cultivating in the forest area which has been degraded. The host population is currently an estimated 100 households. As the forest was progressively degraded people moved from one part of the forest to another in search of mature trees for their charcoal production.

After it emerged that a group of 295 households may not have been captured by the cut-off date of screening conducted by DMMU and other stakeholders, the affected households appealed to the Office of the District Commissioner for alternative land for their resettlement. The available information indicates that the process of identifying alternative land took nearly two years. In 2015 a total of 2,000 hectares of the Mphande Forest was degazatted and these households were resettled from 28 November to 31 November 2016. However, the land were the affected households have been resettled has not yet been demarcated into 5 hectare plots to be allotted to each household. The households resettled in the area claim that they have had no other assistance since being moved there except for the 8 IRB roofing sheets given to each household on 8 April 2016 and 1 X 50kg bag of maize given on 11 April 2016.

Welfare Facilities – Mphande Resettled Community

There are no education or health facilities near the resettlement area. These facilities are accessed at Kazioneli Clinic and Chipapa Primary and Secondary School located about 15km away from the Mphande Resettled Community. There is one hand pump which was installed by World Vision Zambia through their Chipapa Area Development Programme. The hand pump is located 2 km from the settlement.

Mphande Forest Community Leaders

Some members of the Mphande Forest Community

Borehole provided by World Vision in the Host Community.

The social baseline survey of the Mphande Forest Community has revealed that the area has no basic facilities such as water supply, education facilities and health services. They also have limited employment opportunities to improve or at least restore their livelihoods and standards of living.

5 Impact Assessment

5.1 Introduction

This section summarises the impact assessment presented in the specialist reports appended in Volume 3 of the ESIA document. It summaries impacts on the following topics:

- Soils and Geology (Appendix C);
- Hydrology and Hydrogeology (Appendix B);
- Air Quality and Noise (Appendix D)
- Biodiversity (Appendix E)
- Archaeology and cultural heritage (Appendix F)
- Social Impact Assessment (Appendix G)
- Occupational Health and Safety
- Community Health, Safety and Security.

5.2 Landscape and Visual Amenity

The proposed site is generally flat characterised with dolomite rock outcrops in places. It is surrounded by agriculture holdings on the East and the Lusaka National Park on the South. The tarred road that cuts across the project area to the entrance gate of Lusaka National Park also forms the northern perimeter boundary of the project site.

The potential impact associated with the project on landscape and visual amenity is the creation of visual intrusion and disruption to aesthetic quality and light reflectivity from the solar module surfaces arising from the clearing of the project site (construction phase) and installation of solar PV modules (operation phase). The project site has some regenerating vegetative cover. Therefore, clearing of vegetation on-site will create a visual intrusion and disruption to aesthetic quality. The proposed solar PV installations will be no taller than 2-3 metres above ground level and as such there will be limited visibility of the project site from the surrounding area, aided by existing screening from vegetation / hedgerows surrounding the project site and the generally flat topography of the surrounding area. In addition, light reflectivity (glare) is not likely to constitute a major risk on sensitive receptors because of the existing screening from vegetation.

The potential impacts on landscape and visual amenity relating to visual intrusion and disruption of aesthetics arising from site clearing and installation of solar PV modules are considered to be negative, indirect and localised in nature. The duration the impact is predicted to be long term while the impact magnitude is low. It is probable the impact would occur. The sensitivity of the receptors of the visual character of the landscape following installation of the solar modules is considered to be medium. The overall significance of the impact is considered to be minor.

Aviation operations can also be potentially affected by light reflectivity (glare) of solar modules' surfaces. The proposed solar PV modules are designed to absorb sunlight to enable generation of the electrical energy. This will result in minimal reflection to interfere with aircraft navigation. The residual solar reflection from the proposed solar modules has

been shown to be comparable to those from the leaves of plants. The overall significance of the impact of the project on aviation in terms of reflectivity is therefore considered to be minor.

Mitigation Measures

Potential Landscape and visual impacts will be mitigated by:

- Use of low level solar module mount design system (2 - 3 metres) that will not disrupt the aesthetic view of the project /surrounding areas;
- Leaving a perimeter buffer of trees and grass vegetation along the boundaries to screen sensitive viewing areas such as sides of the road to the Lusaka National Park entrance gate and the area along the eastern boundary area where there are some agriculture holdings; and
- Use of low visual reflective solar modules with anti-reflective coating (ARC) that reduces reflectance from the solar PV modules.

Landscape and visual impacts from the proposed project are minimal with the identified impact being site specific in nature and of low magnitude. Therefore, although landscape and visual impacts will arise from undertaking the project; with the implementation of the recommended mitigation measures, the potential impacts will be insignificant in nature. In addition, the significance of the potential impacts anticipated on aviation is considered to be minor. With implementation of the proposed mitigation measures, the significance of the mitigated impacts on aviation will be very low to negligible.

5.3 Soils and Geology

Appendix C presents detailed explanation of the geology of the project area and highlights the geotechnical issues that may present risks with project implementation. It also presents detailed assessment of the impacts and risks of the project.

The assessment covers the site specific geological conditions and associated impacts and risks that may arise on the proposed project. It assesses the risks of the project based geological formation and geotechnical aspects of the project site. A detailed methodology used to establish the baseline geological conditions of the specific project site is presented in Appendix C.

Predicted impacts

The proposed project will not, in geological terms, have any direct or indirect impacts to the geological environment. However, there are a few geological situations related to secondary negative impacts that may arise at construction stage (short term) and during the operation phase of the project (long term). There are no anticipated negative or positive geological impacts at decommissioning stage.

The short term and long term secondary negative impacts are assessed further in the subsections below:

Construction Phase

Short term negative impact

The anticipated negative impacts at construction stage are associated with exposure of the rock, soil and rock breaking cavities during excavations. Most secondary negative impacts will likely occur during construction on short term basis. These secondary negative impacts relate to the following:

- Generation of fugitive dust during leveling of the surface and excavation of foundation pits in dry season; the duration of impacts associated with fugitive dust generation will be short term and localized. Its frequency will be periodic during construction and it is likely the impact will occur.
- Slippery ground during rainy season due to wetting of the soil (clay).
- Irregular soil profile that may cause foundation construction problems.
- Floating rock boulders in subsoil that may impact negatively on foundation designs.
- Noise from rock blasting – noise to the environment during construction. Rammed piles (with or without predrilling), with possible use of concrete when required, will also be used during construction works.
- Sinkholes – unidentified sinkholes may pose a danger to workers during and after construction.

Operational Phase

Long term impacts on the project infrastructure

The secondary long term negative impacts will be on the stability of infrastructure foundations in areas where continued rock weathering, dissolution and leaching takes place. Weathering though is a minor negative impact as the rate of weathering in geologic terms is very slow. The impact may never be felt if the project life span is only 25 years. This impact will only occur if there is no good drainage constructed in and around the solar farm area.

The anticipated long term (Operation stage) secondary negative impacts include the following:

- **Rock weathering** - may cause infrastructure instability over a long period of time
- **Sinkholes** – risk of sinkholes later after construction can lead to stability problems and safety to people working in the area
- **Floating rock boulders in sub soil**; risk from continued weathering of rock may pose infrastructure instability
- **Underground caverns in base rock formation** - if not picked during investigation can cause a risk to the stability of infrastructure foundations
- Underground stream in subsurface Limestone rock formations have the potential to undermine structure foundations.

Impacts on Land and Soil

Clearing of existing site vegetation and scarifying of topsoil together with compaction during site preparation and levelling will reduce the grounds ability to retain water. This is likely to increase surface run-off during periods of rainfall and lead to soil erosion especially in

exposed places were subsoils will be destabilised by construction activities. This will be limited to some extent because of the generally flat topography at the site.

Mitigation measures

- Fugitive Dust - This is likely to occur during construction phase (Short term) especially when construction activities are carried out in the dry months. The effect will be on the health of workers and on the environment (sensitivity –high). Water bowsers will be used to suppress dust generation.
- Irregular soil profile – this is a risk / impact during the construction phase (short term) and can result in unstable foundations (sensitivity - high). Detailed mapping of the subsurface will mitigate the risk. Specific and detailed geotechnical investigations for foundation design should be undertaken.
- Noise from rock blasting – Noise disturbance is likely to occur during the construction phase and could negatively affect noise sensitive receptors. Residual vibration is likely to occur as well (sensitivity – medium to low). The use of low density blast charges, if required, will mitigate the noise and residual vibration to the surrounding.
- Development of Sinkholes – This is likely to occur at the project site during and after construction of the project (short / long term). This poses a high risk to the stability of surface structures (high sensitivity). As a mitigation measure, detailed surface mapping and subsurface ground penetration surveys, including specific geotechnical investigations for foundation design should be undertaken.
- Slippery ground during wet months – this is likely to occur during the construction phase during the rainy season and it can be a safety risk to workers and mobile equipment (sensitivity – medium). This can be mitigated by avoiding resuming work immediately after the rains and by applying blast on road networks.
- Rock weathering – This is likely to occur during the operation stage of the project and can result in unstable surface structure foundation (sensitivity – low). The mitigation measure is to undertake detailed borehole drilling and logging at specific sites to identify weathering zone.
- Flooding/Drainage – this is likely to occur during the operation phase (long term) of the project. It presents a threat to electrical equipment mounted close to the ground (sensitivity – medium/low). This will be mitigated by construction of good drainage network in and around the project area. The drainage network will be integrated with the planned LS MFEZ internal catchment areas and the system of ponds. The proposed Solar PV Project will not, however, have full responsibility for the LS MFEZ internal catchment areas and pond systems.
- Floating rock boulders in sub soil – This can present a high risk during the construction / operation stages of the project. It can result in unstable structures. Detailed mapping of subsurface should be carried out as a mitigation measure.
- Underground caverns in base rock formation – This presents stability threat to heavy surface structures during the operation stage of the project (sensitivity high). Detailed mapping of the subsurface should be carried out.
- Underground stream in subsurface rock formation – This is a threat to surface structures/ formation of swallow holes and is likely to occur during the operation stage of the project

(sensitivity – medium). As a mitigation measure, effective drainage should be constructed in and around project area.

- A storm water management plan should be developed and implemented. An effective storm water drainage network should be constructed to channel increased surface runoff to designated catchment areas as part of implementation of the storm water management plan. An effective drainage network will minimise soil erosion over exposed surface and will minimise the risk of erosion of the support structures and foundations. It will also reduce the risk of flooding the project site especially the north eastern part of the project site.

Though the project will be carried out in a geological environment that is prone to change due to weathering and leaching and uneven rock subsurface, these conditions can be dealt with.

The current detailed studies being done in terms of ground penetrations should be able to pinpoint problematic areas and geotechnical remedial actions taken.

The Solar structures are not that heavy, so the problems of foundation stability are not much of a threat both in short and long term basis and can be handled adequately at design stage.

There will be no change to the geological environment both at construction and operation stage. This is because operational stage of the project will not deplete any geological resource; soil or rock and will not alter the existing geological baseline conditions in the environment. The project will use the sun as its source of raw material and will not generate any waste that will have negative or positives impact on soils and rock within the Solar Farm and surrounding areas. The implementation of the project will not add or deplete any geological materials (rock or soil) within the farm area or surrounding areas. The project should therefore be allowed to proceed.

5.4 Water Resources (Hydrology and Hydrogeology)

The assessment of potential impacts and risk on water resources of the proposed Solar PV project associated with the construction and operations of the Solar PV project are presented in Appendix B.

The scope of the study included the assessment of the water resources within and around the project site. Water resources baseline conditions were determined through review of site specific hydrological, geological, topographical and geotechnical studies carried out on site. It also included site visits to the project site. The baseline conditions established are presented in subsection 4.3 of this report and in Appendix B.

Predicted impacts

The potential impacts and risks associated with the proposed project relate to the following:

- Increase in surface runoff during the rainy season or storm rainfall than infiltration into the ground resulting in reduced recharge of groundwater aquifer.

- Flooding risks due to surge in groundwater table.

Construction and Operation Phases

Increased surface runoff at the project site

Preparation of the site and construction of the Ngonye Solar PV plant at the proposed site in the LS-MFEZ will involve clearing of all the existing secondary vegetation that is currently at the site. The clearing of vegetation will expose the soil surface and create a condition suitable for increased surface runoff coefficient in excess of the current estimate of 15%. This implies that there will be more surface runoff during the rainy season or storm rainfall than infiltration at the project site. The use of heavy equipment in clearing the area will also invariably disturb the natural soils' characteristic behaviour. The removal of topsoil and compaction of the exposed remaining soil horizon will lead to attenuation of surface runoff. This will subsequently reduce the recharge of groundwater aquifer with rainwater. The review of hydrological studies undertaken on site show that there will be an estimated increase in surface storm water runoff of up to 160% as a result of proposed developments.

Increased surface runoff at the site may potentially result in increased risk of erosion of support structures and the foundations. This may potentially lead to increased risk of damage to the solar plant and reduced production.

The hydrological study conducted at the project site shows that very high peak flows of storm water runoff will not be at the project site but further downstream of the project area. It has also revealed that the risk of runoff pooling and flooding on some sub-basins of the project site (northern, central and south-western parts of the site) is lower than on the extreme end of the eastern part of the project site, which has a possible flood line.

Flood risks

The conversion of the existing vegetation cover to bare or impervious surface at the project site will change the soil surface characteristics. This will result into reduced infiltration and attenuated surface runoff. The increase in surface runoff will lead to increased risk of flooding the project area as well as reduced recharge of groundwater. The potential increase in surface runoff is such that unless adequate drainage systems are put in place to quickly route the peak flows from the project area, the runoff would pool up within the project area and cause flooding, which may subsequently cause damage to equipment mounted close to the ground.

It is expected that pooling of water may exacerbate flooding risks as a result of projected future developments in the area. This is because the proposed developments are likely to reduce water infiltration and groundwater recharge.

A review of available data indicates that possibility of flood risks arising as a result of flooding due to surge in groundwater levels is unlikely (AMC, 2015b). This is partly because the large karst system underneath the area with visible fissure and outcrop of dolomite makes slim the possibility of groundwater rising so high at the recharge area (Siwale & Baumle, 2012; AMC, 2015b).

Potential Groundwater contamination

Small quantities of fuel and oil will be stored on site during the construction and operation phases of the project. Mainly diesel will be stored on site and a maximum of 30 cubic metres is expected to be stored. The oil (conforming to codes DZS 385 Part 1: 2015, ICS 13.300; 75.200, Second Edition) will be used in a couple of small transformers that will be installed on site. The quantities of fuel and oils that is expected to be stored on site will be limited and thus the proposed Solar PV Plant are not expected to generate on site significant quantities of used oil from transformers and other maintenance works. Vehicle maintenance and

service will be carried out at designated service stations or workshops away from the project site.

Accidental spillage of some fuels and oils onto the ground may potentially occur during storage and handling with potential contamination of groundwater should surface runoff contaminated with oil spillages be indirectly released, through seepage, into the groundwater aquifer. The impact would be negative, indirect and localised. The duration of the impact could be short to long term. The magnitude of the potential impact is however considered to be low and its overall significance is considered to be moderate. It is unlikely that the impact will occur because of the proposed mitigation measures coupled with limited quantities that will be stored on site. With implementation of the mitigation measures, the overall significance of the impact is considered to be negligible. Therefore, the potential for groundwater contamination through handling and storage of oils, fuels and hydraulic fluids on site is limited and is not likely to occur during project development phases.

Mitigation measures

The following measures have been identified as mitigation measures to manage identified significant adverse impacts that include requirements for attenuation of erosion and pollution control in the impact management plan.

Increased surface runoff and flood risks

- A storm water management plan should be developed and implemented.
- Storm water drainage system should be properly designed and constructed to convey the surface runoff away from the project site into a nearby planned catchment pond, which will be part of the overall LS MFEZ internal catchment areas (drainage network) and a system of ten ponds. The pond will hold runoff and allow it to filter slowly into the ground. This will also contribute to recharging of the groundwater aquifer;
- Surface drainage system should be designed and constructed to avoid erosion of support structures and foundations.

Potential Groundwater Contamination

Though limited quantities of fuel and oils are expected to be stored on site during the construction and operation phases of the project, the following mitigation measures are proposed:

- Appropriate procedures for storage and handling of fuels and oils should be adopted to avoid spillages of fuels and oils onto the ground. These included the following: Fuel tanks must be bunded to contain possible spills and to prevent the infiltration of fuel into the ground; The fuel tanks used for the storage of fuel must be designed and installed in accordance with relevant Oil Industry standards; The tanks must be constructed to conform to the requirements of all relevant legislation, which includes the Environmental Management (Licensing) Regulations, 2013; use of all generators on site must include the use of drip trays.
- Secondary containment structures, made of impervious and chemically inert material and capable of containing the larger of 110 percent of the largest storage vessel should be constructed for storage of fuels, oils and other hazardous substances. All products (fuels, oils) shall be stored in a bund area that can carry 10% more than the product's capacity.

- Handling, storage and disposal of hazardous substances (used transformer oils) should be carried out in accordance with the World Bank General Environmental Health and Safety Guidelines (Hazardous Materials Management) and the applicable Zambian Environmental Management (Licensing) Regulations, 2013.
- Dedicated secured storage areas for fuels, oils and other hazardous materials should be provided as part of the design. Mainly diesel, to a maximum volume of 30 cubic metres, will be stored. All fuel stored on site will be above ground level and the storage areas shall be secured. The storage areas and containers shall be clearly marked and labelled for the content stored within. Drip trays, a thin concrete slab or a facility with PVC lining shall be in place to prevent soil and water pollution.
- All products shall be used in an open well-ventilated area and according to manufacturer's specifications.
- MSDS Hazard list and First aid treatment notices shall be prominently displayed.
- Training on handling, storage and disposal of hazardous waste should be provided as part of the overall environmental management of the site. Only trained personnel shall be allowed to work and handle the chemicals.
- Uncontrolled dumping of any toxic or hazardous waste, including used transformer oils from a couple of transformers to be installed on site should be avoided.
- Uncontrolled dumping or littering of any waste within the project area and areas adjacent to the project site should be avoided.

The Solar plant project area lies on groundwater divide and a groundwater recharge zone for the karst aquifer supplying 50% of Lusaka city's water. There is therefore need to protect this area from activities which have the potential to interfere with the quantity and quality characteristic of this resource.

Other mitigation measures include the following:

Secondary Woodland and surface areas

- Avoid unnecessary removal of vegetation during Solar PV plant construction.
- Avoid unnecessary soil surface removal around the site that might lead to attenuation of surface runoff, erosion and flooding.
- Enhance retention of surface vegetation cover and wherever possible woodland canopy vegetation in road reserves and other open spaces to enhance recharge to the aquifer;
- Retain as much of original soil during land preparation to minimize soil compaction.

Geology and geomorphic processes

- Avoid highly charged rock explosion methods and jack-hammering techniques of foundation excavation.
- Avoid unnecessary blasting and abstraction that will exaggerate water table fluctuations

Groundwater management and wastewater

- Avoid uncontrolled discharge of liquid and solid waste, particularly potentially toxic and hazardous substances or compounds such as PV-based substances.
- Avoid unnecessary storage of hazardous-material-containing vessels on the project site to avoid leakage to groundwater aquifer and/or sinkholes in the area.
- Set targets for voluntary water conservation.

Waste management including toxic and hazardous waste

- Distribute and display LS-MFEZ standards and management procedures for all waste types around the plant operation area.
- Provide sufficient litter collection and waste and re-cycling station bins.
- Monitor and regulate all solid waste disposal.

Cumulative impacts

- Impacts on recharge of the aquifer: other developments within the LS MFEZ will reduce infiltration and groundwater recharge subsequently affecting water supply in Lusaka and base flow into rivers and streams draining out of the Lusaka Dolomite Aquifer. The LS MFEZ area represents 5% of the total aquifer zone (ZEMA, 2014). Despite the area being small climate change risks and increased demand for groundwater from the Lusaka Dolomite will increase the sensitivity of even small reduction in recharge to the system. These effects are likely to be cumulative, arising from proposed developments in the MFEZ.
- Aquifer contamination may arise as a result of other developments that may potentially and indirectly release into the groundwater raw sewage, agricultural products, wastewater, hydrocarbons effluent and leakages. The impacts associated with potential aquifer contamination will be within the LS MFEZ as well as the central Lusaka groundwater source areas.

5.5 Air Quality

This section considers assessment of the potential impacts associated with dust generation arising from proposed project activities. Appendix D of this report contains details on the assessment.

The assessment considers the air quality impacts of the project relating to dust generation on people including construction workers, amenity areas and nearby facilities in the LS MFEZ during the development phases of the project.

The air quality impact assessment methodology considered is presented in Appendix D.

Predicted impacts

Construction Phase

Dust emissions and particulate matter are likely to be generated during construction works relating to the following:

- Site clearance and levelling of the proposed project site area to create a geotechnically suitable development platform for the installation of the PV modules, footings and other supporting structures.
- Transportation of plant components to site.
- Construction of a small control building for storage and maintenance equipment and as well as welfare facilities.
- Fixing of the module footings and support structures into the ground and mounting of modules onto the support structures within the site.
- Internal roads will be constructed as part of the project development works.

