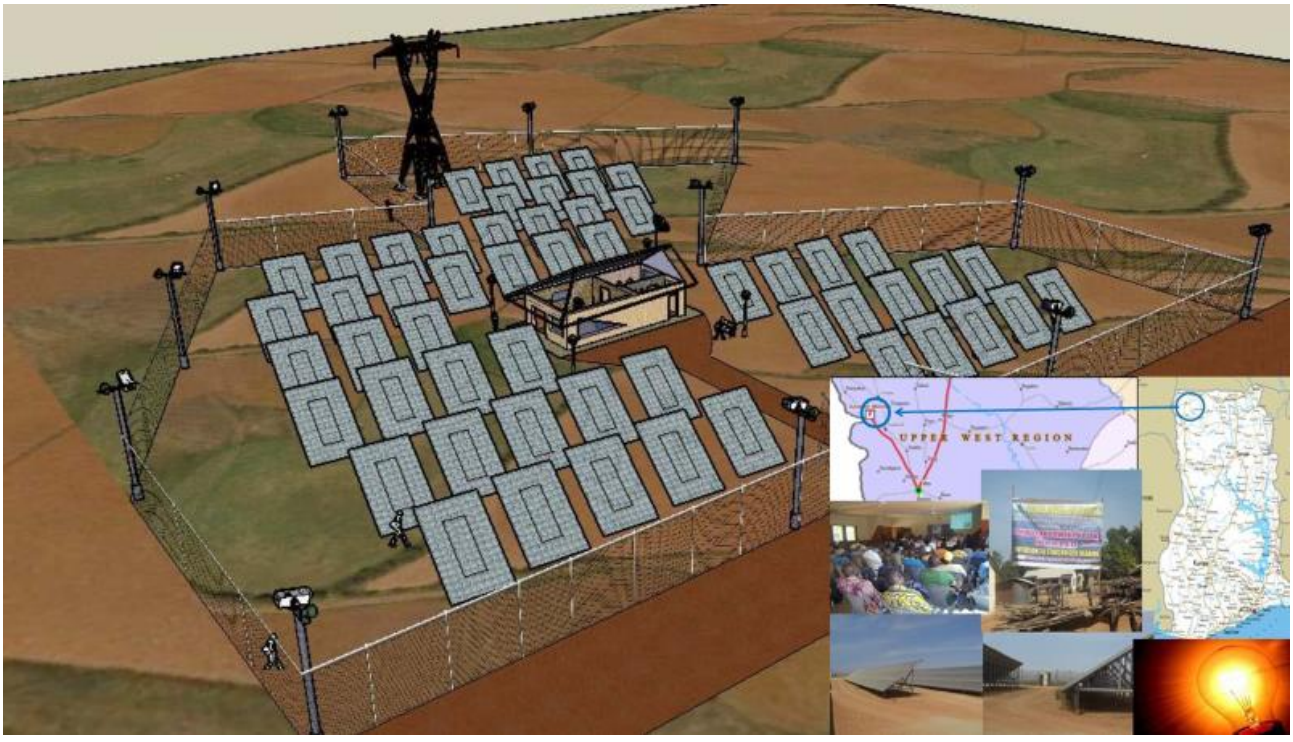
35MW Solar Power Project:
Upper West Regional Project Sites



Environmental & Social Impact Assessment Report - DRAFT

VOLTA RIVER AUTHORITY

MARCH 2019

VOLTA RIVER AUTHORITY

VRA CORPORATE ENVIRONMENTAL POLICY STATEMENT

1. The Volta River Authority (VRA) is committed to ensuring continuous improvement of environmental performance that minimizes potential impacts of all its operations on the environment, in line with the principles of sustainable development, in addition to complying with national and international environmental protection regulations.

2. In respect of the above, VRA will:

   a. Make environmental considerations a priority in all business planning and decision-making and comply with relevant national and international environmental protection regulations.
   b. Take reasonable steps to mitigate the impact of its actions with regard to the development, operation and management of its assets.

3. VRA will thus pursue the following specific objectives:

   a. Develop and implement Environmental Management Systems for all its business units to:

      i. Assess environmental impact of processes, operations and products.
      ii. Focus on pollution prevention and waste reduction.
      iii. Ensure compliance with national/international environmental protection regulations.
      iv. Set annual environmental targets to ensure continuous improvements.
      v. Monitor and report on environmental performance as required to the appropriate stakeholders.

   b. Ensure minimum environmental impact of VRA's projects and take adequate steps to mitigate any such anticipated adverse impacts as far as is practicable.
   c. Promote environmental awareness and individual sense of responsibility among its employees through print material for distribution, safety meetings, and the corporate website which will continue to be updated, and provide adequate empowerment and training for personnel to perform environmental jobs satisfactorily.
   d. Support research efforts on materials, products, processes and pollution reduction techniques that are directly related to its operations.
   e. Contribute to the development of public policy and programmes that enhance environmental awareness and protection.
   f. Promote open communication on environmental issues.
   g. Undertake projects and programmes in collaboration with relevant agencies to preserve the Volta Lake resource, and reasonably restore/mitigate ecological imbalance caused by the creation of the lake.
   h. Undertake projects and programmes to mitigate the impact on the livelihood of individuals and communities displaced or affected by VRA's developmental projects.

4. VRA shall design evaluation procedures for all processes that fall under this policy to ensure that these processes comply. Deficiencies, in the policy or in the evaluation procedure, shall be addressed as required.

5. Each employee of VRA is charged to exercise his or her responsibility on behalf of VRA to assure that the intentions of this Policy Statement are diligently carried out.

SIGNED:..... **REVISED DATE:** 16/05/13

CHIEF EXECUTIVE

SIGNATURE PAGE

Project Name	35MW Solar Power Project: Upper West Regional Project Sites		
Proponent	Volta River Authority		
Report Name	Environmental & Social Impact Assessment Report		
Name	Position	Signature	Date
Leader of Team of Consultants			
Ben A. Sackey	Manager, Environment & Social Impact		
Acceptance & Declaration of Proponent			
Ing. Emmanuel Antwi-Darkwa	Chief Executive		

REPORT DETAILS

Title:	Environmental & Social Impact Assessment Report for the proposed 35MW Solar Power Project: Upper West Regional Project Sites
Project Description:	This EIA Report forms part of a series of reports and information sources that are being provided during the ESIA Process for the proposed project. In accordance with the EIA Regulations, the purpose of the ESIA is to: • Present the details of and need for the proposed project; • Describe the affected environment, including the planning context, at a sufficient level of detail to facilitate informed decision making; • Provide an overview of the ESIA Process being followed, including public consultation; • Assess the predicted positive and negative impacts of the project on the environment; • Provide recommendations to avoid or mitigate negative impacts and to enhance the positive benefits of the project; • Provide an Environmental Management Plan (EMP) for the design, construction and operational phases of the project.
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Mapping:	Engineering Services Department, VRA
Date:	March 2019

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LIST OF ABBREVIATIONS

Abbreviation		Meaning
AC	-	Alternating Current
ACP	-	Affiliate Country Program
ANSI	-	American National Standards Institute
CIS/CIGS	-	Cadmium Telluride and Copper Indium/Gallium Diselluride
COD	-	Commercial Operation Date
CPV	-	Concentrating Photovoltaic
dBA	-	A-weighted decibels
DC	-	Direct Current
DCP	-	Decommissioning and Site Closure Plan
ECG	-	Electricity Corporation of Ghana
EDFI	-	European Development Finance Institutions
EIA	-	Environmental Impact Assessment
EIS	-	Environmental Impact Statement
EMF	-	Electro-Magnetic Fields
EMPs	-	Environmental Management Plans
EPA	-	Environmental Protection Agency
EPRD	-	Environmental Performance Rating & Public Disclosure
FSD	-	Forest Services Division
GEDAP	-	Ghana Energy Development and Access Project
GRIDCo	-	Ghana Grid Company Limited
GMMB	-	Ghana Museums & Monuments Board
HGVs	-	Heavy Goods Vehicles
IBRD	-	International Bank for Reconstruction and Development
ICNIRP	-	International Commission on Non-Ionizing Radiation Protection
ICP	-	Informed Consultation and Participation
IDA	-	International Development Association
IEC	-	International Electrotechnical Commission
IFC	-	International Finance Corporation
ILO		International Labour Organization
LARF	-	Land Acquisition & Resettlement Policy Framework
LI	-	Lahmeyer International
MIGA	-	Multilateral Investment Guarantee Agency
MoU	-	Memorandum of Understanding
MV	-	Medium Voltage
MW	-	Megawatts
NED	-	Northern Electricity Department
NEDCo	-	Northern Electricity Distribution Company
NHIS	-	National Health Insurance Scheme
NLBI	-	Non-Legally Binding Instrument

NRPB	-	National Radiological Protection Board
OECD	-	Organisation for Economic Corporation & Development
O&M	-	Operational & Maintenance
OPD	-	Out Patients Department
PAPs	-	Project Affected Persons
PDD	-	Project Design Document
PEA	-	Preliminary Environmental Assessment
PER	-	Preliminary Environmental Report
PM	-	Particulate Matter Concentrations
PURC	-	Public Utilities Regulatory Commission
PV	-	Photovoltaic
RE	-	Renewable Energy
REDP	-	Renewable Energy Development Programme
SIA	-	Social Impact Assessment
SPP1-UWR	-	Solar Power Project 1: Upper West Regional Project Sites
SPP2-UWR	-	Solar Power Project 2: Upper West Regional Project Sites
STC	-	Standard Test Condition
UWR	-	Upper West Region
VRA	-	Volta River Authority
WBG	-	World Bank Group
WHO	-	World Health Organization

NON-TECHNICAL SUMMARY

Chapter 1: Introduction

1. In line with the Environmental Assessment Regulations, LI 1652 (1999), the Volta River Authority (VRA) in September 2014 obtained an Environmental Permit to construct a 12MW solar power plant, comprising of 8MW plant at Kaleo and a 4MW plant at Lawra, all in the Upper West Region of Ghana. Currently, the VRA intends to expand the scope of the development from 12MW to 35MW, and this is to be achieved through the acquisition of additional lands at the Kaleo and Lawra sites to accommodate the extra 23MW capacity.

2. The project which is titled the ***"35MW Solar Power Project: Upper West Regional Project Sites"*** (hereinafter referred to either as the "Project") is to be developed in two phases by utilizing four (4) separate sites with a total land area of 44.92Ha. Phase 1 and Phase 2 will involve the installation of 17MW and 18MW respectively. The breakdown of the developmental phases and land sizes to be utilized under the project is as shown below:

Name	Size (Ha)	Phase 1	Phase 2	Total	Latitude	Longitude
Kaleo Site 1	10.22	8 MW	-	8 MW	10°10'22.89"N	2°32'1.07"W
Kaleo Site 2	18.39	-	13 MW	13 MW	10°10'49.91"N	2°32'4.98"W
Kaleo Site 3	10.18	5 MW	2 MW	7 MW	10°10'49.91"N	2°32'4.98"W
Lawra	6.13	4 MW	3 MW	7 MW	10°66'24.01 N	2°89'92.18W
Total	**44.92**	**17 MW**	**18 MW**	**35 MW**		

Source: "***Requirements for modifications of Phase 1 to accommodate Phase 2 (2018)***

3. An associated 34.5kV sub transmission and water supply systems are to be constructed under both phases. Developments activities under Phase 1 will allow for relevant modifications and ease of installations for those under Phase 2. Constructional activities for Phase 1 are expected to commence latest by June 2019, and depending on financial closure, that of Phase 2 is targeted by March 2020. Thus, based on the timing of financial closure for Phase 2, project construction for both phases may run concurrently.

4. The Environmental Permit for the 12MW component (i.e. 8MW Kaleo Site 1 and the 4MW Lawra Site under Phase 1) is in force and is valid until August 2019. There is therefore the need to acquire an Environmental Permit to cover the entire 35MW PV power plants, hence the preparation of this ESIA Report, which is a requirement under the Environmental Assessment Regulations, LI 1652 (1999).

5. The environmental assessment has been undertaken by a team of in-house experts of VRA, made up of Environmental Safeguard Specialist, Ecologists, Resettlement Specialist, Land Economist, Land Valuation Experts, Engineers and Geodetic Surveyors. The general methods

used involved data review, field visits, consultations with individuals and or groups as well as formal stakeholder public engagements. For detailed project description, various background documents, correspondences and diagrams/figures on the proposed project were obtained and reviewed. The ESIA Report has been structured under ten (10) Chapters with a Non-Technical Summary, in line with the structure and content as released by the Ghana EPA in 2016 and revised further in November 2018. The 2018 revision was to ensure the incorporation of climate change issues into the ESIA process.

Chapter 2: Policy, legislative & Administrative Requirements

6. It is a requirement to provide an overview of all national legislation and international conventions/guidelines that may inform the ESIA Process in Ghana to ensure that the proposed project meets the highest possible standards of ESIA and the subsequent management policies. Subsequently, the relevant policies, legislative and administrative framework, including VRA's Corporate Policies, that must be considered for the successful implementation of this project have been gathered and how they apply discussed as part of this environmental assessment report.

7. The project is partly financed by the KfW Group through an on-lending Agreement between the VRA and the Government of Ghana. Thus, in addition to the national laws, the proposed solar power project has also committed to align as far as possible with the requirements of international financiers. Generally, KfW bases project assessments on the regulations that apply in the country in which the project is to be implemented. These regulations must be consistent with international environmental, social, health, safety and labour standards. Thus, international safeguards such as those of the World Bank Group, including International Finance Company, Organisation for Economic Corporation & Development (OECD), European Development Finance Institutions (EDFI) as well as the Equator Principles that dictate 'best-practice' from an environmental and social impact perspective are outlined briefly along with guidelines developed by the international community.

8. All relevant national and international environmental, social, health, safety and labour laws, policies, regulations, guidelines and standards that may apply to the development of the project will be applied as required.

Chapter 3: Project Description & Alternatives

9. The 35MW Solar Power Plants and associated electrical infrastructure is to be installed within Kaleo and Lawra communities within the Nadowli-Kaleo District and the Lawra Municipal respectively. The project will install ground mounted grid tie PV panels on fixed tilt axis systems depending on the location. These PV panels with the help of semi-conductor material convert sunlight into direct current electricity. Inverters then transform the DC electricity produced by the PV modules into the alternating current electricity which will then be stepped up and fed into the distribution grid. The power generated by the solar power generation units shall be boosted to 34.5kV after merged together, then connected to the indoor high-voltage

switch gear cabinet and finally access to the power grid through a 34.5kV overhead transmission line. Subsequently, all the PV Plants will be connected to the 34.5 MV network operated by the VRA subsidiary company, Northern Electricity Distribution Company (NEDCo). The source of the network is the main feeder at Sawla.

10. The development will proceed on a turnkey engineering, procurement and construction basis. Currently, the engagement of an Engineering, Procurement and Construction (EPC) Contractor through international competitive bidding is about completed and physical construction is expected to commence by close of June 2019. Design specifications to be followed during construction are to be in line with both the Ghana Building Code, 2018 as well as international standards such as the British Standards (BS). The EPC Contractor is required to provide a Health & Safety Plan, an Environmental Protection Plan as well as a Quality Assurance Plan as part of the bidding documents, and this has been done by the successful bidder and is to be monitored during project construction.

11. In line with the VRA Local Content Policy, the contractors would be required to have a local component. All contractors for the project shall assume full professional liabilities regarding fulfilment of any statutory requirements and shall be expected to carry out all civil based works in line with VRA approved specifications and drawings as well as national/international standards and codes. VRA shall seek and allocate funds to cover eligible payments under the contract for the project.

12. Feasibility studies regarding the project basic design, network connection assessment and field surveys were done which has helped the Environmental Assessment to present alternatives in comparative form, defining the differences between each alternative and providing a clear basis for the selected option. In this respect, the "**No Development Scenario"** is analysed followed by the Geographical Situation and meteorological conditions which formed the basis for selecting the sites in Northern Ghana. In addition, an evaluation of the selected sites, selection of optimal route for the sub-transmission line as well as the technological options for the PV facility including module technology, inverter concept and mounting system and components suitable for the project conditions have been provided in the ESIA Report.

Chapter 4: Description of Existing Environment

13. An environmental assessment requires that a baseline survey should be undertaken to establish the existing ecological and socio-economic situation in the project area. This will inform the impact receptors and informs the level of mitigation to be put in place during project implementation. In this regard, study on the existing biophysical and social environment commenced in June 2011 and has been ongoing since. A detailed report covering all aspects of the existing physical environment, biological environment, ecological sensitive areas as well as socio-economic conditions has been outlined in the ESIA Report. Information provided on physical environment include national GHG Gases Emissions, Atmospheric & Climatic Conditions, Ambient Noise, Air Quality, Topography and Drainage as well as Geology & Soils.

14. It must however be noted that even though the project is specific to the Kaleo and Lawra communities, described as the immediate impact area (assessed within 2km from the specific project sites), its environmental and social influence may affect a large area of the other parts of the affected districts in question. Thus, aside providing specific data on the project site, it also includes information such as climate, social-economic development that transcends the specific communities and is general to the affected districts, the broader impact area.

15. All the three (3) Kaleo sites are degraded and characterized by annual bush fires, continuous farming, and animal grazing etc. Located within the project vicinity across the main road of Kaleo Site 1 are the Kaleo DA Nursery and Primary schools, and the Church of Pentecost. One key historical resource in Kaleo is the burial ground of the Late Hon. Jatoe Kaleo, who died on June 6, 1998. This site is about 500 m to the Kaleo Site 1. The Late Hon. Jatoe Kaleo was one of the leading Ghanaian politicians who led Ghana into independence. The Kaleo Police Station and the Ahmadiya Mission Hospital are both located close to the western side of the Kaleo Site 2. There are 2 Fulani nomadic settlements, one just outside the Kaleo Site 2 and the other located within the site, made up of 2 hamlets. Discussions with the landowners indicate that these are illegal settlers and will be required to relocate prior to project construction.

16. The Lawra site is also degraded and characterized by annual bush fires, continuous farming, and animal grazing. There are no settlements on this site, and the land is largely fallow with Acacia and Sheanut being the most dominant trees. The site is located parallel to the N12 Lawra - Hamile road, which was untarred when the baseline studies started in 2011 but asphalted as at close of 2018. There is an untarred road located on the southern end of the site that leads to the Black Volta, which will serve as access route prior during construction. The waters of the Black Volta serve as the demarcation between Ghana and Burkina Faso. The water body also serves as a recreational facility during public holidays for the youth of Lawra. Just by the side of this road, but outside the project area, is a tree shrine, comprising of Ebony / Nim Tree, known as the Kulbonuo Shrine belonging to the Bayoyire Community in Kaleo. The site was acquired in such a way to avoid the shrine, however, its nearness to the project site is a recipe for future conflict with the shrine owners and will be advisable to relocate them as part of project implementation.

17. The vegetation of the project areas is generally the Guinea Savanna Zone with light undergrowth and scattered medium sized trees. It is mostly characterized by short grasses. A total of 1,442 trees were enumerated at all the sites. At the Lawra Station Forest Reserve, 105 trees comprising of 8 species were identified, with the dominant species being Leocarpus and Teak which are not endangered species. Again, total of 1,337 trees of 29 species were enumerated at the four (4) off reserve areas, with the dominant species being Dawadawa and Sheanut trees.

18. The major trees which are also economic ones are Sheabutter (42.65%) and Dawadawa (13.87%). The neem tree (10.26%) is basically used for fuel wood and is also medicinal. These trees provide a major source of income to households particularly women who play important roles in the provision of household needs. These economic trees provide a potential for the establishment of processing industries to increase employment opportunities for the people. Fire is a common feature here, and the more successful tree species have adapted to the annual fires by having thick barks. It is also characterized by several species of grasses which survive the fires by way of their rhizomes and fibrous roots that remain buried in the soil during the sweeping fires.

19. Due to closeness of the sites to human settlement coupled with continuous farming activities and annual bushfire, few wildlife resources are identified at the project sites. The fauna of the project area has been extensively affected by over-exploitation, alteration and fragmentation of habitat resulting from especially bushfire, human settlements, and agricultural activities. Livestock were common. Some birds were found perching on the trees and in an interview, community members confirmed that the identified birds are occasionally seen in this area.

Chapter 5: Stakeholder Consultations

20. Stakeholder engagements forms a key activity in the environmental assessment process. To identify stakeholders for this project, a stakeholder mapping was done to identify those critical to be consulted during the process. It largely involved identifying stakeholders located within the project's proximity as they are the most likely persons to be impacted upon, like those whose properties will be affected by the project, or those who reside in the communities.

21. Based on the mapping assessment, the following categories of key stakeholders were identified and engaged with:
    a. Property Affected Persons (PAPs), including landowners within the Lawra and Kaleo as well as crop owners.
    b. Community members within Lawra and Kaleo, including Traditional Authorities and elected representatives.
    c. State Agencies within the Nadowli-Kaleo District and Lawra Municipal.
    d. Forestry Services Division, Lawra Office.
    e. Water Resources Commission, Accra.

22. Based on the issues raised at the project briefings, status quo conditions of the study area and the nature of the proposed development, the key issues of concern that must be considered during project implementation are summarized as below:
    a. Effective Community Entry by Project Contractors
    b. Employment for Community Members
    c. Implementation of a Corporate Social Responsibility Programme
    d. Availability of Grievance Redress Mechanism
    e. Environmental Challenges

f. Land Acquisition & Compensation for Loss Property
g. Changes in Land Use
h. Risk to Public Safety, Community Health & Security Issues
i. Groundwater Abstraction and Community water demand
j. Change management
k. Continued Engagement During Construction & Operational Phase
l. Effective Monitoring & Evaluation Process

23. With respect to public disclosure, copies of the ESIA Report shall be made available at the under-listed locations for the public to assess and provide any review comments:
    a. E-copy on the VRA Corporate website at www.vra.com.
    b. EPA Head office in Accra
    c. EPA Upper West Regional Office in Wa
    d. Lawra Municipality
    e. Nadowli-Kaleo District Assembly
    f. Paramountcy of Lawra Naa

Chapter 6: Impacts Identification & Significance

24. As required under the Ghana EA Regulations, the ESIA process is expected to identify the potential impacts, both positive and negative, of the proposed development that occurs during the pre-construction, construction, operational and decommissioning phases of the development. The following categories/attributes: nature, duration, spatial extent reversibility, direct and indirect impacts, short term and long term, positive or negative, cumulative, have been utilized in identifying project impacts.

25. The major positive impacts of the project identified are listed as follows:
    a. Minimisation of Greenhouse Gas Emissions
    b. Increased employment opportunities,
    c. Stabilization of electricity,
    d. Promotion of economic growth in the country.

26. Identified negative impacts of the project are listed as follows:
    a. Disturbance to general populace
    b. Increase levels of fugitive dust and vehicular emissions
    c. Flood risks
    d. Soil Pollution
    e. Water Pollution
    f. Increase risks to environment and health
    g. Altered sense of place and visual intrusion from construction activities
    h. Loss of habitat and listed/rare species
    i. Destruction / loss of Historical & Cultural Heritage Resources

j. Injury to workers
k. Loss of Properties
l. Loss of land for personal and commercial use
m. Reduction in productivity
n. Injury to public
o. Increase in traffic and road accidents

27. Within the project area and its surrounding there are no existing and/or planned developments which would result in cumulative impacts on any of the environmental or social receptors investigated as part of the ESIA. The assessment of cumulative impacts in that sense is not relevant. However, impact on water resource especially, ground water, is critical as water is required for cleaning of the PV modules on a regular basis. Estimated volume of water demand for wet cleaning of solar panels ranges from 19.5 m3/year to 84.5 m3/year for a duration of 20 years. There is the need to ensure that enough water is available and that there is no negative impact on the drinking water supply situation of the nearby communities which may create substantial social conflicts.

Chapter 7: Mitigation & Enhancement Measures

28. Information on the enhancement or mitigative measures to be put in place based on the identified impacts has been accessed through the consideration of the following:
    - Enhancement measures, which outlined measures to be implemented to enhance already positive benefits of the project.
    - Embedded or In-built Controls, which outlines mitigation measures which is built into the project during the design process as well legal requirements that must be adhered to in order for easy transfer into all contractual documents with the EPC Contractor, if required
    - Mitigation of significant effects or key mitigation (pertinent measures that will be written into and enforced through the EMP for implementation to ensure that the significance of the associated impact is acceptable).
    - Mitigation of non-significant effects or additional mitigation (management actions to be considered by proponent and authority).

29. The identified measures are to be implemented mostly by the EPC Contractor in collaboration or under the supervision of VRA at the constructional stage whilst the VRA is solely responsible for the operational stage. Based on expert experience. an evaluation of the residual, i.e. remaining, impacts after implementation of the mitigation measures, has also been undertaken and indicated.

Chapter 8: Environmental Management & Monitoring Plan

30. An Environmental and Social Management Plan (ESMP) for the Project has been developed the purpose of which is to specify the standards and controls required to manage and monitor environmental and social impacts during construction and operation phase. To achieve this, the ESMP identifies potential adverse impacts from the planned activities and outlines mitigation

measures required to reduce the likely negative effects on the physical, natural and social environment.

31. VRA/EPC Contractor is committed to execute all construction and operation related activities for the proposed PV Project as per the best established environmental, health and safety standards and it will be aligned with upcoming project to be implemented at asset level. Mitigation measures are proposed for impacts which are identified and quantified. Some residual impact will however persist after the all mitigation measures are employed, the Environmental and Social Management Plan intends to delineate monitoring and management measures to minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures during construction and operational phase. The ESMP therefore includes proposed mitigation measures, environmental monitoring and reporting requirements, training measures, implementation schedule and cost estimates.

Chapter 9: Decommissioning & Dismantling Plan

32. Each of the solar power projects shall typically have a life expectancy of 20 to 25 years. The current trend in the solar energy industry has been to replace or "re-power" older solar energy projects by upgrading older equipment with more efficient PV plants and ancillary equipment. However, if not upgraded the PV plants will be decommissioned. The solar power facility decommissioning process shall be initiated upon the termination of the leases with the landowners. VRA or the project owners at the time agree to meet with the landowner prior to the lease expiration date to ensure that the owners perform its obligations to remove its property and restore the premises. Removal of machinery, equipment, PV Modules/Inverters and all other materials related to the project is to be completed within one year of decommissioning. Thus, within twelve (12) months of initiating the decommissioning, the relevant project components will have been removed from the leased land.

Chapter 10: Conclusion & Recommendation

33. VRA believes that the ESIA Report has sufficiently dealt with the significant issues on the ground. It is hoped that the report will meet the expectations of the EPA and warrant the issuance of Permit to enable VRA to commence the project. VRA commits to collaborate with EPA to jointly manage the environmental and social concerns related to the solar power plant project and shall submit progress environmental reports to the EPA as required. The study therefore recommends that the ESIA Report should be approved with the provision that the suggested mitigations measures will be adopted, and the ESMP / Monitoring Plans will be followed in the letter and spirit.

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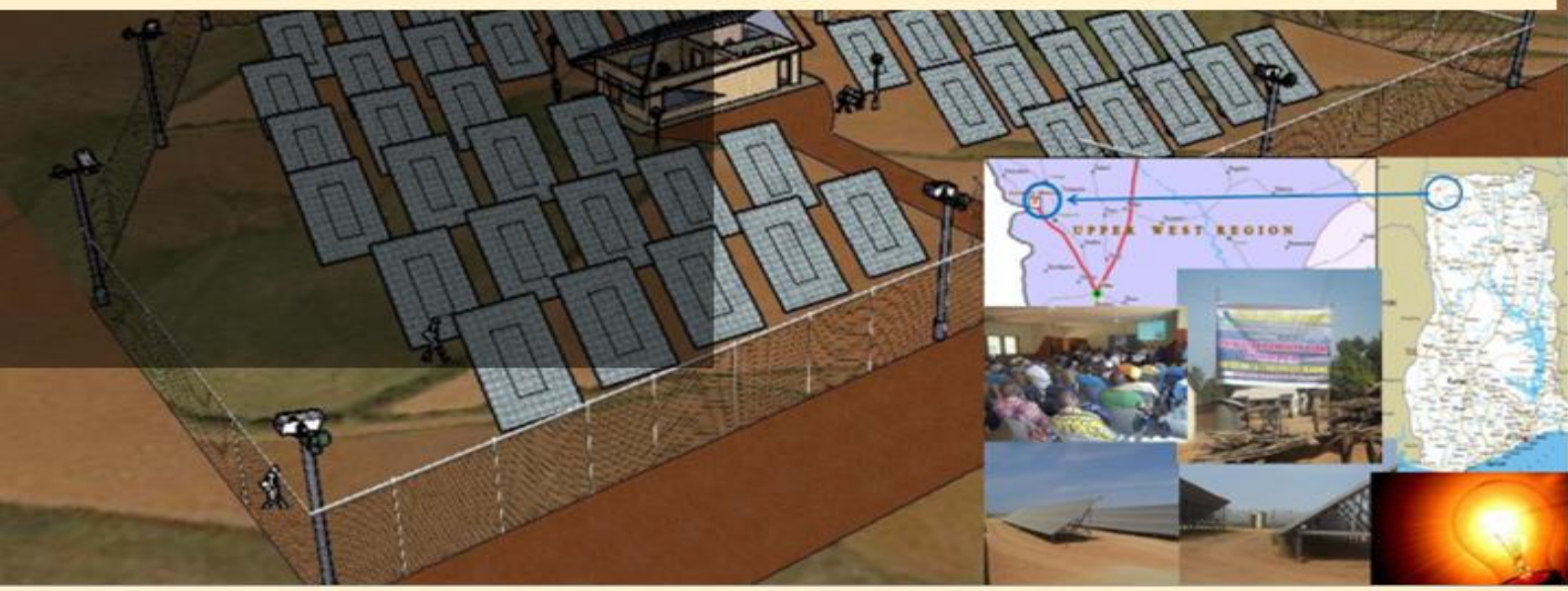
Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



CHAPTER 1:

INTRODUCTION

1 INTRODUCTION

1.1. The Project

The Volta River Authority (VRA) proposes to construct and operate a total of 35MW Solar Power Plants and associated electrical infrastructure within Kaleo in the Nadowli-Kaleo District and Lawra in the Lawra Municipal, all in the Upper West Region of Ghana. The location of project districts within the Upper West Region in the context of Ghana is shown in Figure 1-1. The project which is titled the "***35MW Solar Power Project: Upper West Regional Project Sites***" (hereinafter referred to either as the "Project") is to be developed in two phases by utilizing four (4) separate sites with a total land area of 44.92Ha. The breakdown of the developmental phases and land sizes to be utilized under the project is as shown in Table 1-1.

Table 1-1: 35MW Solar Power Project: Upper West Regional Project Sites

Name	Size (Ha)	Phase 1 (MW)	Phase 2 (MW)	Total (MW)
Kaleo Site 1	10.22	8	0	8
Kaleo Site 2	18.39	0	13	13
Kaleo Site 3	10.18	5	2	7
Lawra	6.13	4	3	7
Total	**44.92**	**17**	**18**	**35**

Source: "***Requirements for modifications of Phase 1 to accommodate Phase 2 (2018)***

Developments activities under Phase 1 will allow for relevant modifications and ease of installations for those under Phase 2. Constructional activities for Phase 1 are expected to commence latest by June 2019, and depending on financial closure, that of Phase 2 is targeted by March 2020. Thus, based on the timing of financial closure for Phase 2, project construction for both phases may run concurrently An Environmental Permit for the 12MW component, comprising of 8MW Kaleo Site 1 and the 4MW Lawra Site under Phase 1 is in force and valid until August 2019. Outstanding is the acquisition of the Environmental Permit to cover the additional 23MW, comprising of the 5MW Kaleo Site 3 for the Phase 1 as well as the 18MW associated with the Phase 2 development, to cover the entire 35MW PV power plants.

1.2. The Applicant

VRA was established on April 26, 1961 under the Volta River Development Act, 1961 (Act 46) of the Republic of Ghana with the mandate to generate, transmit and distribute electricity. Under the Volta River Development (Amendment) Law, 1987, PNDC 171, responsibility for distribution of power in the Northern part of Ghana was transferred from the then Electricity Corporation of Ghana; now Electricity Company of Ghana (ECG) to the VRA and this was performed by its Northern Electricity Department (NED). Act 46 was amended again by the Volta River Development Amendment Act 2005 (Act 692) in the context of the Ghana Government Power Sector Reforms, and the power transmission function of the VRA was transferred to a separate transmission utility, known as the Ghana Grid Company (GRIDCo), which became operational in August 2008. The amendment was aimed at creating the requisite environment to attract Independent Power Producers (IPPs) into the Ghana energy market.

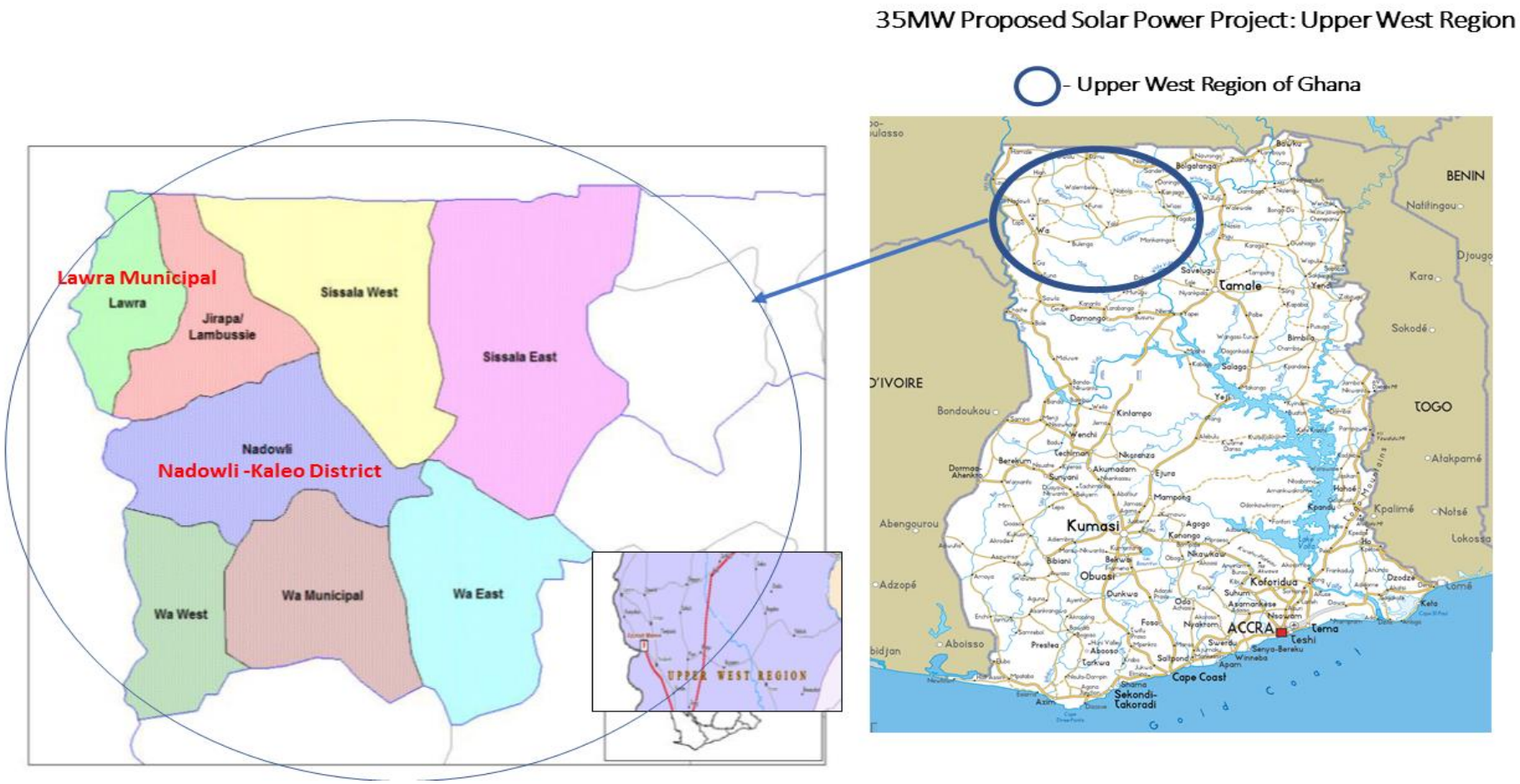


Figure 1-1: Location of Project Districts in the Upper West Region in the Context of Ghana

In addition, NED has been transformed into the Northern Electricity Distribution Company (NEDCo), a stand-alone, wholly-owned, subsidiary of VRA with the responsibility of electricity distribution in Northern Ghana and became operational in May 2012. NEDCo is currently the sole distributor of electricity in the Brong-Ahafo, Northern, Upper East, Upper West, and parts of Ashanti and Volta Regions of Ghana. Based on the various amendments to Act 46, VRA's current mandate has now been largely restricted to generation of electricity and distribution of electricity in the northern parts of the country.

VRA as at September 2018 had an installed electricity generation capacity of 2,600MW, representing 58.8% of the national installed capacity of 4,420MW, and this is from two hydroelectric plants, one solar power plant and seven thermal power plants. With the recent decommissioning of one of the thermal power plants, the Mines Reserve Power Plant, VRA's dependable capacity is now 2,267MW, representing 58.2% of the national dependable capacity of 3877MW. VRA reaches its customers in Ghana and neighbouring countries through GRIDCo. VRA's regulated customers are the Electricity Company of Ghana (ECG) for the southern part of Ghana and to its subsidiary company, NEDCo for the northern part. Details of the VRA can be accessed on its website www.vra.com.

1.3. Purpose & Objectives of the Project

1.3.1. Purpose of Project

The Government of Ghana (GoG) passed the Renewable Energy Act (Act 832) in November 2011 to provide the necessary legal and regulatory framework for promoting the provision of energy from renewable sources. The objective of this Act is to promote the sustainable development and utilization of renewable energy resources for electricity and heat generation; consequently, increasing the proportion of renewable energy in the total national energy mix. The support for the law is also guided by the need to address climate change, as well as the rationale that Ghana has a range of renewable resources and that renewable applications are in fact the least-cost energy service in many cases - and more so when social and environmental costs are considered. It is targeted that 10% of Ghana's electricity needs should come from Renewable Energy sources by 2030.

In line with the National Renewable Energy Act, 2011, VRA in February 2010 adopted a Renewable Energy Policy in order to develop and operate RE plants in an efficient, cost effective and environmentally sustainable manner. To achieve the purpose set out in the VRA RE Policy, the Renewable Energy Development Programme (REDP) was formulated. The VRA REDP sets a 5-10 years' Renewable generation capacity target, taking cognisance of the local and export demand and the system constraints and is being rolled out in two (2) phases as shown in Table 1-2.

Table 1-2: VRA Renewable Energy Development Programme

REDP	Solar Power Project	Wind Power Project
Phase 1	a. 2.5 MW Navrongo Solar Power Plant in the Kassena Nankana East District of the Upper East Region and the plant has been operational since May 2013. b. 17MW (8MW and 5MW in Kaleo, 4MW Lawra) in the Upper West Region. Feasibility Study, including this ESIA and procurement of EPC Contract is ongoing.	a. 76 MW Wind Power Project -1 (Anloga, Srogbe, Anyanui in Volta Region) b. 76.5MW Wind Power Project -2 (Wokumagbe and Goi in Greater Accra Region) Feasibility Study, including ESIA, for WPP1 and WPP2 are ongoing and are expected to be completed by close of June 2018.
Phase 2	200MW Solar Power project to be built in different phases, including the following: **a.** 18MW (13MW and 2MW in Kaleo, 3MW Lawra) in the Upper West Region. Feasibility Study, including this ESIA is ongoing. **b.** 40MW Bongo Solar Power Project: Feasibility Study, including ESIA, is ongoing.	200MW Wind Power Project, and wind measurements completed at four (4) sites.

Source: "Scoping Report for 40MW Bongo Solar Power Project, 2018

The first RE project with a capacity of approximately 2 MWp at Navrongo, Upper East Region, has been in operation since May 2013. The existing scenario is that currently no major power station is operating in Northern Ghana. All the power generating stations are in Southern Ghana, comprising large hydropower plants on the Volta Lake as well as the thermal power stations which are mainly located in the city of Tema and Aboadze, near Takoradi. Hence, electricity for consumers in Northern Ghana is only transported via the National Interconnected Transmission System. In case of grid failures or power plant shut downs, no electricity is available in Northern Ghana. The implementation of the 35MW Solar plants in the Upper West Region of Northern Ghana will stabilize the local grid and therefore improve electricity supply.

1.3.2. Objectives of Project

This "***35MW Solar Power Project: Upper West Regional Project Sites***" is being developed with the following objectives:

- To utilize solar as an additional source of generation to supply the increasing domestic and export demand.
- To align VRA's generation capacity development with GoG Policy on Renewable Energy that seeks that 10 % of all electricity generation to come from renewable sources.
- To meet any future renewable energy purchase obligations to be placed on NEDCo with VRA's owned RE plants.

- Develop the requisite skills required in solar plant development, design and operation to position the VRA to provide leadership technical expertise for deployment of renewable based electricity generation in African.
- Improve VRA's power supply security by diversifying it sources of power generation.
- Increase VRA power generation capacity without increasing the organisation's exposure to fuel supply risks and price escalations.
- Increase VRA's power generation capacity whilst reducing the carbon foot print of the electricity generated.

1.4. Purpose of Environmental Impact Assessment

Under the provisions of the Ghana Environmental Assessment Regulations, 1999 (LI 1652), power generation and transmission projects are categorized under environmentally critical projects for which an Environmental Permit is required from the Environmental Protection Agency (EPA), the nationally designated environmental authorisation agency. Section 2.2 of the Environmental Impact Assessment (EIA) Guidelines for the Energy Sector, Volume 1, dated September 2011, indicates that ground mounted PV power plant/system, either stand-alone, hybrid or grid-tied with total surface area of array exceeding one (1) hectare but below 20 hectares requires the undertaken of an environmental assessment and the preparation of a Preliminary Environmental Assessment (PEA) Report. A full-blown EIA Report is required when the land area required exceeds 20Ha. It is therefore a legal requirement in Ghana that development projects such as the solar power plants under VRA's REDP are subjected to an environmental impact assessment process, and environmental authorisation through the issuance of an Environmental Permit by the EPA. Guidelines for the environmental assessment processes have been further outlined in the Volume 2 of the EIA Guidelines for the Energy Sector.

In line with the Environmental Assessment Regulations (1999), VRA in September 2014 obtained an Environmental Permit for the initial 12MW component, through the preparation of a ***Preliminary Environmental Assessment (PEA) Report (Updated Version) for "12MW Solar Power Project Phase 1: Upper West Regional Project Sites", June 2014.*** This Environmental Permit is in force and valid until August 31, 2019[1]. Currently, the VRA intends to expand the scope of the development from 12MW to 35MW, and this is to be achieved through the acquisition of additional lands at the Kaleo and Lawra sites to accommodate the extra 23MW capacity as shown in *Table 1-1*. The capacity of the proposed 12 MW PV Plant under Phase 1 has now been upgraded to 17MW, by the addition of a 5WM solar power plant at Kaleo Site 3. In addition, an 18MW solar power plant is also to be developed under Phase 2. Four sites with a total land area of 44.91 Ha are to be utilised under the project. Site plans of the four distinct sites indicating the proposed PV capacity to be installed at each site are shown in **Figure 1-2** and **Figure 1-3**.

[1] *See Appendix 1 for the Environmental Permit, dated March 18, 2018.*

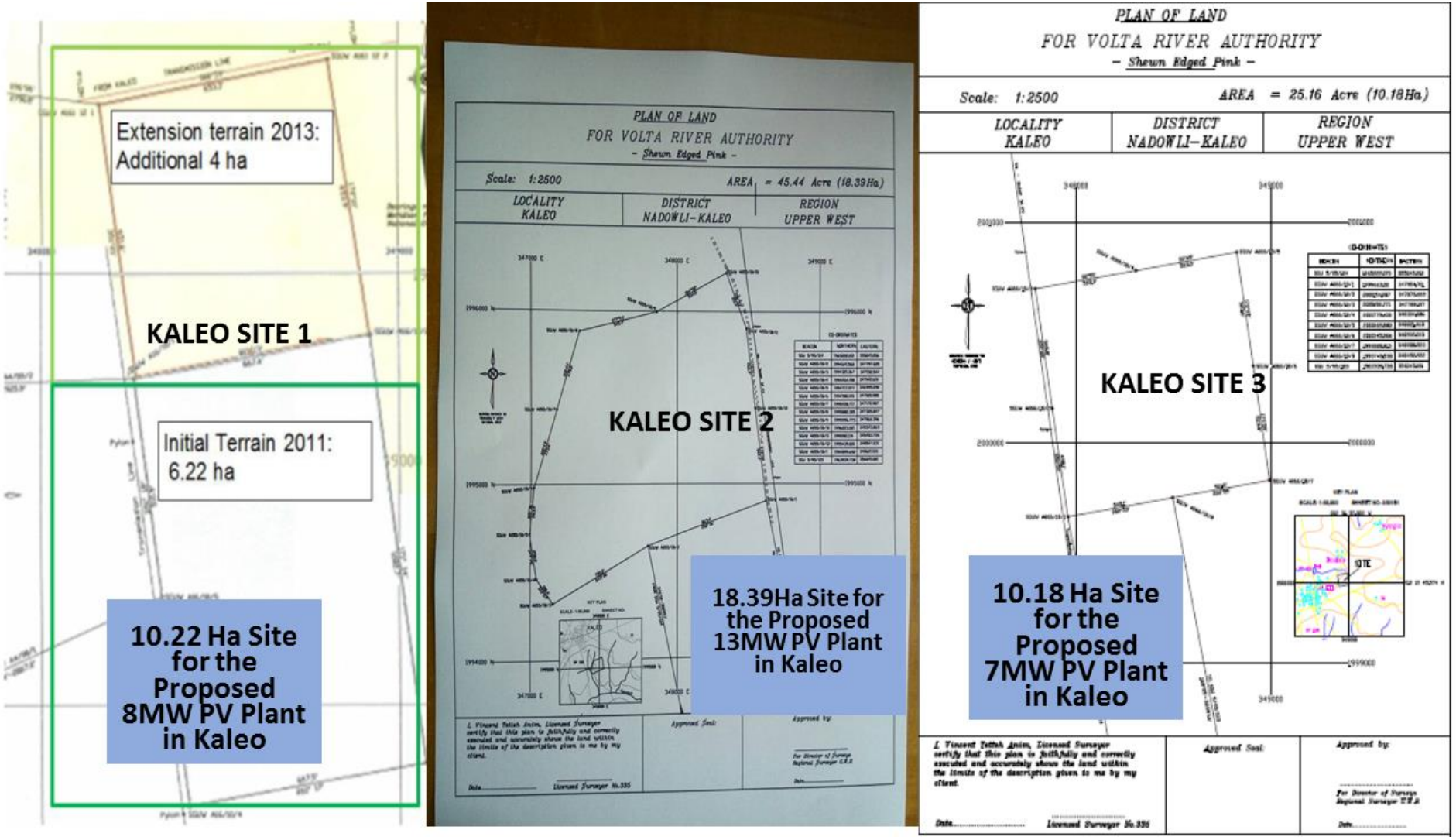


Figure 1-2: **Site Plans of Kaleo PV Sites**

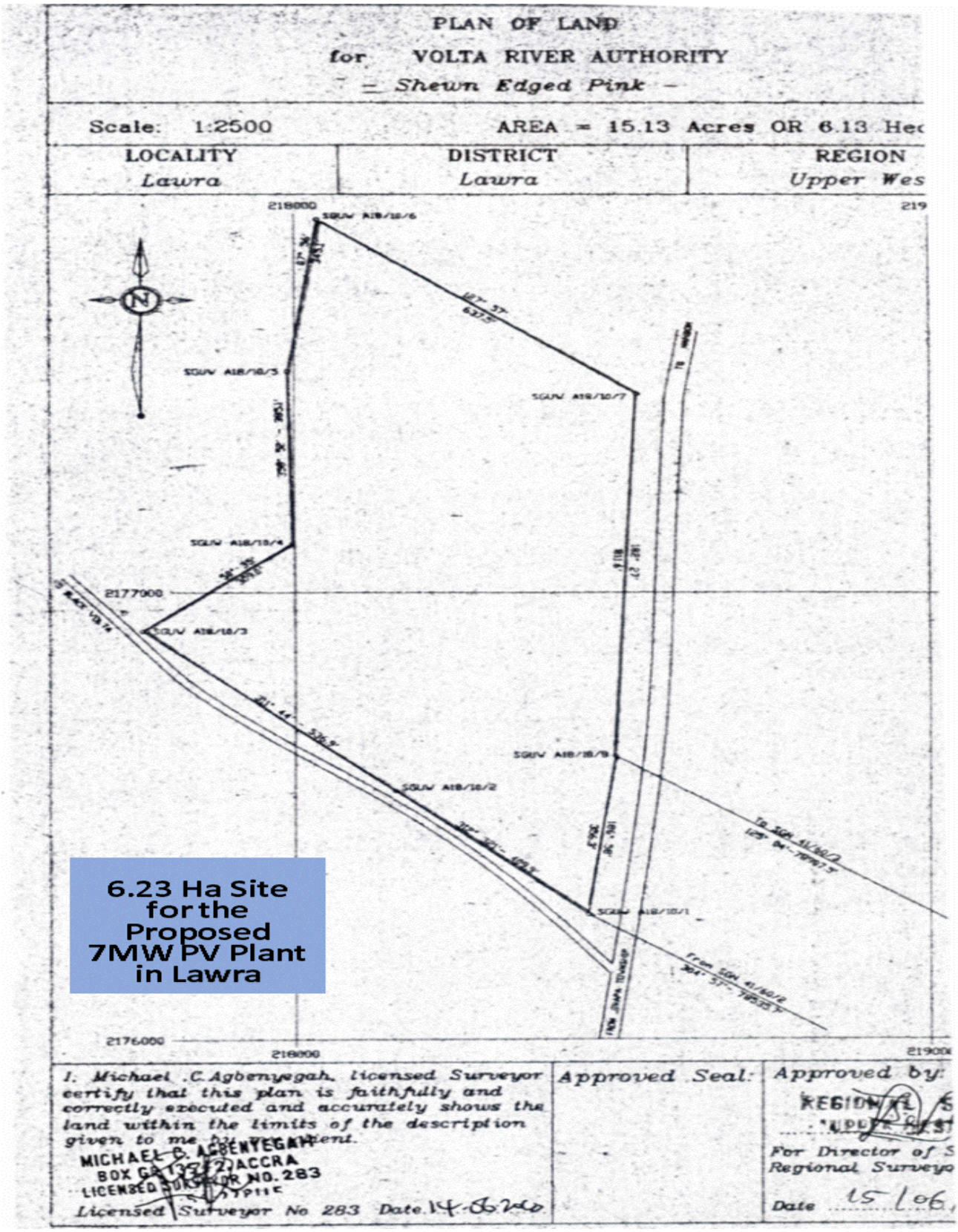


Figure 1-3: **Site Plan of Lawra**

As indicated earlier, project construction for both phases may run concurrently depending on the timing of financial closure and therefore activities have been linked and redefined as a singular project. Thus, with the increase of the project to 35MW as well as the utilisation of land area of 44.91Ha, VRA is now mandated by LI 1652, to update the EIA report to seek environmental authorisation for the project. This ESIA Report has been prepared in adherence to this requirement and is to address any predicted environmental and social issue associated with the construction and operation of the "***35MW Solar Power Project: Upper West Regional Project Sites"***.

1.5. Approach & Methodology

1.5.1. Overview

ESIA is a process designed to ensure that new developments, and extensions to existing developments, are located and designed in such a way as to minimise environmental impact. An ESIA is an information gathering exercise from which a clearer picture emerges of the potential environmental effects of a project. The objectives of an ESIA are to:

- Identify environmental constraints and opportunities within the study area, taking account of the characteristics of the development and the local environment;
- Identify potential impacts and interpret the nature of these impacts;
- Describe the mitigation measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment, including the appropriateness of avoidance and prevention measures; and
- Determine the significance of any residual environmental effects following mitigation measures.

To achieve the above objectives, a baseline survey should be undertaken to establish the existing ecological and socio-economic environment in the project area to determine the anticipated impacts of the project on the environment or vice versa. Such impacts are then analysed to enable the potential mitigation measures to be put in place. Mitigation measures are proposed through the consideration of alternatives, physical design, project management or operation to avoid, reduce or remedy any significant adverse effects on people and the environment resulting from the proposed development.

1.5.2. Environmental Assessment Study Team

The environmental assessment has been undertaken by a team of in-house experts of VRA, made up of Environmental Safeguard Specialist, Ecologists, Resettlement Specialist, Land Economist, Land Valuation Experts, Engineers and Geodetic Surveyors[2]. The ESIA Team is led by Ben. A. Sackey, the Manager, Environment & Social Impact of the Environment & sustainable Development Department. Mr. Sackey currently works as an Environmental Safeguard Specialist and has over twenty (20) years of

[2] See Appendix 2 for members of the study team and their roles.

experience in the coordination of environmental auditing, environmental scoping, EIA studies, resettlement planning as well as the production of Environmental Management Plans (EMP), particularly in the energy sector, both for the public and private sector. He is now a Certified Environmental Auditor with the Institute of Environmental Management & Assessment as well as a Certified Lead ISO 14001 EMS Implementer by the Professional Evaluation & Certification Board.

1.5.3. Data Collection

The general methods used in this environmental assessment involved data review, field visits, consultations with individuals and or groups as well as formal stakeholder public engagements. For detailed project description, various background documents, correspondences and diagrams/figures on the proposed project were obtained and reviewed, and this included the following:

- Update Project Design Report – August 2013
- Project Network Connection Assessment – August 2013
- Renewable Energy Development Programme Ghana: Work Package Closure – CDM PV Projects, August 2013
- Project Tender Document - Tender No: ICT/KLSPP2/2017
- 12MWp Solar PV Plants in UWR, Ghana, Kaleo & Lawra (Technical Proposal – Volume 1), 2017

Again, various internal documents prepared to describe how the two phases of the project will align were also reviewed. This included ***"Proposed Concept for Expansion of the 12 MWp Project to 17 MWp And Kaleo Phase II, 2018***" as well as the "***Requirements for modifications of Phase 1 to accommodate Phase 2 (2018)***.

For data on the existing biophysical environment, field visits were undertaken done by the EA Team to gather primary data as well as secondary data through extensive review of baseline environmental data for the project area. Data was gathered from June 2011 – March 2012, updated in December 2013. VRA in May 2018 engaged the services of the Forest Services Division, Lawra Office to undertake a quantification and listing of identified flora and fauna within the PV project sites as well as the Lawra Forest Reserve, through which the sub-transmission line component would traverse. A review of the District Forestry Plan for the Lawra Forest District, 2011 provided an insight of the management requirements of the Lawra Forest Reserve.

The compilation of the social data in the communities was mainly coordinated by the local government representatives from the communities, popularly known as Assemblyman/woman. Consultations were held with high profile community personnel, including the Traditional authorities, as well as with various stakeholders including area administrative officials and government departments such as Department of Urban Roads, Physical Planning Department (formerly Town & Country Planning Department), Ghana Health Service, Ghana Education Service, Ghana Statistical Service, the Ghana National Fire Service, District Assemblies within the Nadowli-Kaleo District and Lawra Municipal in the Upper West Region,

the project affected districts. Public stakeholder engagements held in January 2012 and November 2017 also provided key socio-cultural information that needs to be addressed during project execution.

The secondary data to supplement the primary social as well as biophysical data was collected through a wide literature review on the project as well as the project area, both published and unpublished, and through internet search. The 2010-2013 as well as the 2014-2017 Medium Term Development Plans, Annual Health Reports and Annual Education Performance Report as well as the 2010 Population & Housing Census Reports for the Lawra Municipal and the then Nadowli District Assemblies provided detailed environmental and social information.

1.5.4. Structure of ESIA Report

In terms of legal requirements, a crucial objective of an ESIA Report is to satisfy the regulatory requirements of the environmental authorisation agency and environmental assessment process. It is also aimed to comply with relevant international guidelines and performance standards. These regulate and prescribe the content of the ESIA Report and specify the type of supporting information that must accompany the submission of the report to the authorities. The Ghana Environmental Assessment Regulations, 1999 (LI 1652) outlines basic information required to be provided in ESIA Reports. Details specific to power generation and transmission projects such as this proposed project are provided in the EIA Guidelines for the Energy Sector, dated September 2011 (Volumes 1 & 2).

The process and outputs of this environmental assessment, including this ESIA Report, is therefore intended to meet the formal requirements of Ghana's EPA as well as that of international funding agencies. The Report has been structured under ten (10) Chapters with a Non-Technical Summary as shown in Table 1-3, in line with the structure and content as released by the Ghana EPA in 2016 and revised further in November 2018. The 2018 revision was to ensure the incorporation of climate change issues into the ESIA process.

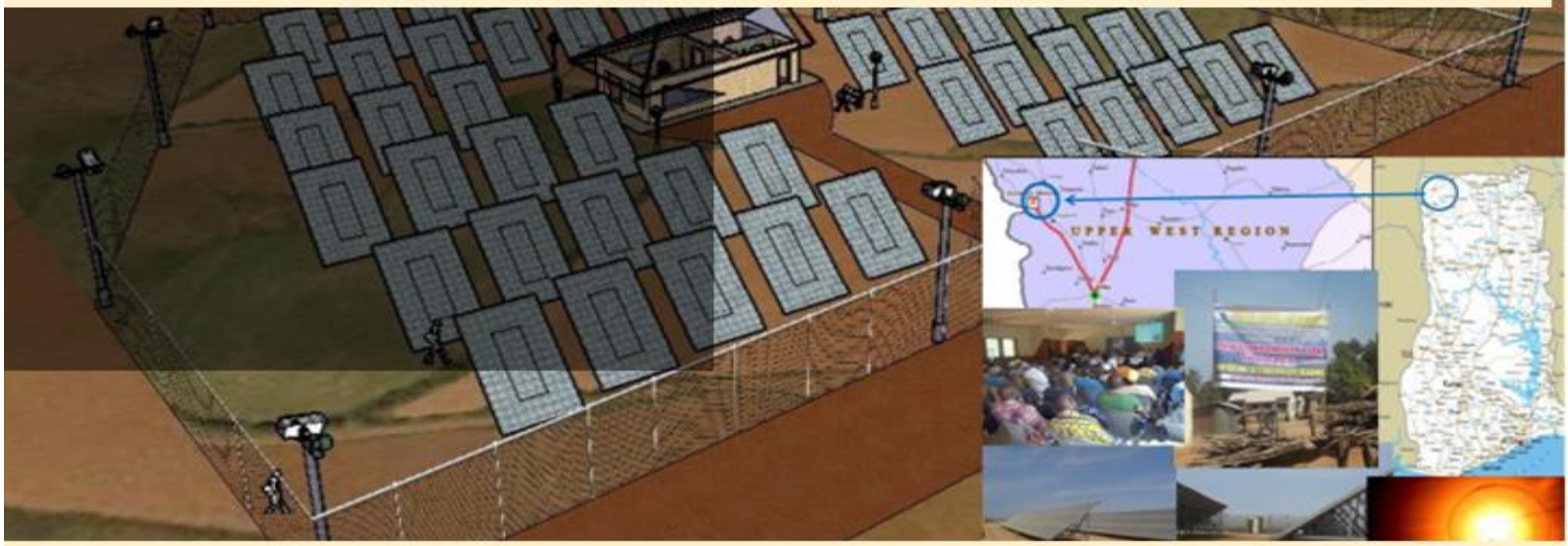
Table 1-3: Structure & Content of the ESIA Report

Title	Content to be Provided
Non-Technical Summary	▪ The scope, purpose and objectives of the project ▪ Brief project description ▪ The legal basis of the project ▪ Brief explanation of the methods by which information and data were obtained ▪ Brief on the baseline data ▪ Impacts identified and their mitigation ▪ Monitoring ▪ Any other critical matters
Chapter 1: Introduction	▪ The purpose and objectives of the undertaking ▪ The aims of the environmental assessment and how those aims are to be achieved. ▪ Methods by which information and data were obtained
Chapter 2: Policy, Legislative and Administrative	▪ Overview of relevant policy, legislative and regulatory framework and an indication of how each of these relate to the undertaking. This should include both national and international Climate Change and Gender related policies (e.g.

Title	Content to be Provided
Requirements	GH-NDCs, National Gender policy, the SDGs, AU Agenda 2063, and the Paris Agreement etc.).
Chapter 3: Project Description & Alternatives	▪ The location (geo coordinates), land take, design, size and scale of the development, components of the project, the nature and duration of constructional and operational activities with diagrams, plans, charts and/or maps ▪ Description of adjoining land uses and land use requirement ▪ Description of constructional activities (proposed works; source and quantities of materials) ▪ Description of the physical characteristics, scale and design, quantities of material needed during construction and operation, description of the production processes. ▪ Description of operational phase (processes or activities; scope; facilities and utility services required; all outputs (products and wastes) ▪ Climate change related features/components of the project ▪ Description of other development (off-site areas or facilities affected by the project) ▪ Numbers of workers involved with the project during both construction and operation ▪ The types and quantities of waste generation including emissions, heat/noise/radiation discharges, deposits and residuals (where applicable) and the rate at which these will be produced, are adequately estimated. Uncertainties are acknowledged, and ranges or confidence limits given where possible. ▪ Alternatives sites, processes, designs and operating conditions where these are practicable and available to the developer. The main socioeconomic and environmental advantages of these should be discussed and the reasons for final choice given. All the alternatives should consider Climate Change Mitigation and Adaptation issues and must be environmentally sustainable. ▪ Where alternatives are not considered, explain.
Chapter 4: Description of Existing Environment / Baseline Information	This chapter should discuss the biophysical and socio-cultural environment of the proposed undertaking (project) to include ▪ The land area taken up by the development, its location clearly shown on a map and geographical coordinates provided ▪ Climatic and atmospheric conditions / Geology / Hydrology/ Ecology Climate zone (refer to the GMet Climate Zones classification) within which the project is located ▪ Land use: ▪ Noise levels / Air quality ▪ Potential sources of Greenhouse Gases (GHGs) where applicable ▪ Human beings: (population composition and distribution, socio-economic conditions, cultural and ethnic diversity, population growth rate); ▪ Social services: (electricity, telecommunication, water supply, hospitals, etc.); ▪ Cultural heritage: (unique features of the area or its people; cemetery, fetish grove, festivals etc.).
Chapter 5:	▪ Identify all relevant stakeholders pertaining to the sector and project.

Title	Content to be Provided
Stakeholder Consultations	▪ Outline concerns of the stakeholders ▪ Provide evidence and outcomes of the consultation
Chapter 6: Impacts Identification & Significance	▪ It is important to set impact boundaries (geographical area of influence) to limit the amount of information to be gathered and analysed. ▪ Identify potential impacts for all phases of the project (i.e. pre-construction, construction, operation and decommissioning) ▪ The identified Impacts should be presented based on the following categories/attributes: nature, duration, spatial extent reversibility, direct and indirect impacts, short term and long term, positive or negative, cumulative, etc. ▪ Methodology for the identification of impacts should be well presented using the following (where applicable) matrices, checklists, expert opinion, modelling, GIS, Climate Change Vulnerability Assessment /Climate Trend Analysis among others. ▪ The assessment of significance should also be based on environmental guidelines, standards and thresholds, socio-cultural and economic values, health and safety, and ecological importance of the resource. The determination of significance must also take into consideration Climate Change issues. ▪ Climate change tools for profiling Climate Change Risk and emission foot prints as well as opportunities for building resilience and reducing emissions. ▪ Stakeholder (interested and affected) concerns should be accounted for in the identification of impacts.
Chapter 7: Mitigation & Enhancement Measures	▪ The mitigation of all significant impacts should be considered, and specific mitigation measures defined in practical terms (e.g. costs, equipment and technology needs, timing). Measures proposed for enhancement of all beneficial impacts should be provided in practical terms. ▪ The mitigation exercise should address Climate Change issues and concerns. ▪ Proposed ways of handling and/or treating wastes and residuals where applicable should be indicated, together with the routes by which they will eventually be disposed of to the environment. ▪ The extent of the effectiveness of the mitigation measures should be presented and where the mitigation measure is uncertain or depends on assumptions about operating procedures, climatic conditions, etc. data should be provided to justify the acceptance of these assumptions
Chapter 8: Provisional Environmental Monitoring Plan	▪ Comprehensive listing of the mitigation measures (actions) that the Project will implement at all phases should be provided in a proposed action plan, ▪ Environmental quality parameters that will be monitored to track how effectively actions and mitigation would be implemented should be presented in a tabulated monitoring plan.
Chapter 9: Decommissioning	▪ Overview of mitigative measure during decommissioning
Chapter 10: Conclusion	▪ Consideration should be based on the pillars of sustainability (economic viability, socio-cultural acceptability, institutional arrangements and the environmentally friendly or benign) amongst others.

Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



CHAPTER 2:

POLICY, LEGISLATIVE & ADMINISTRATIVE REQUIREMENTS

2 POLICY, LEGISLATIVE & ADMINISTRATIVE REQUIREMENTS

2.1. Overview

It is a requirement to provide an overview of all national legislation and international conventions/guidelines that may inform the ESIA Process in Ghana to ensure that the proposed project meets the highest possible standards of ESIA and the subsequent management policies. Subsequently, the relevant national policies, legislative and administrative framework as well as that of VRA's Corporate Policies, that must be considered for the successful implementation of this project have been gathered and how they apply discussed as part of this environmental assessment report. All relevant national laws, policies, regulations, guidelines and standards that may apply to the development of the project will be applied as required. In addition, the proposed project has also committed to align as far as possible with the requirements of international financiers. Thus, international safeguards such as those of the World Bank Group, including International Finance Company, as well as the Equator Principles that dictate 'best-practice' from an environmental and social impact perspective are outlined briefly along with guidelines developed by the international community.

2.2. VRA Corporate Policies

The VRA is committed to providing exemplary levels of care and safety for employees, the local populations and the environment in general. To achieve these, VRA has developed corporate policies regarding environmental protection, health and safety of its workers as well as welfare of the affected population. These corporate environmental, health, safety and social polices all aim at conducting its operations in such a manner that the safety, health and welfare of its workers, impacted communities and the integrity of the environment are safeguarded.

Key applicable corporate policies to the project are listed below.

2.2.1. Renewable Energy Generation Policy

To remain a competitive edge in the power market of Ghana and West Africa, VRA adopted Renewable Energy Generation Policy in February 2010 and is being executed to ensure competitive and timely addition of renewable energy plants to maintain its market share and to also be a renewable energy power and service provider of choice. The development of this proposed solar project is in line with this VRA RE Policy.

2.2.2. Environmental Policy Statement[3]

The VRA Corporate Environmental Policy Statement commits the organization to ensuring continuous improvement of environmental performance to minimize the impacts of all its operations on the environment, in line with the principles of sustainable development, in addition to complying with national and international environmental protection regulations. The policy mandates the

[3] See Front Page (i)

environmental process of the Ghana EPA in project implementation. The Corporate Environmental Policy is under review and it's expected that the monitoring and reporting on carbon footprint as required to the appropriate stakeholders is to be included in the revised document.

2.2.3. Framework on Land Acquisition & Resettlement

To carry out its obligations under the Environmental Assessment Regulations Agency LI 1652 and the Ghana Energy Development and Access Project (GEDAP), VRA prepared a "***Land Acquisition & Resettlement Policy Framework***" (LARF) which establishes broad principles, organizational arrangements and fair criteria to be applied in acquiring various interests in land and handling the attendant impacts on Property Affected Persons was also prepared and is under implementation. Even though these frameworks were prepared under GEDAP, they are relevant for all VRA projects. The plan and mode of dealing with issues regarding compensation for the acquisition of land for this proposed solar project is outlined in the VRA's Corporate **"Land Acquisition and Resettlement Framework"** and relevant portions discussed as appropriate in this Report.

2.2.4. Community Development Programme

VRA launched its **Community Development Programme** (CDP) to enhance the Community Development Initiative (CDI) programme initiated in 2003. The CDP sets out a framework for guiding the process of support for the development of all communities impacted by the operations of VRA. The primary goal of the CDP is to continue to maintain mutually beneficial relationships with the communities in which the Authority has carried out its primary operations since its establishment in 1961. It is expected that by promoting their empowerment and supporting the people to develop their skills, VRA will boost economic activities in all our communities and foster veritable development. Key areas of support under the CDP are an Education Scheme, Cultural Activities, Health Issues, Social Infrastructure Projects, Environmental Protection Activities and Charitable Donations. Communities within the area of influence of this proposed solar project are to benefit from the VRA CDP during the operational phase.

2.2.5. Corporate Social Responsibility

The VRA Corporate Social Responsibility (CSR) Policy (2015) was developed to reflect standards based on national and international guidelines. These include the Ghana Business Code, the UN Global Compact, the United Nations Universal Declaration of Human Rights and the International Labour Organization Convention as well as best emerging practices in CSR. VRA aspires to meet these standards within the context of its Corporate values and through a continuous improvement approach while advancing its mandate to provide electric power safely, responsibly and sustainably and by exhibiting the same commitment of responsibility to all VRA businesses. Communities within the area of influence of this proposed solar project are to benefit from the VRA CSR activities.

2.2.6. Health & Safety Policy

The VRA Corporate Health & Safety Policy commits the organisation to ensuring that all employees work in an injury-free environment where safety is paramount with continuous drive to improve on

safety. All VRA personnel are to make health and safety a way of life. A Corporate Safety Rules & Standards Protection Code document and a Corporate Safety, Health and Environment Rule Book are in place to inform, educate and ensure adherence of staff of this policy.

Within the context of project implementation, VRA has developed a "**Safety, Health and Environment Standards for Contractors**" which provides a framework for better practices and continual improvement in the wellbeing of construction workers and for the elimination of injuries and fatalities through VRA's engagement in construction as a contractor. This document will guide EPC contractor in the implementation of this project.

2.2.7. Workplace HIV/AIDS Policy

In line with national HIV Policy, VRA in 2008 has developed a "Workplace HIV/AIDS Policy" to serve as a guide to both employees and Management in their endeavours to mitigate the impact of HIV/AIDS in both VRA and its business environment and work locations. In line with this policy, VRA will ensure worker education on HIV under this proposed solar project.

2.2.8. MOU Between VRA and the Forest Services Division

VRA and Forest Services Division entered an MoU on October 20, 2003 to outline guidelines for the two institutions to collaborate for the effective management of power related activities in national forest reserves[4]. A 4.4 km of a new sub-transmission line is to be constructed to interconnect the PV Site at Lawra to the existing 34.5 kV Domwini – Lawra Line. It is noted that about 0.5Km section of this new line shall traverse through the Lawra Forest Reserve. VRA has applied these guidelines to project implementation in this reserve and engaged the Lawra Office of the Forest Services Division to undertake a quantification of the flora and fauna in the reserve, as well as the off-reserve areas of the project.

Currently, VRA and FSD in pursuance of this collaboration have found it necessary to revise its separate roles and responsibilities of the partnership under this **MOU** to strengthen the collaborative initiative not only in forest reserves but in off-forest areas as well as the Volta Lake Basin in Ghana. A revised MOU is under review for adoption.

2.2.9. Local Content Policy Document

VRA as a strategic industry in April 2012 developed a Local Content Policy for its operations. The primary objective of this Policy is to promote and sustain industrialization through the utilization and optimization of the indigenous resources of the country. This Policy covers the VRA, its subsidiaries, contractors, subcontractors and other entities involved in any projects, operations, activities or transactions in Ghana. Contractors under the proposed solar project are to adhere to this local content policy.