The site clearing has potential to raise dust especially when the ground is very dry. The dust may be generated by the actual stripping and ripping of the surface. The dust emission can also arise from wind erosion of exposed surfaces or any form of temporal stockpile.

Dust releases will be limited largely to the site preparation phase of the project and due to the absence of residential areas and other properties on the immediate boundaries of the site; the dust will mostly impact construction workers. The duration of the impact will be short term and localized. The frequency of the impact is once off during construction. The impact is unlikely to occur as at the moment there are no residential areas or sensitive receptors (apart from construction workers and wildlife in the Lusaka National Park) on the immediate boundaries of the project site. Therefore, site clearance and levelling will cause a negative minor impact to local air quality.

The transportation of plant components will be mostly on paved roads except for short distances in the project area. This is not expected to generate significant dust emissions. Transported items themselves are not a source of dust. Transportation of plant components is a once off activity and will be for a short term. There could be some gaseous emissions from the exhaust of transportation mobile equipment that may include oxides of nitrogen and carbon monoxide but these will not cause any air pollution problems within the project area. Air quality impacts are unlikely to occur. The transportation of plant components will cause a minor adverse impact on local air quality.

Excavation works associated with the construction a small control building may generate small amount of dust when excavating the foundations. The handling and mixing of building materials may also raise a small amount of dust. The above activities are once off and for a short term. The impact to air quality will be only onsite. The impact is unlikely to occur. The construction of a small control building therefore will cause a negligible impact to the air quality.

Fixing of the module footings and support structures into the ground and mounting of modules onto the support structures within the site will involve some excavation works and in some cases rock breaking. Dust emissions are likely to be generated from these works. The impact associated with these works will be for a short duration and localized. The impact is unlikely to occur. Therefore, the significance of the impacts associated with fixing of the module footings and support structures with regard to air pollution will be minor.

Internal road construction will generate some dust. The heavy equipment will also generate some exhaust gases that include carbon monoxide and oxides of nitrogen (NOx) however the impact of these emissions are only expected to have a minor adverse impact on the air quality.

Internal road construction will generate some dust. The heavy equipment will also generate some exhaust gases that include carbon monoxide and oxides of nitrogen (NOx). The emissions of dust and exhaust gases will be once off and for a short term and may impact ambient air quality in the local area. The impact on air quality is unlikely to occur. The construction of internal roads will cause a minor adverse impact on air quality.

Operational Phase

Solar modules do not generate any direct air emissions. The main activities on site will be regular cleaning of the modules to remove dust from the surfaces and periodic vegetation removal. Neither of these activities is expected to generate significant dust. However, insignificant dust emissions are likely during maintenance works relating to clearing of vegetation from under and around the modules to ensure that the solar plant operate at full capacity. The grass will be cut and maintained by dedicated personnel and appropriate equipment suitable for the purpose of cutting grass under the modules will be used. The potential impacts associated with dust emissions from this activity will be negative and indirect in nature. They will be temporary and their extent will be on-site. The frequency of occurrence will be periodic but it is unlikely that the impact will occur. The overall impact significance is considered negligible since there will be no discernible deterioration to the existing environment.

Operational efficiency of solar models after installation do not cause any direct environmental impact. Air quality can affect the efficiency of the amount of global horizontal solar radiation received on the panels. According to the IFC Utility Scale Solar Power Plants (USSPP) a Guide for Developers and Investors (IFC, 2015) pollution from industry and agriculture can affect the solar resource significantly. In the current project setting there are no industries emitting air pollutants neither is there any agricultural industry with emissions that are affecting the air quality.

Soiling of panels from environmental dust or dust arising from industrial point source or other anthropogenic sources can best be established by conducting site specific extended field dust deposition tests. However, based on weather characteristics and environment surrounding the site, the following observations are made:

- There are no operational industries that are emitting dust in the area or gases that form aerosol particles. The exception is a quarry and aggregate plant that has a potential to generate some dust. A comprehensive dust control system on such a plant can limit its impact on the project should it be a problem.
- There are no storage stockpiles of loose fine materials within the vicinity of the project. The wind speeds in the project area and vast areas of Zambia are low and hence do not continuously generate windblown dust. Lusaka is also not in the direct deposition of the dust that are transported in large world dust movement in the desert areas of the Northern Hemisphere (Terradellas, 2015). During the rainy season the windblown dust is further curtailed as the small dust particles are bound by the moisture.

According to the (USSPP) Soiling Losses due to soiling (dust and bird droppings) depend on the environmental conditions, rainfall frequency, and cleaning soiling losses can be as high as 15% on an annual basis but less than 4% unless there is heavy soiling problem (IFC, 2015). It is anticipated that in this project there will not be a situation that will lead to heavy soiling. The frequency of solar panel cleaning should follow the manufactures recommendations.

Decommissioning Phase

The main activity activities associated with the decommissioning phase are:

- Removal from site of used solar modules, associated electrical components and cabling for disposal or recycling.
- Demolition of site buildings. The buildings may not be demolished if alternative use for them is agreed upon with other stakeholders.

Dust emissions from main activities associated with decommissioning phase are likely to be insignificant and less likely to affect sensitive receptors. The impact significance is considered to be negative and minor.

The restoration of the site to its pre project condition will cause a minor negative impact to ambient air quality from the works that will be carried out but will cause a minor positive impact after the site is restored with a forest as it is currently.

Mitigation Measures

Dust generated from project activities

Land clearing and levelling are the main activities that has the potential to affect ambient air quality through dust generation. This is likely to happen during the construction phase of the project. Dust emissions will also arise from construction of internal roads. The operation phase of the project has no dust emissions. Some dust will also be generated at decommissioning of the project. The dust that will be generated is of minor significance. Some mitigation measures to reduce exposure to dust and fugitive dust generation will include:

- Provision of Personal Protective Equipment such as dust masks to all the workers that might be exposed to dust emissions should be done by the Contractor.
- Where dust emission will arise from unpaved roads and any other exposed surfaces as a result of proposed project related activities, the Contractor should apply water on the surfaces to reduce or suppress any fugitive dust emissions.

The project as proposed will have low impact on the air quality. The project will have low level emissions of dust from land clearance and levelling activities. The exhaust emissions of gases and particulates will also be of low. The project at operation stage will not have emissions from the primary plant except for utilities such as plant vehicles. The decommissioning activities will have low levels of emission of dust. The impact of emissions to the air quality of PM10, PM2.5, CO, NOx, SO_2 will all be of a minor adverse significance and the incremental values in the baseline values is negligible. The air quality will still remain within with the Zambian emission limits for ambient air pollutants and the IFC ambient air guideline limits during and after project implementation.

Emissions from other installations within the surrounding LS MFEZ site, once it is fully developed out, are likely to significantly alter the ambient air quality in the zone and will be more impactful than the proposed project.

5.6 Noise and Vibration

Noise and vibration surveys were conducted as part of the ESIA study to determine the baseline noise levels at the project prior to implementation of the proposed Solar PV Project.

The surveys were also meant to evaluate potential noise and vibration impacts of the proposed project on surrounding communities, amenity areas, wildlife and surrounding facilities in the LS MFEZ (industries and offices) during the construction, operation and decommissioning phases of the project. Appendix D of this document provides details on the assessment of noise and vibration impacts that may arise as a result of the proposed project.

This assessment considers the potential sources of noise during the construction, operation and decommissioning phases of the project. The equipment and tools with low levels of noise and ground borne vibration will be used. Considering the rocky terrain at the project site, controlled rock blasting will be employed on site.

The proposed development will involve generation of additional traffic movements on access roads and on-site. Therefore, noise levels are anticipated to increase but their impact is considered to be negligible considering the distance between the noise source and the identified sensitive receptors.

5.6.1 Noise Disturbance

Predicted impacts

Construction Phase

The site clearing and levelling will involve the use of heavy equipment. The machinery will include bulldozers, frontend loaders and tipper trucks. The use of such equipment will generate some noise. The presence of rock outcrops and rock pinnacles may impact on earthworks in that excavation may have to potentially involve blasting of rock, where required. The noise generated though high in decibel terms is reduced to normal permissible daytime values at distances not so far from the working area. Sound level measured during a noise survey when a bulldozer was clearing on-site near the ZESCO substation was 50 Leq dB(A) at approximately 130 metres away from the working dozer. Between the project site and the core area of the Lusaka National Park, there is a wire fence and a 200 metre buffer zone created by the Department of National Parks and Wildlife under the Ministry of Tourism and Arts. The buffer zone is within the National Park boundary fence. The zone will not be developed in future. The buffer zone will therefore contribute to reducing potential noise disturbance on wildlife. The significance of the impact of noise on noise-sensitive receptors will be negative and minor as there is no sensitive receptor close to the project site.

Movement of traffic transporting plant components to site will result in increase in noise levels. The levels will be for short period and the significance of the impact is considered to be minor and negative.

Construction of internal roads as part of the project development works will involve use of heavy equipment that will also generate some noise during land clearing and levelling. The noise disturbance on sensitive receptors is expected to be negative and minor.

Operational Phase

Some noise will be generated by the inverters. A review of Acoustic and EMF levels for solar photovoltaic projects had the following findings Massachusetts Clean Energy Centre, Boston (Tech Environmental, 2012):

The measured levels ranged from 48 to 61 Leq dB at one site and 59 to71 Leq dB at two other projects sites measured at 10 feet (3m) from the face of the inverter. Sound levels drop with distance from the source. The noise level from utility scale solar plants showed that

noise levels from the inverters and solar arrays dropped to back ground at between 50 feet to 150 feet (15.2 to 45.7m). The noise level would not be heard at a distance of 100m at the current low background daytime level but the background will increase as more developments and human settlements increase. The significance of the impact of noise on sensitive receptors during the operation phase of the project is expected to be negligible.

Decommission Phase

The main activity during the decommissioning phase will be removal from site of used solar modules, associated electrical components and cabling for disposal or recycling and demolition of site buildings. The buildings may not be demolished if alternative use for them is agreed upon with other stakeholders.

Noise disturbance associated with decommissioning phase is considered to be temporary, site specific and one-off. It is unlikely that it will disturb sensitive receptors. Its overall significance is considered to be negligible.

When conducting earth works to restore the project site to near pre-project conditions, some heavy equipment will be used but it is expected that noise levels that will be generated will be near the operating machines and hence can only affect nearby by workers rather than the surrounding community. The significance of the impact arising of this activity is considered to be negative and minor.

The noise generated from construction, operation and decommissioning phases of the proposed project will be of minor adverse impact and negligible in significance. The project noise emission will be within the IFC noise guideline limits of 70 Leq (dBA).

5.6.2 Vibration

Construction Phase

The impacts due to vibration have been determined by considering the likely construction and operational processes involved at the proposed project site.

Certain construction processes, particularly ones involving site preparation and civil works e.g. ground breaking and excavations have the potential to create vibrations within the vicinity of the works. Vibrations are also anticipated to occur sporadically around the construction site due to movement of materials and equipment. However, as vibration dissipates rapidly with distance (due to its spreading loss from the source), there are anticipated to be few and minor vibration impacts upon sensitive receptors.

Due to the nature of the expected earthworks being relatively minor, it is unlikely that the impacts upon the surrounding receptors caused by vibration will be significant (in terms of disturbance to humans, animals in the nearby Lusaka National Park or damage to structures).

Where any vibration impacts do occur, they will be temporary in nature. Prior to the implementation of mitigation measures, this impact can be assessed as being negligible. Moreover, the construction activities at the ZESCO substation (located near the project site), which involves major earthworks relative to the ones anticipated during the construction of the solar power plant have had negligible impact on the surrounding receptor areas as seen with the intact Louvre windows observed at the main entrance to the Lusaka National Park building a few metres from the substation. The presence of the animals seen on the area

close to the construction site of the ZESCO substation at the time of measuring vibration levels is further proof of the negligible impact of vibrations to the surrounding receptor areas.

While no detailed information was available on the actual equipment that will be used during construction, it is anticipated that similar equipment and processes used during land clearing and construction activities at the ZESCO substation which have had negligible impact on the project site and surrounding receptor areas will be employed.

Vibration impacts to construction workers may directly occur to those who will be operating vibration inducing machinery or, who are in close proximity to piling and excavation works.

Operation Phase

During the operation phase, the operations of the solar power plant will not include the use of heavy machinery and equipment. Therefore, the solar field area will not contribute any significant vibrations to the receptor areas.

Mitigation

The following measures will be considered, where appropriate, and will be implemented throughout the construction phase:

- Provision of adequate PPE such as ear plugs to site workers likely to be exposed to high noise levels;
- Where appropriate, bored piling techniques will be considered in preference to impact piling to minimise vibration impacts;
- The presence of 200 metres buffer zone within the National Park from the park boundary fence will minimise potential noise disturbance on wildlife;
- The movement of heavy vehicles during the night will be avoided wherever practical.
- The contractor and their sub – contractors will, at all times, carry out all work in such a manner as to keep any disturbance from vibration to a minimum especially when working in close proximity to receptor areas.
- Operators of vibrating hand- held machinery will be provided with appropriate PPE (e.g. protective gloves) and be given suitable breaks from using such equipment to reduce the impacts of vibration.

Residual impacts

Residual impacts resulting from vibration generated during construction phase, following implementation of mitigation measures, are considered to be negligible to minor negative significance. For the operation phase, it is considered that residual operational vibration impacts will be of minor negative significance at the project site and surrounding receptor areas.

The current baseline noise levels at the site are all within IFC standards. Currently, there are no sensitive receptors in the area as such developments are yet to come. The noise that the project may generate may come from the inverters. The noise from inverters is however only audible at very short distances from the source. The noise levels from such a source are unlikely be heard even at 100m from source.

Following an assessment of the processes anticipated during the entire construction and operation of the proposed solar power plant and the mitigation measures recommended, it is concluded that they will be negligible impacts to the project site as well as the surrounding receptor areas arising from ground–borne vibrations.

5.7 Land Use

Predicted impacts

The project site is partly within the LS MFEZ designated for industrial and commercial development and partly within the Lusaka National Park area (11 ha additional land for the project) owned by the Ministry of Tourism and Arts. The piece of additional land is located outside the physical boundary fence for the park and is currently not used as a park. The land at the site in its current state is degraded because of previous human activities such as charcoal burning. The land immediately to the South of the project site is a protected Lusaka National Park which is progressively developing into a forest. The National Park is fenced off around its boundary and within the park boundary fence, there is a 200 metre buffer zone created by the National Parks and Wildlife Department under Ministry of Tourism and Arts. The project area within the LS MFEZ is already zoned as a multi-facility economic zone and mostly for commercial and industrial purposes. Implementation of the project on the project site is expected to be seen as a landmark energy project both locally and nationally which will in turn attract more investment in the LS MFEZ.

The impacts associated with use of the land for the project will be negative, direct and localised in extent. The frequency of the impact will be once-off and it will certainly occur since the land will be cleared to pave way for construction of the solar plant. Considering the project footprint (52 ha) and the current state of the land, the magnitude of the potential impact is considered to be low. The land is a recharge area for the Lusaka Dolomite Aquifer. Therefore, the sensitivity of the receptor is considered to be high. The significance of the impact is assessed as moderate negative as the project will cause a noticeable deterioration to the existing environment.

The additional 11 ha land required for project development is currently not used as part of the National Park. The area is physically located outside the National Park fence boundary and extends along the southern boundary of the LS MFEZ.

The impacts associated with the change in land use of the additional 11 ha from being part of the Lusaka National Park to development of a solar PV Plant will be negative, direct and long-term in nature as the change will continue for the life of the project. The change will be on-site as this will be limited to the boundaries of the project site. The resource sensitivity or value of the additional land is considered to be low having been previously subjected to human activities such as charcoal burning and is not currently being used as a park. The magnitude of the impact of the change in land use is assessed to be low. The overall significance of the impact is considered to be minor as the proposed project would cause a barely perceptible deterioration to the existing national park.

The presence of the protected Lusaka National Park located immediately South of the project site will mitigate the change in land use of a 11 ha piece of land. The Lusaka National Park will continue to play its role of conserving wildlife resources and its other important role as recharge area and as a positive barrier to negative influences on the overall economic zone.

5.8 Biodiversity

This assessment considers flora and fauna likely to be affected by the proposed project. The baseline conditions of flora and fauna has been established and is presented in subsection 4.7 of this report. The proposed project site has vegetation comprising mainly of herbaceous plants with scattered shrubs.

The flora and fauna survey covered the project site and its immediate surroundings. The methodology employed to undertake the survey is outlined in Appendix E. It involved site selection to capture plant diversity taking into account that the project site is mainly a habitat of modified nature. Transect walks across the project site were also employed in the assessment of fauna at the site. Signs such as trails and droppings and also the actual animal species were used in fauna identification, where possible, to establish the baseline.

Predicted impacts

Construction Phase

Construction activities at the project site will include clearing the existing vegetation from the project site footprint. The predicted impacts that may arise from the activities relate to the following:

- Removal of tree species - clearing of areas for installation of the scaling solar project infrastructure will result in removal of tree species from the project footprint. The baseline flora conditions established indicate that there are no flora species classified as rare, threatened or endemic to the project area or of scientific value. The proposed project site is in an area that has a modified habitat and which is in an early stage of the woodland recovery from previous disturbances. In addition, the area that will be disturbed is relatively small in size because only the site where the infrastructure will situated will be cleared. The potential impact arising from removal of trees species will be direct, negative. It will be localised and will likely occur during the construction phase. The magnitude of the impact is considered to be low while the sensitivity of the receptor (receiving environment) is considered to be medium. The overall significance of the impact is considered to be minor.

- Loss of Vegetation – The removal of trees will affect the biodiversity status of the area. The vegetation within the project site is modified and there are no flora species of scientific value or that can be classified as rare or endangered. The impact associated with loss of vegetation will certainly occur and will be negative, direct and localised. . Its duration will be long term. The magnitude of the impact is considered to be medium while the sensitivity of the receptor is assessed as low. The overall significance of the impact is considered to be minor.

- Loss of wildlife habitats - Although the project area exhibited a conspicuous absence of big game, small animals including moles, rats, common duikers, rabbits, lizards and various types of snakes are found in the area. Therefore, clearing of vegetation / tree cutting will result in loss of their habitat. Wildlife found at the project site are not classified as rare or endangered. They are categorised as of least concern under the IUCN Red List Database. They are locally, regionally and nationally distributed. The impacts associated with loss of wildlife habitat will certainly occur and will be negative and localised. They will be one-off and their duration will be long term. The overall significance of the impacts is considered to be minor.

Operation Phase

The operation phase will involve clearing of vegetation from under and around the modules to allow for maintenance and operation at full capacity of the solar plant. The impacts on biodiversity associated with the activity are considered to be negligible.

The reflective solar modules may potentially impact on birds. The potential impact is associated with birds and their insect prey mistaking a reflective solar module surface for water body or spot of water ponds. The predicted impacts on birds that may potentially arise may be negative, direct and localised. The duration of the impact will be long term as it will potentially occur during operational phase. It is probable will occur. The magnitude of the impact is considered to be low and the sensitivity of the receptors are also considered to be low since the project site does not have birds or insects categorised as rare, threatened or endemic to the project site. The significance of the impact is therefore considered to be minor.

Mitigation measures

- Clearing of vegetation will only be confined to areas where the solar infrastructure will be installed to minimise loss of vegetation and wildlife habitats. The Lusaka National Park located immediately to the south of the project site provides habitat for a variety of wildlife and is progressively growing into a forested area. Within the Lusaka National Park boundary fence there is 200 metre buffer zone that keeps wildlife (animals) safely away from the economic zone and its activities. This will minimize disturbances on wildlife.
- Using low reflective surface module coated with anti-reflective coating to minimise potential impacts on birds.

The project site has modified habitat with flora and fauna species that are not classified as rare, endangered, and endemic to the area or of scientific value. The site provides habitat to small mammals, reptiles and birds. The species found in the area are locally, regionally and nationally distributed and are categorised as of least concern in the IUCN Red List Database.

Therefore, the significance of the impacts associated with loss of vegetation and loss of wildlife habitat are considered to be minor negative because the proposed project is likely to cause a barely perceptible to noticeable deterioration in the existing environment. Implementation of proposed mitigation measures will reduce the impacts. In addition, the significance of the potential impacts anticipated on birds as result of implementing the proposed project is considered to be minor.

The other likely ecological impact is on movement of burrowing and nocturnal animals through and across the project site during the operation phase. However, this may be minimal as most of these animals will not be able to move into the project area due to the restriction arising from the erected wire fence around Lusaka National Park and from the fence that will be erected during project development phases. In the case of burrowing animals, those that may be noted during the operation phase will be removed and the burrows filled.

5.9 Archaeology and Cultural Heritage

Site specific archaeological and cultural heritage survey was carried out as part of the overall ESIA study. The details on the survey and assessment of impacts are presented in Appendix F.

The archaeological and cultural heritage impact assessment covered the proposed project site. It involved review of available data, oral interviews and transect walks across the across the project site. Review of available information and site specific archaeological and cultural heritage survey have indicated that there are no known archaeological and cultural heritage sites at the proposed project site. However, construction works may expose, unearth or remove of unknown subterranean and chance surface archaeological finds.