[4] See Appendix 3 for copy of MOU Between VRA and FSD

2.3. Institutional & Administrative Framework

The governmental bodies in Ghana that will be directly responsible for overseeing the project at all stages are:

- Ministry of Energy
- Energy Commission
- Public Utilities and Regulatory Commission
- Volta River Authority
- Northern Electricity Distribution Company
- Ghana Grid Company

The legal framework within which these institutions exist and their roles in the administration of the proposed solar project are explained as follows:

2.3.1. Ministry of Energy

The Ministry of Energy (MOE) is responsible for formulating, monitoring and evaluating policies, programmes and projects in the power sector. It is also the institution charged with the implementation of the National Electrification Scheme (NES), which seeks to extend the reach of electricity to all communities in the long term. For achieving this, the National Energy Policy, 2010 includes a section on expansion of electricity production as well as its distribution and transmission. MOE is therefore the governmental ministry directly responsible for the project.

2.3.2. Energy Commission

With respect to oversight responsibilities of the energy sector, the ***Energy Commission Act (1997), Act 541*** established the Energy Commission and provided for its functions relating to the regulation, management, development and utilization of energy resources in Ghana; provide for the granting of licenses for the transmission, wholesale supply, distribution and sale of electricity and natural gas; refining, storage, bulk distribution, marketing and sale of petroleum products and to provide for related matters. The Commission performs these regulatory functions through elaboration and enforcement of technical rules.

Subsidiary legislations enacted under the authority of the Energy Commission Act for the proper management of the power sector of Ghana include:

- Electricity Transmission (Technical, Operational and Standards of Performance) Rules, 2008 (LI 1934).
- Electricity Supply and Distribution (Standards of Performance) Regulations,2008 (LI 1935).
- Electricity Regulations, 2008 (LI 1937).
- Electricity Supply and Distribution (Technical and Operational), 2005 (LI 1816).
- Layout-Designs (Topographies) of Integrated Circuits Act, 2004 (Act 667).
- National Electricity Grid Code, 2009.

- Renewable Energy Sub-Code for NITS connected Variable Renewable Energy Power Plants in Ghana, January 2015.
- Renewable Energy Sub-Code for Distribution Network connected Variable Renewable Energy Power Plants in Ghana, January 2015.
- Net Metering Sub-Code for Connecting Renewable Energy Generating Systems to the Distribution Network in Ghana, January 2015.

The rationale for passing the Ghana Renewable Energy Act, 2011 (Act 832) has been outlined under Section 1.3 of this report. The law provides for a feed-in tariff mechanism to encourage the adoption and use of renewable energy as well as creates a platform for the trading of renewable energy. The law also provides for a renewable energy purchase obligation for the utility services and bulk customers as well as the integration of biofuel into petroleum so that those who produce biodiesel can have a market. The Ghana Renewable Energy Fund is to be created under the law to support renewable energy promotion, research and other activities. Besides, the fund will supply seed money for renewable energy companies, depending on how much will be demanded by the companies.

Energy Commission is to provide technical regulation and licensing for RE electricity generation, transmission and distribution. By Section 11 of the Energy Commission Act, participation in any segment of the power sector, either for transmission, wholesale supply, distribution or sale of electricity, requires a license. A license may only be granted to (a) a citizen of Ghana, or (b) a body corporate registered under the Companies Act, 1963 (Act 179) or under any other law of Ghana, or to a partnership registered under the Incorporated Private Partnerships Act, 1962 (Act 152). Thus, the development of the solar power project would require a license from the Energy Commission to supply and distribute electricity. EC has issued Siting Permits for both the project sites at Lawra and Kaleo and these are attached as part of Appendix 1. Constructional license will be dependent on VRA receiving the Environmental Permit from the EPA.

2.3.3. Public Utilities and Regulatory Commission

The ***Public Utilities Regulatory Commission (PURC) 1997, Act*** 538 required the PURC to set up guidelines for pricing of power generated taking into consideration assurance of financial viability of power produced, investor interests and best use of natural resources. Under the PURC Act, the PURC, among other things, approves rates chargeable by public utilities, ensures competition among public utilities, monitors standards of performance of public utility service provision and ensures the protection of consumer rights. In seeking to achieve this, PURC has various legislations to support its work. This includes the Public Utilities (Termination of Service) Regulations, 1999 (L.I. 1651), the Public Utilities (Complaints Procedure) Regulations 1999 (LI 1665), the Public Utilities (Consumer Service Committee) Regulations 2002 (LI 1704A).

PURC in 1999 issued guidelines for electricity rate-setting in Ghana. It provides the key elements of electricity rate making methodology and contains the general guiding principles used as the basis for rate-setting. PURC is to provide economic regulation and setting tariffs for electricity including the Renewable Energy Feed-in-Tariff. As with all generating plants in Ghana, the PURC shall be

responsible for setting prices for power generated from the solar power facility taking into consideration the generation mix at any time. PURC gazettes these tariffs as and when produced.

2.3.4. Volta River Authority

The legal entity of VRA has been discussed under Section 1.1. VRA as a utility company is the developer for the proposed solar power project, and this is being done within the context of the Ghana Renewable Energy Act, 2011 (Act 832). The following legislations are in place to assist the VRA in its power generation installations and these have been applied as relevant in the associated land acquisition processes:

- ***Volta River Authority (Transmission Line Protection) Regulations, 1967 (LI 542)*** provide security for VRA Transmission Lines and ensure public safety. Define "transmission line right of way" and prohibit/restrict a number of activities in the RoW including farming, cultivation, mining and construction of buildings, which are only allowed with prior consent from the VRA.
- ***Volta River Authority (Transmission Line Protection) (Amendment) Regulation, 2004*** which provides for the right of way distances for 69 kV, 161 kV, 225kV, 330 kV transmission lines. The RoW for 225 kV and 330 kV transmission towers is 40 meters, whilst that of 69kV and 161 kV is 30 m. This regulation prohibits a number of activities in the RoW including mining, construction of buildings, and cultivation of some types of crops.

2.3.5. Northern Electricity Distribution Company

In pursuant of the Power Sector Reforms, VRA has also registered NEDCo as a wholly-owned VRA subsidiary and is responsible for distributing electricity in the Brong-Ahafo, Northern, Upper East, Upper West, and parts of Ashanti and Volta Regions of Ghana. NEDCo will be responsible for distributing and direct sale of the power generated from the project.

2.3.6. Ghana Grid Company

GRIDCo was established in accordance with the Energy Commission Act, 1997 (Act 541) and the Volta River Development (Amendment) Act, 2005 Act 692, which provides for the establishment and exclusive operation of the National Interconnected Transmission System (NITS) by an independent Utility and the separation of the transmission functions of the VRA from its other activities within the framework of the Power Sector Reforms.

GRIDCo was incorporated on December 15, 2006 as a private limited liability company under the Companies Code, 1963, Act 179 and granted a certificate to commence business on December 18, 2006. The company became operational on August 1, 2008 following the transfer of the core staff and power transmission assets from VRA to GRIDCo.

The establishment of GRIDCo is intended to develop and promote competition in Ghana's wholesale power market by providing transparent, non-discriminatory and open access to the transmission grid for all the participants in the power market particularly, power generators and bulk consumers and

thus bring about efficiency in power delivery. The amendment has a key function of creating the requisite environment to attract independent power producers (IPPs) onto the Ghana energy market. GRIDCo shall collaborate with NEDCo in transmission of power from the solar power project.

2.4. National Legislation and Guidelines of Relevance to the Proposed Project

Key national legislation, regulations and guidelines of relevance to the envisaged project and this ESIA report relates to that of Environmental Protection, Occupational Health & Safety, Road Traffic Safety, Labour & Other Social Responsibility, Property Acquisition & Compensation, Land & Water Resource Protection, Biodiversity & Resource Protection and Climate Change & Vulnerabilities.

Brief discussions on these are provided under this section.

2.4.1. Environmental Protection

The broad mandate for environmental protection and over-arching resources and sustainable development fall under the Environmental Protection Agency (EPA), as the Lead Regulator. The EPA Act 490 defined environmental impact assessment as a method used to identify a project's probable impacts on the environment. Under the EPA Act, 1994, (Act 490) and the Environmental Assessment Regulations, 1999 (LI 1652), the EPA has the mandate and power to request, assess and generate a record of decision through an environmental assessment for all developments which may be detrimental to the environment, including that in the energy sector. Proponents are to carry out environmental assessments in order to influence project design and the choice of project alternatives. Subsequently, every undertaking or project that may have an impact on the environment must register with the EPA. No licenses, permits or approvals required from other government departments relating to the project, will be issued unless a request for an EIA is complied with. Of relevance once the project is operational is that the EPA is also empowered to serve an enforcement notice on any person responsible for any project requesting him to prevent or cease any activity it considers harmful.

The EPA has issued formal guidance on regulatory requirements and the ESIA process. The following documents are relevant to the ESIA process and the project:

a) Environmental Impact Assessment Guidelines for the Energy Sector (2011), Volume 1 has been prepared to ensure the sustainable use of energy resources and also contribute towards sound environmental management in the energy sector. Volume 2 of the Guidelines provides systematic procedures on EIS preparations for the energy sector as well as guidelines on common potential impacts and mitigation measures. The implementation of the environmental assessment of this project has been guided by this guidelines document.
b) Environmental Assessment in Ghana, A Guide (1996) produced by the EPA provides detailed guidance on the procedures to be adhered to when undertaking an ESIA.
c) Environmental Impact Assessment Guidelines for the General Construction and Services Sector (2011), has been prepared to ensure the sustainable development of the general construction and services sector and contribute towards sound environmental management in the general construction and services sector.

d) The EPA has published guidelines for industrial or facility effluents, air quality and noise levels. Relevant guidelines are outlined below, and their permissible values would be indicated where relevant data is collected or are to be used in environmental quality monitoring.

- *Schedule 1*: Ghana's EPA Guidelines for discharges into natural water bodies provide maximum permissible concentrations for a number of parameters. Sector specific guidelines for discharge into water bodies have also been developed.
- *Schedule 2*: Waste Discharges into Air
- *Schedule 3*: Ghana EPA Environmental Quality Guidelines for Ambient Air
- *Schedule 4*: Environmental Quality Guidelines for Ambient Noise (EPA)

Ground mounted PV power plant/system, either stand-alone, hybrid or grid-tied with total surface area of array exceeding 20 hectares has been classified as mandatory for environmental impact assessment (Category C): Based on this legal requirement, the proposed project has been subjected to an environmental assessment and permitting prior to construction leading to the preparation of this ESIA Report. The Environmental Assessment Fees and Charges (Amendment) Instrument, 2015 LI 2228 applies for the purposes of the processing and Environmental Permit Fees charged by the EPA depending on the scale of the undertaken. VRA has so far paid various stipulated charges regarding the environmental assessments to the EPA.

The ***Pesticides Control and Management Act, 1996, Act 528*** that has been integrated into Act 490 as Part 2 was enacted to provide for the control, management and regulation of chemicals and pesticides in Ghana and to provide for related matters. It provides the EPA the powers to register and classify chemicals, to determine restricted and suspended chemicals, to license and approve dealers, and to ensure enforcement and penalties. It states that no person shall import, export, manufacture, distribute, advertise, sell or use any chemical in Ghana unless the chemical has been registered by the EPA in accordance with this Act. There will be no importation of chemicals associated with the project.

2.4.2. Occupational Health & Safety

a) **Factories, Shops and Offices Act of 1970 (Act 328)** was enacted to promote and ensure the health, welfare and safety of persons employed in the country as well as the responsibilities of the employer. Under the Act, employers are required to ensure that a safe and healthy workplace is provided for the safety, health and welfare of all employees.

b) **Ghana National Fire Service Act, 1997 (537)** mandates that a Fire Certificate be required for premises used as a public place or place of work. The owner or occupier of the premises shall apply to the Chief Fire Officer for a Fire Certificate, which will be valid for 12 months from the date of issue and subject to renewal. Power facilities require a fire certificate. Subsequently, the Fire Precaution (Premises) Regulations, 2003, LI 1724 necessitates that adequate measures are taken to eradicate potential sources of fire outbreaks and that a fire certificate be acquired for any project or facility.

c) **Hazardous & Electronic Waste Control Management Act, 2016 (Act 917)** provide for the control, management, disposal of hazardous waste, electrical and electronic waste and for related purposes.

d) The **Control and Prevention of Bushfires Act, 1990 (PNDC Law 229)** was issued to prohibits any person from starting of bushfires which results in the uncontrolled burning of a farm, forest or grassland, and to provide for related matters. It repeals the Bush Fires Law, 1983 (P.N.D.C.L. 46).

e) **Workmen's Compensation Law, 1986** recasts the law in relation to compensation awarded to workers for personal injuries arising out of and while in their employment. It governs, inter alia, the employer's liability in such cases, the distribution of compensation in the event of the worker's death (including a related schedule), degrees of partial incapacity set forth in a schedule, determination of claims, remedies against the employer and third parties, protection of compensation against attachment or assignment, payment of medical expenses and provision of medical aid, and occupational diseases (with 13 such diseases listed in an attached schedule). The new enactment grew out of a study undertaken by the Tripartite National Advisory Committee on Labour. It repeals the Workmen's Compensation Act 1963 (No. 174) and the 1966, 1968 and 1969 amendments thereto. Statutory Instruments made under those Acts remain in force until amended, varied or revoked in accordance with the provisions of the new law.

f) **Persons with Disability Act, 2006, Act 715** Act provides for persons with disability, to establish a National Council on Persons with Disability and to provide for related matters. The law requires owners or occupiers of public structures to provide appropriate facilities to make them easily accessible by persons with disability. The Act deals with issues such as rights, employment, education, transportation, housing facilities, effective health care, adequate medical rehabilitation services, generation and dissemination of relevant information and participation of PWDs in cultural activities. Pursuant to the passage of the Disability Act 2006 (Act 715), the National Council on Persons with Disability was established in line with Article 41 of the Persons with Disability Act.

g) **The National HIV & AIDS STI Policy of 2004** and revised in Feb. 2013 has been developed to address the very serious health and developmental challenges posed by HIV/AIDS. The policy provides the framework for Ghana's strategy to reduce the spread of HIV infection. It provides the necessary statement of commitment around which a legislative framework will be built for an Expanded Multi-Sectorial Response to reduce further spread of the epidemic, and for the protection and support of people infected with HIV/AIDS in Ghana. Subsequently, a National HIV/AIDS Strategic Framework for Ghana has been formulated in recognition of the developmental relevance of the disease. Ghana, by this document has joined the global community in a united effort to combat the epidemic. The Strategic Framework document is updated periodically, and it provides for a Workplace HIV Policy. Ghana has now developed a National HIV/AIDS Strategic Plan 2016-20.

h) The **Ghana National Building Regulations, 1996, LI 1630** establishes a common set of baseline requirements for all structures erected in Ghana, enforce the regulations, and educate building contractors on building the safest buildings possible. Within this framework, the

Ghana National Building Code, 2006 was enacted to minimise structural failures in the building construction industry, promote safety as well as ensure qualitative housing. The Code was revised in 2018 and new sections have been included, among others being **Energy Efficiency and Sustainability (Part 10)**, setting out the requirements and recommendations for the energy efficient use of service appliances and other equipment installed in buildings as well as **Constructional Practices, Safety and the Environment (Part 11)** which covers the constructional planning, management and practices in buildings; storage, stacking and handling of materials and safety of personnel during construction operations for all elements of a building and demolition of buildings. It also covers guidelines relating to maintenance management, repairs, retrofitting and strengthening of buildings.

i) The **Ghana Seismic Code, November 1990** sets down the minimum design requirements to be met when dealing with seismic situations. It applies to among others, reinforced and pre-stressed concrete buildings for ordinary uses.

j) The **Ghana National Environmental Sanitation Policy** 2010, which was originally passed in 1999, seeks to develop a clear and nationally accepted vision of environmental sanitation as an essential social service and a major determinant for improving health and quality of life in Ghana. The policy is a necessary tool required to help shape all efforts in dealing with the overwhelming challenges of poor sanitation in Ghana.

k) The **"Health Care Waste Management Policy & Guidelines", 2006** was developed by the Ministry of Health to ensure that health care waste is managed effectively in compliance with existing laws and regulations and others to be passed in future in order to protect health care workers, their clients and the environment from potentially disease-causing waste materials. The Guidelines provide standards, procedures and processes for handling health care waste in the sector institutions and mechanisms for performance and performance monitoring.

Applicability to Project

The safety of the public as well as all workers is critical in project execution, and these legal requirements seek to ensure public safety and compensation in the event of injury. The laws seek for projects to anticipate and avoid adverse impacts on health and safety of the affected communities during the project life from both routine and non-routine circumstances. Projects are to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimises risks to the affected communities. Subsequently, risks associated to public health, safety and security is required to be assessed.

The tenets of the law place a large share of the burden of supporting workers injured at the workplace on the shoulders of the employers. The project and its contractors will be responsible for the health and safety of workers and the impacted communities as well as the public. The project shall be responsible for providing for the payment of compensation to workers for personal injuries caused by accidents arising out and while in employment. In addition, developmental activities of the project will provide equal opportunities for all persons, including persons with disabilities and the project should not discriminate against a qualified applicant or employee because of the known disability. HIV&AIDS education for workers is key and must be adhered.

2.4.3. Road Traffic Safety

a) The **National Road Safety Commission Act, 1999 (Act 567)** established the National Road Safety Commission and provide for its functions relating to the development and promotion of road safety in the country and to provide for connected matters.

b) **The Road Traffic Acts, 2004, Act 683** deals with restrictions on road use in the interest of Road safety, registration and licensing of motor vehicles and trailers, licensing of drivers of motor vehicles, test of vehicles and issuance of road use certificates and licensing of drivers of commercial vehicles. It is supported by the **Road Traffic Offences Regulations, 1974 (LI 952)**, which was amended by the **Road Traffic (Amendment) Regulations (1995), LI 1605**, and the **Road Traffic (Amendment) Act 2008 (Act 761)** as well as the **Road Traffic Regulations, 2012, LI 2180.**

c) **Driver & Vehicle Licensing Authority Act, 1999 (ACT 569)** which establishes Driver and Vehicle Licensing Authority to promote good driving standards in the country; and ensure the use of road worthy vehicles on the roads and in other public places.

d) The **National Road Safety Policy, 2007** was developed to underpin and validate road safety interventions that have been implemented in Ghana since 1999 till 2007. The Policy provides guideline for the design, implementation, monitoring and evaluation of national road safety programmes and activities from 2008 and beyond.

e) The **Road Reservation Management: Manual for Coordination" (June 2001)** has been prepared form infrastructure and utilities to help promote coordination in the utilization of road reservation in the country.

f) The **Truck Driver's Guide - Ghana, 2010** provides information on what a driver needs to know what the laws say and how the rules are implemented. This guide presents the most important information about Ghana's traffic laws and enforcement.

Applicability to Project

It is expected that the solar power materials will be brought by sea to the Tema Port. From there, it will be offloaded and brought to Accra on the N1 Highway in the southern sector, where it will be transported up north to site through to Kumasi through Wa, the regional capital, and finally to Lawra, covering a total distance of about 860 km. These legal requirements provide guidelines for the Client and the EPC contractor to manage associated road safety issues.

2.4.4. Labour & Other Social Responsibility

a) **Labour Act 2003 (Act 651)** of 2003 consolidates and updates the various pieces of former legislation and introduces provisions to reflect International Labour Organisation (ILO) Conventions ratified by Ghana (see Section 3.5). The Labour Act covers all employers and employees except those in strategic positions such as the armed forces, police service, prisons service and the security intelligence agencies. It ensures employer and employee relationships. **The Labour Regulations, 2007 (LI 1833)** provide details regarding conditions of employment in the country. Section 9(c) of the Act mandates an employer to take all practicable steps to ensure that the worker is safe from risk of personal injury or damage to his or her health during and in the course of the workers' health while lawfully on the

employer's premises. Provisions specifically related with occupational health, safety and environment are included with the Part XV of the Labour Act. These include general health and safety conditions, exposure to imminent hazards, employer occupational accidents and diseases reporting.

The National Labour Commission in Ghana was established in 2005, under Section 135 of the Labour Act 2003 with the sole mandate to facilitate and settle industrial disputes using dialogue. Its law applies to all workers as well as employers with the exception of Security and Intelligence Agencies provided for under the Security and Intelligence Agencies Act 1996 (Act 526). Its major mandate includes receiving labour-related complaints, facilitating the settlement of Industrial disputes, settling industrial disputes and promoting effective cooperation between labour and management.

b) **Children's Act No. 560 of 1998** defines a child as a person below the age of eighteen years. It is stated within the Sections 12 and 87 of the Act 560, that child must not be engaged in exploitative labour. Exploitative labour is defined by a labour depriving the child of its health, education or development.
c) **The Criminal Code, 1960 (Act 29)** provides for procedures for dealing with criminal activities in Ghana. Section 296(1) that whoever places or permits to be placed, any carrion, filth, dirt, refuse, or rubbish, or any offensive or otherwise unwholesome matter, on any street, yard, enclosure, or open space, except at such places as may be set apart by the local authority or health officer for that purpose commits a punishable offence.
d) **Commission on Human Rights and Administrative Justice Act (Act No. 456 of 1993)** establishes a Commission on Human Rights and Administrative Justice to investigate complaints of violations of fundamental human rights and freedoms, injustice and corruption, abuse of power and unfair treatment of persons by public officers in the exercise of their duties, with power to seek remedy in respect of such acts or omissions.
e) **National Vocational Training Act (Act No. 351 of 1970)** obliges all employers to provide training for their employees for the attainment of the level of competence required for the performance of their jobs and to enhance their career, according to the provisions of the National Vocational Training Act (Act 351) of 1970 and the National Vocational Training Regulations (Executive Instrument 15).
f) **Ghana Investment Promotion Centre ACT, 2013 Act 865**, is an Act that that provides for the Ghana Investment Promotion Centre as the agency of Government responsible for the encouragement and promotion of investment in Ghana. The aim is to provide for the creation of an attractive incentive framework and a transparent, predictable and facilitating environment for investment in Ghana and for related matters.
g) **The Ghana Business Code** is a set of principles introduced into the Ghanaian business environment through the initiative of three key business associations in Ghana – the Association of Ghana Industries (AGI), Ghana National Chamber of Commerce and Industry (GNCCI) and Ghana Employers Association (GEA) under the DANIDA funded project, Improving Business Practice (IBP), Sub-Component of the Business Sector Programme Support (BSPS). The GHBC is a series of prescriptions based on UN Global Compact

relating to human rights, labour standards, the environment and transparency in business operations.

Applicability to Project

These legal requirements seek to promote the fair treatment, non-discrimination and equal opportunity of workers. They aim to stablish, maintain and improve the worker management relationship and to promote compliance with national labour and employment laws. The project is therefore expected to protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the clients supply chain. In addition, the project is required to promote safe and healthy working conditions and health of workers and to avoid the use of forced labour. A Labour Management Plan is to be developed and implemented by the EPC Contractor to guide constructional activities. Operational Staff engaged by VRA will be guided by existing organisational labour rules which are in line with these national labour laws.

2.4.5. Property Acquisition & Compensation

a) **The Constitution of Ghana** and the protection of individual property is outlined in Article 20 and this provides for the protection from deprivation of property unless such acquisition is made in the interest of defence, public safety, public order, public morality, town and country planning, or the development or utilisation of property to promote public interest. Under the same Article 20 of the Constitution, such compulsory acquisition of property by the State should be made under a law which makes provision for prompt payment of fair and adequate compensation as well as a right of access to a High Court by any person who has interest in or right over the property for the determination of his interest or right and the amount of compensation to which he is entitled.

b) **Local Government Service Act, 2003 Act 656** was developed in accordance with the constitution and details the establishment and regulation of local government systems. The Act was created to establish and regulate the local government system in accordance with the Ghanaian constitution and outlines the stipulations and qualifications regarding local elections, provides requirements for the functioning of district assemblies and outlines the responsibility of each level of local government.

c) **New Lands Commission Act (2008) Act 767** provides for the management of public lands and other lands and for related matters. The Commission manages public lands and any other lands vested in the President by the Constitution or by any other enactment or the lands vested in the Commission. The act advises the Government, local authorities and traditional authorities on the policy framework for the development of particular areas to ensure that the development of individual pieces of land is co-ordinated with the relevant development plan for the area concerned. The commission formulate and submit to Government recommendations on national policy with respect to land use and capability; advice on, and assist in the execution of, a comprehensive programme for the registration of title to land throughout the Republic in consultation with the Title Registration Advisory Board established under section 10 of the Land Title Registration Act, 1986.

d) **State Lands (Amendment) Act (2005) Act 586** relates to compulsory acquisition in the country which has relied on State Lands Act, 1962 (Act 125) and State Lands (Amendment) 2005, Act 586. The two statutes are limited to the acquisition of private interest in real estate whiles stool lands are acquired drawing on Administration of Lands Act, 1962 (Act 123). States Lands (Act 125) also provide for lump sum of compensation payable to property owners affected by acquisition. Section 4 also spells out the procedure for making claims whiles section 11 also outlines mechanism for settlement of disputes generating from dissatisfaction of compensation.

e) The **State Lands Regulations (1962) LI 230** was passed for the purpose of inspecting and making a recommendation as to the suitability or otherwise of any land proposed to be acquired. The Regulation requires the setting up of a Site Advisory Committee for this function. After the submission of an application to acquire land, a Site Advisory Committee'' is set up in order to assess the application. The application is then assessed by the Ministry to a Land Commission, which prepare an executive instrument. Once this instrument is accepted and endorsed by the Minister, it is published in the newspapers and property owners can submit claims. The valuation board estimates the corresponding compensation. Compensation is then made to the property owners and sometimes resettlement is followed. Administration of Lands Act 1962 (Act 123) empowers the Minister responsible for lands to manage stool lands in accordance with the provision of the law.

f) **Stools Lands Act, 1994 (Act 481)** establishes the management and administrative processes applicable to Stool land and describes the appropriate distribution of any revenue accrued from stool lands.

g) **Concessions Act, 1962;** An Act to provide the provisions of the Concessions Ordinance which ceased to apply in respect of stool lands, to continue in force certain existing concessions subject to their terms and to provide for purposes connected therewith or incidental thereto.

h) **The Immovable Property Rate Regulations (1975) LI 1049** applies for the purposes of valuation of immovable property.

i) **Lands (Statutory Wayleaves) Act 1963 (Act 186)** provides for entry on any land for the purpose of the construction, installation and maintenance of works of public utility, and for the creation of rights of way for such works. The owner / occupier of the land must be formally notified at least a week in advance of the intent to enter, and be given at least 24 hours' notice before actual entry. An authorized person may enter at any time for the purpose of inspecting, maintaining, replacing or removing any specified works (Section 5). Any damage due to entry must be compensated in accordance with the established procedure, unless the land is restored or replaced. In the case of roads, not more than one-fifth of a plot may be taken and the remainder must be viable, or the entire plot must be taken; Section 6-3(b). The Act and its accompanying Regulation, **the Lands Statutory Wayleave Regulation 1964 (LI 334)** provides the modalities and procedures for the acquisition of the Statutory right of ways.

j) **National Museums Act, Act 387 of 1969 (formerly National Museums Decree (1969) NLCD 387),** the Executive instrument (EI 42) of 1972 and the National Museums Regulation

(EI 29) of 1973 provides for the management of any antiques and archaeological finds. This is the law governing the activities and operations of the Ghana Museums and Monuments Board (GMMB). Procedures to be followed on the discovery of any such artefacts are outlined in NLCD 387. Any archaeological finds during the construction activities shall be reported accordingly. Ghana ratified the World Heritage Convention in 1975. Therefore, GMMB is guided by the operational guidelines for the implementation of the World Heritage Convention.

k) **Survey Act 1962, Act 127** relates to geological, soil and land survey. Part II of the Act deals with demarcation and survey of lands. Under the law, the sector minister may appoint official surveyors and the Chief Survey Officer (Director of Surveys) may license private surveyors. It is the official surveyor or licensed surveyor that shall certify plans for attachments to instruments of conveyance, leases, assignment, charge or transfer. Under the law it is an offence to damage, destroy or alter any boundary mark. The Act 127 with its amendments gave legal backing to the Director of Surveys to carryout cadastral and other surveys through official surveyors who work directly under him at the Survey Division of the Lands Commission. It also gave authority to the Director of Surveys to recommend from time to time experienced surveyors to the Minister responsible for Lands to be licensed to undertake surveys.

l) **Resettlement Policy Framework (RPF), 2011** document was developed in 2011 by the Ministry of Finance and Economic Planning as part of the Government of Ghana's Public-Private Partnership (PPP) programme. This programme was established to increase investment in public service delivery and infrastructure in support of the country's growing development needs. The developments and projects proposed by the PPP are likely to involve land acquisition and resettlement impacts, which are addressed by the RPF.

Applicability to Project

These legal requirements seek to avoid, and when avoidance is not possible, minimise avoid forced eviction. It also expects to anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. Projects are expected to improve, or restore, the livelihoods and standards of living of displaced persons as well as the living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites. They also seek to protect cultural heritage from the adverse impacts of project activities and support its preservation and to promote the equitable sharing of benefits from the use of cultural heritage.

Land is to be acquired under the project and this can lead to the possibility of land restrictions and economic displacement of the community members. The Project will need to adhere to the regulations previously mentioned and ensure the project is implemented according to the management structures in place in the region. This is particularly relevant if resettlement and

livelihood restoration are needed. The project will need to ensure that they communicate and build relationships with the correct levels of local government in the region where the project site is located.

Although the project will take place in an area that has already been disturbed, the project will need to still take cognisance of tangible and intangible cultural heritage sites and items, including archaeological heritage within the Area of Influence. This will also need to include basic mitigation for the construction phase, such as a chance find procedure for the construction phase.

2.4.6. Land & Water Resource Protection

a) **Water Resources Commission Act, 1996, Act 552** establishes the Water Resources Commission. The mandate of the Commission is to formulate a comprehensive national policy on water resources management; to plan, coordinate and monitor water resources development, conservation and management; as well as control and regulate the utilization of Ghana's water resources.
b) **The Water Use Regulations, 2001 (L.I. 1692),** outlines procedures for allocating permits for various water uses including domestic, commercial, municipal, industrial, agricultural, power generation, water transportation, fisheries (aquaculture), environmental, recreational, and under water (wood) harvesting. The Water Use Regulations enable the Water Resources Commission to grant rights for water use, and in the granting of these water use permits, the Commission must ensure that water allocations for various uses will be beneficial to the public interest and the greater good of society.
c) **The National Water Policy of Ghana, 2007** is intended to provide a framework for the sustainable development of Ghana's water resources. It is targeted at all water users, water managers and practitioners, investors, decision- makers and policy makers within the central Governmental and decentralised (district assemblies) structures, non-Governmental organisations and international agencies.
d) **The National Land Policy, 1999** seeks to address some of the fundamental problems associated with land management in the country. It also aims to protect a variety of habitat types, and recognizes Forest reserves, National Parks and wildlife reserves and similar land categories including Ramsar Sites as fully protected ecosystem for biodiversity conservation. The Policy recognises wetlands as environmental conservation areas and precludes practices such as physical draining of wetland water; draining of streams and watercourses feeding the wetlands and human settlements and their related infrastructural developments in wetlands. The policy, however, seeks to promote the use of wetlands for farming, grazing, fishing, timber production and salt winning, if such uses serve to conserve the ecosystem, biodiversity and sustainable productivity of wetlands.
e) **Land Planning and Soil Conservation Act, 1957** provide for the better utilisation of land in designated areas by land planning and soil conservation and for the establishment of committees for purposes incidental to this. Government can therefore for the purposes of preserving land, reclaiming land and protecting water resources, by an executive instrument declare an area within a designated area to be a planning area.

f) **Drilling License And Groundwater Development Regulations, 2006, LI 1827** was enacted for the purpose of obtaining a drilling license from the Water Resources Commission for the construction of a well for the abstraction, or monitoring of groundwater or for research.

Applicability to Project

These legal requirements seek to address some of the fundamental problems associated with land-use and water management and their impacts on such resources and means to ensure sustainable use of these resources in the country. They are targeted at all users, managers and practitioners, investors, decision-makers and policy makers within the central Governmental and decentralised (district assemblies) structures, non-Governmental organisations and international agencies. The policy also recognises the various cross-sectoral issues related to such uses and the links to other relevant sectoral policies such as those on sanitation, agriculture, transport, energy et cetera. The project will have to recognise that the use of such resources would require permitting from relevant state agencies. For example, any use of underground water through abstraction will need to be regulated by the Water Resources Commission through a formal application for abstraction purposes.

2.4.7. Biodiversity Protection

a) **Wild Animals Preservation Act 1961 (Act 43)**; An Act to consolidate and amend the law relating to wild animals, birds and fish and to continue the observance of the Convention signed at London on nineteenth day of May 1900.
b) **Wildlife Conservations Regulations, LI 685, 1971** (and Amendments), a legislative instrument for restrictions on wildlife destruction and hunting, game licencing and export of game and trophy. It provides a system of permits and certificates for regulating international trade in line with CITES regulations. It is the main instrument under which endangered species are legally protected through trade.
c) **Wildlife Reserves Regulations 1971 (LI 710**) empowers the government to establish wildlife Protected Areas, including Ramsar Sites (and Marine Protected Areas) and defines permissible and non-permissible activities within the Protected Area.
d) **Economic Plants Protection Act, 1979**; An Act to provide for the prohibition of the destruction of specified plants of economic value and for related matters.
e) **Biodiversity Strategies and Action Plan, 1998**, is an action plan to ensure sustainable use of the country's biological resources as enshrined in the Convention on Biological Diversity.
f) **National Biodiversity Strategy for Ghana, 2002**; The Strategy document seeks to ensure sustainable utilization of the country's biological resources and the need to integrate biodiversity issues into national development planning programmes. Some of the actions that have been identified include capacity building to ensure an in-depth assessment of biological resources, promotion of community participation in sustainable management of biodiversity and the strengthening of the management of forests and protected areas as well as other off reserve biological resources.
g) **National Wildlife Management Policy, 2006:** The Policy seeks to give a more proactive, pragmatic and comprehensive framework to guide and determine government actions towards

wildfire management. The policy is also to ensure consistency in formulation of legislation and bye-laws at all levels of governance to deal with the issues of wildfires in the country. In addition, by developing a national policy on wildfire, Ghana will be addressing global concerns for environmental quality management and minimise risks from climate change.

h) **Forest and Wildlife Policy, 2012** aims at the conservation and sustainable development of forest and wildlife resources for the maintenance of environmental stability and continuous flow of optimum benefits from the socio-cultural and economic goods and services that the forest environment provides to the present and future generations whilst fulfilling Ghana's commitments under international agreements and conventions. This policy replaces Ghana's first forest and wildlife policy formulated in 1994 which resulted in the merging of sector institutions into a corporate Forestry Commission and also introduced reforms to improve the **forest** and wildlife base.

i) **Wildlife Division Policy for Collaborative Community Based Wildlife Management, September 2000** aims to enable the devolution of management authority to defined user communities and encourage the participation of other stakeholders, to ensure the conservation and sustainable use of the nation's wildlife for the maintenance of environmental quality and a perpetual flow of optimum benefits to all segments of society. It was prepared based on national convictions, current national policies and Ghana's commitment to international conventions and guidelines. This policy seeks to incorporate where appropriate new ideas and approaches involving communities in wildlife management. In this respect, this policy recognises Ghana's commitment under Articles 6, 10 and 11 of the Convention on Biological Diversity and the principles outlined in World Conservation Strategy.

Applicability to Project

Biodiversity provides tangible benefits for human health. Preserving intact ecosystems and their native biodiversity can sometimes reduce disease transmission by changing the abundance, behaviour, and condition of the host or vector. These regulations turn to provide the legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities to ensure the protection and conservation of such biodiversity. They provide strategy for sustainable utilization of the country's biological resources and the need to integrate biodiversity issues into national development planning programmes. The project installation process may affect some biodiversity. The potential issues of concern identified include the removal of natural vegetation. Currently, the Forest Services Division has undertaken detailed quantification and listing of identified flora and fauna within all the PV project sites as well as the Lawra Forest Reserve. This is in line with the "Memorandum of Understanding" (MoU) between the two agencies in managing projects within forest reserves.

2.4.8. Climate Change & Vulnerability

a) The ***National Climate Change Policy (NCCP), 2013*** is Ghana's integrated response to climate change, and the policy provides a clearly defined pathway for dealing with the challenges of climate change. The Policy takes account of the current socioeconomic context of Ghana and incorporates the opportunities and benefits of a green economy.

b) ***The Ghana National Climate Change Master Plan Action Programme for Implementation (2015-2020)*** includes the details of initiatives and programmes to achieve the objectives of each Policy Focus Area within the NCCP. It details the mainstreaming process; the estimated costing for each sector and monitoring and evaluation; and outlines financing mechanisms and strategies for effective implementation.

c) ***The Ghana Nationally Determined Contributions (GhNDC) (2020 -2030***), has been developed based on national circumstances, and includes both mitigation and adaptation actions. The inclusion of both mitigation and adaptation in the GhNDC resonate with the medium-term development agenda, developed every four years to guide national development at the local government level. Ghana has raised its mitigation ambitions in the nationally determined contributions after recalibrating the baseline emissions and included four additional unconditional measures in the energy sector. The revision has translated into a two-tiered emission reduction goal of 17% relative to a business-as-usual (BAU) scenario emission of 73.3 million tonnes by 2030. Additional 43% is attainable on condition that external support is made available to cover the full cost of implementing the mitigation actions. The full implementation of the identified mitigation actions is expected to yield a total of 44.2 million tonnes of GHG emission savings and sustainable development outcomes.

There are 35 climate programme of actions in Ghana's commitment that cut across 7 priority sectors which will be implemented from 2020 to 2030. One of the programmes of action is attaining utility-scale solar electricity installed capacity up to 150-250 MW.

d) ***Ghana Renewable Energy Master Plan, February 2019*** has been developed with the goal to provide investment-focused framework for the promotion and development of the country's rich renewable energy resources for sustainable economic growth, contribute to improved social life and reduce adverse climate change effects. The successful implementation of the plan would lead to an installed electricity capacity of 1363.63 MW (with grid connected systems totaling 1094.63 MW), the creation of 220,000 jobs, and carbon savings of about 11 Million Tonnes of CO_2 by 2030.

e) The ***Ghana Gender Policy, 2015*** has the overarching goal to mainstream gender equality concerns into the national development processes by improving the social, legal, civic, political, economic and socio-cultural conditions of the people of Ghana particularly

women, girls, children, the vulnerable and people with special needs; persons with disability and the marginalized.

f) The National Climate Change Adaptation Strategy (NCCAS), 2012, was developed "*to enhance Ghana's current and future development to climate change impacts by strengthening its adaptive capacity and building resilience of the society and ecosystems*". Its main objectives are *to improve societal awareness and preparedness for climate change, enhance the mainstreaming of climate change into national development planning*. The NCCAS has 10 priority programmes for climate change adaptation and integration into national development:

Applicability to Project

The energy sector contributes to most of the country's carbon dioxide emissions, and a key strategy to cut down on energy related emissions of carbon dioxide is by employing renewables energy. According to the Second Biennial Update Report submitted to the UNFCC in September 2018, the energy sector contributed 50.2% of the total 2016 GHG emissions. Following the signing and ratification of the Paris Agreement, and in line with the reporting requirements of the Kyoto Protocol, Ghana developed its GhNDCs and has till date submitted its Third Communication Report as well as Second Biennial Report to the United Nations Framework Convention on Climate Change (UNFCCC). The initial 12MW component of the 35MW solar power project has been included as part of the GhNDCs to help the country achieve its legally-binding targets of reducing greenhouse gases for the period 2020 - 2030. This is to help minimize greenhouse gas emissions in line with the NCCP Master Plan Action Programme for Implementation. Within the same context, one of the key actions under the NCPP Master Plan Action Programme is to address gender issues in climate change programming.

2.5. International Guidelines & Standards

The project is partly financed by the KfW Group.KfW ensures Environmental and Social Impact Assessments (ESIA) for all relevant investments and projects in emerging markets and developing countries as well as project and export financing in order to prevent potentially negative impacts or risks to human health and the environment and, if necessary, to mitigate or offset them with suitable measures. Generally, KfW bases project assessments on the regulations that apply in the country in which the project is to be implemented. These regulations must be consistent with international environmental, social, health, safety and labour standards. These include the standards set by the EU and leading OECD countries, the Performance Standards of the International Finance Corporation (IFC) and the Environmental, Health and Safety (EHS) Guidelines of the World Bank Group. These standards are adhered to as regards the information provided to the general public and the involvement of the people directly impacted by the project, as well as when dealing with specific objections to projects.

By its Sustainability Guidelines, the framework for ESIA and the most important referenced environmental, social, health, safety and labour standards on which the KfW Group bases its assessment on is as shown in Figure 2-1[5].

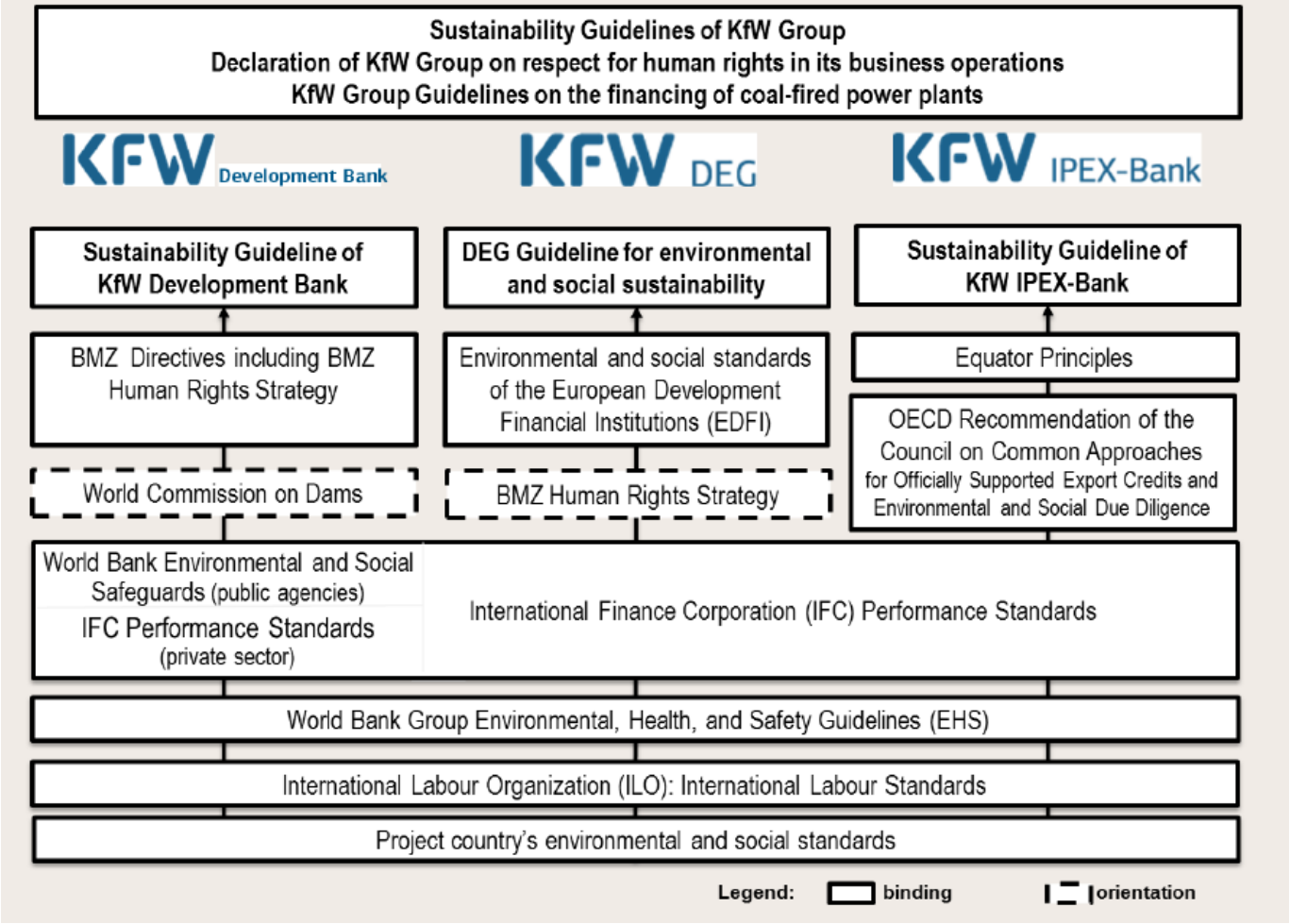


Figure 2-1: KfW standards for ESIA Process

As can be seen in Figure 2-1, the binding international standards that KfW will require this solar power project to adhere to are:

a. The project country's environmental and social standards,
b. International Labour Organisation (ILO) Labour Standards.
c. World Bank Group Environmental, Health, and Safety Guidelines
d. International Finance Corporation (IFC) Performance Standards,
e. Organisation for Economic Corporation & Development
f. Environmental & Social Standards of the European Development Financial Institutions

[5] *Source: Central Sustainability Management, nachhaltigkeit@kfw.de, July 2017*

g. Equator Principles

The country's environmental and social standards and how the project complies has already been discussed. This Section discusses how the international guidelines and standards as required by the KfW Group are to be complied with under the project.

2.5.1. International Labour Organisation Labour Standards.

Since 1919, the International Labour Organization (ILO) has maintained and developed a system of international labour standards aimed at promoting opportunities for women and men to obtain decent and productive work, in conditions of freedom, equity, security and dignity. In today's globalized economy, international labour standards are an essential component in the international framework for ensuring that the growth of the global economy provides benefits to all.

International labour standards are legal instruments drawn up by the ILO's constituents (governments, employers and workers) and setting out basic principles and rights at work. They are either conventions, which are legally binding international treaties that may be ratified by member states, or recommendations, which serve as non-binding guidelines. In many cases, a convention lays down the basic principles to be implemented by ratifying countries, while a related recommendation supplements the convention by providing more detailed guidelines on how it could be applied. Recommendations can also be autonomous, i.e. not linked to any convention. The ILO's Governing Body has also designated another four conventions as "priority" instruments, thereby encouraging member states to ratify them because of their importance for the functioning of the international labour standards system. The ILO Declaration on Social Justice for a Fair Globalization , in its follow-up, underlined the significance from the viewpoint of governance of these Conventions

Ghana has been a member of the ILO since May 20, 1975, and has since ratified 51 Conventions, comprising of all the eight Fundamental Conventions, two out of the four Governance Conventions, as well as 41 out of the 177 Technical Conventions. Out of **51** Conventions ratified by Ghana, of which **37** are in force, **10** Conventions have been denounced; **4** instruments abrogated; **none** have been ratified in the past 12 months[6]. Legal requirements on labour in Ghana and how the project will adhere to this has been discussed.

2.5.2. World Bank Group Operational Policies

The World Bank is an international institution, which provides financial and technical assistance to developing countries around the world. It is made up of two distinct development-related institutions owned by over 100-member countries; these are the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA), with affiliations in the International Finance Corporation (IFC). The World Bank projects and

[6] https://www.ilo.org/dyn/normlex/en/f?p=1000:11200:0::NO:11200:P11200_COUNTRY_ID:103231

activities are governed by Operational Policies, which are designed to ensure that the projects are economically, financially, socially and environmentally sound. The Bank's Operational Manual details these policies and provides guidance on how to comply with them ("Bank Procedures" and "Good Practices"). The policies/procedures are to ensure the safe development of projects it is funding. That is to prevent and mitigate unintended adverse effects on third parties and the environment in the development process.

The policies of relevance to this project are the safeguard policies.

a. The Environmental, Health & Safety (EHS) Guidelines

This was produced by the World Bank Group are technical reference documents on cross-cutting environmental, health, and safety issues applicable to all industry sectors. They cover general and industry-specific examples of Good International Industry Practice, as defined in IFC's Performance Standard 3 on Resource efficiency and pollution prevention. Key guidelines of relevant to this project are the General EHS Guidelines (2007) and EHS Guidelines for Electric Power Transmission & Distribution (2007). The General EHS Guidelines (April 2007) contain the performance levels and measures that are normally acceptable to the IFC and are generally considered to be achievable in new facilities at reasonable costs by existing technology. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects 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 environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

b. World Bank Policy on Access to Information

This took effect from July 2013 and has since June 30, 2015 been revised. The Policy governs the public accessibility of information in the Bank’s possession and describes how the World Bank makes information available to the public. Underlying the new policy is the principle that the World Bank will disclose any information in its possession that is not on a list of exceptions. The Access to Information Policy is based on the following five principles: 1) maximizing access to information; 2) setting out a clear list of exceptions; 3) safeguarding then deliberative process; 4) providing clear procedures for making information available; and 5) recognizing requesters' right to an appeals process.

c. Environmental & Social Safeguards Policies

The World Bank "Safeguard Policies," are the mechanism for addressing environmental and social issues in project design, implementation and operation, and they provide a framework for consultation with communities and for public disclosure. Examples of these requirements include conducting environmental and social impact assessments, consulting with affected communities about potential project impacts, and restoring the

livelihoods of displaced people. These policies, which include the Environmental Assessment Policy (OP 4.01), are designed to prevent unintended adverse effects on third parties and the environment. This ESIA follows national best practice as well as the OP 4.01 on contents of the Environmental Assessment as far as possible. Specialists were contracted to conduct specialist studies which have assessed an element of the impacts regarding natural habitat. Throughout the project there have been several stakeholder engagements sessions to ensure transparency of the project and to address socio-cultural issues. Voluntary land acquisition was applied under this project.

In August 2016, the World Bank adopted a new set of environment and social policies called the Environmental and Social Framework (ESF). As of October 1, 2018, the ESF applies to all new World Bank investment project financing. With existing projects continuing to apply the Safeguard Policies, the two systems are to run in parallel for an estimated seven years.

d. Environmental and Social Framework (ESF)

The World Bank Environmental and Social Framework sets out the World Bank's commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards that are designed to support Borrowers' projects, with the aim of ending extreme poverty and promoting shared prosperity. The Environmental and Social Framework (ESF) therefore enables the World Bank and Borrowers to better manage environmental and social risks of projects and to improve development outcomes. The ESF offers broad and systematic coverage of environmental and social risks. It makes important advances in areas such as transparency, non-discrimination, public participation, and accountability, including expanded roles for grievance mechanisms. It brings the World Bank's environmental and social protections into closer harmony with those of other development institutions.

The ESF comprises of the following:

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

As indicated, the ESF was approved in August 2016 and launched on October 1, 2018. Under this project, VRA intends to adhere to the requirements of ESF and the list of the standards and its applicability is shown in **Table 2-1**.

Table 2-1: World Bank's Environmental & Social Frameowrk Standards

Standard		Requirements	Relevant	Compliance status and rationale
ESS1	Assessment and Management of Environmental and Social Risks and Impacts	Sets out the Borrower's responsibilities for assessing, managing and monitoring environmental and social risks and impacts associated with each stage of a project supported by the Bank through Investment Project Financing (IPF), in order to achieve environmental and social outcomes consistent with the Environmental and Social Standards (ESSs). Annex 2 and 3 of this provides for environmental and social commitment plan as well as management of contractors.	Yes	Complies: An environmental assessment has been undertaken for the project and this EIS Report is available for funding agencies to assess any associated environmental risk. An environmental and social commitment plan has been developed as part of this ESIS Report whilst a Contractor's Management Plan is expected to be submitted by the EPC Contractor and this is to be assessed through regular project meetings.
ESS2	Labor and Working Conditions	Recognizes the importance of employment creation and income generation in the pursuit of poverty reduction and inclusive economic growth. Borrowers can promote sound worker-management relationships and enhance the development benefits of a project by treating workers in the project fairly and providing safe and healthy working conditions.	Yes	Complies: A Labour Management Plan shall be developed by the EPC Contractor to outline labor management procedures applicable to the project. These procedures will set out the way in which project workers will be managed, in accordance with the requirements of national law and this ESS.
ESS3	Resource Efficiency and Pollution Prevention and Management	Recognizes that economic activity and urbanization often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services and the environment at the local, regional, and global levels. This ESS sets out the requirements to address resource efficiency and pollution prevention and management throughout the project life-cycle.	Yes	Complies: Management of resources such as energy, water and raw materials have been addressed in the project EMP whiles pollution and prevention measures have been outlined.
ESS4:	Community	Addresses the health, safety, and security risks and	Yes	Complies: Some occupational safety and health hazards are

Standard		Requirements	Relevant	Compliance status and rationale
	Health and Safety	impacts on project-affected communities and the corresponding responsibility of Borrowers to avoid or minimize such risks and impacts, with particular attention to people who, because of their particular circumstances, may be vulnerable.		expected during the various phases of the project and these have been identified and mitigative measures outlined. The VRA "**Safety, Health and Environment Standards for Contractors**" is to be adhered to be the Contractor. Again, the contractor is mandated by the requirements of the tender document to develop a **Health & Safety Plan** for project construction purposes. An operational H&S Plan in line with corporate rules will be developed for the operational phase.
ESS5:	Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Involuntary resettlement should be avoided. Where involuntary resettlement is unavoidable, it will be minimized and appropriate measures to mitigate adverse impacts on displaced persons (and on host communities receiving displaced persons) will be carefully planned and implemented.	Yes	Complies: Voluntary sale of lands were applied under the project. Land owners have been compensated at fair market or replacement value. There are no affected persons at the PV power plant site as the land is currently vacant.
ESS6:	Biodiversity Conservation and Sustainable Management of Living Natural Resources	Recognizes that protecting and conserving biodiversity and sustainably managing living natural resources are fundamental to sustainable development and it recognizes the importance of maintaining core ecological functions of habitats, including forests, and the biodiversity they support. ESS6 also addresses sustainable management of primary production and harvesting of living natural resources and recognizes the need to consider the livelihood of project-affected parties, including Indigenous Peoples, whose access to, or use of, biodiversity or living natural resources may be affected by a project.	Yes	Complies: A detailed ecological survey of the power plant site has indicated that there are no species or habitats of conservation value. The Lawra Station Forest Reserve falls within the project area. Work within the reserve shall be done in line with an MOU between the Forest Services Division and VRA to ensure sustainable management and conservation-oriented forestry. Meanwhile, a detailed ecological survey has been undertaken within the project area and their ecological significance determined to inform mitigative actions.
ESS7:	Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local	Ensures that the development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods of Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities. ESS7 is also meant to avoid adverse	No	Not Applicable: No indigenous peoples are to be affected by the project

Standard		Requirements	Relevant	Compliance status and rationale
	Communities	impacts of projects on Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities, or when avoidance is not possible, to minimize, mitigate and/or compensate for such impacts.		
ESS8:	Cultural Heritage	Recognizes that cultural heritage provides continuity in tangible and intangible forms between the past, present and future. ESS8 sets out measures designed to protect cultural heritage throughout the project life-cycle.	Yes	Complies: Just outside the project area at Lawra, is a tree shrine, comprising of Ebony / Nim Tree, known as the Kulbonuo Shrine belonging to the Bayoyire Community in Kaleo. There is also a grave within the access road to the PV Site at Kaleo. Measures will be taken to ensure that no damage occurs to this cultural asset as a result of project implementation.
ESS9:	Financial Intermediaries	FIs recognizes that strong domestic capital and financial markets and access to finance are important for economic development, growth and poverty reduction. FIs are required to monitor and manage the environmental and social risks and impacts of their portfolio and FI subprojects, and monitor portfolio risk, as appropriate to the nature of intermediated financing. The way in which the FI will manage its portfolio will take various forms, depending on a number of considerations, including the capacity of the FI and the nature and scope of the funding to be provided by the FI.	Yes	The KfW Group is providing part financial support and are currently monitoring and managing the environmental and social risk of the solar project.
ESS10:	Stakeholder Engagement and Information Disclosure	Recognizes the importance of open and transparent engagement between the Borrower and project stakeholders as an essential element of good international practice. Effective stakeholder engagement can improve the environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.	Yes	Complies: Detailed stakeholder engagement, including public forum have been held under the project. A Community Liaison Officer is to be appointed to coordinate all stakeholder engagement activities as well as redress of public grievances.

2.5.3. International Finance Corporation (IFC) Performance Standards

The IFC is a global investor and advisor and is committed to promoting sustainable projects in developing member countries that are economically beneficial, financially and commercially sound, and environmentally and socially sustainable. To manage the social and environmental risks and impacts of IFC projects, the IFC has developed a number of environmental and social performance standards (PS), and these are indicated in Table 2-2. The IFC PS indicate that the party responsible for implementing and operating the project must comply with the applicable national laws, including those laws implementing host country obligations under international law. The project operator is also required to meet the requirements of the standards throughout the life of an investment by IFC or other relevant financial institution.

Table 2-2: IFC Performance Standards

IFC Performance Standard	
Performance Standard 1	Assessment and Management of Environmental and Social Risks and Impacts
Performance Standard 2	Labour and Working Conditions
Performance Standard 3	Resource Efficiency and Pollution Prevention
Performance Standard 4	Community Health, Safety, and Security
Performance Standard 5	Land Acquisition and Involuntary Resettlement
Performance Standard 6	Biodiversity Conservation and Sustainable Management of Living Natural Resources
Performance Standard 7	Indigenous Peoples
Performance Standard 8	Cultural Heritage

IFC categorises projects to determine the level of environmental and social assessment that will be required. Renewable energy (except large hydroelectric power projects) developments are classified as Category B projects. That is a project "with potential limited adverse social or environmental impacts that are few in number, site-specific, largely reversible, and readily addressed through mitigation measures". This project is therefore classified as a Category B project by the IFC. The scope of EA for a Category B project may vary from project to project, but it is narrower than that of an EA for Category A projects.

The IFC produces a number of Guidance Notes and other reference documents providing advice on undertaking ESIA. Specific guidance is contained in the Guidance Notes to the WB/IFC Performance Standards. The IFC's set of Guidance Notes provide guidance on the requirements contained in the WB/IFC Performance Standards, including reference materials on good sustainability practices to improve project performance. Those of relevance to this project include:

- Guidance Note A - Checklist of potential issues for an Environmental Assessment.
- Guidance Note B - Content of an ESIA Report
- Guidance Note C - Outline of an Environmental Action Plan.

The following IFC handbooks are also relevant to the Project:

a) *Stakeholder Engagement*: A Good Practice Handbook for Companies Doing Business in Emerging Markets.
b) *Strategic Community Investment*: A Good Practice Handbook for Companies Doing Business in Emerging Markets.
c) *Good Practice Handbook* - Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets.
d) *Good Practice Note*: Addressing Grievances from Project-Affected Communities.

VRA commits to meeting the requirements of the following IFC PS[7]:

- Performance Standards (PS)1: Assessment and Management of Environmental & Social Risks and Impacts (2012);
- PS2: Labour and working conditions (2012);
- PS3: Resource Efficiency and Pollution Prevention (2012);
- PS4: Community Health, Safety & Security (2012);
- PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (2012):
- PS8: Cultural Heritage (2012).

The IFC PS are like that of the ESS and Operational Polices and compliance status as indicated in **Table 2-1** are applicable.

2.5.4. Equator Principles

The Equator Principles, revised in June 2013, are a set of voluntary principles for financial institutions to ensure that the projects financed are developed in an environmentally and socially responsible manner. The principles are based on the IFC PS on social and environmental sustainability and on the World Bank Group EHS Guidelines, and are relevant for the purposes of this Project as they represent industry best practice (see Table 2-3). The financial institutions that have signed up the Equator Principles are called Equator Principle Financial Institutions (EPFIs) and the principles are intended to serve as a common baseline and framework for the implementation by each EPFI. The Principles apply to all new EPFI project financings globally with total project capital costs of US$10 million or more, and across all industry sectors.

[7] Note that PS7: Indigenous Peoples are not considered applicable to the project.

Table 2-3: Summary of Equator Principles

PRINCIPLE		DESCRIPTION
Principle 1:	Review and Categorisation	Relates to the categorisation of projects based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the IFC.
Principle 2:	Social and Environmental Assessment	Requires a Social and Environmental Assessment. The Assessment should propose mitigation and management measures relevant and appropriate to the nature and scale of the Project.
Principle 3:	Applicable Social and Environmental Standards	Establishes the IFC PS and EHS Guidelines to complement the host country legislation as the basis for social and environmental performance.
Principle 4:	Action Plan and Management System	Requires preparation of an Action Plan which should describe and prioritise the actions needed to implement mitigation measures, corrective actions and monitoring measures.
Principle 5:	Consultation and Disclosure	Requires consultation with project affected communities in a structured and culturally appropriate manner, ensuring free, prior and informed consultation and facilitate informed participation.
Principle 6:	Grievance Mechanism	Requires the establishment of a grievance mechanism as part of the management system which addresses concerns promptly and transparently, in a culturally appropriate manner, and is readily accessible to all segments of the affected communities.
Principle 7:	Independent Review	Requires an independent social or environmental review of the Assessment.
Principle 8:	Covenants	Requires compliance with all relevant host country social and environmental laws, regulations and permits, Action Plan implementation commitments, periodic reviews of reports, and facility decommissioning in accordance with an agreed decommissioning plan.
Principle 9:	Independent Monitoring and Reporting	Requires ongoing monitoring and reporting over the life of the loan through the appointment of an independent environmental and / or social expert.
Principle 10:	EPFI Reporting	Commits the EPFIs to report publicly at least annually about its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations.

In accordance to the Equator Principles, potential social and environmental issues to be addressed in Social and Environmental Assessments where applicable include the following:

- Assessment of the baseline social and environmental conditions;
- Consideration of the feasible environmentally and socially preferable alternatives;
- Requirement under the host country laws and regulations, applicable international

- treaties and agreements;
- Develop an Environmental and Social Action Plan (ESAP) as part of this ESIA report that defines the means, by which impacts will be mitigated, managed and monitored.
- Protection of human rights and community health, safety and security (including risks, impacts and management of project's use of security personnel);
- Protection and conservation of biodiversity, including endangered species and sensitive ecosystems in modified, natural and critical habitats, and identification of legally protected areas;
- Sustainable management and use of renewable natural resources (including sustainable resource management through appropriate independent certification systems);
- Use and management of dangerous substances;
- Major hazards assessment and management;
- Labour issues and occupational health and safety;
- Fire prevention and life safety;
- Pollution and prevention and waste minimisation, pollution controls (liquid effluents and air emissions) and solid and chemical waste management.
- Socio-economic impacts;
- Protection of cultural property and heritage;
- Land acquisition;
- Consultation and participation if affected parties in the design, review and implementation of the project;
- Develop a grievance mechanism and system to address complaints;
- Impacts on affected communities, and disadvantaged or vulnerable groups;
- Develop a process for public consultation and disclosure;
- Provide periodic reports documenting compliance with EMS and relevant limits etc.;
- Ensure ongoing monitoring and reporting to verify its monitoring; and
- Decommission the facility in accordance with agreed decommissioning plan.
- Cumulative impacts of existing projects, the proposed project, and anticipated future projects;
- Efficient production, delivery and use of energy as well as water resources.

2.5.5. Organisation for Economic Corporation & Development

The Organisation for Economic Corporation & Development (OECD) recommends that Members, before taking decisions on officially supported export credits, apply the "Common Approaches" for addressing environmental and social issues relating to exports of capital goods and/or services and the locations to which these are destined.

Under "The Common Approaches", the "***35MW Solar Power Project: Upper West Regional Project Sites***" falls under Category B listed projects requiring EIAs. The defined safeguard instruments under the Common Approaches that needs to be adhered to are the "World Bank Safeguard Policies"

and "IFC Performance Standards" and these have been discussed in detail in previous sections in this report.

2.5.6. EDFI Principles for Responsible Financing

EDFI is the Association of European Development Finance Institutions ("EDFIs"), a group of 16 bilateral investment organizations which provide finance for private sector companies in developing and reforming economies. The aim of EDFI is to have a positive impact on the local communities they invest in. EDFI strives to ensure respect for human rights and environmental sustainability. The EDFI benchmarks are the UN Declaration of Human Rights, the ILO Core Conventions and the IFC Performance Standards on Economic and Social Sustainability and associated Environmental and Health & Safety Guidelines.

2.6. International Conventions

2.6.1. United Nations Framework Convention on Climate Change

The primary purpose of the Convention is to establish methods to minimize global warming and the emission of the Greenhouse Gases (GHG). The United Nations Framework Convention on Climate Change (UNFCCC) was adopted on 9th May 1992 and came into force on 21st March 1994. As at close of September 2018, there were 197 Parties (196 States and 1 regional economic integration organization) to the UNFCC (source: https://treaties.un.org). The UNFCCC provides the basis for global action to protect the climate system for present and future generations. The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 189 countries having ratified.

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Under the Convention, governments:

a) Gather and share information on greenhouse gas emissions, national policies and best practices.
b) Launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and
c) Cooperate in preparing for adaptation to the impacts of climate change.

Ghana became a party to the United Nations Framework Convention on Climate Change (UNFCCC, hereinafter referred to as the Convention) after ratification in September 1995. Upon ratification, Ghana had committed itself to pursue coordinated actions to reduce greenhouse gas (GHG) emissions and climate change impacts on the most vulnerable people, while continuing to advance national economic development. As a party to the Convention, Ghana has an obligation under Article 4, paragraph 1, and Article 12, paragraph 1 of the Convention to regularly prepare, publish and report its national communication to the Conference of Parties (COP) to the UNFCCC.

Ghana has so far submitted its Third National Communications as well as Second Biennial Update Report (BUR) to the Conference of Parties (COP) to the UNFCCC in compliance consistent with the country's obligations under the Convention. Indeed, the second BUR was submitted by the Ghana EPA just recently in September 2018. The main objective of these reports is to update and communicate to the COP, policies and measures Ghana has taken and envisaged to implement the convention in the country and at the regional level. Components being reported on include Energy, Industrial Processes and Product Use, Agriculture, Forestry and Other Land Use and Waste.

Ghana intends to increase the contribution of RE source (including hydro, solar, biomass and wind) by 10% for grid, mini grid and off-grid applications; by 2030, thus the development of the solar power projects is one of the proposed carbon offsets projects in Ghana.

2.6.2. Kyoto Protocol

UNFCC has been identified as only the initial step in the international response to climate change. Climate prediction models showed that greater reductions in emissions will be needed to prevent serious interference with the climate. The Kyoto Protocol to the United Nations Framework Convention on Climate Change [5], agreed in December 1997, was designed to address this issue. The Protocol has since been ratified by over 150 countries, including Ghana, and entered into force (becoming legally binding) on 16th February 2005.

The 1997 Kyoto Protocol shares the Convention's objective, principles and institutions, but significantly strengthens the Convention by committing developed countries to individual, legally-binding targets to limit or reduce their overall greenhouse gas emissions (of carbon dioxide, methane, nitrous oxide, hydro fluorocarbons, perfluorocarbons and sulphur hexafluoride). Developing countries are not required to reduce emissions of greenhouse gases to specific targets as yet on the basis that it is industrialised countries that produce most of the emissions and more urgently need to take corrective action.

Developing countries were asked to contribute as far as possible, but were not bound to take action, under the principle of 'shared but differentiated responsibility'. The Kyoto Protocol sets out how developing countries must monitor and report on their greenhouse gas emissions. There are also agreements on how the international community must help developing countries adapt to the impacts of climate change.

Currently, VRA has initiated a Carbon Accounting Programme, with assistance from the Ghana EPA, and is expected to report annually on its carbon emissions for the generating plants as well as carbon offsets projects. The maiden report covering 2012-2015 has been completed and is under review.

2.6.3. Sustainable Development Goals (SDGs),

The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. There are 17 Goals under the SDGs and these build on the successes of the Millennium Development Goals, while including new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among other priorities. The goals are interconnected – often the key to success on one will involve tackling issues more commonly associated with another.

Goal 13 requires governments to take urgent action to combat climate change and its impacts. To strengthen the global response to the threat of climate change, countries adopted the Paris Agreement at the COP21 in Paris, which went into force in November of 2016. In the agreement, all countries agreed to work to limit global temperature rise to well below 2 degrees centigrade.[8]. As at close of October 2018, 184 parties had ratified the Paris Agreement. Ghana ratified the Agreement on September 21, 2016 and has accordingly submitted its nationally intended contributions, as discussed earlier.

2.6.4. Africa Union Agenda 2063

Agenda 2063 – a shared strategic framework for inclusive growth and sustainable development – was developed through a people-driven process and was adopted, in January of 2015, in Addis Ababa, Ethiopia by the 24th African Union (AU) Assembly of Heads of State and Government, following 18 months of extensive consultations with all formations of African society.Agenda 2063 is anchored on the AU vision and is based on the seven aspirations derived from the consultations, namely:

1. A prosperous Africa based on inclusive growth and sustainable development;
2. An integrated continent, politically united, based on the ideals of Pan Africanism and the vision of Africa's Renaissance;
3. An Africa of good governance, respect for human rights, justice and the rule of law;
4. A peaceful and secure Africa;
5. An Africa with a strong cultural identity, common heritage, values and ethics;
6. An Africa whose development is people-driven, relying on the potential of African people, especially its women and youth, and caring for children; and

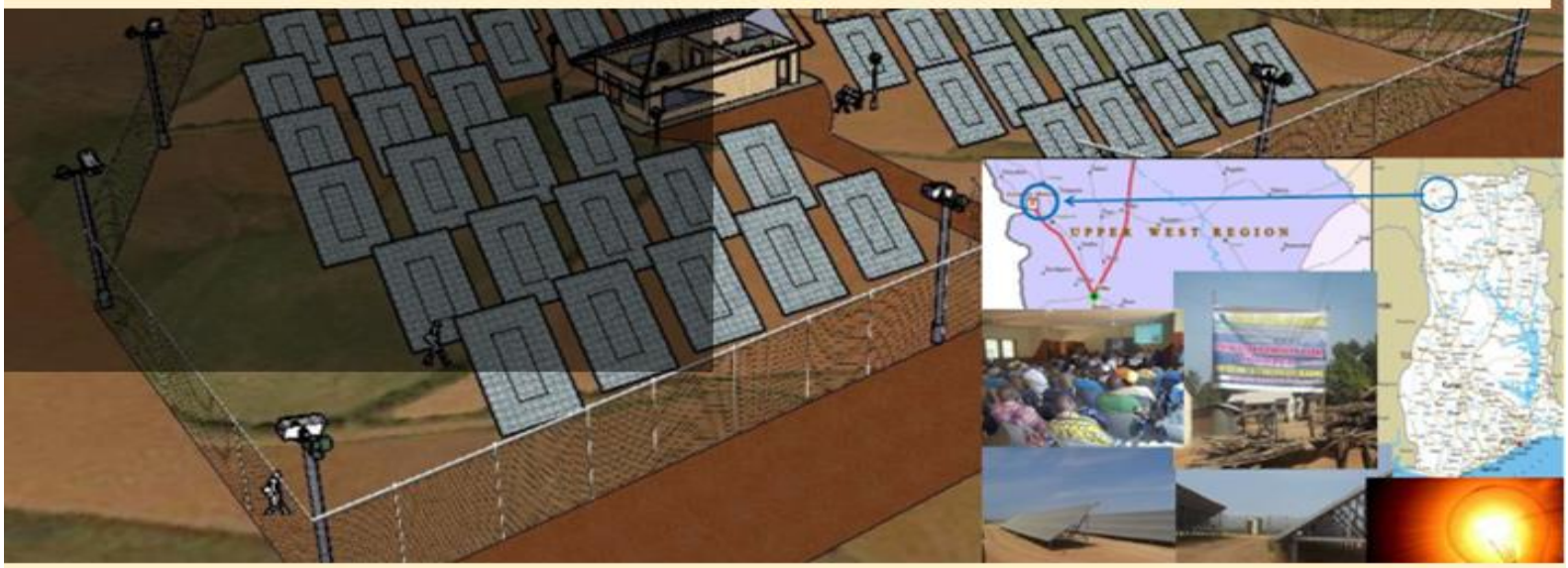
[8] (https://www.un.org/sustainabledevelopment/climate-change-2/).