Predicted potential impacts

The occurrence of underground and chance surface archaeological finds are a possibility during the construction phase of the Project.

The potential negative impacts could be damage to archaeological finds that may the exposed or unearthed during construction works.

If by any chance cultural and natural heritage resources are exposed or unearthed during the construction phase, the positive impact will relate to documentation of these resources in the Project area. It is important that the cultural and natural heritage resources are exhibited and presented at an information centre for purposes of education, research, tourism and posterity

Mitigation measures

IDC and the company that will be hired to construct the Solar Power infrastructure should take into account the possibility of unearthing or stumbling over fossil/ ancient or prehistoric archaeological materials. These resources, if unearthed, will need to be assessed and documented. In an event that archaeological or ancient prehistoric materials are stumbled over, IDC should contact the East Central Regional Headquarters of National Heritage Conservation Commission (NHCC) for professional advice and rescue excavations.

Construction of an information Centre by IDC Solar power project in consultation with NHCC to exhibit the cultural and natural heritage (in an event that irreplaceable heritage material is found during construction) storylines and exhibition for education, research, adventure and posterity within or outside Project Area. Collection and display/ exhibition of heritage artifacts and fossils

Challenges

The cultural heritage survey of the proposed solar power project area was surface extensive. A number of areas were sampled to identify and document any archaeological chance surface heritage resources and other cultural and natural heritage sites of significance.

However, the survey findings showed that the project area did not host any archaeological and cultural heritage resources of significance. Therefore, it is most unlikely that the construction activities of the Solar Power project will come across archaeological/ cultural heritage resources of irreplaceable significance.

Further, it is important to note that the survey had one major challenge though. The challenges included poor visibility as the project area was overgrown with vegetation since it was towards the end of the rainy season. Tall vegetation constrained visibility and accessibility in a few areas.

Nevertheless, in an event that archaeological finds of cultural significance are found during the construction and operation phases of the Solar Power Project, National Heritage Conservation Commission (NHCC) - East Central Regional office should be contacted as a matter of urgency for specialist advice and intervention. Heritage artifacts require careful

archaeological excavation, treatment and exhibition for purposes of scientific research, education and tourism/ recreation. The contact details are: The Regional Director, National Heritage Conservation Commission, East Central Regional office, P.O. Box 320013, Lusaka. Telefax 260 211 226506.

5.10 Traffic and Road Infrastructure

The LS FMEZ is serviced by a network of roads such as the Leopards Hill Road and the newly constructed inner ring roads. The Project site is located on Chifwema Road, which is off Leopards Hill Road. Tarred access roads have been constructed within the economic zone. The volume of traffic on the access roads and internal roads of the project area is currently low. However, traffic volume is expected to increase as the economic zone is being developed. Access to the economic zone and the project site is either through the Lusaka Inner Link Road that terminates on the LS MFEZ north-western boundary or through Chifwema Road, which branches off the Leopards Hill Road (D152). For transportation of construction material to the project site, it is expected that inner ring roads joining the Kafue Road will be used mainly.

Transportation of material to site is expected to increase traffic volume on the roads leading to the economic zone.

Predicted impacts

Construction phase

The number of delivery vehicles and other utility vehicles (transport for workers/contractors) expected during the construction phase of the project is currently not known. However, the project will likely result in an increase in construction related traffic in the local area travelling to and from the site delivering materials and removing waste as well as vehicles associated with the transportation of workers. The increase in traffic is likely to result in increased traffic congestion and decreased road safety. Congestion is likely to increase at key road corridors leading to the economic zone. Much of the traffic generated will travel between Lusaka and the site. However, the additional impacts on general traffic congestion or road safety in the project vicinity are considered very low.

Longer distance haulage will also be necessary associated with the import of the solar modules and other specialist equipment especially during the construction phase.

The impacts associated with congestion as a result of the proposed project are likely to occur principally during the construction phase. They will be regional in extent and their frequency will be once off (construction phase). The magnitude of the impact is considered to be low while the sensitivity of the potential receptors is considered to be high. The overall significance of the impacts associated with the project in relation to traffic congestion is considered to be moderate.

Potential Impacts of Traffic on Road Safety

Haulage vehicles carrying materials to site have a potential to increase traffic and decrease road safety especially on access routes. Increase in traffic and decrease in road safety may potentially cause traffic-related injuries and fatalities among members of the public including construction workers.

Operation phase

The transportation of workers and use of utility vehicles during the operation phase is likely to increase traffic to and from site. However, the additional impacts on general traffic congestion in the vicinity of the project are still considered to be negligible. Overall significance of the impacts during the operation phase is considered to be negligible.

The impacts associated with increase in traffic volume at the LS MFEZ will be cumulative as development of the economic zone progresses.

Mitigation measures to be put in place by the Contractor include the following.

- Developing and implementing a site specific Traffic Management Plan for transportation purposes during construction. The transportation service provider will adhere to the plan during transportation of Solar PV plant components.
- Enhancing traffic safety management within the economic zone;
- Putting up appropriate signage (road markings, road traffic signs) including speed limits and applying speed control structures;
- Road safety training for workers and other stakeholders within the zone.

To enhance road safety, the following measures should be implemented:

- Separating site access routes for construction vehicles and pedestrians to minimise pedestrian interaction with construction vehicles.
- Bulk storage of materials on site to lessen constant vehicular traffic.
- Employing speed calming devices.
- Induction of drivers on safe conduct of vehicles on construction sites and placing emphasis on safety aspects among them.
- Providing reflective vests and coveralls for workers of site.
- Employing safe traffic control measures, including road signs and flag persons to warn of dangerous conditions.

Transportation of materials to site is likely to increase traffic congestion on existing roads corridors leading to the economic zone especially during the construction phase. However, the overall significance of the impacts is considered to be negative and moderate. With implementation of the recommended measures, significance of impacts on other road users and pedestrians along nearby townships through which the main access roads to the economic zone pass will be negligible.

5.11 Socio-economic conditions

The social impact assessment covered areas surrounding the LS MFEZ (Appendix G). The areas surveyed are Mahopo and Shantumbu Villages, Leopards Hills, Chalala and New Kasama residents and the farming community in New Kasama bordering the eastern end of the proposed project site. A survey of the Mphande Forest Community area was also carried out.

The social impacts and risks that may arise as a result of the proposed project have been identified and assessed following the methodology presented in Section 1.8 of this document.

Social conditions in settlements

The social baseline survey carried out identified the following as the prevailing negative social conditions in Shantumbu, Mahopo and Chifwema settlements:

- limited sources of livelihood activities;
- inadequate schools and associated facilities such as library facilities, learning facilities and teaching materials;
- inadequate health facilities; and
- inadequate water supply and sanitation services.

In addition, the Mphande Forest Community, where some households moved from Lusaka South Local Forest No. 26 have been resettled, is not a planned settlement. The settlement does not have basic facilities such as clean drinking water, education facilities, health services, proper access roads. The local community members do not have title to land on which they have been resettled.

The baseline social conditions within the identified settlements around the project area are considered to be negative and the conditions are likely to further deteriorate in the long term if there is no community support rendered. The magnitude of the deterioration in the social conditions likely to arise if no community support is rendered will be experienced at both local (project area and adjacent settlement) and regional (district) scales.

In order to improve the negative baseline social conditions in settlements in the vicinity of the project area, it is recommended that a Community Development Plan be developed and implemented by the Operators/Contractors of the Solar PV Plant. The CDP will include community projects aimed at improving living conditions and livelihoods in identified settlements. Such projects could include the following:

- Provision of adequate schools and associated facilities (education services) such as library facilities, learning facilities, learning materials and play parks for children;
- Provision of adequate water supply and sanitation services;
- Provision of adequate health facilities;
- Provision of any other community help necessary to improve the living conditions and livelihoods in identified settlements.
- Provision of titled land for settlement and farming for those settled in Mphande and assistance to restore agricultural livelihoods.

These community development activities can be undertaken in conjunction with a non-state actor (such as World Vision Zambia) already operating in the respective settlements.

The value of the benefits or services that will be provided through implementation of highlighted possible community projects will be high. In addition, the magnitude of the beneficial impacts that will arise through improving the social baseline conditions in identified settlements are also considered to be high.

The significance of the beneficial impacts that could arise through implementation of the recommended community support to the identified communities of Shantumbu, Mahopo and Mphande is considered to be major. This is because implementation of Community

Development Plan through which community support will be rendered will result in a significant improvement to the living conditions and livelihoods in the identified settlements besides strengthening stakeholder engagement and relationships beneficial for long-term positive Solar PV project outcome.

Predicted project impacts

Construction phase

The positive socio-economic impacts of the proposed project relate to the following:

- Increased Employment Opportunities.
- Increased Contribution to the Construction Sector and National Economy.
- Capacity building and technology transfer.
- Increased revenue to the local authority and government.

Increased Employment Opportunities

Employment opportunities will be created for both skilled and non-skilled labour during the construction and operation phases. This will result in employment opportunities and training for the local community. Approximately 100 people will be required at the peak of the construction phase to undertake works regarding site clearance, trenching and the building of the module infrastructures. This will bring about both employment and training opportunities for the local community.

The knock-on opportunities for employment will also be fostered in the other sectors associated with construction, such as manufacturing and supplying of local raw materials. Other opportunities will extend to those selling food and drinks to the construction workers. The potential impacts are considered to beneficial.

Enhancement measures: In order to maximize the benefits of employment opportunities, where possible, the EPC contractor for the proposed solar project should employ members of the local communities. The jobs for which local people qualify (including non-technical and technical) will be as much as possible be offered to the local people.

Increased Contribution to the Construction Sector and National Economy

The construction phase of the proposed project and the related infrastructure will make a positive contribution to the local and national economy through its multiplier effect.

Enhancement measure: to maximize this benefit, where possible procurement of services from local contractors and locally produced raw materials during the construction phase should be done.

Capacity building and technology transfer

The Scaling Solar project offers potential in capacity building and technology transfer to local contractors, skilled manpower and unskilled workers. Collaboration between the project developers and their skilled work force will foster transfer of skills and will also build additional local capacity.

Enhancement measure: in order to enhance this benefit locally skilled specialists and experts should be used to benefit from technology and skills transfer.

Increased revenue to the local authority and government

The implementation of the proposed project will contribute to increased revenue in form of taxes to the local authorities and government. This includes both indirect taxes from the purchase of construction materials and statutory taxes and contributions such as Value Added Tax (VAT), and Pay As You Earn (PAYE).

Enhancement Measure: in order for this benefit to be enhanced exacting correct taxes and dues should be done and paid timely.

Operation phase

The operation of the project will also have beneficial socio-economic impacts relating to the following:

- Creation of employment opportunities – employment opportunities are expected to be created for local staff who will be involved in maintenance works onsite.
- Increased revenue to the local authority and government arising from increased employment opportunities and other multiplier effect downstream in the economy.
- Capacity building and knowledge transfer – training should be provided to permanent maintenance staff at the proposed solar plant to maximise of the benefits.
- Tourism potential.

Tourism Potential

The Scaling Solar project with its attendant solar farm will be the first of its kind in Zambia. It therefore offers great potential for tourism.

Enhancement measure: in order to realize this benefit, construction of an Education Centre and recreational facilities will be necessary. These facilities will provide educational talks about renewable energy and conduct tours around the solar farm. This could be packaged together with entry into Lusaka National Park.

The potential negative impacts of the project relate to the following:

- Impacts of traffic on road safety;
- Influx of population at construction site;
- Impacts on public safety
- Occupational Health and Safety at Project Site
- Potential Upsurge of Sexually Transmitted Infections (STIs) and Human Immuno-deficiency Virus (HIV) / Acquired Immune Deficiency Syndrome (AIDS)

Influx of Population at Construction Site

Any new construction project attracts an influx of job seekers. This influx of people poses health and security risks. An influx of people may also lead to unplanned housing/structures and commercial activities around the project site area.

Mitigation Measures

Enforcement of relevant by-laws laid down by the respective Lusaka City Council and Kafue District Councils to prevent mushrooming of unplanned structures and activities. Security measures such as security fence around project site, security staff permanently guarding the solar plant, among other measures, should be put in place to prevent theft of project infrastructure (solar modules, copper cabling, etc.).

Potential Upsurge of STIs and HIV/AIDS

Construction projects/sites have been known to promote risky sexual behaviour. This can contribute to an escalation of new STIs, including HIV/AIDS in the local population.

Mitigation Measures

To minimize the spread of STIs among the workforce and within the population surrounding the project site, measures have to be put in place by the Contractor. This will include:

- Developing an HIV/AIDS Policy by the Contractor to be adhered to during the construction and operation phases of the project.
- Developing and implementing sensitization programs on preventing the spread of STIs and HIV/AIDS for project workers including contractors and suppliers.
- Provision of condoms (including Female Condoms) in places where they can be easily accessed such as toilets.
- Education programs on fighting stigma of those infected with HIV/AIDS.

5.12 Community Health Safety and Security

Construction Phase

The impacts on public health and safety that may arise from the proposed project relate to the following:

- Outbreak of water borne diseases arising from lack of or inadequate provision of good water and sanitation facilities on site to workers;
- Increased safety and security risks through an unauthorised access to construction site.

Outbreak of water borne diseases

Outbreak of water borne diseases can occur on site if adequate good water supply and sanitation services are not provided to workers.

Security risks

Security risk will form one of the major risks during construction and operational phases of the project. In addition, safety risks resulting from unauthorised persons inadvertently venturing onto the construction site is likely to occur. The location of the site within the zoned MFEZ site, which is subject to security measures, is not completely fenced on the eastern side. This presents considerable security and safe risks.

Mitigation Measures

- Provision of good water supply and sanitation facilities should be done to prevent an outbreak of waterborne diseases among workers which can affect the surrounding communities.

- The project will recruit a large part of the labour force locally. The labour force will be transported to the site on a daily basis. Therefore, social and epidemiological factors which are commonly associated with construction projects where large foreign workforces or migrant labour is used will be negligible.
- The project site should be enclosed within a security perimeter and no unauthorized persons should be allowed access to the site. Caution signs should also be placed around the site to prevent occurrence of accidents. The actions of security shall be done within the confines of the law and respect of human rights. Reasonable steps will be taken in the provision of security and in particular the use of force and establishment appropriate conduct towards workers and affected communities. A grievance mechanism would be put in place for the Affected Communities to express concerns about the security arrangements and acts of security personnel.

5.13 Occupational Health and Safety at the Project Site

Construction Phase

The construction works will involve activities and procedures with potential risk to the occupational health and safety of workers and personnel. The potential risks include accidents and injuries. The activities and procedures that can expose workers to potential risks such as accidents or injury or illness include:

- Movement of machinery around the site
- Blasting or rock breaking
- Work in dusty environment
- Work in trenches

Strict adherence to health and safety measures and procedures will minimise (or eliminate) risks of accidents, injury or hazardous developments occurrences.

Mitigation Measures

- A Health and Safety Policy shall be established to guide operations of the facility.
- All construction activities should be conducted in accordance with provisions of the Occupational Health and Safety Act, No. 36 of 2010 and international best practice such as the IFC Performance Standard 4 on Community Health, Safety, and Security and the associated World Bank Environmental, Health and Safety Guidelines (General EHS Guidelines: Occupational Health and Safety);
- Safety rules and induction of visitors should be enforced and complied with by workers, contractors and those coming to site:
- Personal Protective Clothing (PPE) should be issued and used as required by the various classes of the workers on project site;
- Barrier tapes and caution signs should be erected in all potential hazardous areas to prevent injury or loss of life among construction workers
- Where rock blasting will be required, controlled blasting and low density blast charges will be used during blasting operations to minimise on noise disturbance, residual

vibration impacts including flying stones. Blasting mitigation will be adhered to during blasting to avoid injuries.

- No unauthorized person should be allowed on site including workers without appropriate PPE.

5.14 Electrical and Magnetic Field (EMF)

This section presents the electrical and magnetic field impact assessment. The power ratings of the inverters and transformers or their distribution at the site are not known. In addition, the number and distribution of Low Voltage and High Voltage centres are also not known.

The assessment of potential electrical and magnetic impacts on sensitive receptors is mainly based on literature review and site visit of the project site.

Baseline Data

The proposed Round 1 Scaling Solar Zambia project will provide up to a total of 100 MW from two solar plants under a Public Private Partnership Scheme. The power will be transferred to the national grid through the ZESCO substation under construction.

The ZESCO substation will provide electricity to industries and other commercial activities that are being developed at the LS MFEZ and surrounding areas. The substation will comprise the following:

- 2 X 150MVA transformers 330kV/33kV – 3 Bays for MFEZ and 2 Bays for Solar Project.
- 2X 150 MVA transformers 330kV/132kV – 3 Bays to reinforce the 132KV Lusaka transmission ring and one bay spare.

Electromagnetic Fields

Electromagnetic field (EMF) radiation emanates from every electrical equipment including inverters which are a major component of a solar power plant. Studies have substantiated a link between extremely low frequency (ELF) electromagnetic radiation and increased risk of leukaemia, lymphomas and cancer of the brain and nervous system. Power frequency EMF typically has a frequency in the range 50 – 60 Hz and is considered Extremely Low Frequency.

Health Effects

For frequencies up to 100 kHz the main interaction of the electric and magnetic fields with tissue is the induction of currents. Exposure to frequencies above 100 kHz could result in the induction of currents and absorption of sufficient energy to cause significant temperature rises (UNEP/WHO/ICNIRP, 1998).

The health effects for both bands can be divided into two main areas, recognised and uncertain.

Recognised Health Effects

Exposure up to frequencies of 100 kHz

Because the wavelengths for these frequencies are greater than three kilometres it is more than likely that the measurements performed to establish field strengths will be conducted in the near field. There is no fixed relationship between the electric and magnetic fields within the near field. For this reason the effects of the magnetic and electric fields have been considered separately.

Electric Fields

The human body is completely penetrated by the electric field because the wavelengths are quite long in comparison to the dimensions of the body. However, the internal organs will be shielded from these fields because the human body can be a conductor. Therefore the main effects of electric fields are due to surface charges and small skin currents. The biological effects due to induced currents by electric fields are summarised in Table 5.1 (UNEP/WHO/IRPA, 1987).

Table 5.1: Biological Effects Due to Electric Fields of Frequency less than 100 kHz Current

Current Density	Biological Effect
Below 1 mA/m^2	No known effects. The background current densities in most body organs are in this range.
1 to 10 mA/m^2	Subtle biological effects such as changes in calcium metabolism or suppression of melatonin production (controls the day/night rhythm). The background current densities of the heart and brain are in this region
10 to 100 mA/m^2	Clearly demonstrated effects, such as changes in protein and DNA syntheses and in enzyme activity, evident visual and possible nervous effects. The healing process of fractured bones can be accelerated or brought to a standstill
100 to 1000 mA/m^2	Clearly demonstrated effects, such as changes in protein and DNA syntheses and in enzyme activity, evident visual and possible nervous effects. The healing process of fractured bones can be accelerated or brought to a standstill
Above 1000 mA/m^2	Extra systoles and ventricular fibrillation (heart dysfunction) can occur (acute health hazards).

Magnetic Fields

The biological effects due to induced current densities generated by magnetic flux densities from whole body exposure to sinusoidal homogeneous fields are summarised in the Table 5.2 (UNEP/WHO/IRPA, 1987).

Table 5.2: Biological Effects due to Magnetic Fields of Frequency less than 100 kHz		
Magnetic Flux Density	**Current Density**	**Biological Effect**
0.5 to 5 mT	1 to 10 mA/m^2	Minor biological effects have been reported
5 to 50 mT	10 to 100 mA/m^2	There are some well-established effects, including visual and nervous system effects
50 to 500 mT	100 to 1000 mA/m^2	Stimulation of excitable tissue is observed and there are possible health risks
Above 500 mT	Above 1000 mA/m^2	extra systoles and ventricular fibrillation can occur (acute health hazards)

A study on electromagnetic radiation emissions from remote area power supply systems such as Solar Power System has shown that:

- Some power supply system equipment generate electromagnetic radiation levels likely to cause concern (B>0.4μT). However, provided these devices are situated at least 1.6 metres from regularly occupied areas there is no cause for concern.
- The major sources of electromagnetic radiation are generators, inverters and battery banks.
- The main area of concern is ELF magnetic fields emitted by generators, inverters and battery banks.

Electromagnetic Interference (EMI)

In solar power systems a source of EMI is the inverter. The corona of overhead transmission line conductors and high frequency currents of overhead transmission lines may result in the creation of radio noise.

Electric shock

Fatalities and injuries resulting from electric shock are recognised risk.

Impacts due to Electromagnetic Fields during Construction Phase

There will be no impacts due to electromagnetic fields during the construction phase arising from activities on the project site.