7. Africa as a strong, united, resilient and influential global player and partner.

Aspiration 1: *A Prosperous Africa based on inclusive Growth and Sustainable Development* targets ending poverty, inequalities of income and opportunity; job creation, especially addressing youth unemployment; facing up to the challenges of rapid population growth and urbanization, improvement of habitats and access to basic necessities of life – water, sanitation, electricity; providing social security and protection; developing Africa's human and social capital (through an education and skills revolution emphasizing science and technology) and expanding access to quality health care services, particularly for women and girls; transforming Africa's economies through beneficiation from Africa's natural resources, manufacturing, industrialization and value addition, as well as raising productivity and competitiveness; radically transforming African agriculture to enable the continent to feed itself and be a major player as a net food exporter; exploiting the vast potential of Africa's blue/ocean economy; and finally putting in place measures to sustainably manage the continent's rich biodiversity, forests, land and waters and using mainly adaptive measures to address Climate change risks.

In line with this, Ghana has developed the National Climate Change Adaptation Strategy (NCCAS), 2012, and this has been discussed in the earlier section.

Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



CHAPTER 3:

PROJECT DESCRIPTION AND ALTERNATIVES

3 PROJECT DESCRIPTION AND ALTERNATIVES

3.1. Introduction

As shown in Table *1-1*, the 35 MW "Solar Power Project Phase: Upper West Regional Project Sites", is to be developed in two phases and utilising land areas within Kaelo and Lawra. Factors considered in site selection included direct solar radiation, sky scattering radiation, and ground reflection radiation. The sunshine in the Upper West Region is enough as the average annual total radiation can reach 7384.3MJ/ m^2. The proposed selected PV sites areas are therefore rich in sunlight; the total amount of annual solar energy radiation is abundant, and thus very suitable to build PV power plants. An associated 34.5kV sub transmission and water supply systems are to be constructed under both phases. In the case of Lawra and Kaleo Site 3, modifications in network connections needed to allow easy installation of the Phase II Solar Capacity would be provided under the Phase I Project.

Currently, the procurement of an EPC Contractor is about completed, subsequently details of the project description as provided in the most responsive tender has been considered in this report. Lahmeyer International GmbH as the Engineer for the projects will be responsible for site verifications, design, specification and all technical aspects of the tender and contracting. The services will furthermore expand to the supervision of the whole construction process and commissioning, including working as specialist environmental advisors. During operations and maintenance, the responsibility is going to be taken over by a dedicated VRA Team. This Chapter provides an overview of the components of the proposed solar power and associated sub-transmission line facilities, details of the pre-construction, construction, operation and maintenance, and decommissioning stages of these components as well as the alternatives considered in the selection of the project's facilities.

3.2. Generation Process and Scheme

The grid-connected PV plants will consist of the following main equipment: PV Modules, Inverters, Support structures, Power Station (Power transformers and MV cables) and Security and Monitoring systems. The PV array mainly consists of the PV module, the direct current (DC) combiner box, PV lightning protection power distribution cabinet and the direct current cable etc. The grid-connected inverter system mainly consists of the inverter, low-voltage alternating current power distribution cabinet and low-voltage AC power cable etc., whilst the high voltage power transmission and distribution consist of a transformer, power distribution equipment of 34.5 kV, etc.

The monitoring system mainly consists of two parts, i.e. the photovoltaic system monitoring and the transformer substation monitoring. The incident solar radiation energy is transformed into direct current electrical energy by the PV array and conveyed to the direct current input end of the inverter through the connected combiner box (DC power distribution cabinet). The direct current electrical energy will be converted into AC electrical energy of the same frequency and phase of the grid to which it is to be connected, and after being merged, the power shall be switched into the 34.5kV power grid. A schematic diagram of how photovoltaic systems will work as presented at a project Stakeholder Hearing by Lahmeyer International in 2012 is show in Figure 3-1.

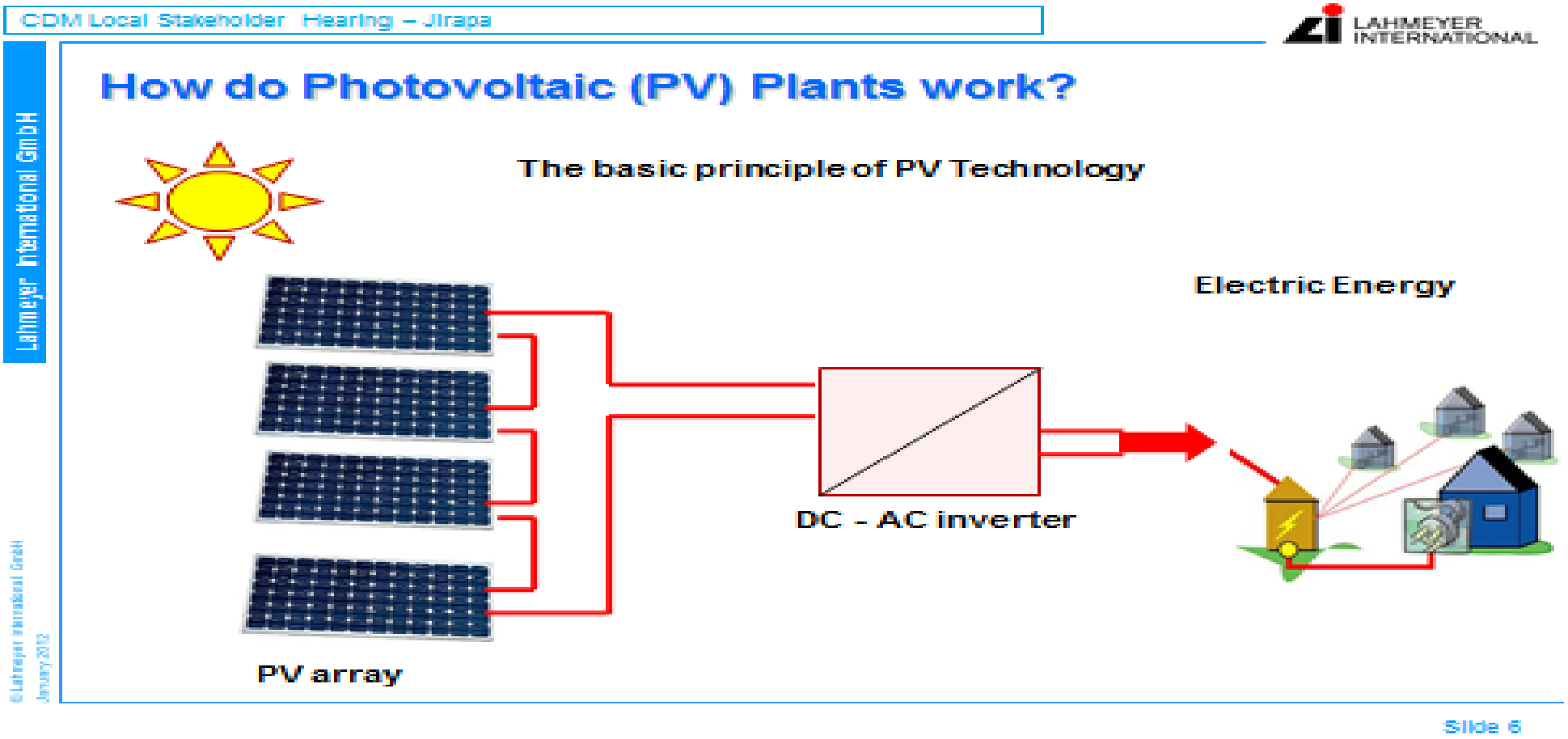


Figure 3-1: Block diagram of Photovoltaic Power Generation

3.3. Location & Land Use

3.3.1. Kaleo Solar Power Project

The project site is located on the eastern side of the Kaleo township within the Nadowli-Kaleo District, formerly known as the Nadowli District. Figure 3-2 shows the Kaleo Township within the context of the Nadowli-Kaleo District. Three sites of land sizes of 6.22 Ha, 4Ha and 18.39Ha are to be utilised for the Project (See Figure 1-2 and Figure 3-3). The geographic coordinates of the PV Sites at Kaleo are provided in Table 3-1. The terrain of the three (3) project sites are mostly flat with a slight slope towards south. They are rectangular shaped which is regarded as suitable for PV installation. However, it needs to be adequately prepared for some part. Kaleo is an attractive site for PV development due to its direct access to the distribution grid and the flat terrain surface. This indicates that ramming the foundations of the support structure will be possible.

Table 3-1: Geographical Coordinates of Kaleo PV Sites

Name	Size (Ha)	Latitude	Longitude
Kaleo Site 1	6.22	10°10'22.89"N	2°32'1.07"W
Kaleo Site 2	18.39	10°10'49.91"N	2°32'4.98"W
Kaleo Site 3	10.18	10°10'49.91"N	2°32'4.98"W

The only significant constraint which needs to be considered for the future operation is the anticipation of the growing of the town and farms towards the PV area. Consequently, safety margins close to property borders are essential not only for safety reasons but also to avoid any energy production losses from shadows (small houses, pylons etc.). It is further recommended to re-establish the existing footpath at the North of the site. This path is used by dwellers from the town to arrive at their farms. Keeping those paths would certainly prevent any conflicts. The sites are all degraded and characterized by annual bush fires, continuous farming, and animal grazing. Parts of the area were previously used as a major farm land but is now mainly fallow. It is now used partly for farming of annual crops and legumes as well as animal grazing. Specifically, some tall trees, comprising mostly of Dadawa, Sheanut, Red Flowered Silk cotton, Nim Trees as well as shrub vegetation exist on the land. There are 2 Fulani nomadic settlements, one just outside the Kaleo Site 2 and the other located within the site, made up of 2 hamlets. Discussions with the landowners indicate that these are illegal settlers and will be required to relocate prior to project construction.

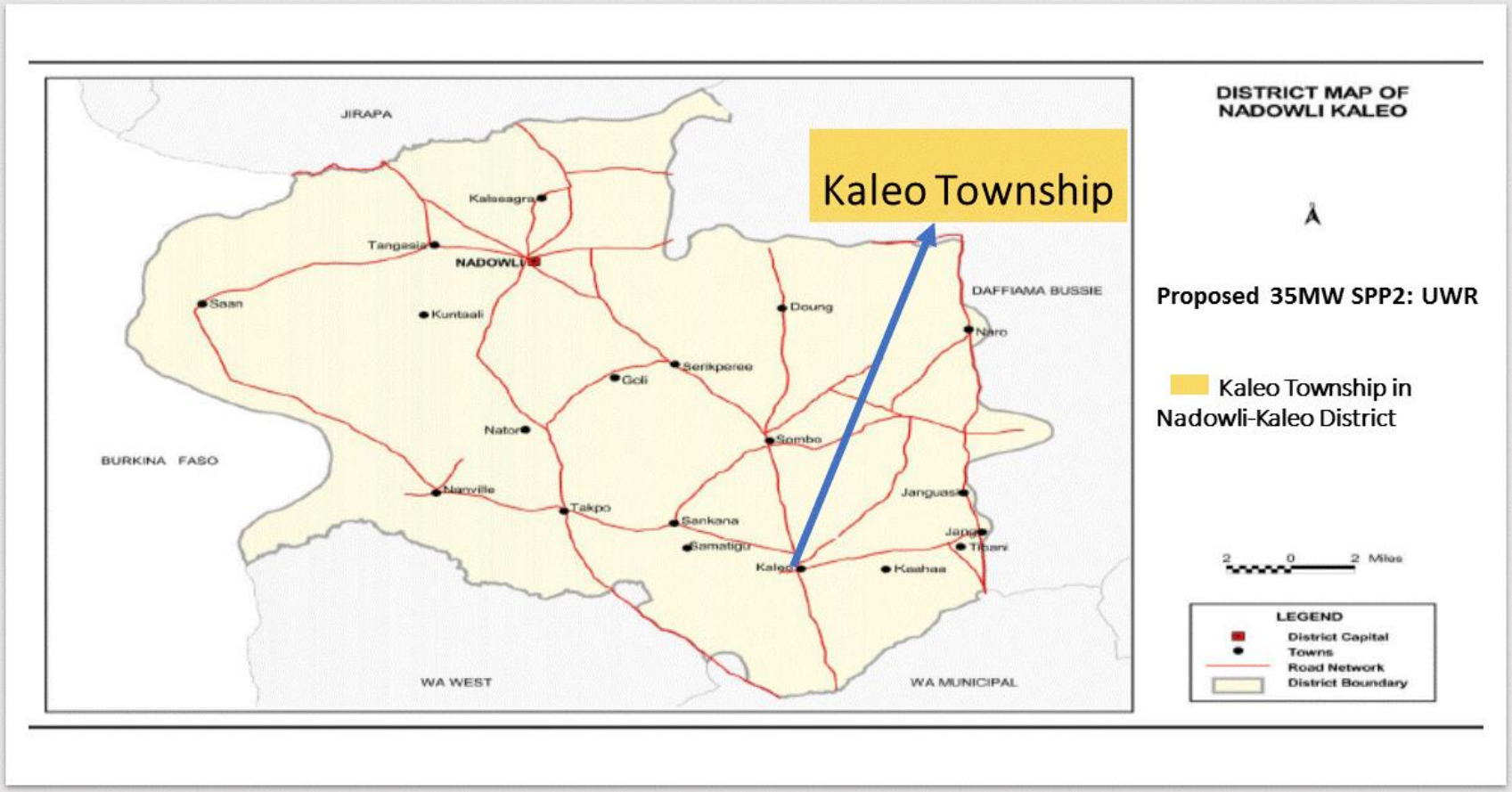


Figure 3-2: Kaleo Township in the Nadowli-Kaleo District

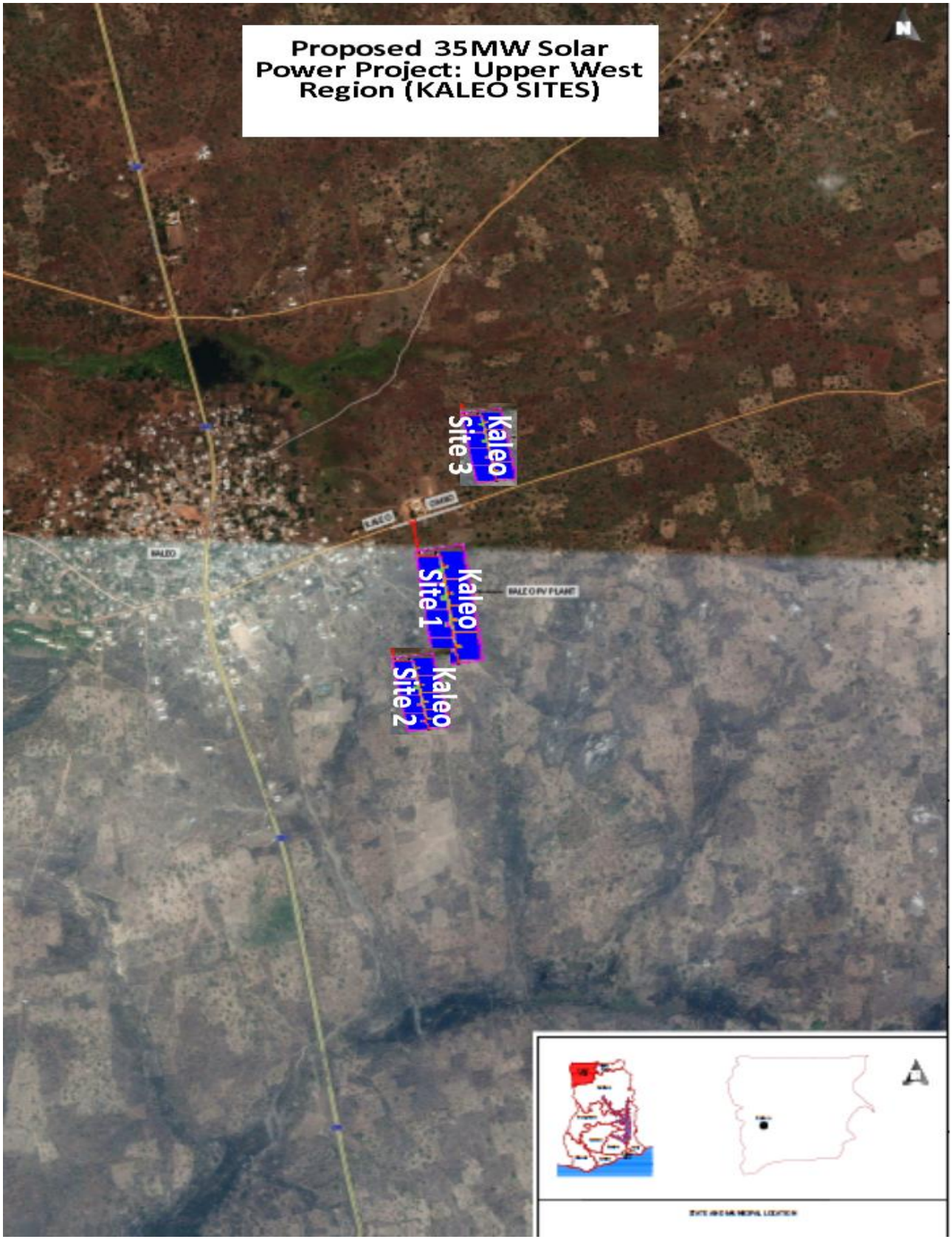


Figure 3-3: Three (3) PV sites at Kaleo Township in the Nadowli-Kaleo District

3.3.2. Lawra Solar Power Project

The Lawra PV Site has an area for installation of 6.13 hectares and is located in Lawra in the Lawra Municipal. Figure 3-4 shows the Lawra Township within the context of the Lawra Municipal. This site is located 3.96 km Northwest of Lawra village on the road Lawra-Hamile and has an area for installation of 6.1Ha (See Figure 3-5). The geographic coordinates of the PV Site at Lawra is 10.6624010 N, 2.8992180 W. There are no settlements on this site, and the land is largely fallow with shrubs and Acacia and Sheanut being the most dominant trees. The land is also used for farming of annual crops and legumes as well as animal grazing.

The terrain is not completely flat showing small bumps and slight slope descending towards North with 2.5-3% in average. The slope needs to be considered in the design by adjustment of the row to row spacing. Based on the recorded GPS logs, the difference along the longer side of the property next to the road was estimated with 3 m. On each row of the mounting structure two PV modules are fixed in portrait position. Consequently, the distance between the front and back row is set to a minimum value of approximately 2.1 m in order to maintain the annual row to row shading losses to -1.8%. A 3 m bushfire buffer, 8-10 m towards road Wa-Lawra-Hamile is to be established. For the construction of the PV collector field, ground levelling will need to be conducted and tall trees as well as smaller vegetation will have to be removed in the terrain here as well.

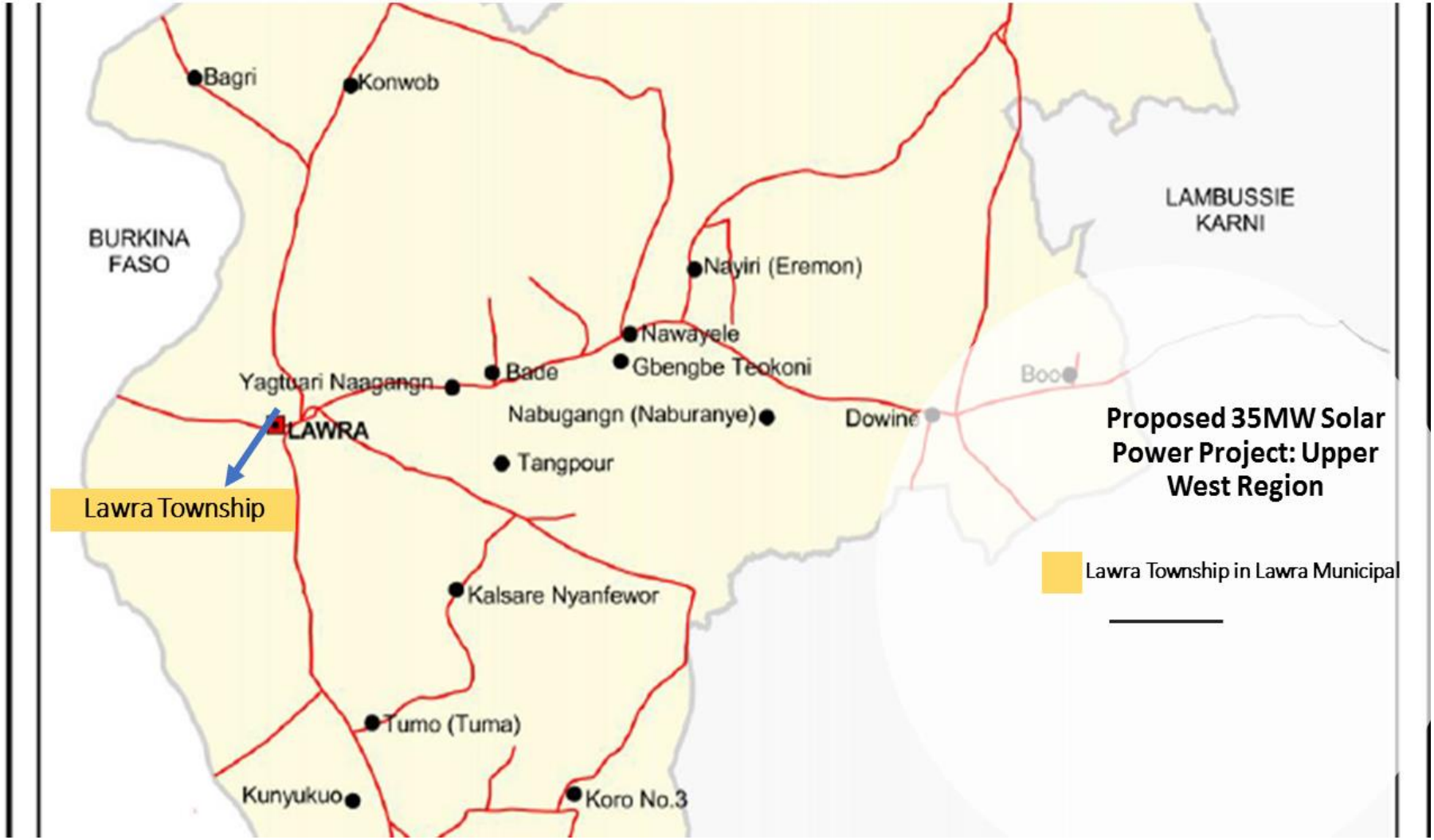


Figure 3-4: Lawra Township in the Lawra Municipal

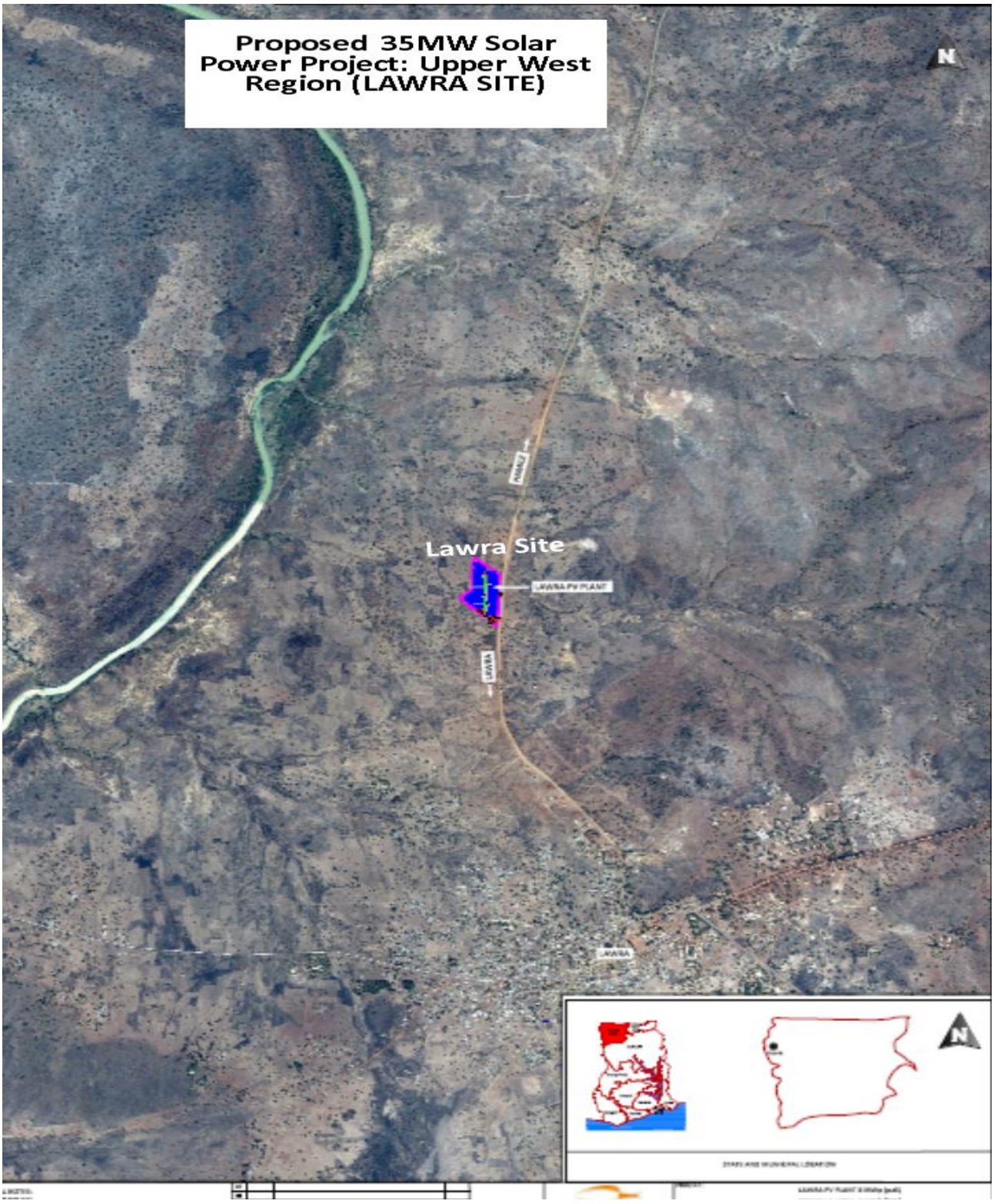


Figure 3-5: PV Site at Lawra Township in the Lawra District

3.4. Facilities at PV Sites

Basic civil designs for the Lawra and Kaleo PV Sites are provided in Appendix 5, the civil layouts shown in Figure 3-6 and Figure 3-7 and a write up of the necessary facilities to be provided for execution of operation and maintenance of the PV Plants are discussed below. Project facilities shall largely be obtained from German or Canadian manufacturers, thus reducing the number of manufacturers and assuring best quality and after service support.

3.5.1. Module Invertor Set Ups

A summary of the configurations for the Kaleo and Lawra PV Plants is provided in Table 3-2.

Table 3-2: Module Inverter Set-up for Kaleo and Lawra PV Plants

Parameter	**Unit**	**Kaleo**			**Lawra**
		Site 1	**Site 2**	**Site 3**	
Orientation	Degree	12°, perfect South			12°, perfect South
Module power	Wp	330	330	330	330
Type of module	-	Poly	Poly	Poly	Poly
Modules in String	-	20	20	20	20
Total Modules	-	24,320	39,520	21,280	21,280
Nominal AC inverter power	kW	25	25	25	25
Number of inverters per array	-	38	38	38	38
No. of total inverters	-	304	494	266	266
No. of arrays with 1 transformer each	-	8	13	7	7
Total Peak Power (DC)	kWp	8,026	13,042	7,022	7,022
PDC/AC ratio	-	1.056	1.056	1.056	1.056

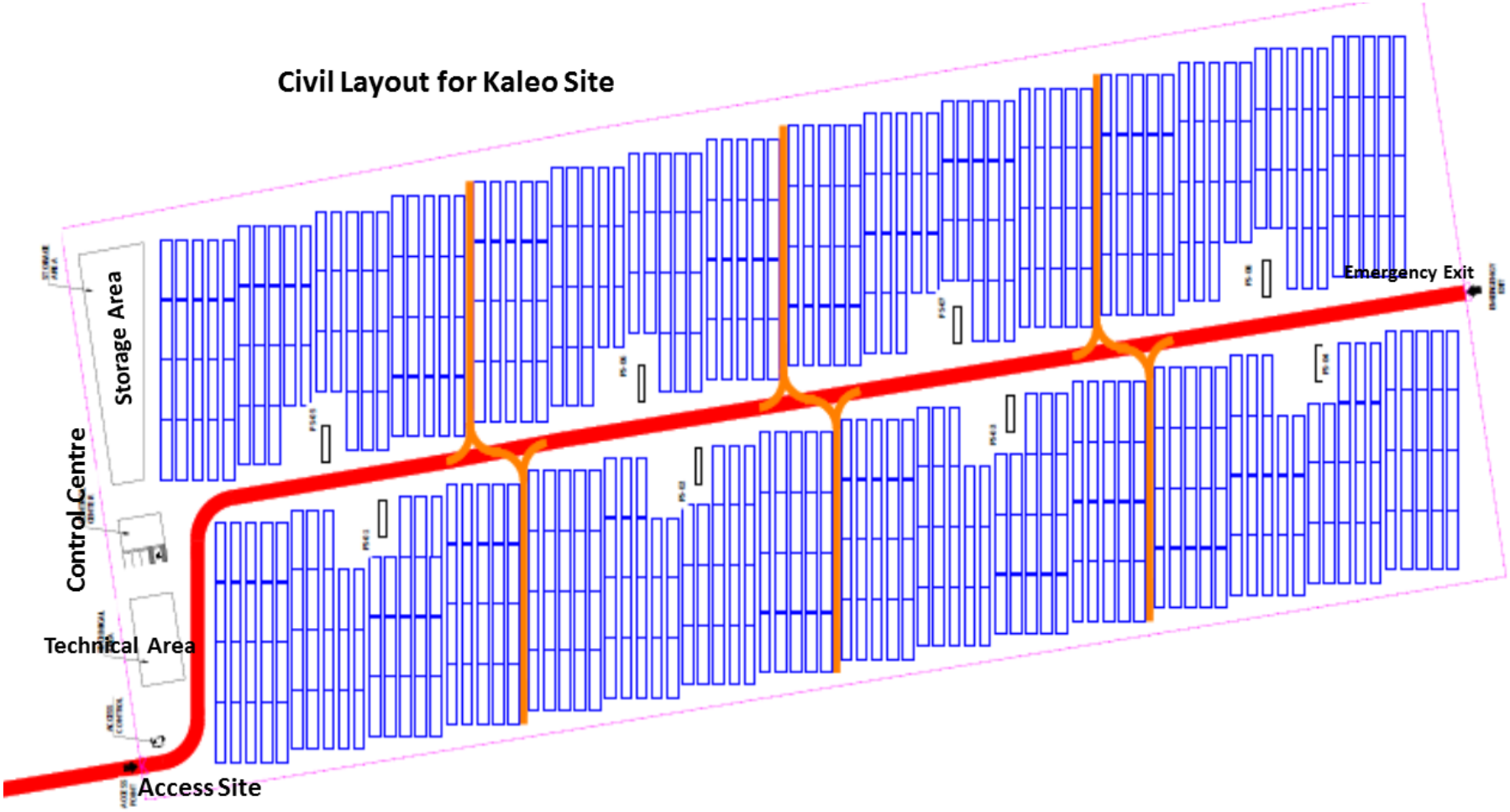


Figure 3-6: Civil Layouts of Kaleo PV Sites

Figure 3-7: Civil Layouts of Lawra PV Sites

3.5.2. Spare Parts Store

According to international standards, 0.1% of the installed nominal power should be stocked. It will be in the responsibility of the Operational & Maintenance (O&M) team to manage the stock of spare parts. The spare parts list would be guided by the considerations such as whether the element is critical, how high the probability for malfunction is, and how long will be the delivery time for replacements or warranty claim procedures. Generally, it is suggested that a minimum of one-two modules per year and MW installed are to be kept on stock. With an approach of using string inverters, it is recommended to keep 15% of the total number of units in stock. Table 3-3 presents the list of main spare parts to be kept in stock for the project.

Table 3-3: Estimated Spare Parts List

Item	Number, Type
Modules	Modules 1-2 modules per year and MW,
Module Mounting Structure	Screws, bolts, clamps and other. auxiliary parts
Inverters	15% of total number of inverters per plant,
Transformers	Required spare parts for validity of transformer
Calibrated Sensors for Weather Station	1 for each parameter per plant
Module Connector Plugs	5 per plant
Replacement Fuses	2 of each type (if any) per plant
String Cable Set	2 sets per plant
Replacement Magnetothermic Switch	1 of each type per plant
Electric Bulb	2 for each cabin per plant
Programmable Logic Controllers (PLC) for Control Room	1 per plant

3.5.3. Water Supply

All the PV sites shall be equipped with a borehole, drainage system and sink/tap water for operational and domestic use. For the Phase 1 water supply, boreholes with storage tanks will be constructed at Lawra and the Kaleo Site 1. For Kaleo, the borehole at Kaleo Site 1 will be connected to the Kaleo Site 3 with a high-density pipe buried at a suitable depth along the MV line right of Way. Additional storage tanks would be erected for Kaleo Site 3. For the Phase 2 water supply, Kaleo Site 2 will have a dedicated water supply, which would be interconnected to the water supply system of Kaleo Site 1 and the community water supply as a backup. The link to the community water supply would have a valve installed and metered so any water taken from this source can be monitored and properly accounted for as part of resource use efficiency strategies of the VRA for its operation power plants. Even though, water from the borehole will be filtered to make it fit for consumption, it is expected that water for drinking purposes will sourced mainly from local merchants during operations.

3.5.4. Main House

In this building kitchen, a washroom, workshop and rest rooms shall be located. Practically, the main house shall accommodate local staff. The planned personnel shall consist of a continuous watchman staffing (24/7) and sporadic presents of skilled maintenance technicians and operations engineers.

3.5.5. Main Distribution Room

This is the place where:

- The MV busbar 34.5 kV coming from all the transformers shall be connected to the main MV switchgear before they feed in the grid line.
- Auxiliary transformer and battery banks are accommodated for internal electricity consumption of the technical area in a physically separated compartment.
- The control room which is responsible for monitoring and ensuring the safe operation of the PV plant as well as the safety of the equipment and local personnel.
- The metering system shall be located.

3.5.6. Waste Water Collection

A sewage treatment tank shall be located at the back of the main house, accessible to vehicles from outside for services. It will receive mainly the outflow of the latrine. All local and national environmental regulations shall be respected when disposing contaminated water containing residues such as oil or chemicals. Water collected the drainage channels from on-site precipitation is collected into larger gravel filled channels at the fences where it can trickle away.

3.5.7. Internal PV Roads & Parking Area

Internal roads, accesses and parking areas on the site would be designed and constructed of sufficient width and for maximum likely loads. The main internal roads would have a width of 5 m and they would be illuminated by solar street lights. In addition, smaller internal roads will be constructed of 2.50 m width for 0&M purposes. The aggregates of base and sub—base of the main road material will be of well graded pit run gravel or equivalent. Moreover, some indicative dimensions of small and big trucks have been included in the civil layout in order to show the accessibility through the site. A designated part of the internal road system shall be reserved for parking of maintenance vehicles.

The sub-distribution cabinets and transformer kiosks shall be between the arrays and internal road, making their access for any maintenance and repair quite convenient. Their distance from the road is 2 m and lights shall be located along the internal roads as safety margins against potential crashes during manoeuvring.

3.5.8. Security & Fencing

Construction of a wall fence around the power plant is required for power plant's equipment protection, as also for avoiding any accident by external causes. Mesh fencing is to be installed and this is appropriate to protect the area. Steel posts, struts and extension arms would be galvanized steel tubes. The height of posts would be 2.50 m (above surface level). The extension arms shall form an angle of 45° to the outside with the vertical line. Earthing connections would be provided where necessary. Rows of barbed wire of stainless or galvanized steel would be provided at the top. Barbed wires shall consist of two strands twisted and four pinned barbs. Regarding the construction of the Fencing, the steel posts would be fixed in concrete foundations, aligned in horizontal and vertical direction and grounded. Four evenly spaced rows of the line wires with a double wire at the top

The bottom part of the fence shall be buried 0.15 m into the ground. At the entrances T for each Site, gates shall be planned onto the main and secondary access roads. The gates would be of the double—type, with an opening width of 6 m and be secured with barbed wire on top. Each gate would be equipped with a security lock supplied with a set of 5 matching keys and a lockable switch to enable the alarm system from outside of the Plant. There would also be a pedestrian access gate at the main entrance. Each site would have one main gate and a secondary emergency gate.

Installing an open field PV Plant raises at the same time the request for security against theft. Hence, security systems have become state of the art in free-field PV Plants. Generally, security systems are recommended to be equipped with periodically maintained backup battery banks, which are regarded as market standard. In other cases, an automatic message is sent to the operator in case of disruption and / or interruption of the grid. For the three plants in UWR, a system based on Sensor Post with Barbed Wire System and CCTV is recommended. The final requirements are to be clarified with the insurance provider.

3.5.9. Meteorological Station

Two meteorological stations are to be constructed at each site. Each station shall be equipped with high quality sensors for the measuring the following parameters:

- Global solar radiation (GHI) – Pyranometer
- Inclined solar radiation - Pyranometer
- Diffuse solar radiation - Pyranometer
- Ambient temperature – Thermometer
- Module temperature – Thermometer
- Anemometer
- (Module temperature sensor)

The measurement devices shall be connected to the SCADA system.

3.5.10. Fire Fighting Concept

A fire fighting and emergency concept shall be developed for each site. The firefighting concept shall be in line with current VRA Health, Safety & Environmental and local regulations as well as national standards, and contain the placement of adequate equipment on the sites and facilities therein such as smoke detectors and extinguishers. Additionally, the organisational issues that will be addressed will include an interface with the regional fire brigade, training of fire fighters and on-site staff to take correct actions in case of a fire.

3.5. Network Connection

The envisaged connection of these utility scale PV power plants based on decentralised inverter configuration concept is stated to be at the 34.5 kV level. Relevant aspects for the grid connection at 34.5 kV level of the PV Power Plants with a nominal power feed capacity of the PV power plants have been analysed. The general layouts of the medium voltage interconnection transmission lines are shown in *Figure 3-8* and Figure 3-9. In the case of the Lawra PV plant, the network connection will comprise of the development of a 4.5 km overhead line system integrated into the existing 34.5 kV main corridors' line at Lawra as a Tee-off connection. The envisaged point of connection is located close to the Lawra –Nadowli road, south east of Lawra town at Pole No. XLN 0255.

Depending on the type of lines and their electrical characteristics to be applied for the grid connection of the PV Plants, the expected peak values for electrical losses range between 1.8% (AAAC 100 mm²) and 1.4% (AAAC 150 mm²). In comparison with the line Type AAAC 100 mm², the implementation of the network's connection with the overhead line type AAAC 150 mm² can reduce the electrical losses for the transmission of power from the PV plants by approx. 20% (peak value of losses), therefore the interconnection lines of the envisaged PV Plants, are recommended to be realized with the overhead line Type AAAC-150 mm². The substation to be built at Lawra as part of the first phase would have some minor modifications to accept an additional 3 MWp capacity. This includes fencing of the additional land and upgrading the evacuation and communication/control facilities for a total station capacity of 7MWp.

For the Kaleo PV Plants, based on preliminary analysis about alternative points of connection (T-Off Connection), the most favourable option based on technical as well as monitoring issues is the direct connection to the Wa GRIDCo Substation. This is based on the understanding that a way leave carrying two lines requires less ground area than two-way leaves each carrying one line. Thus, for the Kaleo Sites, and as stated in the responsive technical proposal, approximately 12.5km overhead line system outgoing from Kaleo PV substation to the 34.5 kV busbar of the Wa GRIDCo Substation will be developed. In order to allow ease of the expansion of Phase I from 12 to 17MW and Phase 2, the general interconnection concept is to extend the Kaleo-Wa MW line to Kaleo Site 3 and for each site to aggregate the PV arrays through a 34.5 kV bus to the MV line.

The transmission line is also intended to be upgraded from 23MVA to 30MVA. The Kaleo Site 2 Capacity of 13MW would have a complete Control Room and Substation for evacuation via the Kaleo -Wa MV line. There is an already an existing trench under WA AIR STRIP and the project intends to use that tunnel to lay down the underground cable (See Plate *3-1*). There shall be no civil works, such as the use of pipe ramming machine regarding to this part of the interconnection line, however, VRA shall engage the Ghana Civil Aviation Authority prior to the commencement of works.

Plate 3-1: Area under Wa-Airstrip for overhead interconnection line

Figure 3-8: General layout of Kaleo PV medium Voltage Overhead Transmission Line

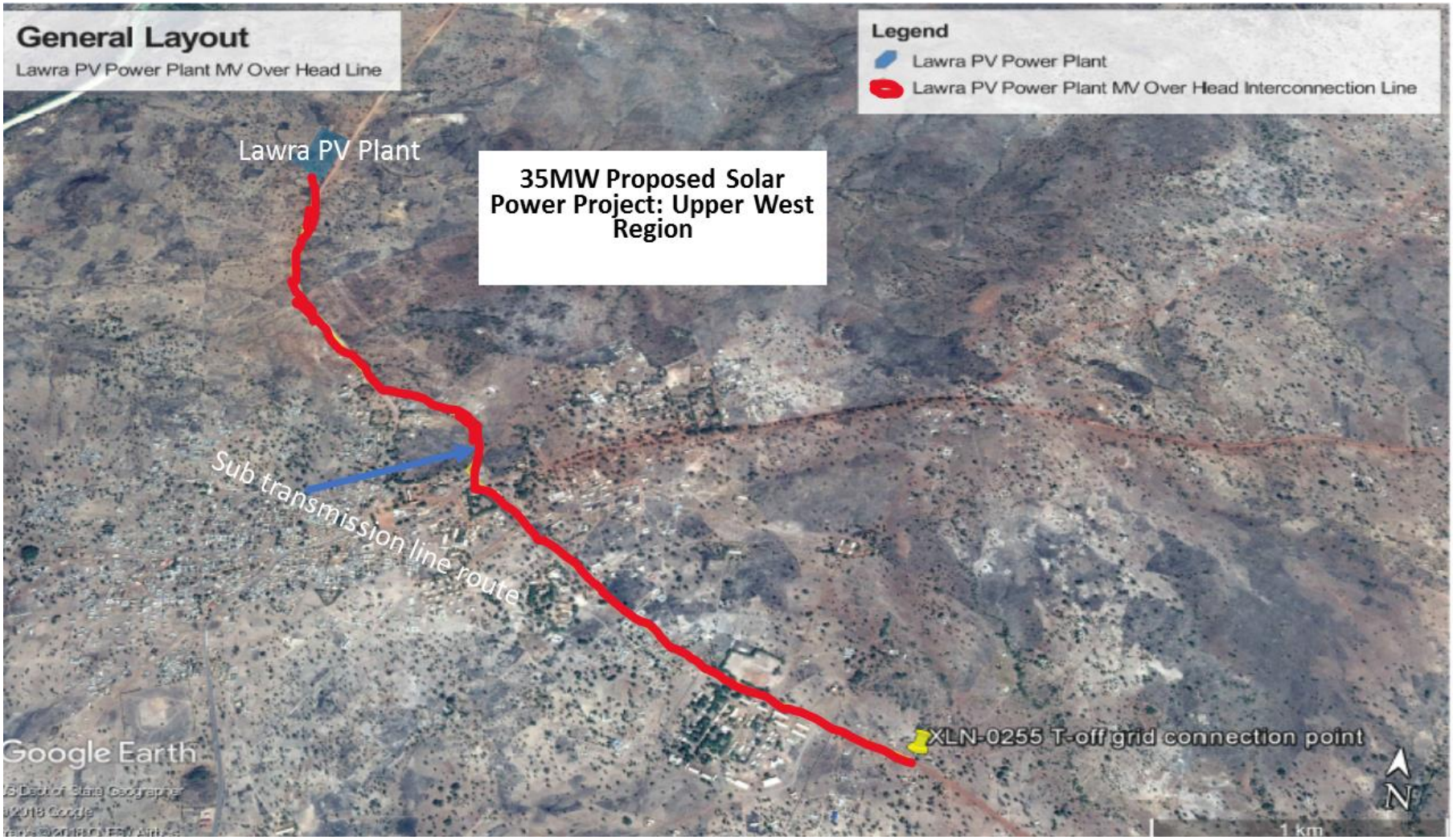


Figure 3-9: General layout of Lawra PV medium Voltage Overhead Transmission Line

3.6. Pre-Constructional Phase

The elements of the PV plants that has currently been carried out at this pre-construction stage are outlined below.

3.6.1. Development of Project Design Documents

The preparation of project design documents for the PV plants, both civil and electrical, have been completed and a list of available documents outlined under Section 1.5.3. These design documents were prepared to correspond to the environmental constraints and grid requirements of the MV network as well as the de-facto standards of VRA for substations. The basic design is developed to set a reference for reliable and easy manageable power plants. Therefore, a clear focus was given to market-ready and proven technologies. Existing approaches employed in developed PV markets were considered and adapted to Ghanaian conditions and the project framework, making this project promising for the future.

3.6.2. Stakeholder Engagements

Consultations play a major role in identifying the potential impacts of any proposed transmission system project. Extensive consultations, including two (2) separate public hearings each, have subsequently been carried out with residents of Lawra and Kaleo, the property affected persons, state agencies including the District Assemblies, Forest Services Department and the water Resources Commission have been reported herein. Details of the consultations undertaken are provided in Chapter 5 of this report.

Consultations shall continue all through the project life cycle and on-going public consultations would be held with all stakeholders, including Project Affected Persons (PAPs) as well as the relevant Chiefs, Opinion Leaders, and Governmental Agencies with the aim of providing information on project environmental and social management issues, including valuation and compensation.

3.6.3. Line Route Site Survey for Sub-Transmission System

Till date, a line route survey has been completed to identify the sub-transmission component of the project. Marked survey pillars at vantage areas for the identification of the project sites have been installed ae geographical coordinates of the survey pillars taken with a GPS. For the Lawra PV Plant, a new overhead interconnection line will have to be built towards Lawra following the line routes provided by VRA. The prepared line routes foresee a new independent interconnection overhead line from the site towards the main Lawra T-off branching from the main MV distribution line Wa-Hamile.

There is a tee off on the existing 34.5kV Sawla-Wa-Nandom-Hamile line at Domwini near Jirapa to Lawra. Since the main Sawla-Wa-Nandom-Hamile is very far from Lawra its' been decided to connect the proposed line from the solar site to the existing 34.5kV from Domwini near Jirapa. Thus, for the Lawra Solar Farm site, the line will run parallel along the Lawra-Nandom road towards Lawra up to the Forestry Services entrance. At the Forestry Services entrance, the line will be expected to run along the Forestry Services road, through the Lawra Forest Reserve (about

500m), till it meets an existing wood pole line close to the SSNIT office building. From the SSNIT office the line will be expected to run parallel to the existing wood pole line along the Lawra-Jirapa road to meet the Domwini-Lawra line at the Lawra Senior High School. The length is expected to be approximately 4.4 Km.

As indicated earlier for the Kaleo PV Plant, it is currently proposed that an interconnection line made up of a direct single overhead line system should be constructed from the Kaleo PV substation to the existing 34.5 kV busbar of the Wa GRIDCo Substation. The new line connection is to be parallel routed to the existing MV transmission line which is located at the western side of the PV plant and quite close to the PV plant area, running a total distance of approximately 11.5 km (line air).

3.6.4. Valuation & Compensation of Properties

The project is to be achieved by utilizing a total land area of 44.92Ha. at three closely sited areas at Kaleo (10.22Ha, 18.39 Ha, and 10.18 Ha) as well as 6.13 Ha at Lawra. VRA used in-house expertise for the land surveying and pillaring of the identified sites. Strategies for acquisition was in line with the requirements of the Land & Resettlement Policy Framework Document, which is as follows:

- Referencing of all properties, land, crops and buildings, by officers of the Land Valuation Division (LVD) to be monitored by VRA.
- Assessment of the compensation values by the LVD and the valuation advice forwarded to VRA.
- The assessed report would be vetted, and corrections effected where necessary to ensure that the amounts are accurate and fair to both claimants and the VRA. These would then be processed for payment.
- Offers would be made to the claimants on the basis of the LVD's advice.
- Claimants dissatisfied with the offer have a right to petition for reconsideration.
- In this regard, such claimants are required to submit counter proposals supported by valuation opinion prepared by private valuers of their choice. The private reports are considered by VRA in conjunction with the LVD to ensure that claimants are treated fairly.
- Where necessary, dissatisfied victims would be invited to negotiate and arrive at acceptable figures.
- Project affected persons may resort to legal action in order to have their grievances addressed.

The process involved extensive consultations with the land-owning families that gave VRA opportunity to be conversant with the land tenure systems and arrangements within the areas as well as to identify right persons to deal with. The first consultation took place in 2010. Within the context of the community engagements, the nature of the project, its impact, the process of land acquisition and consequential compensation matters were explained in detail. This was to enable respective land owners freely to give out lands willingly. Further consultations were also held

with the state land agencies both at the national level and at the Regional Level (Upper West Region). These include Land Valuation Division, Survey and Mapping Division and Public and Vested Lands Management Division of Lands Commission.

VRA acquired the lands for the PV sites through voluntary means and private treaties and therefore there is no involuntary acquisition associated under this project. Compensation was assessed based on an arm's length discussions on current market values within the neighbourhood. In actual sense the final value of amount payable for the land is a negotiated sum. In line with established procedures, compensation have been paid in full to the land owners and details are as provided. VRA negotiated with the Land-owning families and obtained Leases from them. A term of fifty (50) years each was granted. The executed leases for these parcels of land commenced as follows:

- Lawra - December 1, 2010
- Kaleo Site 1 - March 1, 2011
- Kaleo Site 2 - March 1, 2013

The executed leases have been processed and registered at the Lands Commission, Wa in the Upper West Region. The payment of the 10.18Ha Kaleo Site 3 has been completed and "Sale of Land Agreement" executed between VRA and the landowners. The lease is under preparation and yet to be executed. All customary and statutory requirements have been met and complied with. VRA rights and interest in the lands therefore had been fully crystallized and these lands are free from any encumbrances. Following payment of all customary and statutory rites, access has been given to enable VRA carry out its activities[9].

Currently, there is no law or legislation governing the length of Right of Way (RoW) for 34.5 kV transmission line. The 34.5 kV sub-transmission lines will, in principle, be constructed in the wayleave zones of the existing roads and transmission routes. Thus, for the sub-transmission line route, there would not be the need for any RoW acquisition. It is noted that about 0.5Km section of this new line shall traverse through the Lawra Station Forest Reserve. Detailed assessment of economic trees on the various PV sites and the Lawra Forest Reserve, was undertaken by the Forest Services Division, Lawra District and results outlined in the relevant section of Chapter 4. Common tree species in the reserve include Khaya Senegalensis, Tectona grandis and Anogeissus leiocarpus. With the solar power sites, the identified economic trees were Sheabutter, Dawadawa, Red Berry, Cashew, Mahogany, Neem tree and Acacia.

VRA surveyors has subsequently carried out valuation of these economic crops and assessed compensation payable. In carrying out the valuation, careful consideration was given to voids in the farm holdings. The current statutory/Land Valuation Division (LVD) rates were used in computing the compensation payable on each farm. VRA in October 2018 paid land owners for the economic trees to be impacted upon by the project. Values paid are deemed to be fair and

[9] Extracts of the three (3) leases as well as the "Sale of Land Agreement" are provided in Appendix 8.

reasonable as all the relevant issues and determinants have been given due consideration. The proposed PV sites are used for agricultural purposes and there are no residential facilities on it, apart from the Kaleo Site 2, where 2 Fulani nomadic settlements are settled in 2 hamlets. Discussions with the landowners indicate that they will ensure these settlers relocate prior to project construction and there would be no need for any compensation for the relocation.

3.6.5. Performance of Pacification Rites

VRA is sensitive to sociocultural requirements relative to implementation of power projects, as required in the Land & Resettlement Policy Framework Document. Accordingly, the VRA subscribes fully to measures that will ensure environmental/social compliance of Funding Agencies as well as traditional requirements. The land owners and community leaders during the various stakeholder engagements advised that as part of their customs, certain rites ought to be performed before the projects commence and a list of items required made available to the VRA. VRA in February 2019 initiated the relevant pacification rites prior to project construction in order to ensure smooth project implementation. It must be noted that there might also be the need to make pacification rites for relocating the Kulbonuo Shrine belonging to the Bayoyire Community in Lawra prior to project construction.

3.6.6. Acquisition of Permits & Licensing

The necessary statutory permits and licenses that must be acquired for the construction and operational/maintenance phases of the solar power project are as follows:

a. Environmental Permit
b. Siting Permit
c. Construction Permit
d. Development Permit
e. Water Use Permit
f. Fire permit
g. Generation & Electricity Wholesale Supply Licence

VRA has consequently embarked on relevant activities to ensure all required permits have been obtained and has engaged all the state agencies involved to discuss modalities. Currently, an Environmental permit for the 12MW (comprising of 8MW Kaleo Site 1 and the 4MW Lawra Site under Phase1) is in force and is valid until August 31, 2019. Thus, the construction of these two PV plants can commence without the acquisition of permit of the entire 35MW PV plant. In addition, Siting permits for the Kaleo and Lawra sites have been obtained from the Energy Commission. These permits have been provided as part of Appendix 1.

The preparation of this ESIA Report will allow for the acquisition of the Environmental Permit to also cover the extra capacity of 23MW (5MW Kaleo PV Plant at Site 3 under Phase 1 as well as the 18MW PV Plants associated with Phase 2 development) to enable the construction of these additional PV plants to also commence. Following execution of Contract Agreement with the EPC Contractor, VRA will apply for a Constructional Permit from the Energy Commission, Fire Permit from the Ghana National Fire Service as well as a Development Permit from the

respective District Assemblies to enable construction to begin. A Water Use Permit is to be applied for from the Water Resources Commission during project construction after a detailed hydrogeological and geophysical investigations is employed to locate extensive fracture zones to increase the chances of drilling success and higher-yielding boreholes to meet demand. A Generation & Electricity Wholesale Supply Licence is to be obtained from the Energy Commission during operation and maintenance phases. It must be noted that with the exception of the Development Permit, all the above-mentioned permits are to be continuously renewed during the lifetime of the project.

3.6.7. Engagement of Engineering, Procurement and Construction (EPC) Contractor

VRA includes environmental, health and safety management requirements in the bid documents as part of the contractual clauses for the project. The EPC Contractor is required to provide a Health & Safety Plan, an Environmental Protection Plan as well as a Quality Assurance Plan as part of the bidding documents, and this has been done by the successful bidder and is to be monitored during project construction. The Health & Safety Plan establishes the details of the Contractor's overall responsibilities for security services, access control, construction traffic, road usage, construction fencing, security and safety, including protocols for coordination and communication with VRA on such matters. In addition, this ESIA Report and its permitting requirements shall form part of the Contract documents for the Contractor. Subsequently, the contractor will be required to implement the measures proposed in this ESIA and this will be agreed as part of their contracts.

3.7. Constructional Phase

3.7.1. Overview

The development will proceed on a turnkey engineering, procurement and construction basis. Design specifications to be followed during construction are to be in line with both the Ghana Building Code, 2018 as well as international standards such as the British Standards (BS). The EPC Contractor has provided a Health & Safety Plan, an Environmental Protection Plan as well as a Quality Assurance Plan as part of the contract documentations. Notwithstanding the Contractor's obligations, the Contractor is to implement all measures necessary to restore the sites to acceptable standards and abide by environmental performance indicators specified in the ESIA Report to measure progress towards achieving objectives during execution or upon completion of any works.

In line with the VRA Local Content Policy, the Contractor is required to have a local component. All contractors for the project shall assume full professional liabilities regarding fulfilment of any statutory requirements and shall be expected to carry out all civil based works in line with VRA approved specifications and drawings as well as national/international standards and codes. VRA shall seek and allocate funds to cover eligible payments under the contract for the project.

3.7.2. Assessment of Geological Hazards

Geotechnical studies shall be conducted by the EPC Contractor to determine the soil type, which will form the basis for the foundation type to be exploited. The results from the geo-technical study will also determine the topography's effect on the proposed design. Thus, the detailed geotechnical investigation will be dependent on the award of contract and findings and cannot be included in this ESIA Report. Findings of this study will be made available to the EPA when completed, as part of project environmental reporting.

3.7.3. Procurement of Project Items

The EPC Contractor shall be responsible for procuring and constructing the PV Plant and associated components. As part of the EPC Contractor's quality policy, first worldwide level suppliers are to be utilised for the manufacture of the major equipment and accessories. Catalogues, certificates, references list, ISO and OHSAS certificates, etc. are to be provided to VRA for concurrence. Manufacturer's authorizations are to be provided showing that the EPC Contractor has been duly authorized by the main manufacturers for this project to supply and install that item in Ghana. The EPC Contractor is to provide all documents obtained from the supplier during tendering process. Any other documentation required by VRA during clarification period or project execution will be studied with the manufacturers and provided as detailed as possible. It must be noted that aggregates, cement, reinforcing bars and other materials for the construction of the project can be locally procured in Ghana and local materials will be used as much as possible for the project.

The specifications of the new equipment will comply with the international standards to ensure an economical design and compatibility with the existing facilities and equipment. Since 2001, Ghana is taking part in the affiliate country program (ACP) by the International Electrotechnical Commission (IEC) and is adopting more and more IEC standards as Ghana standards. Thus, the basic designs shall be based on IEC standards. The IEC standards, which have been already adopted, are therefore titled with Ghana standard. An example is the GS IEC 61836 - Solar photovoltaic energy systems[10]. The equipment will also have the minimum but necessary configuration to achieve the objectives of the project. It is expected that the materials and equipment for the substation will be stored within the existing NEDCo Substation at Wa.

3.7.4. Transportation to Site

The project sites are both located in the Upper West Region, and therefore the major route to the site will be the Wa – Lawra section of the N12 Highway. The N12 Highway is part of the trunk roads between major urban centers and forms part of the backbone of the road system in Ghana. See Figure *3-10* for the main transportation route in Ghana. The equipment procured will be landed at the Port of Tema and will then be transported overland to the project sites in the Upper west region more than 700 km away, making careful packing of the equipment essential to avoid

[10] http://www.iec.ch/dyn/www/

any problems at the transportation stage. After clearance from the port, the materials shall be stored at a designated storage site.

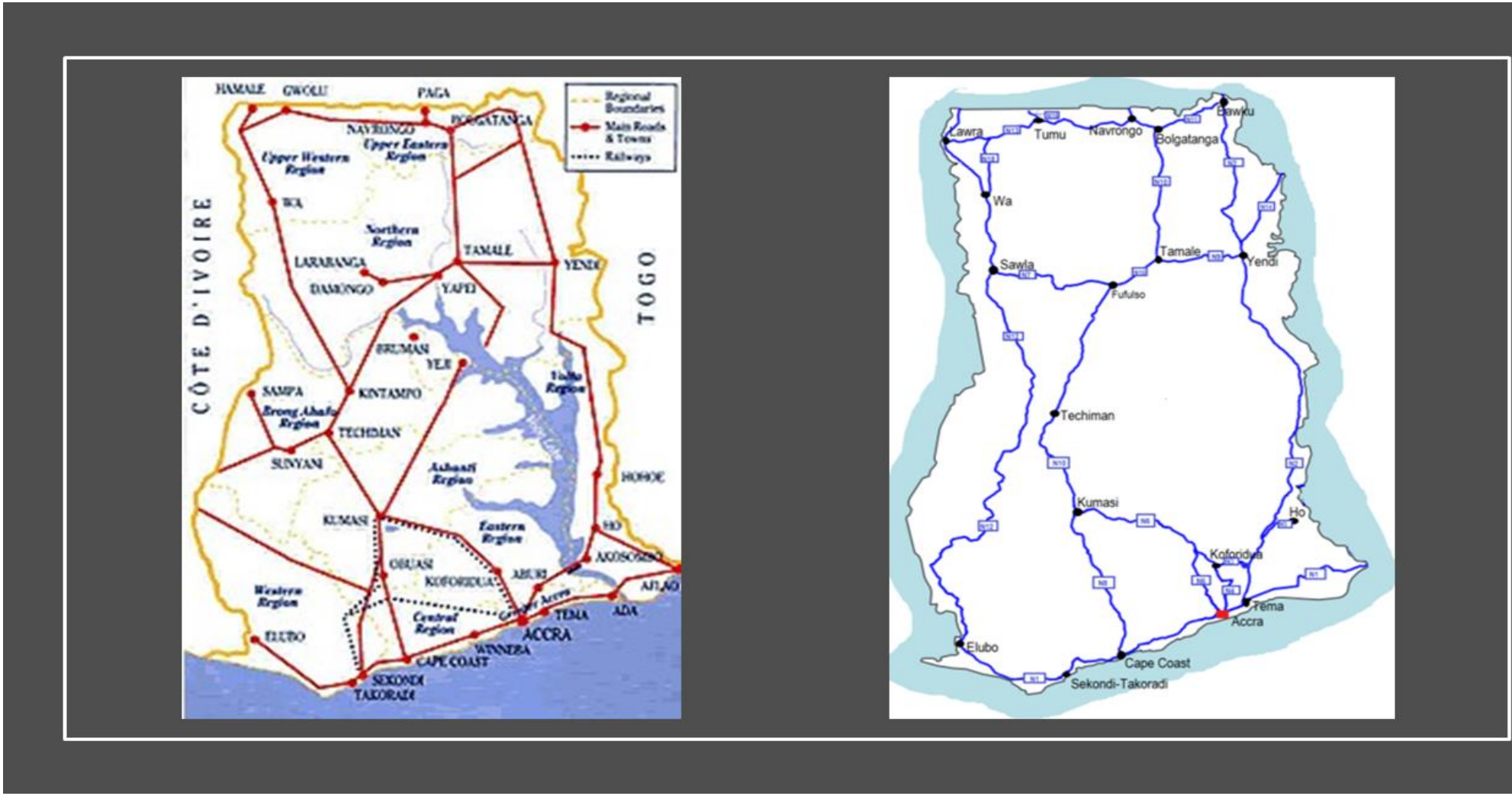


Figure 3-10: Ghana Highway Transportation Route

These materials and equipment will be transported by road on the N12 Highway to the storage site, most likely at Wa or within the project communities dependent on the EPC contractor's choice.

PV modules are fragile equipment; however, the current off-site traffic conditions can satisfy the equipment transport requirements. Estimated average construction vehicle movements are 5 trucks and 10 cars per day. Materials and equipment procured locally or nationally will be transported directly to the storage site. It must be noted that the materials will not be bulky and unwieldy. They will therefore not require any specialised vehicles. During construction, the materials will be transported to the site via public roads.

3.7.5. Construction Workforce

The labour force during the construction of the PV Plant will be the responsibility of the EPC contractor. The EPC contractor will in turn appoint specialist subcontractors, with the VRA Local Content Policy in mind. Thus, the contractor is likely and will be encouraged by VRA to use local sub-contractors and local people for civil works, electrical works and transportation of equipment to the site. A construction work-force of up to 100 is expected, however this is dependent on the turnkey contractor and these will be expected to work on all four sites depending on the stage of construction. This total number would not be on site at the same time for the duration of the construction period. The peak workforce would be onsite during the busiest construction period when multiple disciplines of contractor's complete work simultaneously.

The average numbers on site at any one time would be of the order of 50, and this will at any time include about 30 members of local communities that will be hired as drivers, masons, loaders, carpenters, cooks, security personnel and other assorted personnel. Professionals such as electricians, riggers, crane operators and heavy equipment operators will also be required for the construction of both the PV plant and associated sub transmission lines and these people will most likely not come from the local community but from elsewhere. About 5 VRA support staff, 5 expatriate workers and 10 Specialist staff are also expected to be on site in addition to the above.

3.7.6. Civil Works

3.1.1.1 Terrain Preparation

The following works are to be undertaken as part of the terrain preparation using the following guidelines:

Site Excavation:

a. Prior to the commencement of excavations, the EPC Contractor would clear all areas of site, including the complete removal and disposal of all rubbish, trees, bushes and any other growing vegetation. AII debris would be removed to an approved location.

b. The finished surface of the excavation areas for construction measures would be rendered perfect to the depth required prior to depositing of replacement or construction materials thereon.
c. If unsuitable or weak ground is found below the planned foundation Level, the EPC Contractor shall perform all additional excavation as directed by the Engineer at no extra cost until reaching suitable strata. If excavated material has been approved by the Engineer for re—use, it would be stockpiled in approved locations.
d. Due to the weather conditions of the locations, the EPC Contractor would provide adequate pumping appliances to keep all works free from water and provide for all necessary temporary drainage.
e. Due notice would be given by the EPC Contractor to VRA when considering that any excavation bed has been properly and finally prepared, so that VRA could make an inspection.

Filling

a. The fill for site leveling and fill to be used as supporting strata under foundations/structures would be gathered from a quarry nearby always after VRA's approval. It shall ideally be cohesionless and shall contain less than 10 °/o non—plastic silt.
b. It shall not contain any peat, organic matter, plastic silt or any other swelling material, shall be homogeneous in texture, free from oversize material or any material differing from the average material.

Levelling & Grading

a. Any debris, surplus or unsuitable material would be removed from the Site. In Building Areas, whenever presence of soft or unstable subsoil it could be excavated down to firm subsoil and replaced with compacted suitable imported fill material or, in case the firm subsoil is more than 2m deep, the EPC Contractor might propose for VRA's approval a different type of footing based on continuous concrete slabs.
b. Compaction of fill material would be in layers of not more than 250 mm and up to suitable standard. The leveling, compaction and grading of the entire site would be with mild slopes and falls to provide free drainage of the storm water.
c. Levelling and grading of the Site would match the existing surrounding ground levels to facilitate free
d. drainage of the Site. The finished Site shall be well compacted to suitable standards and grades.
e. Finished ground floor level of technical and non-technical buildings would be fixed at least 200mm above the highest ground level in order to ensure free drainage of the surrounding grounds away from the buildings.
f. All banks and slopes perpendicular to the road would be formed to a gradient not exceeding 1 (vertical): 2 (horizontal).

g. In order to allow easy access to the construction site by car or heavy vehicles, the subbase layer of the roads would be laid and compacted before starting the foundation works.
h. All fill material would be obtained from designated cut materials or imported materials approved by VRA.
i. VRA shall approve the selection, blending, routing and disposition of materials in the various fills. The fill shall contain no sod, brush, roots or other perishable materials.

Ground Finishing

a. Internal roads, walkways and trails along land boundaries: Lightly compacted with heavy gravel and drainage channels along
b. Technical area and surroundings of technical installations: Compacted soil with gravel/crashed rocks (25mm, nominal size to a depth of 100mm).
c. PV array and rest of plot such as extension area: Light compacted natural soil. The minimum required degree of compaction shall be, tested according to modified proctor density: - 98% for the roads.

3.1.1.2 Internal PV Roads

a. Internal roads, accesses and parking areas on the Site would be designed and constructed of sufficient width and for maximum likely loads. As stated in the Tender documents, main internal roads would have a width of 5 m and they would be illuminated by solar street lights. In addition, smaller internal roads will be constructed of 2.50 m width for O&M purposes.
b. The aggregates of base and sub-base of the main road material must be of well graded pit run gravel or equivalent and must fulfill the parameters specified in international standards.
c. Road surface dust treatment Corpi Dust Plus or equivalent would be used to reach the properties mentioned in the tender documents in accordance with the future used of the road and avoiding dust problems, providing a fine surface for vehicles and protecting PV area form dust at the time.
d. The road quality would be tested according to the applicable international standards. The test locations will be determined by the Engineer. The testing would be carried out by the EPC Contractor and be supervised by the Engineer.

3.1.1.3 Foundations for Buildings & Shared facilities

a. The detailed design of all foundations would be the responsibility of the EPC Contractor
b. The requirements of foundations shall be determined by the arrangement of buildings, transformers and equipment, and shall be to the approval of the Engineer.

c. Building and equipment foundations would be designed to withstand the loads to which the foundations will be subjected according to the building and equipment loads and soil investigations.
d. Buildings and equipment foundations, support and ancillary structures must be designed for the worst combination of dead loads, construction loads, live loads, plant loads, impact and dynamic effects due to operation of plant, crane loads, short circuit forces, maintenance loads, earth pressure, wind loads, seismic loads, temperature effects, etc.
e. As there are many different types of loads that could affect the foundation it would be designed for several combinations of them, as stated in the EU regulation (Eurocode 2, EHE-0.8, etc.)
f. The foundations of electric and electromechanical equipment such as solar panels, electrical cubicles, transformers and control switches would be designed and constructed in accordance with the manufacturer's requirements, considering particular load specifications and protections requirements.
g. In addition, the foundation design and level would allow raining water drainage without affecting the supporting equipment, as required by the manufacturer and the Engineer.
h. The foundations final design would be determined by the EPC Contractor in accordance with this Specification and to the approval of the Engineer.

3.1.1.4 Temporary site facilities

a. First, it is important to point that the EPC Contractor is fully responsible to ensure health and safety at site.
b. The EPC Contractor would designate a person for this duty (subject to contractor's approval) and we would form al the working personal to reach the HSE Standards (to be approved by the Contractors in accordance with the local authority) and would provide security equipment to ensure that we reach those standards and procedures.
c. Regarding the temporary site facilities to be installed by the EPC Contractor, they would include the following items:
    - Offices: As stated in the tender documents they must have internet connection, I&T devices such as printers, separate meeting room for twenty persons and storage and air-conditioned offices including three offices for use by VRA and Engineer.
    - Sanitary installations: waste disposals-latrines, dustbins, toilet facilities, etc.
    - Material storage: adequate storage facilities for material and plant equipment.
    - Safety equipment and First Aid Kits.
    - Additional infrastructure: Two borehole, parking area, workshop facilities and lay down areas.
d. The EPC Contractor would erect, operate, maintain and remove a first aid station to meet the requirements of all personnel of one shift working in the area, for the joint use by all other Contractors, VRA and the Engineer.

e. This item includes the building, furniture and all required equipment according to the Tender specifications and always meeting all requirements of the local authorities

f. In addition to the works described above, Site installation comprises the following services/ works:
   - Construction of temporary access roads to the site including maintenance during construction period and other auxiliary works.
   - Clearing, grubbing, stripping, excavation, leveling, draining, disposal of excavated materials (at a site approved by the Engineer) etc. for the areas required for the Site installation.
   - Supply of electric power and distribution to each individual consumer including maintenance from the interface points.
   - Sewer system and sewage disposal, sanitary installations.
   - Surface drainage.
   - Execution of all mechanical and electrical installation, foundation work for the equipment, machinery, storage and Site facilities, etc.
   - Hard standing for vehicles as required.
   - Waste disposal.
   - Watching, lighting and fencing of camp and working areas.
   - Temporary timbering for working spaces, etc.
   - Movable fire-fighting equipment.

g. The working areas would be cleaned frequently in order to keep in good conditions all the facilities. On completion of the construction phase, all temporary installations would be removed and demobilized leaving the occupied location clean and clear of debris or pollution.

3.1.1.5 Fencing

a. Fencing proposed by the EPC Contractor and to be used on the project is mesh, which is appropriate to protect the area. Steel posts, struts and extension arms would be galvanized steel tubes.

b. The height of posts would be 2.50 m (above surface level). The extension arms shall form an angle of 45° to the outside with the vertical line.

c. Earthing connections would be provided where necessary. Rows of barbed wire of stainless or galvanized steel would be provided at the top. Barbed wires shall consist of two strands twisted and four pinned barbs.

d. Regarding the construction of the Fencing, the steel posts would be fixed in concrete foundations, aligned in horizontal and vertical direction and grounded. Four evenly spaced rows of the line wires with a double wire at the top would be secured to each intermediate post by a wire stirrup passing through the holes in the post.

e. The chain link fencing would be strained between posts and would be attached to the line wires by tie wires.
f. Five rows of hot dip galvanized barbed wires with galvanized wire spacers at one-meter centers are proposed to secure the extension arm.
g. The bottom part of the fence shall be buried 0.15 m into the ground but must respect the penetrability by small animals if required by the EIA.
h. At the entrances for each Site, gates shall be planned onto the main and secondary access roads. The gates would be of the double-type, with an opening width of 6 m and be secured with barbed wire on top. Each gate would be equipped with a security lock supplied with a set of 5 matching keys and a lockable switch to enable the alarm system from outside of the Plant. There would also be a pedestrian access gate at the main entrance.
i. Each site would have one main gate and a secondary emergency gate as stated in the Tender documents.