Impacts during Operational Phase

The Project shall generally require limited operational activities which mainly includes the following:

- Commissioning tests which usually involve standard electrical tests for the electrical Infrastructure as well as the solar panels. Careful testing at this stage is vital if a good quality Power Plant is to be delivered and maintained.
- Operation and Maintenance (O&M) of the power plant. This mainly includes maintenance activities which can be divided into the preventive and corrective maintenance. The preventive maintenance follows a routine service schedule aimed at preventing faults from occurring and keeping the plant operating at its optimum level. The frequency of the preventive maintenance depends on a number of factors such as the technology selected, environmental conditions of the site, warranty terms and seasonal variances. It contains for example activities like PV module cleaning, inverter servicing, transformer and switchgear servicing and checks on structural integrity of the mounting structure

Activities of operation and maintenance phase and their probable impacts on some sectors of environment are presented in Table 5.3 below:

IDENTIFICATION OF ACTIVITIES AND PROBABLE IMPACTS (O&M)		
Activity	**Sector**	**Probable Impact**
Operation of Inverters	Electricity	Generation of Electromagnetic Radiation
	Communication	Electromagnetic Interference
Operation of Inverters, transformers and switchgear	Electricity	Generation of Electromagnetic Radiation
Operation of nearby ZESCO substation	Electricity	Exposures to Electromagnetic Fields.

Impact of inverters

Exposure to electromagnetic fields from inverters will occur during these activities. This will mainly affect maintenance and operations personnel. Unauthorized personnel trespassing into the Project site may also be affected.

Impact of transformers and switchgear

Exposure to electromagnetic fields from transformers and switchgear will occur during these activities. This will mainly affect maintenance and operations personnel. Trespassing unauthorized personnel into the Project site may also be affected

Impact on maintenance and operations workers

Exposure to electromagnetic fields (EMF) has potential negatives impact to the health and safety of maintenance and operations workers.

Potential health effects of exposure to static and time varying electric and magnetic fields have been studied by many organisations including but not limited to:

1 World Health Organisation International EMF Project

2 UNEP/WHO/ICNIRP (1998). "Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)."

3 EMR KORUMA2010- 2014

One such study summarised as follows:

“In summary, the research done in the common 50-60 Hz range has demonstrated repeatedly that electromagnetic radiation can cause serious, sometimes fatal disease, major psychological and physical stress, and changes in hormones, body weight, and blood chemistry. EMF-induced decreases in immune competency alone have contributed to a wide range of illnesses and psychological disorders that have resulted in vast suffering, loss of productivity, and shortened lives. The current epidemic of numerous degenerative diseases including cancer and leukaemia and other immune dysfunctions is not purely coincidental and often relates directly to the catastrophic effects of uncontrolled electromagnetic radiation in our ever-declining environment”.

Impact on livestock and crops

As well as possible effects on humans, possible effects of EMFs on various animals (for example, cows, sheep, pigs and horses) have been studied a number of times. No detectable effects of EMFs have been found on, for example, health, milk production, fertility, behaviour, and carcass quality.

Most of the research on EMFs and flora and fauna was conducted in the 1970s and 1980s. Since then little research on this subject has been performed, reflecting the general agreement that EMFs have not been shown to have any detectable effects (with the specific exceptions of honey bees in hives and trees growing close enough to lines to be subject to corona).

Impact on Communication

In Solar Power Systems inverters are a source of Electromagnetic interference (EMI). The inverter transforms the direct current (DC) from the solar generator into alternating current (AC). The DC/AC transformation is performed by means of a fast switching, commonly with pulse width modulation of the semiconductor devices at some ten kilo Hertz. Therefore strong interference currents at radio frequencies on the AC and DC lines are expected. These interferences must be suppressed, in order to avoid disturbances in other electronic equipment.

Mitigation Measures

Mitigation measures for exposure to electromagnetic fields include the following:

- Regular measurement of electrical and magnetic radiation levels and taking appropriate measures when exposure exceeds acceptable levels.
- Only trained and certified workers to be allowed to install, maintain or repair electrical equipment.
- Installing a fence around the entire facility to control access and keep out unauthorized personnel.
- Ensure electromagnetic compatibility (EMC) certified inverters are used on the project.

5.15 Deforestation and Climate Change

The potential impact of deforestation and climate change relate to vegetation clearance within the proposed project site footprint and its effect on soils and climate change. The proposed site is a modified ecosystem, which is characterised with some tall grass and some regrowth vegetation arising from previous disturbances such as shifting cultivation and charcoal production. The vegetation is mainly of regrowth nature with species of Miombo woodland dominating. The site was initially dominated with Miombo woodland vegetation but because of human activities, the vegetation has been reduced to open savannah vegetation characterized by grasses, shrubs and secondary regenerating trees.

Construction activities of the proposed project will involve clearing of existing vegetation cover which has already been disturbed. The site is a modified habitat that is in its early stage of woodland recovery from previous disturbances. Deforestation of the site will occur and the impact will be direct and negative. The extent of the impact will be on-site as the clearing will be limited to the boundaries of the project site. The magnitude of the impact is considered to be low and the sensitivity of the resource in terms of its value is considered to be low having been degraded through previous human activities. The overall significance of the impact is therefore considered to be minor.

Removal of vegetation cover on site can potentially result in soil erosion and dust generation. The predicated impacts that may potentially arise may be negative, indirect and localised. The duration of the impact will be short term as it will potentially occur during construction phase. It is probable impact will occur. The significance of the impact is however considered to be low taking into account that the site has already been degraded and there are no flora species considered to be rare, threatened or of any scientific value.

The proposed project is a clean and renewable source of energy for power supply generating far less to no CO_2/MWh as compared to the conventional / fossil–fuel power plant that produces significant CO_2 per MWh generated. For example, bituminous coal produces 938000 kg CO_2/MWh while natural gas produces 54700kg CO_2/MWh to generate100 MWh equivalent power of the proposed project. (US Energy Information Administration[11]). Therefore, the project will not likely to contribute to Green House Gases (GHG) emissions that contribute to negative effects of climate change.

Mitigation Measures

The impact associated with loss of trees (deforestation) at the project site will be minor considering that the site has already been disturbed. The measures to mitigate loss of trees will include:

- Clearing of the site will however be confined to the project boundaries.

Soil erosion processes by wind and rain due to vegetation cover clearance will increase but these will be controlled by:

- Restricting vegetation clearance and excavations activities within the footprint of the project site; and

[11] US energy information Administration https://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11 updated 29 February 2016 and accessed 20th May 2016.

- construction of an effective storm water drainage network and using other well engineering measures that slow /prevent runoff flow and reduce sediment loads movements.

The proposed project is the clean and renewable source of energy for power supply and will not result in GHG emissions that negatively contribute to human induced climate change. Therefore, no climate change abatement mitigation measures are proposed.

Conclusion

The potential impacts anticipated as a result of deforestation and climate change are considered to be minor. The significance of the proposed project on climate change is positive since it will use a clean and renewable source of energy that will not generate Green House Gases (GHG).

5.16 Cumulative impacts

Cumulative impacts are impacts arising from the combination of multiple impacts from existing projects, the project and/or future projects. The industrial and commercial developments that have been earmarked to be carried out at LS MFEZ will result in cumulative impacts associated with the project. These impacts relate to the following:

- Impacts on recharge of the aquifer: other developments within the LS MFEZ will reduce infiltration and groundwater recharge subsequently affecting water supply in Lusaka and base flow into rivers and streams draining out of the Lusaka Dolomite Aquifer. The LS MFEZ area represents 5% of the total aquifer zone (ZEMA, 2014). Despite the area being small climate change risks and increased demand for groundwater from the Lusaka Dolomite will increase the sensitivity of even small reduction in recharge to the system. These effects are likely to be cumulative, arising from proposed developments in the MFEZ.

- Aquifer contamination may arise as a result of other developments that may potentially and indirectly release into the groundwater raw sewage, agricultural products, wastewater, hydrocarbons effluent and leakages. The impacts associated with potential aquifer contamination will be within the LS MFEZ as well as the central Lusaka groundwater source areas.

- Noise and vibration impacts are likely to increase in the short term during the construction works. These will be short term and localised in nature and are reversible.

- Air quality is likely to reduce in the short term (dust emission during construction) to long term (gaseous pollutants emission during operation) because of the future developments to do with manufacturing industries that will be established in the economic zone.

- Solid waste conditions will cumulatively increase as the LS MFEZ is developed. The proposed project will also contribute to generation of solid waste throughout its development phases. This will cumulatively contribute to waste generation within the LS MFEZ with the potential impact of overwhelming planned centralised waste management facilities at the site.

- Traffic congestion and its associated negative effects will increase along the access roads to economic zone (Leopards Hill Road and Inner Ring Roads) as construction and operations of facilities in the LS MFEZ peaks up. These will negatively and cumulatively

result in reduced road safety along the access roads and may also negatively affect the zone and its expected economic multiplier effects.

- Cumulative positive socio-economic impacts relating to employment opportunities, capacity building and skills transfer for skilled and unskilled workers will arise and will be incremental as the economic zone is developed.

6 Environmental and Social Management Plan (ESMP)

6.1 Introduction

This section presents the Environmental and Social Management Plan (ESMP) for the proposed Ngonye Solar PV Project located within the Lusaka South Multi-facility Economic Zone and partly on land currently owned by the Ministry of Tourism and Arts (See Annex 3 and 4 for letters of on objection from the Ministry of Tourism and Arts and the Ministry of Finance concerning the use of additional land for Solar PV project development). A copy of the Certificate of Title held by the Minister of Finance for the additional 11 hectares of land is presented in Annex 5 of this Report. The impacts and risks that have been predicted to occur during the project development phases will be mitigated through the implementation of the ESMP (Tables 6.2, 6.3 and 6.4). The plan highlights the roles and responsibilities for its implementation as well as monitoring and auditing requirements. The mitigation measures incorporated in the plan have been defined in line with the identified environmental and social impacts and risks summarised in Table 6.1. This has been done in order to avoid or minimise potential adverse environmental and social impacts and risks, and to enhance benefits arising from project development phases.

6.2 Objectives

The ESMP has been prepared to meet the requirements of Zambian environmental legislations as well as the IFC / World Bank Group policies, guidelines and standards. It covers environmental and social management issues and impacts associated with the proposed Project. The overall objectives of the ESMP include:

- Ensuring compliance with the requirements of the Zambian environmental management regulations and other applicable regulations including the Project Company procedures;
- Ensuring compliance with the requirements of the IFC/World Bank policies, guidelines, standards and other requirements;
- Ensuring and verifying environmental performance through monitoring, assessing and controlling potential impacts and risks; and
- Responding to changes in the operations and activities of the Project.

The ESMP provides relevant authorities (local and national) with a framework to confirm compliance with applicable policies and requirements. It should be noted that the plan is a dynamic or flexible document and will be reviewed and periodically updated, as required, throughout the project lifetime. This is of significant importance in order to provide for new and changing circumstances and continual improvement. The updates of the ESMP will be done in consultation with the relevant authorities where necessary.

6.3 ESMP Implementation and Organisation

IDC is the project proponent and has awarded Enel Green Power S.p.A a Contract to finance, construct and operate the Ngonye Solar PV Power Plant at the proposed project site. Therefore, with regard to implementation of the ESMP, IDC, being the project proponent, has senior management commitment to ensure that the level of environmental and social performance identified in the ESMP for the proposed project is achieved while the EPC Contractors will play a central role in achieving the level of performance required. The ESMP will be implemented by the Contractors as part of the day to day management of the

contract and operational procedures. Adequate resources will need to be allocated based on the assessment and review of actions required to manage the potential impacts and risks of the project.

In order to ensure that management action / mitigation measures are implemented during the project development phases, the Contractors will identify personnel that will have specific responsibilities for environmental management and who will form part of the ESMP implementation team.

6.3.1 ESMP Implementation

Each Contractor will appoint a competent person who will have overall environmental responsibility during Project planning, construction and long-term operation. He / She will have the responsibility of coordinating other members in the ESMP Team, liaising with sub-contractors, clients, regulators and the general public concerning environmental and social issues pertaining to the proposed project.

The competent person will also have day to day responsibility for ensuring that environmental management measures are implemented and complied with. He / She will be responsible for monitoring environmental performance, identifying nonconformity and recommending corrective action.

He / she will have direct contact with the persons managing environmental and social issues within the contractor organisation and with them will identify measures to control operations to comply with the commitments made in the ESMP. This will include development and implementation of appropriate procedures and provision of training.

6.3.2 Training

The ESMP includes commitments for capacity building and technology transfer to ensure consistent and acceptable environmental and social performance during the construction and operation phases of the Project. IDC (the project proponent) will have to inform their EPC Contractors of the commitments made in the ESMP regarding capacity building and skills transfer to local skilled specialists and experts including unskilled workers. The necessary skills and information required to achieve the required level of performance should be provided to local specialists to build national capacity. The training aspect will, as far as possible, need to be integrated into routine operational briefings, inductions and procedures.

6.4 Performance Targets and Monitoring

The ESMP includes performance targets. The targets have been set to achieve management actions (mitigation measures) / objectives outlined in the ESMP (Table 6.2). Monitoring of performance will be carried out to assess compliance with the requirements. Should there be any noncompliance issues, appropriate corrective action should be taken by the Contractor to ensure compliance.

6.5 Environmental Auditing

The EPC Contractors will undertake environmental auditing and inspections of all its operations. This will be done to ensure that environmental monitoring activities that will be undertaken at the project site are accurate and relevant to meeting the environmental management objectives of the proposed Project.

The auditing programme will also serve the purpose of measuring the environmental performance, promoting continual improvement in the environmental management of the operations and activities at the proposed Solar PV plant. In addition, audit results will help the EPC Contractor to demonstrate compliance with IFC/World Bank Group requirements and the national legislation and regulations.

The operations of the proposed Solar PV plant will therefore be subjected to internal audits, which shall be compliant with IFC requirements, the Project Proponent procedures, as well as applicable Zambian environmental regulatory requirements.

External environmental audits will be conducted by relevant regulatory agencies such as the Zambia Environmental Management Agency and Energy Regulation Board. Other independent auditors from IFC/World Bank will undertake independent audits of the operations of the proposed solar plant.

6.6 Reporting

The Contractors will be required to report to project proponent on environmental, health and safety issues pertaining to the construction and operations of the Solar PV Plant. The Contractors will prepare reports on the issues above and others for submission to the project proponent. The reports should address compliance issues relating to commitments made in the ESMP as well as any challenges encountered and the corrective action recommended / taken. The Contractors will also be required to be compliant with IFC reporting requirements.

6.7 Contractor Management (contractual commitments)

The Contractors shall play a central role in ensuring that the commitments made in the ESMP are implemented and achieved in compliance with IFC and Zambian legislative requirements. The requirement for implementation of the ESMP for the proposed project, including roles and responsibilities, will be included in contractual terms and conditions for the Contractors. The project proponent shall play an oversight role of ensuring that the environmental and social performance of the Contractors is consistent with IFC requirements, Zambian legislative requirements and project proponent's principles.

The environmental liabilities of the proposed project during the 25 year operating period will be borne by the project company (Contractors). It will be their responsibility to address the environmental liabilities of project.

Table 6.1: Summary of Environmental and Social Impacts and Risks

Environmental Aspect/Issue	Affected Environment	Potential Impact	Type of impact	Nature of predicted impact	Timing of Impact	Duration of Impact	Frequency	Extent of impact	Likelihood of Impact	Magnitude of impact	Receptor / Resource Sensitivity	Significance of impact
Clearing of vegetation at the project site.	Water Resources	Risk of erosion of solar PV support structures and foundations arising from increase in surface runoff during the rainy season or storm rainfall than infiltration into the ground.	Indirect	Negative	Construction / Operation	Short to long term	Periodic (seasonal)	Local	Likely	Low	High	Minor
Conversion of the existing vegetation cover to bare or impervious surface at the project site	Water Resources	Flood risks arising from increased surface runoff and reduced infiltration into the groundwater regime with potential to cause damage to solar infrastructure	Indirect	Negative	Operation	Long term	Periodic (seasonal)	Local	Unlikely	Negligible	High	Minor
Storage and handling of fuels and oils during the construction and operational phases of the project.	Water Resources	Potential groundwater contamination through accidental spillage of fuels and oils on site.	Indirect	Negative	Construction / Operation	Short to long term	Periodic	Local	Unlikely	Low	High	Moderate
Conversion of the existing vegetation cover to bare or impervious surface at the project site as a result of construction works	Water Resources	Reduced recharge of groundwater aquifer.	Direct	Negative	Operation	Long term	Periodic	Regional	Likely	Low	High	Moderate
Site clearing and movement of construction equipment on unpaved surfaces.	Soils and geology	Fugitive dust generation impacting on the health of workers and the environment	Indirect	Negative	Construction; dry months	Short term	Once off	On-site	Likely	Medium	High	Major

Environmental Aspect/Issue	Affected Environment	Potential Impact	Type of impact	Nature of predicted impact	Timing of Impact	Duration of Impact	Frequency	Extent of impact	Likelihood of Impact	Magnitude of impact	Receptor / Resource Sensitivity	Significance of impact
Site clear and construction activities	Soils and geology	Irregular soil profile resulting in unstable foundations	Indirect	Negative	Construction stage	Short term	Once off	On-site	Likely		High	
Rock blasting on site to level the ground	Soils and geology	Noise disturbance arising from rock blasting	Indirect	Negative	Construction	Short term	Once off	On-site	Likely	Medium	Medium	Moderate
Rock blasting on site to level the ground	Soils and geology	Residual vibration affecting sensitive receptors.	Indirect	Negative	Construction	Short term	Once off	Local	Likely	Medium	Low	Minor
Development of Sinkholes	Soils and geology	Threat to stability of Solar PV surface structures	Indirect	Negative	During and after construction	Short/ long term	Periodic	Local	Likely	High	High	Major
Construction works at the project site	Soils and geology	Safety risk to workers and equipment caused by slippery ground during wet months	Indirect	Negative	Construction; rainy season	Short term	Periodic during rainy season	On-site	Likely	Low	Medium	Minor

Environmental Aspect/Issue	Affected Environment	Potential Impact	Type of impact	Nature of predicted impact	Timing of Impact	Duration of Impact	Frequency	Extent of impact	Likelihood of Impact	Magnitude of impact	Receptor / Resource Sensitivity	Significance of impact
Construction works at the project site	Soils and geology	Unstable surface structure foundation caused by rock weathering	Indirect		Operation	Long term	periodic	On-site	Likely	Medium	Low	Minor
Operations of the solar power plant.	Project site	Risk / threat to electrical equipment due to potential flood / poor drainage.	Indirect	Negative	Operation	Long term	periodic	Local	Likely	Medium	Medium / Low	Moderate to minor
Installation of infrastructure at the project site	Soils and geology	Unstable structures caused by floating rock boulders in sub soil.	Indirect	Negative	Construction / operations	Short / long term	periodic	On-site	Likely	High	High	Major
Installation of infrastructure at the project site	Soils and geology	Stability threats to heavy surface structures due to underground caverns in base rock formation.	Indirect	Negative	Operation	Long term	periodic	On-site	Likely	High	High	Major
Construction and operation works on site.	Soils and geology	Risk / threat to surface structures due to formation of swallow holes and possible underground stream in subsurface rock formation.	Direct	Negative	Operation	Long term	periodic	On-site	Likely	High	High	Major
Site clearance and levelling	Air quality	Dust generated may affect workers on site	Direct	Negative	Construction	Short Term	Once off	On site	Unlikely	Low	High	Moderate
Transportation of the plant components	Air quality	Exhaust emissions from the trucks can affect people	Direct	Negative	Construction	Short Term	Once off	Local	Unlikely	Negligible	High	Minor

Environmental Aspect/Issue	Affected Environment	Potential Impact	Type of impact	Nature of predicted impact	Timing of Impact	Duration of Impact	Frequency	Extent of impact	Likelihood of Impact	Magnitude of impact	Receptor / Resource Sensitivity	Significance of impact
Construction of a small control building	Air quality	Dust generated from the works can affect the workers on site	Direct	Negative	Construction	Short Term	Once off	On site	Unlikely	Low	High	Moderate
Fixing of the module footings and support structures into the ground	Air quality	Dust generated on site may affect works on site	Direct	Negative	Construction	Short Term	Once off	On site	Unlikely	Low	Medium	Minor
Construction of internal roads at the project site.	Ai quality	Dust generated can affect works and people in the locality, visitors to the Lusaka National Park	Direct	Negative	Construction	Short Term	Once off	Local	Likely	Low	High	Moderate
Use of Heavy equipment on site	Air Quality	Emission of exhaust gases including CO, NOx which may affect workers	Direct	Negative	Construction	Short Term	Once off	Local	Unlikely	Negligible	High	Minor
Regular cleaning of the modules	Air Quality	Exposure of workers to dust potentially posing health effects.	Direct	Negative	Operation	Long term	Periodic	Local	Unlikely	Low	High	Moderate
Demolition of site buildings at decommissioning.	Air Quality	Some dust will be generated during decommissioning activities.	Direct	Negative	Decommissioning	Short term	Once off	Local	Unlikely	Low	High	Moderate
Restore site to pre-project conditions	Air Quality	Dust maybe generated that affects mainly workers.	Direct	Negative	Decommissioning	Short term	periodic	Local	Unlikely	Low	High	Moderate