3.1.1.6 Other Important Considerations

a. The foundations of the PV structure are considered to be direct ramming poles driven into the ground.
b. MV Cables from Power Stations to the switching station will be laid directly buried in MV trenches according to the national normative and standards.
c. A perimeter trench for the security and earthing system has been projected.
d. Manholes will be installed in all cable's crosses, long distance cable runs (every 50 meters) and Power Stations inputs-outputs. Manholes' measurements will be according to the number of cables that run through them.
e. The grounding system will connect every metallic structure to ground: PV structures, string boxes, Power Stations, security system, fences, etc. using earth cable laid in LV and MV ditches.

3.7.7. Water Source and Water Supply

PV power plant's water supply for construction includes water for building construction, water for construction machinery, fire protection water and domestic water, etc. Water may also be required to moisture and condition the soils for proper compaction at roads and foundations. It is estimated that for dust control and compaction purposes approximately an average of 20,000 litres per day of water will be required per each site. The construction party shall be equipped with at least 2 water trucks to carry out water to the construction areas for concrete mixing and curing. During construction, water shall be fetched by means of drilling deep wells by the EPC Contractor, the design flow is 50m3/ h, and the delivery head of water pump shall be selected in accordance with the groundwater depth. At the same time, the water required during the construction period would also be supplied from this. Data on ground water quality can therefore be available when this aspect is completed by the contractor.

Temporary ablution facilities will be required during construction (i.e. portable toilets). The EPC Contractor shall be responsible for supplying potable water for drinking purposes, waste disposal facilities and sanitary facilities during construction.

3.7.8. Power Requirements

The project will consume about 30Kwh mainly for site operation, lighting purposes and constructional work, during the constructional period. Power for construction and project activities will be obtained from the existing 34.5 kV power system lines of NEDCo which will be connected by NEDCo on behalf of VRA as well as a 135kV Stand-by generator.

3.7.9. Medium Voltage Interconnection Line

3.1.1.7 Kaleo Interconnection to external 34.5 kV Wa GRIDCo substation

The distribution of the generated energy of Kaleo PV Plant into the grid shall be carried out via a connection between the internal PV plant substation and the Wa GRIDCo substation. The network connection will be in accordance with the VRA Standards and Electrical requirements. The connection of the Kaleo PV Plant with the Wa GRIDCo substation with associated equipment comprises also its integration within the grid and monitoring system.

The following are to be considered by the EPC Contractor:

a. One (1) reserve feeder (AIS type) is available for connecting the Kaleo PV plant to the substation.
b. The existing 34.5 kV switchgear of Wa GRIDCo substation has sufficient rating for taking 100 % of the generated PV power and that the corresponding circuit breaker has sufficient breaking capacity.
c. The existing reserve feeder is equipped with aII necessary switching devices, aII measurement transformers, surge arrestors as weII as aII necessary control and protection devices. If not, replacement of components or extension of equipment shaII be taken into account.
d. The existing cable channels/Overhead Lines portals on the Wa GRIDCo substation site have to be prepared in a way to allow the laying of the power cables/Overhead Lines coming from the PV Power plant.

3.1.1.8 Lawra Interconnection to Existing MV Transmission Line

The distribution of the generated energy of Lawra PV Plant into the grid shall be carried out via a connection between the internal PV plant substation and the existing MV Transmission Iine. The network connection will be in accordance with the VRA Standards and Electrical requirements. The connection point will be XLN-0255 T-off grid point. A pole-mounted recloser device will be used to provide the possibility of disconnection from the MV grid.

3.1.1.9 Construction Works

A conventional survey of route has been done and the survey and profile already prepared by VRA for the 34.5kV sub-transmission line component. VRA shall make available detail profiles and pole plotting for each line section after the award of the Contract, to enable a price readjustment based on final design. The Contractor is required:

(1) To check the line profiles that will be provided by VRA and make any amendment, additional survey and updating that might be necessary for the construction of the lines in keeping with the best engineering practice.
(2) To check the ground elevation at the pole location and at the points of minimum clearance of conductors to ground.
(3) To check all the pole-to-pole distances.
(4) To update the line profile and strip route map up to the date of take-over of the line by VRA
(5) To be responsible of the observance of all specified clearances and of pole capabilities.

The project shall utilise Steel galvanised Poles instead of the conventional four-legged freestanding towers of horizontal configuration. Steel Poles occupy less space and are also more resistant to fire than wooden poles. Pole spotting is the determination of the individual sites for the installation of the poles and this takes place over the whole length of the transmission line. Activities that go along with pole spotting will include final survey and soil investigation. These activities necessitate intrusive access and some clearing of vegetation, leading to possible destruction of crops. Studies shall be done to determine the geology of the project area which is important to identify the pole sites. The specific sites for locating the individual poles will be finally determined based on various criteria including baseline information gathered during the PER.

Geotechnical survey and pole spotting are therefore activities that shall be carried out subsequent to the issuance of an Environmental Permit and availability of funds to identify the optimum foundation design for each pole. Foundations for steel poles shall be of the simple earth type employing foundation baulks where necessary as detailed in the plate drawings. The soil resistance values given shall help identify confirm that the types of foundations proposed suit the various ground conditions. Generally, wherever possible the poles will be located at or near the summits of the uplands to maximize the clearance between the lines and the ground.

The Galvanised Steel poles, which are manufactured abroad, are to be shipped to the Tema port from where its components will be transported by lorry to the lay down areas where project office sites are expected to be created. The poles will be assembled on site. Anti-climbing guards would be fitted and maintained at an early stage of erection. Anti-climbing guards for steel poles shall consist of galvanized steel barbed wire having barbs at least 15 mm long and having a maximum spacing of 35 mm. In all other respects the barbed wire shall comply with BS 4102, or such other

standard as may be approved. The barbed wire shall be stapled to each steel pole at approved positions and shall be wound round the pole for 12 turns over a distance of 500 mm to form the anti-climbing guard.

Construction time for installation at each site will be short and will be erected using a crane. Depending on the characteristics of the soil at the selected pole spot, a foundation depth of 1.8 - 2.0 meters will be used. Once foundations have achieved their design strength, the next major task shall involve the assembly and erection of the structure. This commences with the delivery on site of the bundled steelwork members using a load-trailer and the full assemble conducted at the locations. The average span between poles will be about 90m depending on the characteristics of the terrain.

For each pole, the Contractor shall furnish one (1) Danger/Number signs, one (1) circuit identification plate and three (3) phase plates (one each of red, yellow and blue). The pole number shall be painted on a 1.5mm x 100mm x 250mm stake which shall be driven by the centre stake. For daylight obstruction marking, poles are painted in an orange/white or alternatively red/white bar pattern, the bottom and top bars being coloured. The height of each bar shall be 5 m approximately.

The next stage of the process will be to install onto the pole structures the necessary insulators to support the conductors as well as the equipment necessary for running out and stringing the conductors. Once the full sections of poles have been assembled, the lines will be strung. The conductors shall generally comprise an aluminium conductor. The line has been designed to always keep at least a 7.5m clearance between the cables and the ground. This distance is slightly superior to the norms in effect, so it guarantees an optimum safety. As much as possible, the conductors are to conform to VRA's specification for sub-transmission lines in order to cater for any future developments in the area.

The installation equipment and conductor drums would be delivered to each number of pre-selected stages along the line route to allow for stringing using the winch and brake method. The stringing method to be used by the contractor will be subject to prior approval by VRA. In all cases where stringing will cross power lines, telephone lines, public roads etc., due notification to appropriate authorities will be given and the prescribed minimum clearances observed.

A pilot wire would initially be installed for each conductor and then used to draw through the conductor under constant tension so as to ensure that no contact is made with the ground. This would minimise both conductor damages as well as ground damage during installation. Any damage to the conductor during this process (particularly any contact with the ground) will impair the line function.

3.8. Testing & Commissioning

A number of tests will be undertaken to ensure that the PV Plant and sub transmission line performs as per the specifications. The EPC Contractor will be responsible for functional testing and commissioning of the new switchyard. This consists of connecting the line to the national grid to transmit power. Final commissioning involves, among others, the testing of PV modules to ensure that all joints are correctly made and are tight, the integrity of the various hardware, the protection system, etc. Connection of electrical plant will be checked, and once approved power connections established.

3.9. Demobilization

Upon, completion of the constructional phase any temporary infrastructure will be removed, and the areas rehabilitated. The Contractor shall carefully remove in a manner to prevent damage, all equipment and materials specified or indicated to be salvaged and reused. Salvaged items specified to be reused in other works shall be stored and protected until reuse. Salvaged items not to be reused, but to remain VRA's property, shall be delivered in good condition to VRA at its storage area on-site in accordance with the requirements of the contract agreement documents.

The wooden structures, which will be raised as offices, workshop, accommodation and storage rooms will be dismantled and the planks of wood, doors and other materials will be carted away for re-use at other project sites of the contractor. The concrete floors will also be removed and disposed of at an approved landfill site. All mobile toilet facilities for the construction site workers will be removed from the site on completion of constructional works. Constructional equipment will all be transferred to the contractor's premises. Constructional equipment will all be transferred to the contractor's premises. This is to be done by the EPC Contractor under the supervision of VRA. The work campsite will then be filled, levelled and re-vegetated.

The Contractor shall perform final clean-up prior to substantial completion. Such final clean-up shall include the following:

- Removal of dirt and unsightly substances from all visible surfaces and area.
- Removal of deleterious substances from all parts of the work.
- Washing of all windows.
- Inside work "broom clean", including side and overhead fixtures.
- Removal of Contractor's temporary structures, tools, equipment, supplies, surplus materials, and underground utilities.
- Repair of roads, walks, fences, and other items damaged or deteriorated because of Contractor's operations.
- Grading, raking, smoothing, replacing vegetation, and other operations necessary to restore to original or better condition at areas affected by Contractor's operations.

The Contractor shall provide additional clean-up as required to remove items and clean areas affected by work performed by Contractor from Substantial Completion to Final Completion. Such demobilisation processes would be undertaken in accordance with environmental laws and standards in place at the time of decommissioning.

3.10. Operation & Maintenance

3.10.1. Overview of Operation & Maintenance

VRA staff will operate and maintain the PV Power Plants once it has been commissioned. A dedicated team of about 20 VRA engineers and technicians will be responsible for up keeping of the various solar plant during operation as well as coordinate and execute maintenance activities. In addition, about 10 persons from the locality will be engaged for unskilled labour required on site such as security guards, cleaners, gardeners, etc.

An O&M concept shall be drawn-up for all relevant aspects during O&M. In order to conduct the services diligently, the team needs to be trained these topics such as:

a. Basic introduction to the specific PV plant (included in the training by the EPC contractor)
b. Preventive maintenance: Execution of all regular scheduled activities;
    - ✓ Corrective maintenance at
    - ✓ Emergency cases;
    - ✓ Unpredicted failure.
c. Improvements on the plant in order to increase performance or ease operation;
d. Operation supervision via local and remote interface:
e. Commercial management:

VRA shall consider the following from the basic design phase until start of operation:

a. Thorough check, verification and re-consideration of all design aspects, technology scenarios and executive design changes for their relevancy towards operation.
b. Implementation of a specific Computerized Maintenance Management System (CMMS) for the PV plants.

Other items to be considered and is outlined below include administrative and organizational facets which are as important as the technical set-up:

a. Establishment of a common spare part store;
b. Use of commonly employed special tools and equipment;
c. Interface to the grid-operator (NEDCo) and communication channels;
d. Management of security provider.

3.10.2. Water Source and Water Supply

The main water usage shall be for working and living of the personnel in the switch station. Clean water for drinking purposes will be outsourced for drinking purposes. It is noted that from experience at the existing 2.5MW Navrongo Solar Power Station (NSPS) that water required during project operations are low in comparative terms with the key requirement for the need to wash the PV cells, which is done on the average twice in a year and this is dependent on the period of the year and the conditions of the physical environment. Just like the Navrongo PV site, all PV sites under this project shall be equipped with a borehole, drainage system and sink/tap water for operational and domestic use (See *Plate 3-2*). Water shall be abstracted from the onsite borehole into a 1000L storage tank and utilised for panel washing and domestically for cleaning and flushing.

Plate 3-2: Borehole & Storage Tank for Water supply at Navrongo PV Power Plant

At the NSPS, the average annual water consumption for 2017 and 2018 was 32,350 L. This implies that an amount of 3.752 litres of water is used per module (given that there are 8,622 modules at NSPP). Using this background information, the total water requirement for the project has been estimated by the project consultant, Lahmeyer International and the breakdown is as shown in

Table *3-4*. Estimated volume of water demand for wet cleaning of solar panels ranges from 19.5 m^3/year to 84.5 m^3/year. Wet cleaning of the PV arrays is expected to be performed four (4) times in a year and this will be within the months of March, June, August and December. The PV panels will be cleaned manually with a window washer type device (covered with a specialized

cloth material), soft brush, window squeegee or soft cloth. For cleaning purpose, one must observe instructions from the module manufacturer's manual and verify if not further measures such as softeners are required.

Table 3-4: Water Requirements at O&M Phase

Phase	Project Locality	MW	# of boreholes	Cleaning / Annum	Wet Cleaning (Estimated Volume of Water Usage)	Estimated Volume of water per cleaning
Phase 1	Kaleo	13	1	4 months	84.5m^3 / year	21.13m^3
	Lawra	4	1	4 months	26.0m^3 / year	6.5m^3
Phase 2	Kaleo	11	1	4 months	71.5m^3 / year	17.88m^3
	Lawra	3	0	4 months	19.5m^3 / year	4.88m^3

Source: Lahmeyer International, February 2019

3.10.3. Waste Disposal

A waste management procedure shall be implemented which, ideally, would go in line with current VRA Health Safety & Environmental policies. Containers for the different wastes shall be placed closed to the main gate in order to ease the carry-off by the disposal service provider.

3.10.4. Security System

Installing an open field PV Plant raises at the same time the request for security against theft. Hence, security systems have become state of the art in free-field PV Plants. Generally, security systems are recommended to be equipped with periodically maintained backup battery banks, which are regarded as market standard. In other cases, an automatic message is sent to the operator in case of disruption and / or interruption of the grid. For the three plants in UWR, a system based on Sensor Post with Barbed Wire System and closed-circuit television (CCTV) is recommended. The final requirements are to be clarified with the insurance provider.

3.10.5. Fire Fighting

The fire-fighting area for the power plants shall include the power distribution rooms in the substation area and in PV power plant. In accordance with the principle of "prevention first, combination of prevention and fire-fighting", the appropriate fire-fighting equipment shall be adopted. A portable fire extinguisher shall be adopted as the fire-fighting equipment and this shall include the required number of Carbon dioxide fire extinguisher and Dry powder fire extinguisher. Moreover, a fire-fighting shovel, the sand box and other fire-fighting facilities shall all be provided.

3.10.6. Monitoring System

The control and communication architecture will allow achieving the following objectives for a solar
photovoltaic installation:

- Acquisition of the variables that define the state of the series of strings of the plant.
- Monitoring of the inverters of the plant.
- Reading and management of electricity data of the plant.
- Monitoring of electrical parameters on the grid connection point.
- Integration of sensors needed to know the relevant meteorological parameters.
- Data transmission to remote location.

The following key process information will be controlled and supervised from each inverter input and the PV plant related meteorological station:

Control (from plant control room):

- Inverter on / off / reset
- Timer function for automatic start / stop of inverter units
- DC circuit breaker (on / off)
- 0,415 kV AC circuit breakers (on / off)
- Output power (active and reactive) by set-point value

Monitoring / Supervision (from plant control room/remote location)

- Switching position of PV generator internal AC and DC switches
- Input voltage of inverter DC side
- Input current of inverter DC side
- Output voltage of inverter AC side
- Output current of inverter AC side
- Frequency
- Power Factor
- Meteorological / Ambient data:
- Temperature in inverter / transformer houses

The meteorological station will be close to the general services building, in such a way that the pyranometer can be easily cleaned. The SCADA must receive all the relevant information from:

- PV field string combiner boxes.
- Data Acquisition System
- Inverters
- Meters. High accuracy tariff meters of class 0.2
- Protection cells.

The SCADA must include transmission facilities through GSM and Internet. The goal is to provide the necessary tools to efficiently manage the PV installation both locally in the plant's facilities as well as remotely from PV Monitoring Centre in Akuse.

3.10.7. Auxiliary Power Consumption

The auxiliary services of the plant will be fed from the power stations, which will have a small transformer to cover these consumptions. The security surveillance system and building consumptions will be fed from the control center. Auxiliary services consumption has been conducted and for every power station, the maximum auxiliary services need will be as shown in Table *3-5*.

Table 3-5: Auxiliary Power Consumption

Consumptions	**Consumption (kW)**	**No**	**Total (kW)**
Weather Station	0.024	1	0.024
Inverter Night Consumption	0.02	38	0.76
Illumination	0.4	3	1.2
Electrical Sockets	1.2	3	3.6
MV Cubicles	0.9	1	0.9
Ventilation	0.6	1	0.6
Air Conditioner	1.2	1	1.2
SCADA	0.4	1	0.4
Network Analyser	0.1	1	0.1
Total			8.784
For auxiliary transformer in the control center			
CCTV Camera	0.06	15	0.9
Buildings	15	1	15
Control Center	25	1	25
			40.9

VRA is aiming to provide the auxiliary power to the highest possible extend by renewables. Therefore, it is planned to install a PV system on the roof of the control building and run a hybrid system containing also a battery and a diesel generator.

3.10.8. Operations & Maintenance Schedule

Since the PV Plants contain no moving parts as key components and do not represent a very complex system, its availability should be close to 100% and required maintenance is rather small. Nevertheless, certain preventive maintenance activities are suggested in order to ensure an optimal performance. For the specific locations, which are located in open land and affected by dust particles from the surrounding and a sand storm season, regular cleaning of the sensors and modules is regarded as necessary. The other activities remain estimations, as many properties of

the equipment and mounting structure are not yet finally defined. The activities which are regarded as essential are shown in the Table 3-6.

Table 3-6: Overview on Suggested Preventive Maintenance Procedures

Item	**Interval**	**Required Time**	**Workforce per site**	**Equipment**
Cleaning of Modules	6 months	2 days	3 unskilled workers	Filtered water, cleaning brush, rubber lip, Transportation carriage
Maintenance of Inverter (depends on manufacturer instructions)	1 year	1 day	2 engineers	Electrician tools
Maintenance of Mounting Structure (visual inspection)	6 months	2 days	2 unskilled workers	Camera
Checking of Surge Arresters, Cables and PV Junction Boxes (visual inspection, test of cable fit, cleanliness of equipment, check on no intruded water)	6 months	2 days	1 technician	Electrician tools
Monitoring	Weekly	4 days at implementation 0.5 days during operation	2 engineers	Service car, Camera
Metrological Sensor	Weekly	1 hour	1 technician	Filtered water, Cleaning brush
Landscape and auxiliaries (fence, roads, vegetation, cleaning of all housings)	6 months	1 day	2 unskilled worker (for vegetation: 1 shepherd, if necessary)	For vegetation: lawn mower, For housings: broom, vacuum cleaner

VRA Corporate Health and Safety procedures will be in place and enforced for operation and maintenance. A security guard shall be recruited onsite 24/7 as in most VRA power facilities. This person may as well perform small jobs on site and check error signals. Monitoring of the plant is foreseen to be executed on a weekly basis, as well as the cleaning of metrological sensors. Cleaning of modules, which can be done by auxiliary workers, and checking of cables etc., where a technician is needed, should happen twice a year.

Filtered water taken by the water well shall be used for the cleaning process (metrological station and PV modules). The mounting structure shall be maintained once on semiannual basis, e.g. some parts of the structures must be repainted. The fence, roads, housings and vegetation shall be checked and cleaned semi-annually. Landscaping shall be done by means of an unskilled worker and a lawn mower. Depending on the manufacturer's recommendation a yearly check-up of the inverter is due, which could be included in an inverter service contract from the inverter manufacturer.

Small vehicles such as a Bobcat® are to be used for performing maintenance works inside the PV arrays. Additionally, to the preventive maintenance procedures, corrective maintenance shall also be undertaken during the life time of the PV plant. In Table 3-7 below, assumptions have been made based on experiences from other PV projects in operation.

Table 3-7: Overview on corrective maintenance

Item	Interval	Required Time
Inverter	Assumption: Every 5 years after warranty period	Expected life time: ≥10 years
Transformer	Assumptions: 1 transformer fails within 20 years	Expected life time: ≥ 20 years
Switchgear	Assumptions: 1 switchgear fails within 20 years	Expected life time: ≥ 20 years
Module testing	Assumption: 0.5% of modules have to be checked due to decreased power after 15 years	Expected life time: ≥20 years

3.10.9. Sub Transmission Line

Regular inspection of transmission lines, substations, and support systems is critical for safe, efficient, and economical operation of the Project. VRA-NEDCo operation and maintenance of the sub-transmission line will be based on their existing procedures and corporate policies. NEDCo staff will operate and maintain the substation and sub-transmission line once it has been commissioned. No additional staff will be required. Operations and maintenance activities will include transmission line patrols, climbing inspections, tower and wire maintenance, insulator washing in selected areas as needed, vegetation management and access roads repairs.

VRA-NEDCo will keep necessary work areas around structures clear of vegetation and will limit the height of vegetation along the RoW. Growth of vegetation in the wayleave will be controlled to ensure safe and reliable operation of the line; vegetation above 4m in height within the wayleave will be cut down. VRA-NEDCo will be responsible for controlling future land uses within the wayleave. The poles shall be provided with an approved anti-climbing device at height of 3.0 m above ground level. Pole auditing and repairs shall be done to assess the ageing process of the poles.

3.10.10. Resource Use Consumption

Sustainable use principle aims as ensuring that the consumption of resources and their impacts do not exceed the capacity of the environment. VRA's major potential application is in recovery and

reuse. During occupation, the project will use electricity for lighting and other similar activities. Again, water will be used for various activities like washing of solar panels. VRA shall put in place adequate systems to ensure efficient and prudent water supply and management as well as energy use at the facility.

Since electricity generation involves utilization of natural resources, excessive electricity consumption will strain the resources and negatively impact on their sustainability. One of the key positive impacts of this project, as far as resource efficiency, is that it will be utilizing solar energy to produce electricity. The project is expected to be of an installed capacity of 35 MW of solar energy and will contribute to supplying electricity not only for the use of the power house and associated facilities but also to the National Grid for end users and help meet the increasing electricity demands throughout the Upper West Region - as opposed to meeting such increasing demands through conventional electricity production from thermal power plants

Water will be obtained mainly from ground water using boreholes, pumped into overhead tanks and utilised as and when required. VRA notes that good management of water use allows for a reduction in its consumption with its concomitant monetary savings. Depending on a minimum amount of water also allows the organisation to be competitive at moments of shortage with respect to other industries in the sector, in both costs and in production capacity.

Resources that require sustainable management such as water, energy and input materials are currently being monitored to access resource use performance regarding resource use efficiency within VRA's power facilities and this will be replicated on this project and reported upon to the EPA, as is being done under the existing 2.5MW Navrongo Solar Power Station. VRA is currently practicing office waste paper recycling programme and this shall apply to the power facilities.

3.11. Financing Details

The VRA, as Project Executing Agency, is expected to provide funding for the project. A loan facility from KfW Group is to be used to partly finance the Phase 1 of the project (17MW), through an on-lending Agreement between VRA and the Government of Ghana, which has since been executed. Discussions are ongoing for the financing details for remaining 18MW under the Phase 2 component.

3.12. Project Schedule

VRA is the responsible organization of the project's implementation. Preparations of project concept design, project specification and final design documentations have been completed by Lahmeyer International. Procurement of EPC Contractor is underway. All preconstruction activities will be completed before the actual construction works begin. This includes, but not limited to the acquisition of the Environmental Permit for the 5MW under Phase 1 and the 18MW under Phase 2 development.

Depending on the timing of financial closure, project construction for both phases at the various sites may run concurrently to achieve the total of the 35MW PV power plants. Constructional activities for Phase 1 are expected to commence latest by June 2019, and depending on financial closure, that of Phase 2 is targeted by March 2020. As at now, the Commercial Operation Date (COD) is yet to be fixed, however, the total period from the notice to proceed / advance payment to the commissioning phase for each PV site is estimated to be about eleven (11) months for Kaleo and seven (7) months for Lawra for Phase 1, further, the issuances of Provisional Acceptance of Certificate for the PV Plants are also expected to be completed by close of the fifteenth (15) month.

The programme for the sub-transmission line works is critical to the optimum timing for the project and it will be essential to have this infrastructure in place prior to completion and commissioning of the substation. The project schedules supplied by the Contractor shall be used by VRA to monitor the overall progress of the Work. The project schedules shall fully integrate design, procurement, manufacture, erection and commissioning activities. Key events shall be clearly identified on all project schedules and be integrated into the program logic.

3.13. Consideration of Alternatives

Various feasibility studies have been done which has helped the EA to present alternatives in comparative form, defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. This Section outlines the various alternatives that were considered both in terms of equipment and the feasibility of the project itself during the project planning stage, and the rationale for the selected option. Some of the information used to compare the alternatives is based upon the design of the alternative and some based upon the environmental, social, and economic effects of implementing each alternative. Details of the various alternatives considered are outlined below.

3.14.1. The "No Development Scenario"

Taking no action would, naturally, be a feasible option. Under the "No development scenario", there will be no need for land acquisition and development, the likelihood of people having to sell their lands as well as cessation of cropping on these lands by the project would not occur. This is because the over 49Ha of land that would otherwise be occupied by the PV Plant would continue to remain available. Further, the population that employs this land for agriculture, animal grazing and utilisation of existing trees for income-earning activities would continue to derive benefits from them. In addition, there will be no effect from the likelihood of environmental impacts such as habitat disruption.

Although there will be no need for land acquisition and development under the "No Development Scenario", it does not guarantee that the existing environmental quality will continue to be maintained. At the same time, the large society of people in the local area, e.g. Upper West Region

as well as Northern Ghana in general would not derive the associated environmental, economic, employment and political/social benefits benefit but rather they are going to lose in terms of development, good health and improved quality of life, increased pollution and deforestation in some areas. The "No Development" alternative does therefore not represent an option that meets the best interests of the development agenda of Northern Ghana and the Government of Ghana and is proposed that the project proceeds.

3.14.2. Alternative Fuel

With the decommissioning of the MRPS, the VRA now solely operates a total installed electricity generation capacity of 2,520MW, comprise of 46.8% of hydropower, 53.1% thermal and 0.1% solar. A total of 1400MW installed capacity of thermal power plants also exists in operation by Independent Power Producers. The generation capacity in Ghana by VRA and Independent Power Producers (IPP) as at September 2018 is shown in Table 3-8.

Table 3-8: Installed Generation Capacities in Ghana as At September 2018

Company	Thermal	Hydropower	Solar	Total
VRA	1,337.5 MW	1,180.0 MW	2.5 MW	2,520.0
IPP	1,400.0 MW	400.0 MW	20.0 MW	1,820.0
Total	2,737.5 MW	1,580.0 MW	22.5 MW	4,340.0
% Total	63.1%	36.4%	0.5%	100%

Source: www.vra.com

As shown in Table 3-8, thermal and hydropower generation constitutes 99.5% of the total installed capacity in Ghana. The current primary energy generation sources have experienced serious limitations due to low water levels and oil and gas supply constraints, with concomitant shortfall in power supply. Up to date, all these power generating stations in Ghana are in the South, comprising large hydropower plants on the Volta Lake as well as the thermal power stations which are mainly located in the city of Tema and Aboadze. Hence, electricity for consumers in Northern Ghana is only transported via long-distance transmission lines through the National Interconnected Transmission System. With no major power station operating in Northern Ghana, in case of grid failures or power plant shut downs, no electricity is available in Northern Ghana.

There is limitation to the development of hydropower project. Feasibility studies for a 48MW Pwalugu Multipurpose hydro Dam project in the Northern Region of Ghana is progressing steadily. Preliminary feasibility, including ESIA indicates very high cost, lower rate of returns and significant environmental and social impacts. VRA and the funding agency have decided to undertake additional studies aimed at mitigating the adverse impact as well as reducing the overall cost of the project. The two entities are in the process of finalizing the agreements for the additional study.

It is imperative to look for alternatives to fossil fuel-based power generation to achieve long term power solution of the country, especially in the Northern Ghana. The only viable generating options for energy production to meet the supply-demand gap in Northern Ghana is solar energy. This is because the choice of solar power facility is envisaged to contribute significantly to addressing potential power demand and supply growth in-balance and deficit in the near future, as it will play a significant role in the stabilization of power situation in Northern Ghana in specific and the country in general during the operational phase. This is because installation of solar power facilities in Ghana will provide broader electricity supply market space as well as optimize the power generation portfolio and improving generation mix and power supply stability and reliability in Ghana. The choice for implementation of the solar PV plants in the Upper East and Upper West Regions will stabilize the local grid and therefore improve electricity supply in Northern Ghana.

3.14.3. Site Selection

The selection of the solar project sites is based on the total amount of annual solar energy radiation. Factors considered in the total solar radiation reaching the inclined plane of a PV module includes direct solar radiation, sky scattering radiation, and ground reflection radiation. In accordance with the total radiation data from NASA, the solar radiation amount reaching the inclined plane of the equator is calculated using what is known as the Klein method. High resolution irradiation data was used to simulate the annual energy output. *Figure 3-11* shows the solar energy resource assessment in Ghana. The data shows that the solar resource in abundant in Northern Ghana, particularly in the Upper East and Upper West Regions. The 2.5MW Navrongo PV and the 40MW Bongo PV Plants are being developed in the Upper East Region, subsequently focus for site selection for this project is in the Upper West Region.

The sites have been selected according to the best resource characteristics, i.e. the sites with the best solar irradiation features. The estimated 25-years annual average production is 11,324 MWh/a for Kaleo and 5,834 MWh/a for Lawra, a promising number for solar power production with PV. Monthly Radiation and temperature profile for the PV plant based on Solar GUS Information is shown in Figure *3-12* and Figure 3-13. In addition to the evaluation of radiation conditions, land availability, infrastructure and network access as well as preliminary network load center appraisal were also major factors in site specific considerations.

Solar Energy Resource Assessment

- Monthly average solar irradiation is between 4.4 and 5.6 kWh/m²/day.
- sunshine duration of between 1800 and 3000 hours per annum.

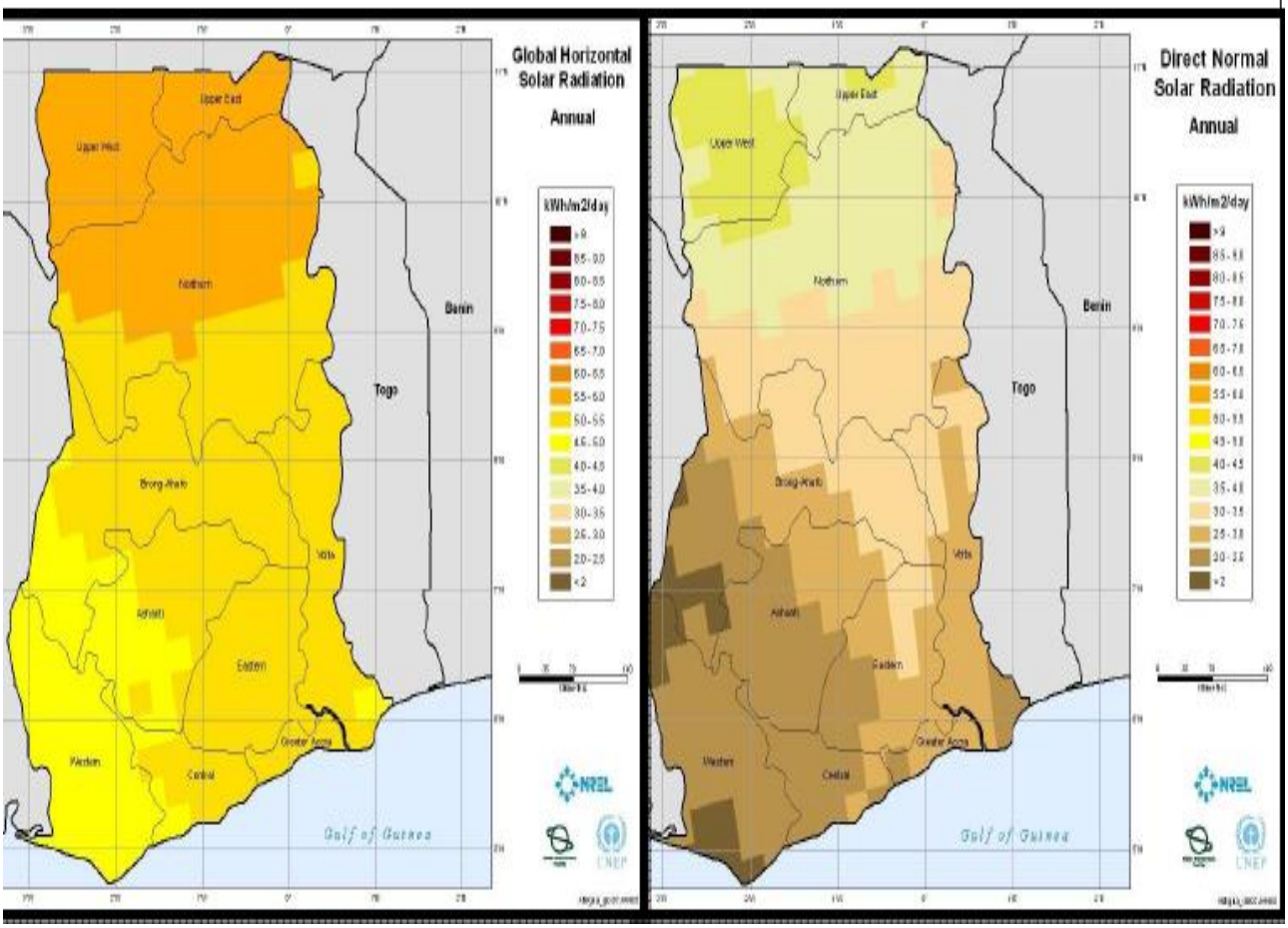


Figure 3-11: Solar Resource Assessment in Ghana

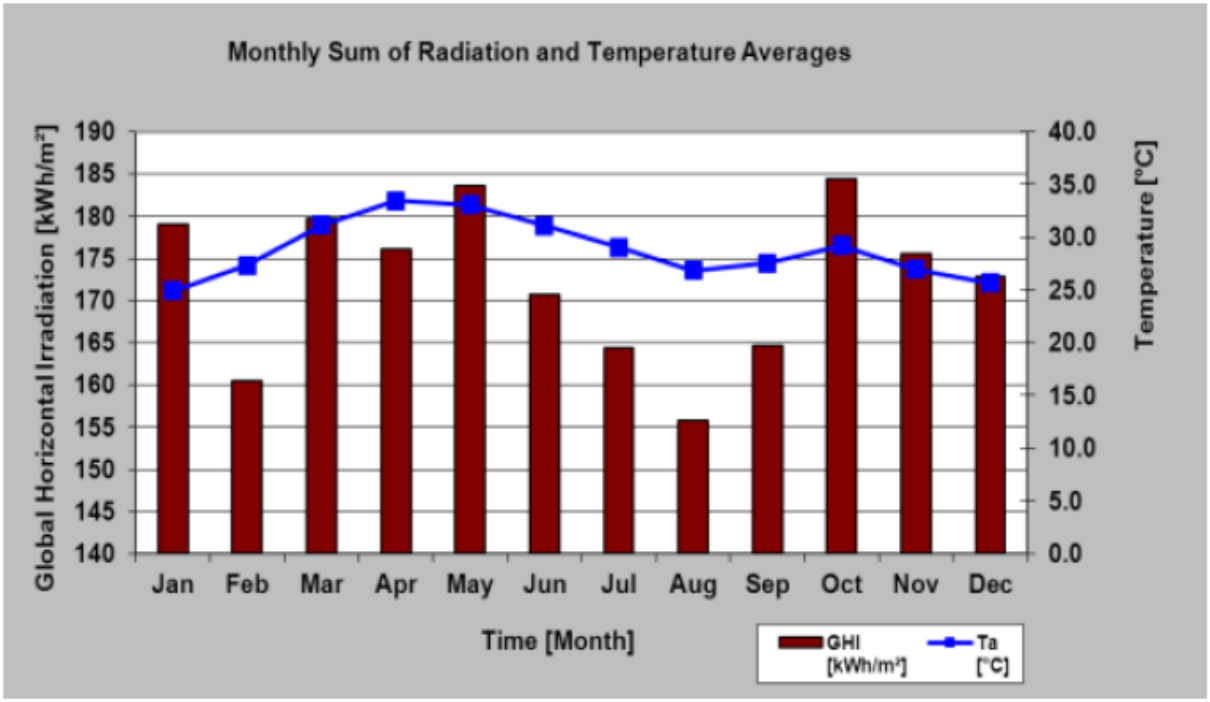


Figure 3-12: Radiation & Temperature Profile at Lawra PV Plant Site

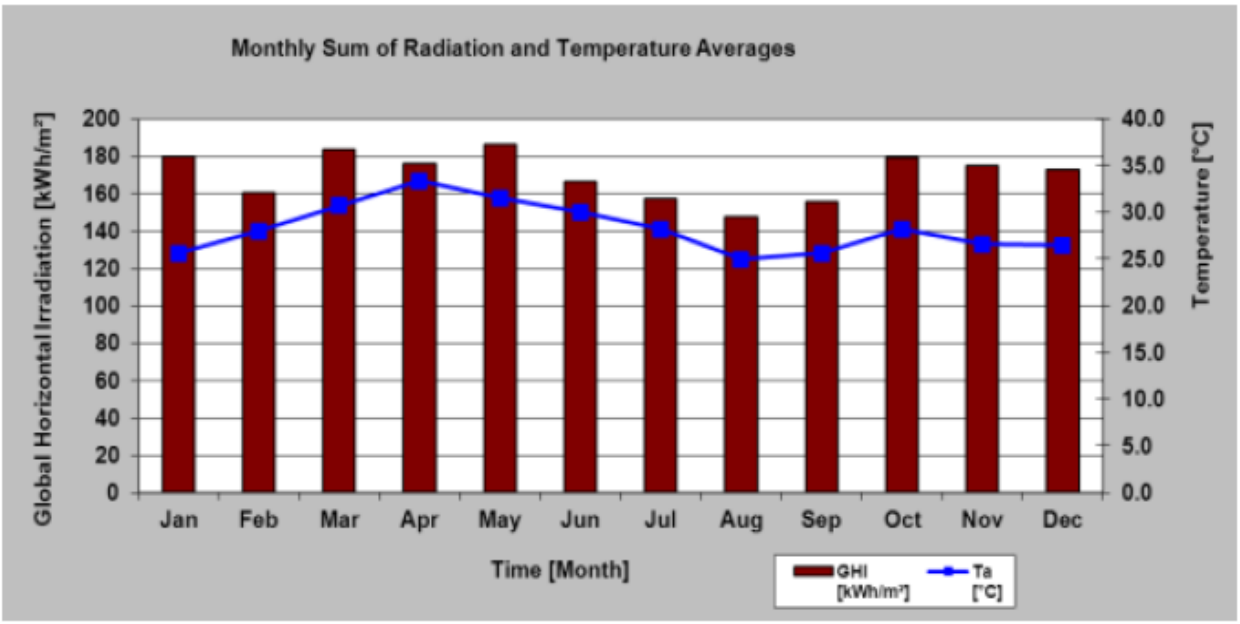


Figure 3-13: Radiation & Temperature Profile at Kaleo PV Plant Site

3.14.4. PV Module Technology Options

Concerning PV power plants, the main component groups can be summarized as follows: modules, inverters, and mounting systems. The final plant configuration is an optimized combination of the respective technologies within each component selection based on cost, performance and local site conditions. For the modules, photovoltaic cells use the photoelectric effect to generate electricity on exposure to sun-light. PV modules can be divided into different types depending upon the materials used in the modules for the photovoltaic effect.