Environmental Aspect/Issue	Affected Environment	Potential Impact	Type of impact	Nature of predicted impact	Timing of Impact	Duration of Impact	Frequency	Extent of impact	Likelihood of Impact	Magnitude of impact	Receptor / Resource Sensitivity	Significance of impact
Site clearance and levelling, Internal roads	Noise	Potential noise from heavy equipment may affect workers on site.	Direct	Negative	Construction	Short term	Once off	Local	Likely	Low	High	Moderate
Transportation of the plant components	Noise	Noise nuisance for people in route	Direct	Negative	Construction	Short term	Once off	Local	Unlikely	Low	High	Moderate
Construction of a small control building	Noise	Noise can affect the workers on site when rock breaking machines and other machines are used on site	Direct	Negative	Construction	Short term	Once off	On site	Likely	Low	High	Moderate
Fixing of the module footings and support structures into the ground	Noise	Some noise will be generated from equipment used in the works that can affect workers on site	Direct	Negative	Construction	Short term	Once off	On site	Unlikely	low	High	Moderate
Supervision of the electricity production	Noise	Inverters will generate some noise that may affect the workers	Direct	Negative	Operation	Long term	Periodic	On site	Unlikely	Low	High	Moderate
Clearing of vegetation from under and around the modules	Noise	Vegetation clearing may generate some noise from small machinery but will only affect people on site	Direct	Negative	Operation	Long term	Periodic	Local	Unlikely	Negligible	Medium	Negligible

Environmental Aspect/Issue	Affected Environment	Potential Impact	Type of impact	Nature of predicted impact	Timing of Impact	Duration of Impact	Frequency	Extent of impact	Likelihood of Impact	Magnitude of impact	Receptor / Resource Sensitivity	Significance of impact
Removal from site of used solar modules,	Noise	Some noise will be generated by loading and trucking equipment and may affect workers on site.	Direct	Negative	Decommissioning	Short term	Once off	Local	Unlikely	Negligible	Medium	Negligible
Demolition of site buildings	Noise	Some impact noise will be generated that may affect workers on site and nearby communities.	Direct	Negative	Decommissioning	Short term	Once off	Local	Likely	Negligible	High	Minor
Restore site to pre-project conditions	Noise	The equipment involved in this activity will generate some noise to the workers and some surrounding community.	Direct	Negative	Decommissioning	Short term	Periodic	Local	Likely	Low	High	Moderate
The clearing of areas for installation of the scaling solar infrastructure may impact on the existing modified habitat.	Biodiversity	Removal of vegetation (removal of tree species)	Direct	Negative	Construction	Long term	One-off / infrequent	Local	Certain	Low	High	Moderate / Low
The clearing of areas for installation of the scaling solar infrastructure may impact on the existing modified habitat.	Biodiversity	Loss of vegetation (removal of trees affecting biodiversity status)	Direct	Negative	Construction	Long term	One-off / infrequent	Local	Certain	Medium	Low	Minor
The clearing of vegetation at the project site.	Biodiversity	Loss of wildlife habitats	Direct	Negative	Construction	Long term	One-off / infrequent	Local	Certain	Medium	Low	Minor

Environmental Aspect/Issue	Affected Environment	Potential Impact	Type of impact	Nature of predicted impact	Timing of Impact	Duration of Impact	Frequency	Extent of impact	Likelihood of Impact	Magnitude of impact	Receptor / Resource Sensitivity	Significance of impact
Construction activities leading to exposure, unearthing or removal of unknown subterranean and chance surface archaeological finds during construction phase of the solar power project.	Archaeology and cultural heritage	Damage to archaeological finds that may the exposed or unearthed during construction works	Direct	Negative	Construction	Permanent	One -off	Local	Likely	Low	Medium	Minor
Construction activities leading to exposure, unearthing or removal of unknown subterranean and chance surface archaeological finds during construction phase of the solar power project.	Archaeology and cultural heritage	Loss of cultural and natural heritage resources in the Project area	Indirect	Positive	Towards end of construction	Permanent	One -off	Regional	Likely	Medium	High	Major
Construction and operation of the solar PV plant	Socio-economic (employment)	Employment opportunities created for both skilled and non-skilled labour and. multiplier opportunities for employment in support sectors	Direct / Indirect	Beneficial	Construction	Short to Long term	Periodic	Local / National	Likely	High	High	Major
Construction and operation of the solar PV plant	Socio-economic (revenue in national economy)	Project contribution to the local and national economy through its multiplier effect	Direct / Indirect	Beneficial	Construction	Short to Long term	Periodic	Local / National	Likely	High	High	Major
Construction and operation of the solar PV plant	Socio-economic (capacity building and technology transfer)	Capacity building and technology transfer to local contractors, skilled manpower and unskilled workers.	Direct	Beneficial	Construction / Operation	Short to Long term	Periodic	Local / National	Certain	High	High	Major

Environmental Aspect/Issue	Affected Environment	Potential Impact	Type of impact	Nature of predicted impact	Timing of Impact	Duration of Impact	Frequency	Extent of impact	Likelihood of Impact	Magnitude of impact	Receptor / Resource Sensitivity	Significance of impact
Haulage vehicles carrying materials to site have a potential to increase traffic and decrease road safety especially on access routes	Traffic and road infrastructure (Road traffic and safety)	Reduced safety on public access roads due to increase in vehicular traffic (potential increase in traffic related accidents)	Indirect	Negative	Construction	Short to Long term	Periodic	Local	Likely	Low	High	Moderate / Minor
Occupational health and safety of workers working on site.	Occupation Health and Safety	Reduced occupational health and safety	Indirect	Negative	Construction / Operation	Short to Long term	Periodic	On-site	Possible	Medium	High	Major
	Socio-economic (Community, Health Safety and Security)	Risk of accident involving members of the general public through unauthorised access to the project site.	Direct	Negative	Construction / Operation	Short to Long term	Periodic	On-site	Unlikely	Low	High	Moderate / Low
Lack of or inadequate good water supply and sanitation facilities	Community, Health Safety and Security	Risk of water borne diseases due to lack of potable water and sanitation facilities	Direct	Negative	Construction / Operation	Short to Long term	Periodic	Local	Unlikely	Low	High	Moderate / Low
Employment opportunities at the project site	Socio-economic	Influx of population of job seekers on site posing health and security risks and leading to unplanned housing/structures and commercial activities around the project area.	Direct	Negative	Construction	Short term	Periodic	Local	Possible	Medium	High	Major

Environmental Aspect/Issue	Affected Environment	Potential Impact	Type of impact	Nature of predicted impact	Timing of Impact	Duration of Impact	Frequency	Extent of impact	Likelihood of Impact	Magnitude of impact	Receptor / Resource Sensitivity	Significance of impact
Construction projects/sites have been known to promote risky sexual behaviour. This can contribute to an escalation of new STIs, including HIV/AIDS in the local population	Socio-economic	Risky sexual behaviour among the population leading escalation	Direct	Negative	Construction / Operation	Short to Long term	Periodic	Local / National	Possible	High	High	Major
Operation of the solar power plant	Socio-economic	Creation of employment opportunities and multiplier effects on support sectors	Direct	Beneficial	Operation	Long term	Periodic	National	Possible	High	High	Major
Occupational Health and Safety	Occupational health and safety.	Risks to workers health and safety during the operation and maintenance activities of the project as they are exposed to Electromagnetic fields	Indirect	Negative	Operation	Long term	Periodic	Site	Likely	Medium	Medium	Minor
Operations of the solar plant	Community Health, Safety and Security	Trespassing of unauthorized personnel into the Project site could result in potential risks from several hazards (e.g. electric shock, thermal burn hazards, exposure to EMF).	Indirect	Negative	Operation	Long term	Periodic	Site	Likely	Medium	Medium	Minor
Operations of the solar plant	Communication	Electromagnetic field interfering with communication.	Indirect	Negative	Operation	Long term	Periodic	Site	Likely	Medium	Medium	Minor
Changing land use of the additional 11 ha of land from being part of the national park to development of a solar farm for power generation.	Land	Reduction in land meant for the Lusaka National Park.	Direct	Negative	Construction & operation	Long term	Once off	On-site	Likely	Low	Low	Minor

Environmental Aspect/Issue	Affected Environment	Potential Impact	Type of impact	Nature of predicted impact	Timing of Impact	Duration of Impact	Frequency	Extent of impact	Likelihood of Impact	Magnitude of impact	Receptor / Resource Sensitivity	Significance of impact
Haulage vehicles carrying materials to site have a potential to increase traffic and decrease road safety especially on access routes	Traffic and road infrastructure	Reduced safety on public access roads and onsite due to increase in vehicle traffic (potential increase in traffic-related accidents and injuries)	Indirect	Negative	Construction	Short to Long term	Periodic	Local	Likely	Low	High	Moderate / Minor
Clearing of vegetation and installation of solar PV modules.	Landscape and Visual Amenity	Visual intrusion and disruption of the aesthetics.	Indirect	Negative	Construction / Operation	Long-term	Once off	Local	Likely	Low	Medium	Minor

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
Air Quality								
Site clearing, levelling and construction of internal access roads and other construction works.	Dust generated can affect workers' health and safety on site and sensitive receptors in nearby locality and visitors to the Lusaka National Park	• Dust generation on unpaved access roads and work areas should be controlled by application of water as need arises. • Appropriate speed limits should be set to minimise dust generation from vehicles moving on unpaved site access roads. • The workers should be trained on handling construction materials and debris to reduce fugitive dust emissions. • Construction workers at risk of being exposed to significant dust emissions should be provided with adequate personal protective equipment (PPE).	No visible dust plumes along access roads and construction sites. Reduced fugitive dust emissions along areas accessed by sensitive receptors and Reduced risks to health and safety of personnel and other sensitive receptors. Construction workers provided with approved dust protection devises.	Daily visual monitoring of dust emissions along access roads and during earthworks and construction activities. Daily safety checklist	Pre and during Construction phase	Contractor	Covered in the Total project Cost.	World Bank General EHS Guidelines: Occupational Health and Safety; Occupational Health and Safety Act 2010 of the Laws of Zambia; IFC PS 2 - Labour and Working Conditions.
Operation of construction equipment and machinery and transportation of solar plant	Exhaust emissions from the construction equipment and	• Construction equipment and vehicles used for transportation of plant equipment should be adequately maintained and inspected to	Well maintained vehicles used during construction and transportation of plant equipment. Reduced risks to	Daily visual monitoring of exhaust emissions during earthworks and other	During Construction phase	Contractor	Cover in the Total project Cost.	World Bank General EHS Guidelines: Occupational Health and Safety;

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
components.	machinery.	minimise exhaust emissions.	health of personnel due to exposure to exhaust emissions. Record of vehicle maintenance.	construction activities. Vehicle maintenance records.				Occupational Health and Safety Act 2010 of the Laws of Zambia; IFC PS 2 - Labour and Working Conditions.
Archaeology and cultural heritage								
Construction activities leading to exposure, unearthing or removal of unknown subterranean and chance surface archaeological finds.	Potential damage to archaeological finds that may be exposed or unearthed (below ground archaeological deposits) during construction works	• A 'chance find' procedure will be developed and implemented to address and protect cultural heritage finds that may be discovered during the construction and operation phases of the project. • Construction activities in the immediate vicinity of the discovery shall be stopped if any archaeological or ancient prehistoric materials are chance found during construction works. • In an event that archaeological or ancient prehistoric materials are discovered, the East Central Regional	• Preservation of any discovered artifacts on site.	• At least one site inspection immediately after chance find. • Creating awareness among personnel on site about chance find procedures should they encounter archaeological or prehistoric materials. Quarterly during construction and operation phases.	Construction and Operation phase	Contractor / NHCC	Covered in the Total project Cost.	IFC Performance Standard 8: Cultural Heritage; National Heritage and Conservation Act, CAP 173 of the Laws of Zambia.

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		Headquarters of National Heritage Conservation Commission (NHCC) should be contacted for professional advice and rescue excavations.						
Construction and operations of the project.	Loss of irreplaceable heritage material (cultural and natural heritage resources) in the Project area	• In an event that irreplaceable heritage material is found, an Information Centre should be constructed in consultation with NHCC to exhibit the cultural and natural heritage, storylines and exhibition for education, research, adventure and posterity within or outside Project Area. Collection and display / exhibition of heritage artifacts and fossils.	Preservation of any discovered artifacts on site	Maintenance of an information centre where any discovered artifacts will be preserved. Construction of information centre at occurrence and frequency of maintenance of centre to be done annually.	Construction and Operation phase	Contractor / IDC	-	IFC Performance Standard 8: Cultural Heritage; National Heritage and Conservation Act, CAP 173 of the Laws of Zambia.
Biodiversity								
Clearing of areas for installation of the scaling solar infrastructure may impact on the existing modified habitat.	Loss of vegetation (tree species) and natural habitats for small mammals, birds and insects.	• Clearing of vegetation should only be confined to areas where the solar infrastructure will be installed to minimise loss of vegetation and wildlife habitats.	No clearing of vegetation beyond the confines of the project footprint.	Daily visual inspection of clearing activities during the construction phase.	Construction phase	Contractor for clearing works	Covered in the total project cost	IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		• The construction workers should be provided with guides and extents of areas to be cleared and site clearing works should be monitored. • Burrowing animals likely to be noted on site during the construction and operation phases of the project will be removed from the site and the burrows filled.						Zambian Forest Act, 1973.
Community, Health Safety and Security								
Construction and operation of the solar PV plant.	Risk of accidents involving members of the public through unauthorised access to the project site.	• The project site should be enclosed within a security perimeter and no unauthorized persons should be allowed access to the site. • Caution signs should also be placed around the site to prevent occurrence of accidents and injuries. • The community should be sensitized on the dangers of trespassing at the project site so as to	Zero accidents or injuries on site involving members of the general public.	Security surveillance and community engagement to sensitize affected members of the community on their health, safety and security. Daily for security surveillance and patrol. Community engagement - quarterly	Construction and Operation phase.	Contractor	Covered in the Total project Cost.	World Bank EHS Guidelines: Community Health and Safety; IFC PS 4: Community Health Safety and Security; Occupational Health and Safety Act, No. 36 of 2010 of the Laws of Zambia.

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		avoid potential accidents that might arise from unauthorized access to the site. • Reasonable steps should be taken in the provision of security and in particular the use of force and establish appropriate conduct towards workers and affected communities. • A grievance mechanism should be put in place for the Affected Communities to express concerns about the security arrangements and acts of security personnel.						
Lack of or inadequate good water supply and sanitation facilities on site.	Risk of water borne diseases due to lack of potable water and sanitation facilities	• Safe and clean water and good sanitation facilities should be provided to construction workers to prevent an outbreak of waterborne diseases among them which can also affect the surrounding communities.	Zero occurrence of water borne diseases among the workers.	Safe and clean drinking water provided on site daily. Operable sanitation facilities provided on site.		Contractor	Covered in the total project cost	IFC Performance Standard 4: Community Health, Safety and Security; Public Health Act, Cap 295

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
Landscape and Visual Amenity								
Clearing of vegetation and installation of solar PV modules.	Visual intrusion and disruption of the aesthetics.	• Low visual reflective solar modules with anti-reflective coating (ARC) that reduces reflectance from the solar PV modules should be used; • Low level solar module mount design system (2 - 3 metres) that will not disrupt the aesthetic view of the project /surrounding areas should be used on site: • A perimeter buffer of trees and grass vegetation (where possible) along the project site boundaries should be left to screen sensitive viewing areas such as sides of the road to the Lusaka National Park entrance gate and the area along the eastern boundary area where there are some agriculture holdings. • General cleanliness and good housekeeping at	Visual intrusion and disruption to aesthetics reduced.	Annual monitoring of existing vegetation screening at the site and ensuring that it is appropriately maintained without providing shades onto the Solar PV modules and daily visual inspection of cleanliness and housekeeping.	Construction phase	Contractor	Covered in the total project cost	-

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		the site should promoted be at all times.						
Noise and vibration								
Construction activities on (site clearance and levelling, internal roads construction), transportation of the plant components to site.	Potential noise disturbance from heavy equipment, may affect workers on site.	• Regular maintenance on all equipment, vehicles and machinery should be performed to minimise noise; • Provision of adequate PPE such as ear plugs to site workers likely to be exposed to high noise levels. • Appropriate transportation routes should be selected.	Zero noise disturbance complaints received. Reduced risk to health and safety of personnel due to exposure to high noise levels. Compliance with IFC Noise Level Guidelines for industrial receptors. Workers at risk of being exposed to occasional high noise levels provided with approved ear protection devises.	Noise monitoring during the construction (e.g. during rock blasting) using a portable noise level meter to demonstrate compliance. Daily safety checklist to ensure workers have approved PPE. Frequency of noise monitoring to be as and when rock blasting is planned.	Construction Phase	Contractor	Covered in the project cost.	World Bank General EHS Guidelines: Occupational Health and Safety; Occupational Health and Safety Act 2010 of the Laws of Zambia; IFC PS 2 - Labour and Working Conditions.
Construction works using pile drivers, earth moving and excavation equipment including blasting of rocks.	Disturbing sensitive receptors and causing structural damage arising from blasting and other construction works.	• The contractor should at all times, carry out all work in such a manner as to keep any disturbance from vibration to a minimum especially when working in close proximity to receptor areas. • Where appropriate,	No disturbing vibration impacts experienced following blasting and other construction works. Operators of vibrating equipment provided with appropriate PPE.	Inspection of construction equipment. Conducting safety checks prior to operating vibrating machinery and other equipment. Initially on procurement or	Construction Phase	Contractor	Covered in the total project cost.	World Bank General EHS Guidelines: Construction and Decommissioning; Occupational Health and Safety Act 2010 of the Laws of Zambia.

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		bored piling techniques should be considered in preference to impact piling to minimise vibration impacts. • Operators of vibrating hand-held machinery should be provided with appropriate PPE (e.g. protective gloves) and should be given suitable breaks from using such equipment to reduce the impacts of vibration.		hiring equipment and daily inspections to ensure no vibration impact are experienced				
Rock blasting on site to level the ground prior to installation of Solar modules and other infrastructure.	Noise disturbance and residual vibration impact arising from rock blasting on site.	• Low density blast charges should be used, if required, during rock blasting operations to minimise on noise disturbance and residual vibration impacts.	No noise disturbance and residual vibration impacts experienced in the area.	Monitoring implementation of blasting procedures and ensure that approved low density charges are used with approved blasting permit. Record of inspections prior to rock blasting. Frequency: Immediately before and after any blasting operation.	Construction Phase	Contractor	Covered in the project cost.	World Bank Group EHS Guidelines: Hazardous Material Management, Construction and Decommissioning; Zambian Explosives Act CAP 115.

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
Occupation Health and Safety								
Occupational health and safety of workers working on site.	Reduced occupational health and safety among workers	• A Health and Safety Policy shall be developed and implemented by the contractor to guide construction and operations of the facility. • All construction activities should be conducted in accordance with provisions of the local legislation and international best practices (General EHS Guidelines: Occupational Health and Safety); • Safety rules should be enforced and complied with by workers, contractors and those coming to site: • Personal Protective Clothing (PPE) should be issued and used as required by the various classes of the workers on project site; • Barrier tapes and caution signs should be erected	Risks of preventable accidents that can potentially result in injuries and/or fatalities substantially reduced.	Daily risks identification and implementation of management measures conducted prior to commencement works.	Construction and Operation Phase	Contractor	Covered in the total project cost	World Bank EHS Guidelines: Occupational Health and Safety; IFC PS 4: Community Health Safety and Security; IFC PS1; IFC PS 2; IFC PS 5; Occupational Health and Safety Act, No. 36 of 2010 of the Laws of Zambia.

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		in all potential hazardous areas to prevent injury or loss of life among construction workers; • No unauthorized person should be allowed on site including workers without appropriate PPE.						
Construction works at the project site	Safety risk to workers and equipment caused by slippery ground during wet months.	• Resuming work immediately after rains should be avoided. Work risk analysis should be undertaken before resuming. Blast should be applied on road networks.	Safe working procedures for wet slippery surfaces developed and implemented.	Permit to resume works to be implemented after a storm event and work risk analysis records. Frequency: As and when required.	Construction and Operation Phase	Contractor	Covered in the total project cost	World Bank EHS Guidelines: Occupational Health and Safety; Occupational Health and Safety Act 2010 of the Laws of Zambia; IFC PS 2 - Labour and Working Conditions.
Socio-economic								
Employment opportunities at the project site arising from construction works.	Influx of population of job seekers on site posing health and security risks and leading to unplanned	• Enforcement of relevant by-laws laid down by the respective Lusaka City Council and Kafue District Councils with the help of IDC to prevent mushrooming of	Development of any unplanned structures and / or activities within the project site and immediate surroundings prevented.	Quarterly Security surveillance and Community Engagement to sensitize on matters relating to development	Construction and Operation Phase	IDC / Lusaka City Council / Kafue District Council.	Covered in the total project cost	IFC PS 4: Community Health Safety and Security; Urban and Regional Planning Act, 2015

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
	housing / structures and commercial activities around the project area.	unplanned structures and activities.		of unplanned structures and activities.				
Construction sites have been known to promote risky sexual behaviour.	Risky sexual behaviour among the population leading to escalation of new STIs including HIV/AIDS in the local population and among the workforce.	• Developing an HIV/AIDS Policy by the Developer to be adhered to during the construction and operation phases of the project. • Sensitization programs on preventing the spread of STIs and HIV/AIDS for project workers including contractors and suppliers. • Provision of condoms (including Female Condoms) in places where they can be easily accessed such as toilets. • Education programs on fighting stigma of those infected with HIV/AIDS	HIV/AIDS Policy developed and implemented; Sensitisation / Education programmes on HIV/AIDS conducted for contractors and suppliers; Accessibility to condoms.	Record of sensitisation / education programmes undertaken including the number of people sensitised / trained on STI and HIV/AIDS. Frequency: Bi-annually	Construction phase	Contractor	Covered in the total project cost	IFC Performance Standard 4: on Community Health, Safety and Security. Public Health Act, Cap 295.

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
Construction of the Solar PV plant	Capacity building and technology transfer to local contractors, skilled manpower and unskilled workers.	• Local contractors, skilled specialists and unskilled workers should be used to benefit from technology and skills transfer during construction and operation of the solar plant. • Appropriate training should be provided to all local contractors, skilled manpower and unskilled workers to enhance expected project benefits.	Skills transferred to local expert.	Bi-annual skills training for locals with assistance from local learning and construction institutions. Number of local people trained.	Construction phase	Contractor / IDC	-	IFC Performance Standard 2: Labour and Working Conditions.
Construction of the Solar PV plant	Employment opportunities created for both skilled and non-skilled labour and. multiplier opportunities for employment in support sectors.	• The contractor, where possible, should employ members of the local communities and local experts to maximize on the benefits of employment opportunities. The jobs for which local people qualify (including non-technical and technical) will be as much as possible be offered to the local people.	Increased employment opportunities leveraged to the local community	Record of employment, annual reports on IDC / Solar Plant Operators. Frequency: Bi-annually.	Construction and operation phase	Contractor / IDC	-	IFC Performance Standard 2 - Labour and Working Conditions; Zambian Employment (Amendment) Act No. 15 of 2015.

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
Construction of the solar PV plant	Project contribution to the local and national economy through its multiplier effect	• Procurement of services and locally produced raw materials from local contractors and local companies should be done during the construction phase, where possible, to maximise on the benefits.	Increased participation of the local entrepreneurs and companies in the provision of services.	Annual reports on IDC / Solar Plant Operators	Construction and operation phase	Contractor / IDC	-	IFC Performance Standard 2: on Labour and Working Conditions.
Soils and geology								
Construction works at the project site	Unstable surface structure foundation caused by rock weathering.	• Detailed and *specific surface mapping,* ***geotechnical investigations for foundation design*** should be undertaken at the project site prior to installation of structures.	Detailed sub-surface study included in the design and weathering zones identified	Survey monitoring (ground subsidence) of all installations prior to construction.	Prior to construction	Contractor	Covered in the total project Cost.	World Bank Group General EHS Guidelines: Construction and Decommissioning
Clearing of the project site to pave way for construction works.	Loss of topsoil cleared / stripped from the project site.	• The soils stripped from the project site will be stockpiled as part of soils conservation measure and will be used for remediation / rehabilitation / re-vegetation of areas that will be disturbed by construction activities.	Soils stripped from the project site stockpiled at designated places	Monitoring stockpiling of stripped topsoil at designated sites. Presence of stockpiled topsoil. Frequency of monitoring stockpiling of stripped topsoil: as and when stripping is taking	Prior to construction phase	Contractor	Covered in the total project Cost	World Bank Group General EHS Guidelines: Construction and Decommissioning; Waste Management.

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
				place				
Site clearing and movement of construction equipment on unpaved surfaces.	Fugitive dust generation impacting on the health of workers and the environment.	• Unpaved surfaces should be maintained through application of water, capping and grading to minimise fugitive dust generation. • Water bowsers should be used to spray water on unpaved access road surfaces to suppress fugitive dust emissions during construction phase.	No visible fugitive dust plumes originating from the unpaved surfaces.	Daily visual inspections of all unpaved areas during construction phase and weekly during operation phase.	Prior to construction phase	Contractor	Covered in the total project Cost	IFC Performance Standard 3: Resource efficiency and pollution prevention.
Development of Sinkholes at the project site.	Threat to stability of Solar PV surface structures potentially resulting in damage to solar plant infrastructure.	• Detailed and specific surface mapping, *geotechnical investigations and subsurface ground penetration surveys for* ***foundation design*** should be undertaken at the project site.	Project site subsurface mapped following ground penetration surveys and potential areas for possible sinkhole development identified. Specific geotechnical investigations for foundations design undertaken.	Survey monitoring (ground subsidence monitoring) of all installations at the project site prior to construction / commissioning and annually thereafter.	Construction and Operation phase	Contractor	Covered in the total project Cost	-
Installation of infrastructure at the project site	Stability threats to heavy surface structures due to underground	• Detailed and specific surface mapping, *geotechnical investigations and subsurface ground*	Design layout based on subsurface mapping to avoid unstable locations.	Check that all construction works are in conformance to the design specifications	Construction phase	Contractor	Covered in the total project cost	World Bank Group General EHS Guidelines: Construction and Decommissionin

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
	caverns in base rock formation	*penetration surveys* ***for foundation design*** should be undertaken at the project site.		and layouts prior to construction and annually thereafter.				g
Construction and operation works on site.	Risk / threat to surface structures due to formation of swallow holes and possible underground stream in subsurface rock formation.	• Detailed mapping of subsurface for foundation design and construction of effective drainage in and around project area should be undertaken.	Design layout based on construction and operation systems to minimise formation of swallow holes by preventing undue low areas of ponding.	Check all drainage structures and disturbed areas to avoid potential ponding. Frequency of monitoring: at commissioning and annually thereafter	Construction phase	Contractor	Covered in the Total project cost	World Bank Group General EHS Guidelines: Construction and Decommissioning
Construction works and operation of the solar plant on site.	Damage to solar support structures and foundations due to soil erosion on site.	• A storm water management plan should be developed and implemented. • An effective storm water drainage network should be constructed to channel increased surface runoff to designated catchment areas. An effective drainage network will minimise soil erosion over exposed surface and will minimise the risk of erosion of the support structures and	Storm water management plan developed. Effective storm water drainage network constructed.	Check construction and effectiveness of all drainages structures on site. Frequency: weekly during construction and bi-annually thereafter.	Construction and Operation phase	Contractor	Covered in the Total project cost	World Bank Group General EHS Guidelines: Construction and Decommissioning

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		foundations. It will also reduce the risk of flooding the project site.						
Installation of infrastructure at the project site	Unstable structures caused by floating rock boulders in sub soil.	• Detailed mapping of subsurface ***for foundation design*** should be carried to identify presence of floating rock boulders and *to design appropriate foundation structures*.	Stable structures installed at the project site following detailed design of foundations taking into account presence of rock boulders.	Inspection of structural stability of all installations at the site (ground subsidence included) Prior to construction and thereafter annually.	Construction Phase	Contractor	Covered in the Total project cost	World Bank Group General EHS Guidelines: Construction and Decommissioning
Site clearing and construction activities	Irregular soil profile causing foundation construction challenges and unstable foundations.	• Detailed mapping of subsurface will be carried to assess risks of soil movement (ground subsidence) prior to installation of Solar PV infrastructure. Detailed specific geotechnical investigations for design should be undertaken.	Detailed specific geotechnical investigations for design undertaken. Approved site layout and construction drawings used.	Quarterly monitoring of structures for stability in accordance with plant specifications.	Operation phase	Contractor	Covered in the Total project cost	
Traffic and road infrastructure								
Haulage vehicles carrying materials to site have a potential to increase traffic and	Reduced safety on public access roads and onsite due to increase in vehicle traffic	• Developing and implementing a site specific Traffic Management Plan for transportation purposes during construction that	Zero incidence of any road related accidents with the project site. Workers trained on road safety.	Undertaking weekly traffic surveillance inspections and road condition surveys. Record of inspections	Construction phase	Contractor	-	World Bank General EHS Guidelines: Community Health and Safety; IFC PS 4: Community

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
decrease road safety especially on access routes	(potential increase in traffic-related accidents and injuries)	the transportation service provider will adhere to. • Enhancing traffic safety management within the economic zone; • Ensuring that only licensed operators and drivers use equipment and vehicles accessing the project site. • Putting up appropriate signage (road markings, road traffic signs) including speed limits and applying speed control structures; • Road safety training for workers and other stakeholders within the zone. • Separating site access routes for construction vehicles and pedestrians. • Bulk storage of materials on site to lessen constant vehicular traffic. • Employing speed calming devices. • Induction of drivers on safe conduct of vehicles		and number of workers trained in road safety.				Health Safety and Security; Road and Traffic Control Act, Cap 464 of the Laws of Zambia.

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		on construction sites. • Providing reflective vests and coveralls for workers of site.						
Water Resources								
Clearing of vegetation and construction works at the project site.	Risk of erosion of solar PV support structures and foundations arising from increase in surface runoff during the rainy season or storm rainfall being more than infiltration into the ground.	• A storm water management plan should be developed and implemented. • Storm water drainage system should be properly designed and constructed to convey surface runoff away from the project area into a catchment area, which will hold runoff and allow it to slowly infiltrate the ground. • The drainage system should also be designed and constructed to avoid erosion of support structures and foundations.	Storm water management plan developed and implemented. Effective drainage system constructed and risks of erosion of Solar PV structures and foundations and their potential damage minimised at the project site by controlling surface runoff.	Weekly inspection of storm water drainage network during construction and operation phases to ensure their structural integrity and capacity to convey surface runoff. At least once before and after the start of the rain season during operation phase.	Construction and Operation phases	Contractor	Covered in the Total project cost	World Bank Group General EHS Guidelines: Construction and Decommissioning; IFC Performance Standard 3.
Storage of fuels and oils during construction phase of the project.	Potential groundwater contamination arising from potential spillage of	• Appropriate procedure for storage and handling of fuels and oils should be adopted to avoid spillages of fuels and oils	Spillages of oils and fuels minimised. Appropriate secondary containment	Weekly inspection of storage areas	Construction Phase / Operation Phase	Contractor	Covered in the total project cost	World Bank Group General EHS Guidelines for Hazardous Material Management;

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
	fuels and oils	onto the ground. These included the following: Fuel tanks must be bunded to contain possible spills and to prevent the infiltration of fuel into the ground; The fuel tanks used for the storage of fuel must be designed and installed in accordance with relevant Oil Industry standards; The tanks must be constructed to conform to the requirements of all relevant legislation, which includes the Environmental Management (Licensing) Regulations, 2013; use of all generators on site must include the use of drip trays. • Secondary containment structures, made of impervious and chemically inert material and capable of containing the larger of 110 percent of the largest storage vessel	constructed. Potential groundwater contamination prevented.					IFC Performance Standard 3; Zambian Environmental Management (Licensing) Regulations, 2013.

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		should be constructed for storage of fuels, oils and other hazardous substances. All products (fuels, oils) shall be stored in a bund area that can carry 10% more than the product's capacity. • Handling, storage and disposal of hazardous substances (used transformer oils) should be carried out in accordance with the World Bank General Environmental Health and Safety Guidelines (Hazardous Materials Management) and the applicable Zambian Environmental Management (Licensing) Regulations, 2013. • Dedicated secured storage areas for fuels, oils and other hazardous materials should be provided as part of the design. All fuel stored on site will be above ground						

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		level and the storage areas shall be secured. The storage areas and containers shall be clearly marked and labelled for the content stored within. Material Safety Data Sheets (MSDS) Hazard list and First Aid treatment notices shall be prominently displayed. Drip trays, a thin concrete slab or a facility with PVC lining shall be in place to prevent soil and water pollution. • Training on handling, storage and disposal of hazardous waste should be provided as part of the overall environmental management of the site. Only trained personnel shall be allowed to work and handle the chemicals. • Uncontrolled dumping of any toxic or hazardous waste, including used transformer oils from a						

Table 6.2: Environmental and Social Management Plan (ESMP) - Construction Phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator (Target)**	**Frequency and Monitoring Action**	**Time frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent/ IFC)**
		couple of transformers to be installed on site should be avoided. • Uncontrolled dumping or littering of any waste within the project area and areas adjacent to the project site should be avoided.						

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
Air Quality								
Regular operational works on site with the potential to generate dust.	Exposure of workers to dust potentially posing health effects to them.	• Operators at least of being exposed to significant dust emissions will be provided with adequate personal protective equipment (PPE).	Reduced risk to health and safety of personnel due to exposure to high dust levels. All workers provided with approved dust protection devises.	Daily safety checklist to ensure workers have approved PPE. Frequency: as and when potential dust generating activities are being done.	Construction phase	Contractor	Covered in the total project cost	World Bank General EHS Guidelines: Occupational Health and Safety; Occupational Health and Safety Act 2010 of the Laws of Zambia; IFC PS 2 - Labour and Working Conditions.
Communication								
Operations of the solar plant	Electromagnetic field interfering with communication	• Electromagnetic compatibility (EMC) certified inverters should be used on the project to prevent electromagnetic fields interfering with communication.	EMC certified inverters procured and installed.	Equipment operations checklists and testing protocols in place at commissioning and during operation phase.		Contractor	Covered in the total project cost	ICNIRP Guidelines for limiting Exposure to Time - Varying Electric Magnetic and Electro Magnetic Fields (UP TO 300 GHZ). World

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
								Bank General & sector EHS Guidelines.
Community Health, Safety and Security								
Operations of the Solar PV plant	Risks of electric shock, thermal burn, exposure to EMF and several other hazards through unauthorised personnel trespassing the site.	• Security fence should be installed around the entire facility to control access and keep out unauthorized personnel.	Installation of fence to appropriate safety and security standard.	Daily inspection of the premises and installed fencing around the project site.	Operation phase	Contractor	Covered in the total project cost	World Bank EHS Guidelines: Community Health and safety (General site Hazards); IFC PS 4: Community Health Safety and Security.
Operation of the Solar PV plant.	Risk of accidents involving members of the public through unauthorised access to the project site.	• The project site should be enclosed within a security perimeter and no unauthorized persons should be allowed access to the site. • Caution signs should also be placed around the site to prevent occurrence of accidents. • The community should be sensitized on the dangers of trespassing at the project site so as to avoid	Zero accidents on site involving members of the general public.	Security surveillance and community engagement to sensitize affected members of the community on their health, safety and security. Frequency: Daily for security	Operation phase	Contractor	Covered in the total project cost	World Bank EHS Guidelines: Community Health and Safety; IFC PS 4: Community Health Safety and Security; Occupational Health and Safety Act, No. 36 of 2010 of the Laws of

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
		potential accidents that might arise from unauthorized access to site. • Reasonable steps should be taken in the provision of security and in particular the use of force and establish appropriate conduct towards workers and affected communities. • A grievance mechanism should be put in place for the Affected Communities to express concerns about the security arrangements and acts of security personnel.		surveillance and patrol. Community engagement – quarterly.				Zambia.
Lack of or inadequate good water supply and sanitation facilities on site.	Risk of water borne diseases due to lack of potable water and sanitation facilities	• Safe and clean water and good sanitation facilities should be provided to workers to prevent an outbreak of waterborne diseases among them which can also affect the surrounding communities.	Zero occurrence of water borne diseases among the workers.	Safe and clean drinking water provided on site daily. Operable sanitation facilities provided on site.	Operation phase	Contractor	Covered in the total project cost	IFC Performance Standard 4: Community Health, Safety and Security; Public Health Act, Cap 295
Landscape and Visual Amenity								
Installation of solar PV	Visual intrusion and disruption	• Use of low visual reflective	Visual intrusion and disruption to	Annually monitoring	Operation phase	Contractor	Covered in the	-

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
modules.	of the aesthetics.	solar modules with anti-reflective coating (ARC) that reduces reflectance from the solar PV modules; • Use of low level solar module mount design system (2 - 3 metres) that will not disrupt the aesthetic view of the project /surrounding areas: • Maintaining a perimeter buffer of trees and grass vegetation along the boundaries to screen sensitive viewing areas in the vicinity of the site.	aesthetics reduced.	existing vegetation screening at the site and ensuring that it is appropriately maintained without providing shades onto the Solar PV modules.			total project cost	
Noise and vibration								

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
Operations of the solar plant (electricity production) including clearing of vegetation from under and around the solar modules.	Noise disturbance arising from the operation of solar plant potentially affecting workers on site.	• Operations workers likely to be exposed to high noise levels will be provided with adequate PPE such as ear plugs.	All workers at risk of being exposed to occasional high levels of noise provided with approved ear protection devises.	Monitoring noise levels to ascertain level of noise generated by inverters and to check compliance with IFC Noise Levels Guidelines for industrial receptors. Frequency: at commissioning and daily during operation phase.	Operation phase	Contractor	Covered in the total project cost	World Bank General EHS Guidelines; IFC PS 4 - Community Health, Safety and Security; Occupational Health and Safety Act 2010 of the Laws of Zambia; IFC PS 2 - Labour and Working Conditions.
Occupation Health and Safety								
Occupational health and safety of workers working on site.	Reduced occupational health and safety among workers	• A Health and Safety Policy shall be established to guide operations of the facility. • All construction activities should be conducted in accordance with provisions of the local legislation and international best practices (General EHS	Risks of preventable accidents that can potentially result in injuries and/or fatalities substantially reduced.	Daily risks identification and implementation of management measures conducted prior to commencement works.	Operation phase	Contractor	Covered in the total project cost	World Bank EHS Guidelines: Occupational Health and Safety; IFC PS 4: Community Health Safety and Security; IFC PS1; IFC PS 2; IFC PS 5;

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
		Guidelines: Occupational Health and Safety); • Safety rules should be enforced and complied with by workers, contractors and those coming to site; • Personal Protective Clothing (PPE) should be issued and used as required by the various classes of the workers on project site; • Barrier tapes and caution signs should be erected in all potential hazardous areas to prevent injury or loss of life among construction workers; • No unauthorized person should be allowed on site including workers without appropriate PPE						Occupational Health and Safety Act, No. 36 of 2010 of the Laws of Zambia.

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
Occupational Health and Safety	Risks to workers health and safety during the operation and maintenance activities of the project as they are exposed to electromagneti c fields.	• Regular measurement of electrical and magnetic radiation levels and taking appropriate measures when exposure exceeds acceptable levels. • Only trained and certified workers should be allowed to install, maintain or repair electrical equipment.	Maintaining exposure levels within the statutory and best practice limits.	Certified and approved monitoring protocols to be carried out for all electrical and magnetic radiation. Approved and authorised work permits to qualified competent persons only. Frequency: as per operations and monitoring guidelines.	Operation phase	Contractor	Covered in the total project cost	World Bank General EHS Guidelines: Occupational Health and Safety; World Bank EHS Guidelines for Electric Power Transmission and Distribution; Occupational Health and Safety Act 2010 of the Laws of Zambia; Electricity Act CAP 433 of the Laws of Zambia.
Socio-economic								
Limited sources of livelihood, inadequate schools and associated facilities such as library facilities, learning facilities and teaching materials,	Deteriorating social conditions in settlements in the vicinity of the project area.	Development and implementation of a Community Development Plan (CDP) with possible projects aimed at the following: • Provision of adequate schools and associated facilities (education	Community Development Plan developed and implemented in identified settlements.	Annually inspecting community projects implemented. Number of community projects implemented.	Operation phase	Contractor	Covered in the total project cost	IFC Performance Standard 2: Labour and Working Conditions; IFC Performance Standard 5.

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
inadequate health facilities inadequate water supply and sanitation services in identified settlements of Shantumbu, Mahopo, Chifwema and Mphande		services) such as library facilities, learning facilities, learning materials and play parks for children; • Provision of adequate water supply and sanitation services; • Provision of adequate health facilities; • Provision of titled land for settlement and farming for those settled in Mphande and assistance to restore agricultural livelihoods. • Provision of any other community help necessary to improve the living conditions in identified settlements such as sourcing unskilled / skilled labour (where available) from the settlements.		Titled land allocated to Mphande Setllers.				
Employment opportunities at the project site arising from construction works.	Influx of population of job seekers on site posing health and security risks and leading to unplanned housing /	• Enforcement of relevant by-laws laid down by the respective Lusaka City Council and Kafue District Councils with the help of IDC to prevent mushrooming of unplanned structures and	Development of any unplanned structures and / or activities within the project site and immediate surroundings prevented.	Security surveillance and Community Engagement to sensitize on matters relating to development	Construction and Operation phase	IDC / Lusaka City Council / Kafue District Council.	Covered in the total project cost	IFC PS 4: Community Health Safety and Security; Urban and Regional Planning Act, 2015

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
	structures and commercial activities around the project area.	activities.		of unplanned structures and activities. Frequency: Daily for security surveillance and quarterly for Community Engagement.				
Operations of the Solar Plant	Risky sexual behaviour among the population leading to escalation of new STIs including HIV/AIDS in the local population and among the workforce.	• Developing an HIV/AIDS Policy by the Developer to be adhered to during operation phase of the project. • Sensitization programs on preventing the spread of STIs and HIV/AIDS for project workers including contractors and suppliers. • Provision of condoms (including Female Condoms) in places where they can be easily accessed such as toilets. • Education programs on fighting stigma of those infected with HIV/AIDS	HIV/AIDS Policy developed and implemented; Sensitisation / Education programmes on HIV/AIDS conducted for contractors and suppliers; Accessibility to condoms.	Bi-annually monitoring records of sensitisation / education programmes undertaken including the number of people sensitised / trained on STI and HIV/AIDS.	Operation phase	Contractor	Covered in the total project cost	IFC Performance Standard 4: on Community Health, Safety and Security. Public Health Act, Cap 295.
Operation of the solar PV plant	Capacity building and technology	• Local contractors, skilled specialists and unskilled	Skills transferred to local expert. Number of local	Bi-annual monitoring of skills training	Operation phase	Contractor / IDC	-	IFC Performance Standard 2:

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
	transfer to local contractors, skilled manpower and unskilled workers.	workers should be used to benefit from technology and skills transfer during operation of the solar plant. • Appropriate training should be provided to all local contractors, skilled manpower and unskilled workers to enhance expected project benefits.	people trained.	for locals with assistance from local learning and construction institutions.				Labour and Working Conditions.
Operation of the Solar PV plant	Employment opportunities created for both skilled and non-skilled labour and. multiplier opportunities for employment in support sectors.	• The contractor, where possible, should employ members of the local communities and local experts to maximize on the benefits of employment opportunities. The jobs for which local people qualify (including non-technical and technical) will be as much as possible be offered to the local people.	Increased employment opportunities leveraged to the local community. Record of employment, annual reports on IDC / Solar Plant Operators.	Bi-annual monitoring of records of employment for local communities.	Operation phase	Contractor / IDC	Covered in the total project cost	IFC Performance Standard 2 - Labour and Working Conditions; Zambian Employment (Amendment) Act No. 15 of 2015.
Operation of the Solar PV plant	Project contribution to the local and national economy through its multiplier effect	• Procurement of services from local contractors and locally produced raw materials during the operation phase should be done, where possible, to	Increased participation of local entrepreneurs in the provision of services.	Annual reports on IDC / Solar Plant Operators	Operation phase	Contractor	Covered in the total project cost	IFC Performance Standard 2: on Labour and Working Conditions.

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
		maximise the benefits.						
Soils and geology								
Development of Sinkholes at the project site	Threat to stability of Solar PV surface structures potentially resulting in damage to solar plant infrastructure, due to sinkholes development and underground caverns in base rock formation.	• Monitoring ground subsidence at the project site to identify early any sinkhole development. • potential backfilling or other methods in areas for sinkhole development.	Potential areas for possible sinkhole development identified and addressed.	Daily visual inspection of potential areas for sinkhole development; Survey monitoring (ground subsidence monitoring) of all installations at the project site to be done bi-annually.	Construction and Operation phases	Contractor	Covered in the total project cost	-
Operation of the solar plant on site.	Damage to solar support structures and foundations due to soil erosion on site.	• An effective storm water drainage network should be maintained to channel increased surface runoff to designated catchment areas. An effective drainage network will minimise soil erosion over exposed surface and will minimise the risk of erosion of the support	No damage to solar support structures arising from soil erosion. Effective storm water drainage network maintained.	Bi-annual monitoring of effectiveness of all drainage structures at the project site.	Construction / Operation phases	Contractor	Covered in the total project cost	World Bank Group General EHS Guidelines: Construction and Decommissioning

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
		structures and foundations. It will also reduce the risk of flooding the project site.						
Operations of the solar power plant.	Risk / threat to electrical equipment due to potential flooding / poor drainage at the project site.	• A storm water management plan should be developed and implemented. • An effective storm water drainage network should be constructed in and around the project area to avoid flooding. • Conduits for electrical installations should be appropriately constructed to avoid flooding them.	Storm water management plan developed and implemented. No flooding of the project site and no damage to electrical installations experienced.	Bi-annual monitoring of storm water drainage system and electrical installations.	Operation phase	Contractor	Covered in the total project cost.	World Bank Group General EHS Guidelines: Construction and Decommissioning; IFC Performance Standard 3;
Water Resources								
Operation of the Solar PV plant at the project site.	Risk of erosion of solar PV support structures and foundations arising from increase in surface runoff during the rainy season or storm rainfall being more than infiltration	• Storm water drainage system should be inspected regularly to ensure that the system conveys surface runoff away from the project area into a catchment area, which will hold runoff and allow it to slowly infiltrate the ground. • The drainage system	No damage of Solar PV structures and foundations arising from erosional process on site. Storm water drainage system inspected and maintained.	Bi-annual inspection (before and after start of rain season) of storm water drainage network operation phases to ensure their structural stability and	Construction and Operation phase	Contractor	Covered in the total project cost	World Bank Group General EHS Guidelines: Construction and Decommissioning; IFC Performance Standard 3;

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
	into the ground.	should also be designed and constructed to avoid erosion of support structures and foundations.		capacity to convey surface runoff.				
Conversion of the existing vegetation cover to bare or impervious surface at the project site	Flood risks arising from increased surface runoff and reduced infiltration into the groundwater regime with potential to cause damage to solar plant infrastructure (especially electrical equipment) mounted on or close to ground level.	• A storm water management plan should be developed and implemented. • Storm water drainage system should be properly designed and constructed to convey surface runoff away from the project area into a catchment area that will hold runoff and allow it to slowly infiltrate into the ground. This will also contribute to recharging of the groundwater aquifer. • Where appropriate, upstands should be erected for installation of electrical equipment to avoid flooding.	Storm water management plan developed and implemented. Effective drainage system constructed and risks of flooding of the project site that can cause damage to electrical equipment minimised.	Inspection of storm water drainage network during construction and operation phases to ensure their structural integrity and capacity to convey surface runoff. Frequency: Before and after the start of the rain season.	Construction and Operation phase	Contractor	Covered in the total project cost	World Bank Group General EHS Guidelines: Construction and Decommissioning; IFC Performance Standard 3;
Storage and handling of fuels and oils on site during operations phase.	Potential groundwater contamination onsite arising from spillage of fuels and oils	• Handling, storage and disposal of hazardous substances (used transformer oils and others) should be carried	• No contamination of groundwater arising from spillage of fuels	• Weekly (and as and when material is received	Operation phase	Contractor	Covered in the total project cost	World Bank Group General EHS Guidelines for Hazardous

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
	onto the ground during operations phase.	out in accordance with the World Bank General Environmental Health and Safety Guidelines, Zambian Environmental Management (Licensing) Regulations, 2013 including Material Safety Data sheets (MSDS). • Appropriate designed bunded storage areas with impervious lining should be constructed and maintained. • Separate storage areas should be provided for all hazardous substances / products and they must be labelled with proper identification of its hazardous properties. • Training on handling, storage and disposal of hazardous waste should be provided to relevant workers on site as part of the overall environmental management of the site.	and oils. • Fuel and oil storage areas provided with appropriate protective lining and labelling. • Training provided to personnel involved in handling, storage and disposal of hazardous materials; • Record of training schedules for trained personnel. • Record inspection of fuels and oils storage areas including other hazardous wastes on site.	and dispatched) inspection of storage areas to monitor or ensure their integrity. • Weekly inspections and update of materials storage bays and inventory.				Material Management ; IFC Performance Standard 3; Zambian Environmental Management (Licensing) Regulations, 2013.
Storage and handling of fuels	Potential contamination	• Uncontrolled dumping or littering of any waste	No groundwater contamination	Weekly inspection of	Operation phase	Contractor	Covered in the	World Bank Group

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
and oils including handling of hazardous waste on site during operational phase.	of groundwater from spillage of fuels, oils contamination	within the project area and areas adjacent to the project site should be avoided. • Uncontrolled dumping of any toxic or hazardous waste, including used oils from transformers should be avoided. • Specific dumping locations for litter and any other waste should be provided on site with adequate protective lining. • Collection, storage and removal of all toxic and hazardous waste should be documented and handled by competent staff.	arising from storage and handling fuels and oils including hazardous waste.	dumping sites within the site to ensure correct labelling and usage.			total project cost	General EHS Guidelines for Hazardous Material Management ; IFC Performance Standard 3; Zambian Environmental Management (Licensing) Regulations, 2013.
Conversion of the existing vegetation cover to bare or impervious surface at the project site.	Reduced recharge of groundwater aquifer.	• Storm water drainage system should be properly designed and constructed to convey clean surface runoff away from the project area into a catchment area from where runoff will be held and allowed to slowly filter into the ground. This will	Storm Water Management Plan with detailed site layout and functionality developed and implemented	Bi-annual inspection of the storm water system (Inspection to be carried put (before and during the rainy season).	Operation phase	Contractor	-	World Bank Group General EHS Guidelines: Construction and Decommissioning; IFC Performance Standard 3;

Table 6.3: Environmental and Social Management Plan - Operations phase								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
		also contribute to recharging of the groundwater aquifer.						

Table 6.4: Environmental and Social Management Plan – Decommissioning Phase (aspects and mitigation measures similar construction phase)								
Aspect / Issue	**Potential Impact / Risk**	**Mitigation Measures**	**Performance Indicator / Target**	**Frequency and Monitoring Action**	**Time Frame**	**Responsible Person**	**Cost**	**Best Practice Guidance (Legal /Project Proponent / IFC)**
Air Quality								
Demolition of site buildings at decommissioning and restoration of the site.	Potential health effects on workers involved in demolition of site buildings and removal of site infrastructure arising from dust generation.	Workers who will be involved in carrying out decommissioning works should be provided with adequate PPE such as dust masks.	Dust emissions reduced and reduced risk to health of personnel due to exposure to high dust levels during decommissioning of the solar plant. All workers provided with approved dust protection devises.	Daily safety checklists to ensure workers have approved PPE.	Decommission phase	Contractor	Covered in the total project cost	World Bank General EHS Guidelines: Occupational Health and Safety; Occupational Health and Safety Act 2010 of the Laws of Zambia; IFC PS 2 - Labour and Working Conditions.
Noise and vibration								
Removal from site of used solar modules, demolition of site buildings and restoration of the site.	Noise disturbance associated with decommissioning activities may potentially affect workers on site.	Workers likely to be exposed to high noise levels should be provided with adequate PPE such as ear plugs. Decommissioning works should be done during day time to reduce on exposing the surrounding community to any potential noise disturbance.	Noise levels not exceeding IFC Noise Levels Guidelines for industrial receptors. All workers at risk of being exposed to high levels of noise provided with approved ear protection devises.	Daily safety checklists during decommissioning works.	Decommission phase	Contractor	Covered in the total project cost	World Bank General EHS Guidelines: Construction and Decommissioning; IFC PS 4 - Community Health, Safety and Security; Occupational Health and Safety Act 2010 of the Laws of Zambia; IFC PS 2 - Labour and Working Conditions.

7 DECOMMISSIONING AND CLOSURE PLAN

The project life is expected to extend for at least 25 years. It is expected that there will be various other commercial and industrial developments within the area. The operation of the Ngonye Solar PV plant will be used to generate electric power, which will be transferred into the national grid through the ZESCO substation. It is expected that the plant will undergo changes during the operation phase due to technological advances as well as climate change. Economic sustainability and technological changes / advances as well as climate change will be the key factors that will influence any decision to decommission the plant. As these factor dictate, as specific closure concept and plan will be developed.

In general decommissioning and closure principles require that a project is decommissioned and the site rehabilitated in a socially responsible manner that reflects sound environmental management practices. The decommissioning and closure phase of a project should be implemented to achieve the following objectives:

- To protect public health and safety;
- To reduce or prevent environmental degradation; and
- To allow for the continued productive use of the project site, similar to its original use or to an acceptable alternative use.

In respect of the proposed construction and operation of the Solar PV Plant, decommissioning and site reclamation activities that may cause environmental impacts include facility removal, land re-contouring, and revegetation. The typical activities that will be undertaken during the solar energy facility decommissioning and site reclamation phase will include the following:

- Facility removal which will include used solar modules, electrical components and cabling for disposal or recycling. The solar modules will be sent to the manufacturer for recycling or any certified industrial recycling chain;
- Breaking up of concrete pads and foundations;
- Removal of access roads that will not be maintained for other uses;
- Re-contouring the surface and revegetation; and
- Reestablishment of the natural drainage pattern of the site.

The above activities are likely to give rise to impacts relating to the following:

- Noise;
- Air quality;
- Groundwater;
- Visual impact;
- Flora and fauna (ecological resources);
- Hazardous materials and waste management;
- Public health and safety;
- Socio-economics;
- Soils and geologic resources;
- Transportation.

Most of the impacts associated with construction phase activities are similar to impacts associated with the decommissioning phase. The decommissioning plan will include measures to mitigate any significant adverse impacts and to enhance beneficial ones. The plan will include responsibilities and roles to manage the impacts in a sound and environmentally sustainable manner.

8 PUBLIC CONSULTATION

Initial stakeholder consultations mainly by way of meetings were conducted in October 2015. They were conducted by WSP | Parsons Brinkerhoff as part of the pre-ESIA consultations. The stakeholders consulted were drawn from key project implementing agencies, which included Lusaka South Multi-Facility Economic Zone Management, ZESCO Management, ZEMA Management and IDC Management. Details of the outcome of the initial consultations are presented in the Environmental and Social Scoping Report for the Scaling Solar – Zambia Project authored by WSP | Parsons Brinkerhoff (WSP | Parsons, 2015).

Public consultations were undertaken at Scoping Meetings held on 11th and 12th March 2016 at Nakatindi Hall (Lusaka Civic Centre) and Cooperative College Conference Hall respectively. The stakeholders were invited to attend planned Scoping Meetings by way of written invitation letters and by placing Public Notices for the meetings in publicly and privately owned print media. These included the Zambia Daily Mail (public) and the Post Newspaper (private). One of the Public Notices placed in the print media is included in Appendix C. Project Information Flyers were also distributed to some residents of New Kasama and local communities/agricultural smallholdings near the project site.

The stakeholders that attended the meetings were drawn from Industrial Development Corporation (IDC), Knight Piésold Zambia, ZESCO, the University of Zambia (UNZA), Lusaka City Council, Lusaka South Multi-Facility Economic Zone, Department of National Parks and Wildlife, Department of Energy, Water Resources Management Authority, Private consultants' firms, Keeper Zambia Foundation | Power Africa, ELFRISM Company Ltd / WISE Engineering, and some residents in New Kasama, Chawama and Chainda. Stakeholders are categorized as shown in Table 8.1.

Attendance lists are included in the minutes of the meetings presented in Appendix A (Terms of Reference). The stakeholders helped to determine the scope of the work to be carried out when preparing the ESIA Report by contributing and raising their concerns on the proposed project. The views of the stakeholders, where appropriate, have been taken into account in conducting the ESIA Study for the proposed project. The key issues raised are presented in Appendix A and have been addressed in Sections 4 (Baseline conditions) and 5 (Impact Assessment) of this document.

Additional consultations were conducted during the baseline surveys. Traditional leadership in the areas considered to be in the project area of influence were consulted on socio-economic issues as well as on cultural heritage sites. Wildlife officers at the nearby Lusaka National Park were also consulted on wildlife issues. Other institutions (DMMU, ZESCO, Clinics, Schools, etc.) were consulted.

Further public consultation meetings were held in Lusaka as part of the ESIA process. These meetings were Public Disclosure Meetings on the Draft ESIA Report. The meetings were held on 8th and 9th July 2016 at Nakatindi Hall (Lusaka Civic Centre) and at Cooperative College Conference Hall respectively. As in the case of the Scoping Meetings, the stakeholders were invited to attend Public Disclosure Meetings by way of written invitation letters and by placing Public Notices for the meetings in publicly and privately owned print media. These included the Zambia Daily Mail (public), Times of Zambia (public) and the Post Newspaper (private). The public notice for the meetings was also placed on IDC website (www.idc.co.zm) The public notice published in the print media included IDC website address were the Draft ESIA Report could be downloaded by the general public.

The notices were regularly published in the print media for a period of not less than fifteen days before holding the meetings. One of the Public Notices for Public Disclosure Meetings published in the print media is included in Appendix A-1.

The stakeholders that attended the public disclosure meetings were drawn from Industrial Development Corporation (IDC), Ministry of Lands, Natural Resources and Environmental Protection, Zambia Environmental Management Agency (ZEMA), ENEL Green Power (EGP), NEOEN, Zambia Watch Advocacy Network and Private Consultancy Firms. The minutes of the Public Disclosure Meetings and Attendance Registers are appended in Appendix A-1 of the ESIA Report. Table 8.2 presents the stakeholder categories at the meetings.

The key issues that arose during the disclosure meetings are listed below, and have been addressed within the respective sections of the document, where necessary.

- Responsibility for environmental liabilities of the project during 25 year operating period;
- Electricity tariff;
- Dust emission from other players (industries) within the zone; and
- Noise disturbance on wildlife in the Lusaka National Park.

Public consultation with key stakeholders will continue during the ESIA process and as part of project development.

Table 8.1: Stakeholder Categorization – Scoping Meetings		
No.	**Stakeholder category**	**Stakeholder**
1	Government	✓ Ministry of Energy and Water development (Dept. of energy). ✓ Ministry of Tourism and Arts (Dept. of National Parts and Wildlife). ✓ Water Resources Management Authority. ✓ ZESCO. ✓ Lusaka City Council.
2	Private Companies	✓ RIDGE Point Geo Consultant Ltd. ✓ PRAXIS Solution Ltd. ✓ Geo Quest Ltd. ✓ Mulungushi Village Complex Ltd. ✓ Energy Consulting Japan. ✓ Elfrism Company Ltd. ✓ Lusaka South Multi Facility Economic Zone (LS- MFEZ). ✓ Knight Piesold Consulting (ESIA Project Team).
3	Community	✓ New Kasama, Chawama and Chainda Residents.
4	Shareholder	✓ Industrial Development Cooperation (IDC).
5	NGOs	✓ Keeper Zambia Foundation| Power Africa ✓ Wildlife and Environment Conservation Society of Zambia. ✓ Red Baobab. ✓ Oxfam Zambia.
6	Academic	✓ University of Zambia. ✓ Bolton University.

Table 8.2: Stakeholder Categorization – Public Disclosure Meetings		
No.	**Stakeholder category**	**Stakeholder**
1	Government	✓ Ministry of Lands, Natural Resources and Environmental Protection. ✓ Lusaka City Council. ✓ Zambia Environmental Management Agency.
2	Private Companies	✓ China Jiangxi. ✓ SOL-WIN Green Power Limited. ✓ PRAXIS Solution Ltd. ✓ TASS Zambia. ✓ Mulilo Zambia ✓ Lusaka South Multi Facility Economic Zone (LS- MFEZ). ✓ Knight Piesold Consulting (ESIA Project Team). ✓ NEOEN ✓ Enel Green Power (EGP). ✓ GreenWorx Management Services Limited
3	Community	✓ New Kasama
4	Shareholder	✓ Industrial Development Cooperation (IDC).
5	NGOs	✓ Zambia Washe Advocacy Network - ZAWN
6	Academic	✓ None

9 CONCLUSION

This Environmental and Social Impact Statement presents the environmental and social baseline conditions of the project area. It also presents the potential environmental and social impacts and risks that are likely to arise as a result of the proposed Ngonye Solar PV Project. Both positive and negative impacts are presented in the document.

The measures to enhance the beneficial impacts and to avoid, reduce or remediate negative environmental and social impacts and risks have been included in this document. Implementation of the measures will be monitored to assess their effectiveness and to adjust them where appropriate.

With the effective implementation of the proposed mitigation measures presented in this document, the construction and operation of the proposed the Ngonye Solar PV Project is not likely to result in adverse environmental and social impacts and risks. The project not only will contribute to redressing the power deficit currently being faced by Zambia but it will also promote the use of renewable energy technologies to generate clean and sustainable energy with the subsequent creation of employment opportunities and associated multiplier effects. In addition, the project will stimulate economic growth and development in Zambia.

10 REFERENCES

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11 Declaration of the Authenticity

I, _____ the undersigned, declare that the contents of this Environmental and Social Impact Statement (ESIS) reflect the available information at the project site and within the broader project area at the time of undertaking the environmental and social impact assessment study for the proposed construction and operations of the Ngonye Solar PV Plant under Round 1 Scaling Solar Zambia Project.

We further declare that the conclusions drawn in this ESIS are based on conditions encountered and available information at the time of the assessment.

We acknowledge that implementation of the project will be regulated by the existing Zambian environmental legislation and other applicable legislation. The implementation of the project will also comply with International Finance Corporation (IFC) Policy on Environmental and Social Sustainability including IFC Performance Standards (2012), Equatorial Principles and World Bank Group Environmental Health and Safety (EHS) Guidelines.

For and on behalf of Industrial Development Corporation Zambia Limited,

_____

Chief Executive Officer

Industrial Development Corporation

12 ANNEX

Annex 1: Letter on Offer of Land in LS MFEZ

Annex 2: Review of Mphande Forest 320 Resettlement Process

Annex 3: Letter from the Ministry of Finance indicating no objection to holding Title to the additional piece of land located in the Lusaka National Park

Annex 4: Letter from the Ministry of Tourism and Arts to the Ministry of Lands on the issuance of Title for 11.9 Hectares in the Lusaka National Park to accommodate the construction of a PV Solar Power Plant

Annex 5: Copy of the Certificate of Title held by the Minister of Finance for the additional 11 hectares of land.

Annex 1

Letter on Offer of Land in LS MFEZ

(14

LS-MFEZ

OFFER OF LAND IN THE LS-MFEZ

Mr Andrew Chipwende
Chief Executive Officer
Industrial Development Corporation (Zambia) Limited
Lusaka

Dear Sir,

RE: Property No P1/13 of F/10723

1. Reference is made to the application by Industrial Development Corporation (Zambia) Limited for an **INDUSTRIAL** property in the LS-MFEZ.
2. I am pleased to inform you that the Board of Directors of the LS-MFEZ Limited at its meeting held on 16th February, 2016 approved the application by the Industrial Development Corporation (Zambia) Limited.
3. Accordingly, Industrial Development Corporation (Zambia) Limited is requested to pay to this office within Thirty (30) Days, the fees as per the schedule attached hereto.
4. The lease shall be for a term of 40 years from the date of signing the Lease Agreement and the annual rent of **ZMW 3,900,000** will be payable in advance per annum to LS-MFEZ Limited and subject to review from time to time.
5. The lease shall include clauses among others.
   i. Completion of the project as stated in the project proposal submitted to the LS-MFEZ
   ii. Restricting the use of the property to the purposes for which approval by the LS-MFEZ Board was granted and no other purpose
   iii. Prohibiting the Sub-letting/Leasing of the property without the consent of the LS-MFEZ Board
   iv. If the sum mentioned in paragraph 3 above, is not paid and evidence of payment not produced within 30days of the date of this offer. The offer will be deemed to have lapsed and no compensation whatsoever will be paid.

6. Industrial Development Corporation (Zambia) Limited is reminded before any development is effected to obtain prior permission from the Lusaka Province Planning Authority, Zambia Environmental Management Agency (ZEMA) and meet any other Statutory Requirement.

Yours faithfully,

LUSAKA SOUTH MULTI-FACILITY ECONOMIC ZONE LIMITED

Name: DR FORTUNE KAMNSAKI
Designation: MANAGING DIRECTOR
Signature: Kamnsaki
Date: 16/2/16

Name: JOSEPH KALUMBI
Designation: ACTING COMPANY SECRETARY
Signature:
Date: 16/02/16

LUSAKA SOUTH MFEZ LTD
PLOT F10723, CHIPWEMA ROAD,
OFF LEOPARDS HILL ROAD
16 FEB 2016
POST NET BOX 392,
P/BAG E 017, LUSAKA.

Annex 2

Review of the Mphande Forest 320 Resettlement Process

Review of the Mphande Forest 320 Resettlement Process

The review of the resettlement process for Mphande Forest community is guided by international best practice such as World Bank Safeguard Policies[12] relating to land acquisition and involuntary resettlement; the relevant Zambian legislation on environmental and social impact assessment[13]; and IFC Performance Standards on Environmental and Social Sustainability[14]**.** Of particular relevance is *Performance Standard 5: Land Acquisition and Involuntary Assessment.*

Performance Standard 5: Land Acquisition and Involuntary Resettlement

This Standard deals with the acquisition of land and involuntary displacement of the affected populations as a result of proposed projects. In particular it is intended to:

- Avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs.
- Avoid forced eviction.
- Anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets and ensuring that resettlement is implemented with appropriate disclosure of information, consultation, and the informed participation of those concerned.
- Improve, or restore, the livelihoods and standards of living of displaced persons.
- Improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.

Guidance Note 5: Land Acquisition and Involuntary Resettlement[15]

The Guidance Note 5 corresponding to Performance Standard 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use that land. In particular:

- *GN38*. Land-based compensation should be offered to affected people in cases where their livelihoods are land-based and the proposed land take is significant enough to render a land holding economically unviable.
- *GN39*. Where physical displacement is unavoidable, resettlement should be planned and executed in a manner that provides displaced persons with opportunities to participate in the planning and implementation of resettlement activities to improve or at least restore their standards of living.
- *GN44*. Relocation assistance should be provided to people who are physically displaced by a project. Assistance may include transportation, food, shelter, and social services that are provided to affected people during the relocation to their new site.

[12] Operational Policy 4.12 updated in February 2011 deals with the resettlement process framework including preparation of Resettlement Plans.
[13] The Zambia Environmental Management Act No. 12 of 2011 is the apex law that provides for environmental management and protection and the sustainable management and use of natural resources; Statutory Instrument No. 87 The Environment Protection and Pollution Control (Environmental Impact Assessment) (Amendment) Regulations No. 28 of 2009; Statutory Instrument 29 of 1997 The Mines and Minerals (Environmental) Regulations.
[14] IFC Performance Standards on Environmental and Social Sustainability Effective January 1, 2012
[15] International Finance Corporation's Guidance Notes: Performance Standards on Environmental and Social Sustainability January 1, 2012.

- *GN50*. Resettlement sites should be selected for locational advantage in terms of availability of basic services and employment opportunities that enable the displaced persons to improve or at least restore their livelihoods and standards of living.

The Forest No. 26 displaced persons livelihoods were land-based. Each household has been promised 5 hectares of land for their settlement. These land parcels are yet to be demarcated. According to the community leaders' own admission, the replacement land has productive potential for agriculture much better than that of Forest No. 26. However, there is no evidence that a Resettlement Action Plan or Livelihood Restoration Plan was prepared before the community was resettled to Mphande Forest. The households are currently waiting for the land to be apportioned and the attendant assistance to be given to them.

It is clear from the foregoing that the resettlement process at Mphande is far from being completed. The land for resettlement of the affected people has been identified but it has not been demarcated and allocated to the beneficiaries. Assistance in terms of transportation of the affected community to the identified land for resettlement was provided but no assistance with regard to provision of adequate shelter and social services has been provided at the host site. The host site does not have basic services and employment opportunities to enable the Mphande Forest Community to improve or at least restore their livelihoods and standards of living.

The outstanding issues on the resettlement of the Mphande Forest Community relate to:

1) Land allocation of 5 hectares
    a. Demarcation and survey of land; and
    b. Process of title to land parcel.
2) Planned settlement with:
    a. Access Roads;
    b. Clean Drinking Water;
    c. Health Services; and
    d. Education Services.
3) Requisite assistance to re-establish their livelihoods:
    a. Assistance with preparation of farm field for next growing season;
    b. Provision of seed and farm inputs for one season; and
    c. Any other assistance deemed necessary to restore livelihood activities.

LS-MFEZ Legacy Resettlement

The Mphande Community resettlement is a legacy resettlement associated with the LS-MFEZ. It is not the responsibility of the proposed IDC Solar PV project because the resettlement of Mphande Community did not arise as a consequence of the proposed Solar PV Project but as consequence of the creation of the LS MFEZ.

In order to mitigate the negative impacts of resettlement on the Mphande Forest Community the following will be required:

- Demarcation of land and processing of title to land parcels

- Offer improved living conditions by providing basic facilities such as water, education and health services
- Offer transitional support to restore their income earning capacity, production levels, and standards of living.

These development activities can be undertaken in conjunction with a non-state actor already operating in the area such as World Vision Zambia through the Chipapa Area Development Programme.

Community Development Projects

Community Development Projects that were identified during the baseline survey for Mphande Community were a planned settlement with:

a. Access Roads
b. Clean Drinking Water
c. Health Services
d. Education Services

Other community development projects identified in Mahopo were:

- A play park for children
- Learning and teaching materials (including library books)

In Shantumbu village proposed projects from the identified needs, especially at the school include:

- Learning and teaching materials
- Library facilities
- Overhead water storage tank to supply drinking water and for sanitation.

Collage of Dwellings in Mphande Forest Resettled Community






Annex 3

Letter from the Ministry of Finance indicating no objection to holding Title to the additional piece of land located in the Lusaka National Park

66

MF/IDM/101/37/33

22nd November, 2016

Mr. Stephen Mwansa
Permanent Secretary
Ministry of Tourism and Arts
P.O Box 30575
LUSAKA

RE: ACQUISITION OF TITLE OF 11.9 HECTORS OF LAND IN THE LUSAKA NATIONAL PARK BY THE MINISTER OF FINANCE FOR THE SCALING SOLAR ZAMBIA PROJECT

Reference is made to the above subject matter.

I wish to acknowledge receipt of your request that the office of the Minister of Finance should hold title to approximately 11.9 hectares of land in the Lusaka National Park for purposes of accommodating the Scaling Solar Zambia Project (the "Project") which requires additional land for successful implementation.

Having made the necessary consultations, I wish to confirm that I have no objection to holding the title to the land pursuant to the **Minister of Finance (Incorporation) Act, Cap 349 of the Laws of Zambia** and thereafter sub-leasing the said land to the Industrial Development Corporation or such other entity as maybe deemed appropriate, which will thereafter sub-lease the land to the Project Company responsible for the construction and development of the Project.

Therefore, kindly proceed to commence with the necessary steps for the acquisition of the land. The Ministry of Finance is available for any assistance that maybe required to ensure that this process is completed as soon as possible.

By copy of this letter, all other stakeholders are informed accordingly.

Hon. Felix Mutati, MP
MINISTER OF FINANCE

CC: The Permanent Secretary, Ministry of Commerce, Trade and Industry
The Executive Director, Zambia Development Agency

The Director, Department of National Parks and Wildlife
The Chief Executive Officer, Industrial Development Corporation
The Commissioner of Lands, Ministry of Lands, Natural Resources and Environmental Protection

Annex 4

Letter from the Ministry of Tourism and Arts to the Ministry of Lands on the issuance of Title for 11.9 Hectares in the Lusaka National Park to accommodate the construction of a PV Solar Power Plant

Tel: +260 211 223930
Fax: +260 211 223930
Telex: ZA 45510
Email: psmta@mta.gov.zm

REPUBLIC OF ZAMBIA

MINISTRY OF TOURISM AND ARTS

OFFICE OF THE PERMANENT SECRETARY

In reply please quote

No.....

KWACHA HOUSE
CAIRO ROAD
P.O. Box 30575
10101 LUSAKA

15th November 2016

The Commissioner of Lands
Ministry of Lands Natural Resources and Environmental Protection
Lusaka

RE: ISSUANCE OF TITLE FOR 11.9 HECTARES IN THE LUSAKA NATIONAL PARK TO ACCOMMODATE THE CONSTRUCTION OF A PV SOLAR POWER PLANT

Reference is made to above captioned matter.

I wish to advise that the Government of the Republic of Zambia, through the Industrial Development Corporation is constructing two Solar PV Power Plants in the Lusaka South Multi Facility Economic Zone to produce up to 100 MW of electricity.

In order to accommodate both projects, additional land to what has been allocated so far is required and the identified portion of land for this additional land is a portion of land which lies in the Lusaka National Park. Enclosed is a copy of the approved site plan which identifies the additional land.

I wish to advise that a previous application for the said land had been made by the Lusaka South Multi-Facility Economic Zone Limited. Enclosed is a letter from your office and made available to the Ministry of Tourism and Arts by the Lusaka South Multi-Facility Economic Zone Limited. The office of the Commissioner of lands advised the Lusaka South Multi-Facility Economic Zone Limited to obtain consent from the Ministry of Tourism and Arts for the land to be released for this project. The Ministry of Tourism and Arts has no objection to releasing the land for the project on condition that it remains within the control of Government. It has therefore been agreed that the additional land should be held by the Minister of Finance, pursuant to the Minister of Finance (Incorporation) Act, Chapter 349 of the Laws of Zambia. The Ministry of Finance has also in principle agreed to this request.

In light of the foregoing, I hereby humbly request your office to assist in the process of issuance of the certificate of title to be held by Ministry of Finance on behalf of Ministry of Tourism and Arts.

{2361535.DOCX /}

Please do not hesitate to contact my office for any clarifications you may require.

Stephen Mwansa
Permanent Secretary
MINISTRY OF TOURISM

CC: Ministry of Finance
Industrial Development Corporation

Annex 5

Copy of the Certificate of Title held by the Minister of Finance for the additional 11 hectares of land

DR 10a

REPUBLIC OF ZAMBIA

CERTIFICATE OF TITLE

No.: 28540

Lot ~~Stand~~ No. CHILA/2045163

DR 1A

No.: 28540

REPUBLIC OF ZAMBIA

Registered No.: 2045163/2

THE LANDS AND DEEDS REGISTRY ACT

(Section 45)

CERTIFICATE OF TITLE

THIS Certificate, dated the ELEVENTH day of JANUARY two thousand and SEVENTEEN under the hand and seal of the Registrar of the Lands and Deeds Registry of Zambia WITNESSETH that MINISTER OF FINANCE (TOURISM AND ARTS)

is a tenant or lessee for the unexpired residue of a term of 99 years from the first day of December, 20 16 (subject to such reservations, restrictions, incumbrances, liens, estates and interests as are notified by memorial underwritten or endorsed hereon) of and In ALL that

Piece of land in extent 11.8402 hectares more or less being Lot No.CHILA/2045163 situate in the Lusaka Province of Zambia which piece of land is more particularly delineated and described on Diagram No.SD_43191 of 2016 except and reserved all minerals oils and precious stones whatsoever upon or under the said land.....

A. C Chuni

Registrar

Memorials

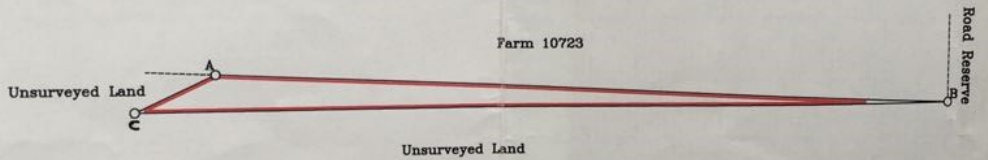
Date of Document	Date of Registration	Registered No.		Cancellation
11/01/2017	11/01/2017	2045163/1	Subject to the exceptions reservations restrictions restricitve covenants and conditions mentioned contained or referred to in a lease (a copy of which is attached hereto) made between The President of the Republic of Zambia of the one part and **MINISTER OF FINANCE (TOURISM AND ARTS)** of the other part.	

PTO

SIDES	METRES	ANGLES OF DIRECTION		CO-ORDINATES SYSTEM UTM 27 E METRES	N
AB	2103.82	92.27.53	A	651932.66	8284057.83
BC	2319.94	269.41.01	B	654034.53	8283967.35
CA	241.25	64.39.11	C	651714.63	8283954.55

FOLD HERE

DIAGRAM NUMBER
SD_43191/2016
APPROVED:
GOVERNMENT SURVEYOR
DATE: 29/12/2016



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SCALE 1: 12500

BEACON DESCRIPTION All are iron pegs in concrete

THE FIGURE A – B – C – A

REPRESENTS 11.8402 ~~Hectares~~ Hectares

OF LAND BEING L/CHILA/2045163

SITUATED IN THE Lusaka PROVINCE REPUBLIC OF ZAMBIA

SURVEYED IN December, 2016

BY ME Mwanakushi
LAND SURVEYOR

PARENT DIAGRAM No.:
SURVEY RECORDS No.: 2625/2016
S G FILE No.: SD/104/13/10
PLAN No.: 2625/2026
MAP REFERENCE: 1528 C2

FOLD HERE

2017/01/10

LF/1
Stocked by Lands
10m M593 12/84 S&T

Lot #: 28540
Regtn: 2045163/2 - CHILANGA
Date: 11/01/17

REPUBLIC OF ZAMBIA

Lease No. LE_8351

Province LUSAKA

LOT No. CHILA/2045163

THIS LEASE MADE the 11th day of January two thousand and SEVENTEEN BETWEEN HIS EXCELLENCY THE PRESIDENT OF ZAMBIA(hereinafter called 'the President') of one part MINISTER OF FINANCE (TOURISM AND ARTS)

(Hereinafter called 'the Lessee' which expression where the context so admits includes itself, its successors in title and assigns) of the other part

WITNESSETH as follows

1. In consideration of the sum of K....0.00.....now paid by the Lessee to the President receipt whereof the President doth hereby acknowledge and of the rent hereinafter reserved and the covenants and condition herein after contained the President hereby demises unto the Lessee ALL THAT piece of land

In extent.....11.8402....hectares.....

More or less being.....Lot/Chila/2045163.....No.....

situated in.....Lusaka.....

province of ZAMBIA which piece of land is more particularly delineated and described on.....

.....SD..43191..of..2016.....No.....

attached to.....these present.....

.....

(hereinafter called 'the said land')TO HOLD unto the Lessee for terms of.....

.....99..... years from the first day of .....December.....

two thousand and .....sixteen..... (herein called 'the said terms')

YIELDING AND PAYING therefor during the said term the rent as hereinafter provided.

EXCEPTING AND RESERVING out of the demise hereby made all minerals, mineral oils and precious stones whatsoever upon or under the said land.

2. The Lessee for .....itself, its successor in title and assigns.....

.....

hereby covenant with the President as follows:

(1) To pay all such rates taxes assessment an imposition whatsoever as may hereafter become payable in respect of the said land according to the law

(2) To permit during the said term the President or any person or persons authorised by the President to enter on the said land at any reasonable time during the day for the purpose of inspection or to lay or have access to water mains drains sewer pipes telegraph or telephone wires and electric manis of all description whether the same or any of them be overhead or underground provided that just and fair compensation shall be paid by the President to the Lessee for any loss or damage occasioned thereby.

(3) To pay on or before the execution of these presents the sum of K0.00..... being rent for the period from the date of commencement or the said to the.....thirty..first.. day of.....December.....two thousand and.....sixteen.....and thereafter a yearly rent of K.....0.00.....on the.....thirty..first.....day of .....December.....in each successive year in arrear free of all deductions.

4) within a period of twenty-four months from the date of the certificate of title to erect on the said land good and substantial buildings to the approval of the planning Authority and to the value as assessed by the local authority of not less than K...500,000.....and to complete the foundations thereof within twelve months from the date of the certificate of title.

5) At all times during the said term well and sufficiently to repair, cleanse, uphold, maintain and keep any messuage or buildings which may be erected on the said land and all additions thereto and the wall fences, sewers drains and amendments and to execute at the lessee's own cost all such sanitary and other works as may from time to time be lawfully required by the local authority.

6) Except with the prior written consent of the President not to assign sublet mortgage charge or any manner whatsoever encumber or part with possession of the said land or any part thereof or interest therein or concerning the same or attempt so to assign sublet mortgage charge encumber or part with possession of the said land.

7) Except with the prior written consent of the President not to use the said land or the buildings thereon or to be erected thereon or any part thereof for any purpose other than for.....

....COMMERCIAL....purposes..in..accordance..with..the..approved..development..plan ....or..any..amendment..thereof..and..for..which..an..application..for..planning ....permission....has..been..submitted..to..and..approved..by..the..Provincial..Planning ....Authority.

President hereby covenants with the Lessee that the Lessee paying the rent of K0.00..... eby reserved and observing and performing the several covenants and condition herein on the Lessee's contained shall peaceably hold and enjoy the said land during the said term without any interruption he President or any person lawfully claiming under the President.

OVIDED ALWAYS and it is hereby mutually agreed as follows:

(1) If and whenever the rent hereby reserved or any party thereof shall be in arrear and unpaid for twenty-eight days after the same shall have become due (whether legally demanded or not) or if the Lessee shall at any time make default in the observance of any of the covenants and conditions herein contained on the Lessee's part to be performed or observed it shall be lawful for the President to re-entre upon the said land and hold the same as of his former estate as if this Lease had not been made but without prejudice to any right of action or remedy of the Lessor in respect of any prior breach non-performance non-observance of any of the lessee's covenants or conditions herein contained.

(2) The annual rent stated in sub-clause shall at the option of the President be subject to revision during the subsistence of the Lease or any extension thereof at such periods as the President might in his absolute discretion decide.

IN WITNESS WHEREOF.....WILFRED KOPA MUMA.....

.....

Commissioner of Lands of the Government of Zambia for and on behalf of the President has hereunto set his hand and seal and.....THE COMMON SEAL OF.....

.....MINISTER OF FINANCE (TOURISM AND ARTS) has hereunto been affixed.

on the day and year first before written.

SIGNED SEALED and DELIVERED

by the said.....WILFRED KOPA MUMA.....

.....

For and on behalf of the President of Zambia

in the presence of:

SEAL

Witness.....GEORGE SUSIKU SINDILA.....

Address: P .O. Box 30069, LUSAKA

Occupation: Civil Servant

SIGNED SEALED and DELIVERED

by the said.....THE COMMON SEAL OF MINISTER OF

.....FINANCE (TOURISM AND ARTS) has.....

hereunto been affixed.

in the presence of:

SEAL

Witness.....MINISTER -.....

Address.....SECRETARY -.....

Occupation.....