Generally, different concepts for generating energy by means of PV technology are available on the market that use both direct and diffuse component of solar irradiation as described below and shown in *Figure 3-14*:

- Mono- and Poly-Crystalline Silicon based PV modules;
- Thin Film based PV modules;
- Concentrating PV modules (CPV) using mainly the direct component of solar irradiation (DNI) to generate electricity.

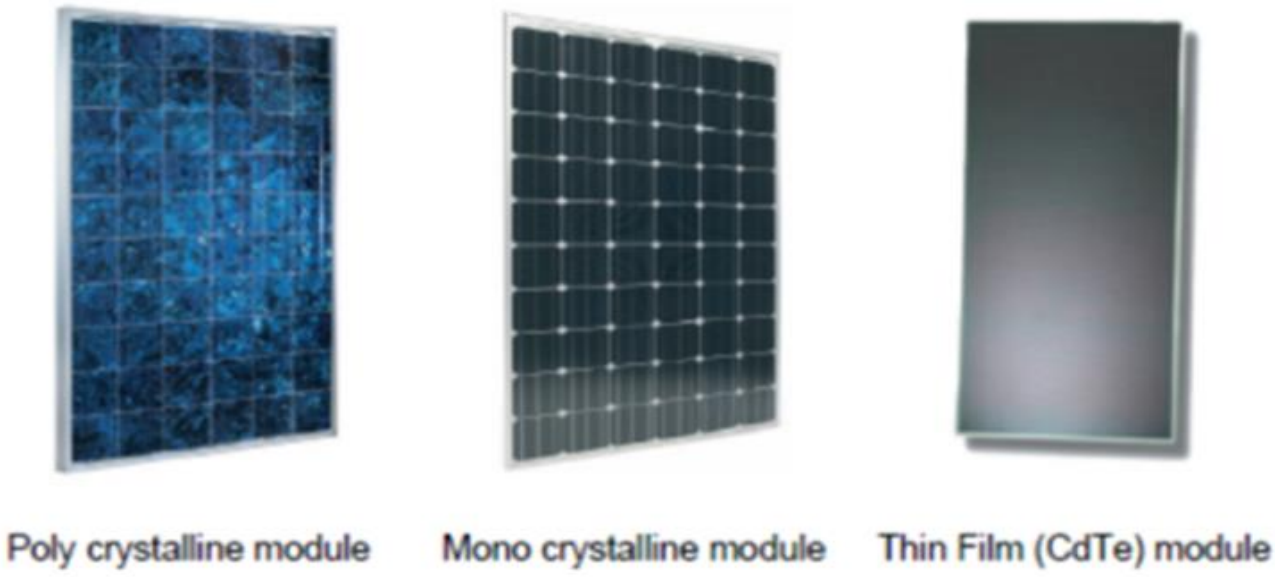


Figure 3-14: Most common commercially available module types

CPV will not be considered for further evaluation, because it uses the DNI which is not viable in Northern Ghana. A CPV production profile would not fit to the MV grid in UWR. Additionally, the track-record of this technology does not fit to the time schedule of the VRA REDP project pipeline.

Mono crystalline silicon: To date PV modules based on mono crystalline silicon cells are the most efficient modules used to generate electrical energy commercially from solar energy. The

PV cells are made from a single crystal silicon wafer that is sliced from single crystal ingots. The ingots are grown by slowly pulling a seed crystal from molten silicon (Czochralski Growth Method). Experimental cells have reached nearly 28% efficiency; Commercial modules of single crystal cells exceed 19% efficiency.

Poly crystalline silicon: Poly crystalline PV cells are based on silicon wafers being cut from an ingot of melted and re-crystallized silicon. Sliced from blocks of cast silicon, these wafers/cells are less expensive to manufacture, but less efficient than single/mono crystal silicon cells. Experimental cells approach 24% efficiency, and commercial modules approach 16% efficiency.

Thin film: Various materials are used to make thin film PV cells, such as amorphous silicon, Cadmium Telluride and Copper Indium/Gallium Diselluride (CIS/CIGS). These are cheaper technologies with lower efficiencies compared to crystalline silicon PV cells.

Although typically mono crystalline modules are more expensive (up to 15%) and more efficient (up to 20%) than poly-silicon PV modules, these margins blur depending on the type of module and quality of production with major variations between manufactures. Both use a large amount of silicon as the semiconductor material, and are more expensive than thin film PV modules, which use only very little or no silicon. However, thin film generally achieves lower efficiencies, though some recently introduced thin-film technologies can reach efficiencies comparable with mono silicon technology.

Aside from the cost advantage, thin film technology has two further benefits to be considered: the more effective use of diffuse light, as well as more favourable temperature related performance compared to crystalline modules. Under full load conditions, with mostly direct irradiation and moderate temperatures, crystalline modules have the better load behaviour. The main characteristics of modules are their voltage and current responses at different irradiation level. Generally, these characteristics are defined and compared under laboratory conditions referred to as Standard Test Condition (STC).

In order to illustrate the performance of different PV technologies (crystalline, thin film) under the climatic conditions at the project sites, a wide selection of diverse modules was taken and used for a test case simulation. Result of equally configured sample plants mounted on fixed tilted structures are compared in order to present the differences and ultimately to suggest the most appropriate concept for the considered climatic and geographical situation in Ghana. The comparisons are made based on energy production, land area requirement and investment cost.

The energy calculations for mentioned technologies and configuration are calculated through modeling in PVsyst. PVsyst is one of the most common and powerful software tools for the simulation of grid connected and stand-alone PV systems. As a benchmark for each configuration,

an electrical installed capacity of approximately 425 kWp (DC) was set as means to facilitate comparison of the plants on a common basis. The following tables present the input data considered for the calculation of energy yield estimation, Performance Ratio and needed Area Module (hectares), for the quantitative comparison purpose.

The energy production for different PV modules is compared on the basis of annual energy yield (MWh/year) as shown in figure 3-13. This represents the amount of electrical energy generation per approximately 0.425 MWp of DC installed power. As a general rule, all thin film technologies (a-Si and uCSi-a-Si:H, CdTe) can produce more energy yield than crystalline during high temperature conditions. More specifically, in spite of lower conversion efficiency of CdTe module in comparison to crystalline and other thin film modules, a PV system with CdTe module produces around 715.57 MWh, which is +1.1% and +4.55% more than a system with HIT (Heterojunction with Intrinsic Thin Layer) and poly crystalline modules, respectively. This increase can be explained by the lower temperature related power coefficient of CdTe modules (-0.25%/0C for First Solar), and consequently, lower temperature related loss compared to crystalline modules.

In case of Ghana, the temperature range is between 15^0C up to 45^0C, hence the modules with lower temperature power coefficient have advantage in terms of energy production. The same conclusions can be derived for the PR results. PR is strongly depended on ambient temperature. The higher ambient temperature corresponds to lower annual PR. This is mainly why thin film PV modules reach higher PR values. On the contrary, the amount of land area required per amount of installed capacity primarily depends on the efficiency of the PV components, mainly on PV modules. The higher the efficiency of module the lower will be the land area requirement for defined amount of installed capacity, and that means less expenses for labour and mounting systems.

Plant configuration with Sanyo HIT and Sunpower modules require lower land area compared to other plant configuration. This is only due to the higher efficiency of these modules compared to the other modules under consideration. However, their high price (Euro/Watt) comparing with other technologies is a disadvantage comparing with thin films and crystalline modules. Finally, it can also be said that the other mono-crystalline and poly-crystalline brands selected for the comparison obviously need lower area than all the thin film modules. Finally, it should be remembered that the crystalline technologies are quite mature and have many references even in areas with high temperature, which provides a big advantage in terms of reliability.

Finally, it should be mentioned that in addition to module energy conversion efficiency, the following main points should be considered as selection criteria for PV module:

- Efficiency at STC and part load condition;

- Power temperature coefficient;
- Nominal Operating Temperature;
- Name plate power tolerance;
- Cost;
- Market situation in terms of supply and bankability of manufacturing companies;
- Certification; and
- Warranty conditions.

Although thin Film technology presents some significant advantages such as low temperature coefficient that leads to higher energy yield, poly-crystalline (c-Si) technology is recommended in this case. c-Si is a reliable technology with good track-record and international competition on the market. Furthermore, it currently experiences a price reduction and very low environmental risk is possible.

3.14.5. Selection of Optimal Transmission Line Route

There is a close relationship between route location, design process and the environmental assessment. Physical constraints, such as rivers, mountains, etc. impact on the selection of the line route. The potential line route is selected through an analysis of alternatives considering constraints on the social and natural environment. The constraints experienced were mostly the presence of built-up areas and the Lawra Forest reserve, described as an environmentally sensitive site. Details of the selected line routes for the PV Plants have been detailed under Section 3.6.3.

Kaleo is quite close to the substation in Wa, which is one of the major load points. The site is close to the existing 34.5kV Sawla-Wa-Nandom-Hamile sub-transmission Line and runs in front of the solar site along the west side of the PV plant and quite close to the technical area. An earlier grid study showed that there is technically no need for the construction of an interconnection line to the feed-in point and therefore, there will be no need for the construction of a transmission line. However, to reduce line losses and increase plant availability, it is now decided to construct a dedicated interconnection line to the Wa GRIDCo Substation. The recommended topology now for grid connection is through the implementation of a direct single overhead line system outgoing from Kaleo PV substation to the 34.5 kV busbar of the Wa GRIDCo Substation. The connection point is stated to be approximately at 11.5 km (line air). The new line connection shall be parallel routed to the existing MV transmission line which is located at the western side of the PV plant and quite close to the PV plant area.

Figure 3-15 provides a diagrammatic impression of the two (2) line routes considered under the Lawra Line route. The adopted line route is indicated as a red line. As shown, the most obvious route, shown as the blue line, will have been a straight route of about 3.94 km from the Lawra Solar Power Project (A1) to tie into a transformer near the Lawra Secondary School at P10. However, due to socio-economic impact because of the presence of the Lawra community,

farmlands, the Lawra Forest Reserve and football field within the course of this line route which would have also added additional cost during the construction, there was the need to divert the line and to utilise the right of way of the existing Lawra-Hamile N12 Highway. Thus, the proposed line route which is a total of 4.22km, commences from the Solar Power Site at A1 through P1 to P3 using the right of way of the western side of Lawra-Hamile N12 Highway.

The proposed line crosses the road to the eastern side at P4 to P4A, with about 0.5Km passing through part of the Lawra Forest Reserve but near the existing road. It again crosses the existing road at the Health Assistance Training School and Lawra English and Arabic School using the right of way corridor of the road to P5 and P6. Even though it passes through the Lawra Forest Reserve, the transmission line route will still be within the right of way of the road corridor. Furthermore, the Line Route had to be diverted to the eastern side, where the Forest reserve is because the western side of the road is encroached on by the presence of existing structures (Buildings). At P6, the Line Route passes through the western side of the existing tarred road through the township and crosses to the western side at P7 and P8 to P10 using the right of way corridor of the road, avoiding the Lawra Secondary School, to tie into the transformer

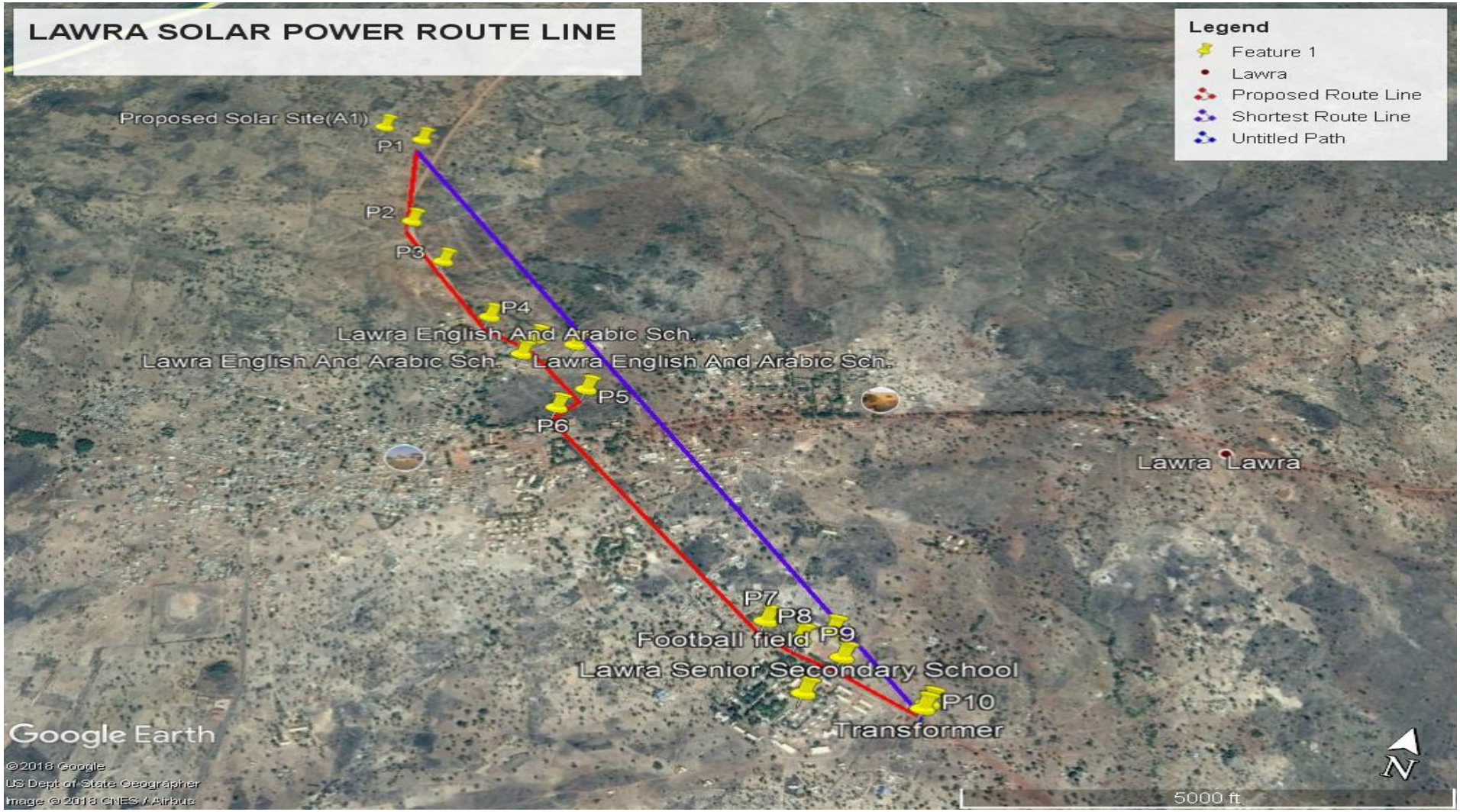
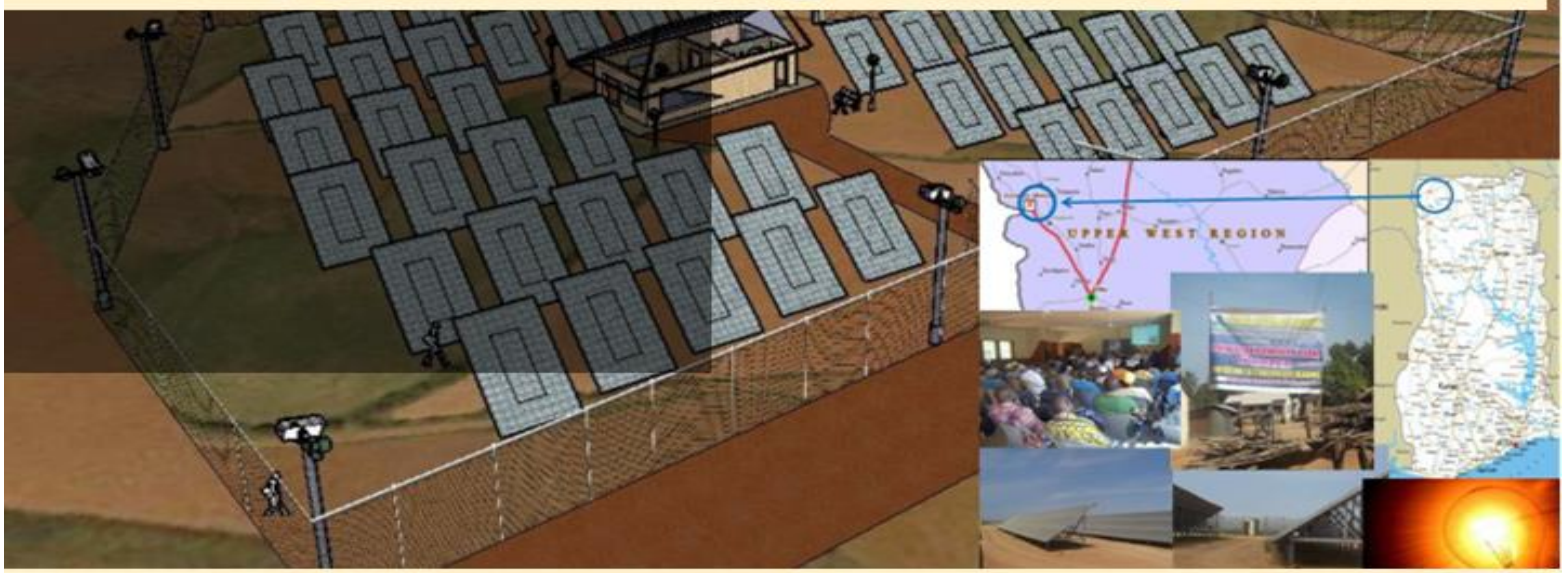


Figure 3-15: Alternatives for Sub-transmission line Routes for Lawra PV Plant and neighbouring Features

Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



CHAPTER 4:

DESCRIPTION OF THE EXISTING ENVIRONMENT

4 DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1. Introduction

An environmental assessment requires that a baseline survey should be undertaken to establish the existing ecological and socio-economic situation in the project area. This will inform the impact receptors and informs the level of mitigation to be put in place during project implementation. In this regard, study on the existing biophysical and social environment commenced in June 2011 and has been ongoing since. The general methods and approach of the ESIA is described under Section 1.5.

This Section outlines a detailed report covering all aspects of the existing physical environment, biological environment, ecological sensitive areas as well as socio-economic conditions. It must however be noted that even though the project is specific to the Kaleo and Lawra communities, described as the immediate impact area (assessed within 2km from the specific project sites), its environmental and social influence may affect a large area of the other parts of the affected districts in question. Thus, aside providing specific data on the project site, it also includes information such as climate, social-economic development that transcends the specific communities and is general to the affected districts, the broader impact area.

4.2. General Site Information

The Solar Power Projects in the Upper West Region are to be located within Kaleo and Lawra communities, located within the Nadowli-Kaleo District and Lawra Municipal Assemblies respectively, and are all in the Upper West Region of Ghana. The respective locations of the districts vis-à-vis the Region in the context of Ghana are shown Figure 1-1. It must be noted that after the December 28, 2018 referendum Ghana has now created six (6) new regions bringing the total to currently **sixteen regions**, which is further divided for administrative purposes into 216 local districts.

4.2.1. Ghana in Brief

The Republic of Ghana is located along the Gulf of Guinea and Atlantic Ocean, in the sub region of West Africa. Spanning a land mass of 238,535 km2, Ghana is bordered by the Ivory Coast in the West, Burkina Faso in the North, Togo in the East and the Gulf of Guinea and Atlantic Ocean in the South. Ghana's population of approximately 29 million and there are diverse geography and ecology ranges from coastal savannahs to tropical rain forests. Ghana is a unitary constitutional democracy led by a president who is both head of state and head of the government. Ghana's growing economic prosperity and democratic political system have made it a regional power in West Africa. It is a member of the Non-Aligned Movement, the African Union, the Economic Community of West African States (ECOWAS), Group of 24 (G24) and the Commonwealth of Nations.

Ghana is classified as a middle-income country. GDP estimates for 2017 showed a growth rate of 8.5% compared to 3.7% in 2016[11]. The Industry sector recorded the highest growth rate of 16.7%, followed by Agriculture (8.4%) and the Services (4.3%) sectors. Ghana is an average natural resource enriched country possessing industrial minerals, hydrocarbons and precious metals. The top exports of Ghana in 2017 were pearls, precious stones and metals (41%); mineral fuels, oils, distillation products (25%); cocoa and cocoa preparations (17%). For the remaining 17%, Ghana has exported mainly fruit, plastic, vegetables, wood, fish and aluminium. Its main exports partners are Netherlands, Burkina Faso, South Africa and United Kingdom[12].

Electricity generation is one of the key factors in order to achieve the development of the Ghanaian national economy, with aggressive and rapid industrialisation.

4.2.2. Kaleo Solar Power Plant

A brief on site information has been provided under Chapter 3. The sites are all degraded and characterized by annual bush fires, continuous farming, and animal grazing etc (See Plate 4-1 to Plate 4-6). Located within the project vicinity across the main road of Kaleo Site 1 are the Kaleo DA Nursery and Primary schools, and the Church of Pentecost. One key historical resource in Kaleo is the burial ground of the Late Hon. Jatoe Kaleo, who died on June 6, 1998. This site is about 500 m to the Kaleo Site 1. The Late Hon. Jatoe Kaleo was one of the leading Ghanaian politicians who led Ghana into independence. The Kaleo Police Station and the Ahmadiya Mission Hospital are both located close to the western side of the Kaleo Site 2. There are 2 Fulani nomadic settlements, one just outside the Kaleo Site 2 and the other located within the site, made up of 2 hamlets. Discussions with the landowners indicate that these are illegal settlers and will be required to relocate prior to project construction.

The neighbouring features around the immediate impact of the project area and their coordinates are shown in Table 4-1 and a satellite view shown in ***Figure 4-1***.

Table 4-1: Neighbouring Infrastructure Within the Immediate Impact Area of the Kaleo PV Site

Feature	Latitude	Longitude
Kaleo Police Station	10° 9'56.28"N	2°32'24.91"W
Ahmadiyah Mission Hospital	10°10'10.81"N	2°32'30.27"W
Kaleo R/C Primary	10°10'19.27"N	2°32'32.54"W
Kaleo DA Nursery	10°10'27.62"N	2°32'20.89"W
Kaleo DA Primary School	10°10'35.84"N	2°32'5.12"W
Burial Site of Late Hon. Jatoe Kaleo	10°10'27.10"N	2°32'21.66"W
Church of Pentecost	10°10'34.12"N	2°32'15.65"W
Fulani Settlement 1	10° 9'54.26"N	2°32'10.14"W
Fulani Settlement 2	10° 9'58.61"N	2°32'18.41"W

[11] Source: https://data.worldbank.org and http://www.statsghana.gov.gh/
[12] Source: https://tradingeconomics.com/ghana/exports

Feature	Latitude	Longitude
Emmanuel Worldwide Synagogue	10°10'46.92"N	2°32'8.53"W
Kaleo Community Dam	10°10'53.74"N	2°32'32.19"W

4.2.3. Lawra Solar Power Plant

A brief on site information has been provided under Chapter 3. Again, this Lawra site is also degraded and characterized by annual bush fires, continuous farming, and animal grazing etc (See Plate *4-7*, Plate 4-8 and Plate *4-9*). There are no settlements on this site, and the land is largely fallow with Acacia and Sheanut being the most dominant trees. The site is located parallel to the N12 Lawra -Hamile road, which was untarred when the baseline studies started in 2011 but asphalted as at close of 2018. There is an untarred road located on the southern end of the site that leads to the Black Volta, which will serve as access route prior during construction. The waters of the Black Volta serve as the demarcation between Ghana and Burkina Faso. The water body also serves as a recreational facility during public holidays for the youth of Lawra. Just by the side of this road, but outside the project area, is a tree shrine, comprising of Ebony / Nim Tree, known as the Kulbonuo Shrine belonging to the Bayoyire Community in Kaleo. The site was acquired in such a way to avoid the shrine, however, its nearness to the project site is a recipe for future conflict with the shrine owners and will be advisable to relocate them as part of project implementation.

The neighbouring features around the immediate impact area of the project site and their coordinates are shown in Table 4-2 and a satellite view shown in Figure *4-2*. The sensitive infrastructure located close to the Lawra PV sites and their coordinates are shown in Table 4-2 and satellite view shown in Figure 4-2. See Plate *4-7*, Plate *4-9* and Plate *4-7* for pictures of the Lawra Site.

Table 4-2: Neighbouring Infrastructure Within the Immediate Impact Area of the Lawra PV Site

Name	Latitude	Longitude
Black Volta	10°40'9.79"N	2°54'41.68"W
Forestry Commission Lawra Office	10°39'13.27"N	2°53'22.55"W
Forest Reserve	10°39'16.02"N	2°53'27.82"W

Plate 4-1: Typical view for Kaleo Site 1

Plate 4-2:*Site panorama in the centre of the terrain facing south for Kaleo Site 1 & Site 2*

Plate 4-3: 360°- Panorama at the district road looking south along the MV line for Kaleo PV Site

Plate 4-4: Pictures of Pentecost Church and Kaleo Primary near the Kaleo PV Site

Plate 4-5: Pictures of neighbouring features of near the Kaleo PV Site

Plate 4-6: Pictures of Fulnani Hamlets and Police Station near the Kaleo PV Site

Plate 4-7: Site for the Lawra PV Plant During Dry Season

Plate 4-8: Status of Lawra – Hamile N12 Highway Road, near the Lawra PV Site, in 2011 and 2018

Plate 4-9: Site for the Lawra PV Plant During Wet Season

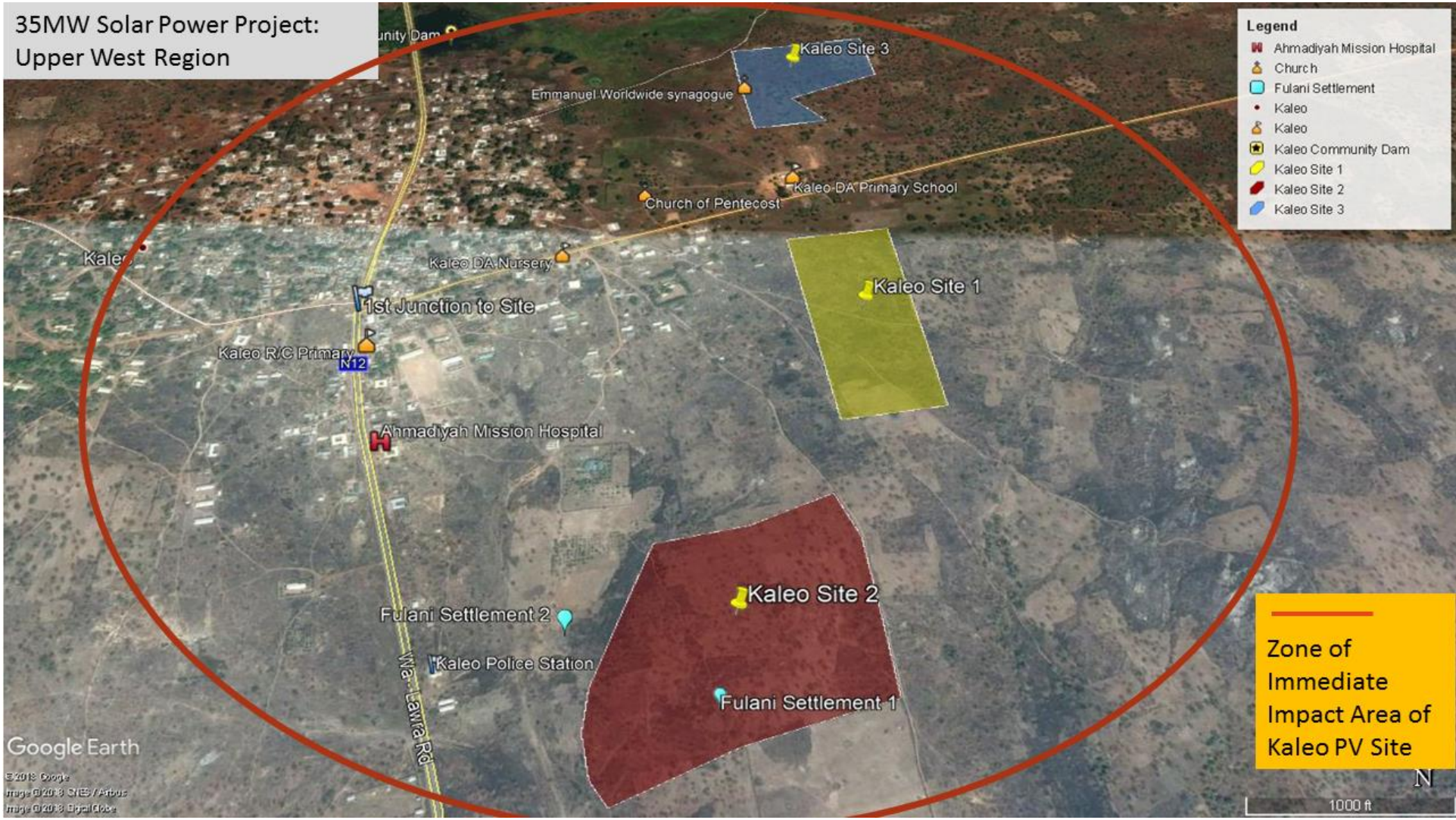


Figure 4-1: Location Map showing relation between Kaleo PV Plants and neighbouring features

Figure 4-2: Location Map showing relation between Lawra PV Plant and neighbouring Features

4.2.4. Transport & Access Roads

The project sites are both located in the Upper West Region, and therefore the major route to the site will be the Wa – Lawra section of the N12 Highway. The N12 Highway is part of the trunk roads between major urban centers and forms part of the backbone of the road system in Ghana. The major communities along the route are Kaleo, Sambo, Sariperi, Nadowli, Yiziiri, Nadawii, Yagha and finally Kwonyonkwon. The main Wa to Lawra road, about 80 km is now largely asphalted and can be classified as a first-class road, with the exception of some parts from Jirapa to Lawra. It is expected that the solar power materials will be brought by sea to the Tema Port. From there, it will be offloaded and brought to Accra on the N1 Highway in the southern sector, where it will be transported up north to site through to Kumasi on the N6 Highway, Techiman on the N10 Highway, and then on to the N12 Highway through Wa (See Figure 4-3), the regional capital, and finally to Lawra, covering a total distance of about 860 km.

Access to public services and traffic by the local people can be affected. Access roads to the various specific sites are all not tarred, raising issues of dust generation and impact on air quality through vehicular activities. With regards to site access, the site for the Kaleo PV development is located off the Wa - Lawra section of the N12 Highway, about 0.85 km to the east of the Kaleo – Zaa Road, which is untarred and a feeder road. The Kaleo – Zaa road runs approximately 125 m parallel to the Northern site boundary of Kaleo Site 1 (See Figure 4-5). From that road, the site access could be built adjutant or even within the line route corridor of 10 m (at each side of the MV lines) where NEDCo owns the right of way. This would eliminate the need for additional road construction and further easement rights significantly.

The Lawra PV site is located 3.96 km Northwest of Lawra village on the Lawra-Hamile section of the N12 Highway, which is now tarred and asphalted and the impact of generating dust during project implementation as was discussed in the earlier EIA Reports is now minimal. As indicated earlier, there is an untarred access route towards the Black Volta south of the site (See Figure 4-4), which would be utilised only during project construction. There will therefore be no need for a new access road construction for the site. This route also provides access to the local resort called “Meet Me There”, and this could be impact upon communities’ lifestyle. This became an issue during the pre-construction stakeholder engagement in 2017 where it was indicated that the route to the local resort is outside the project area, however, alternative access should be provided if required.

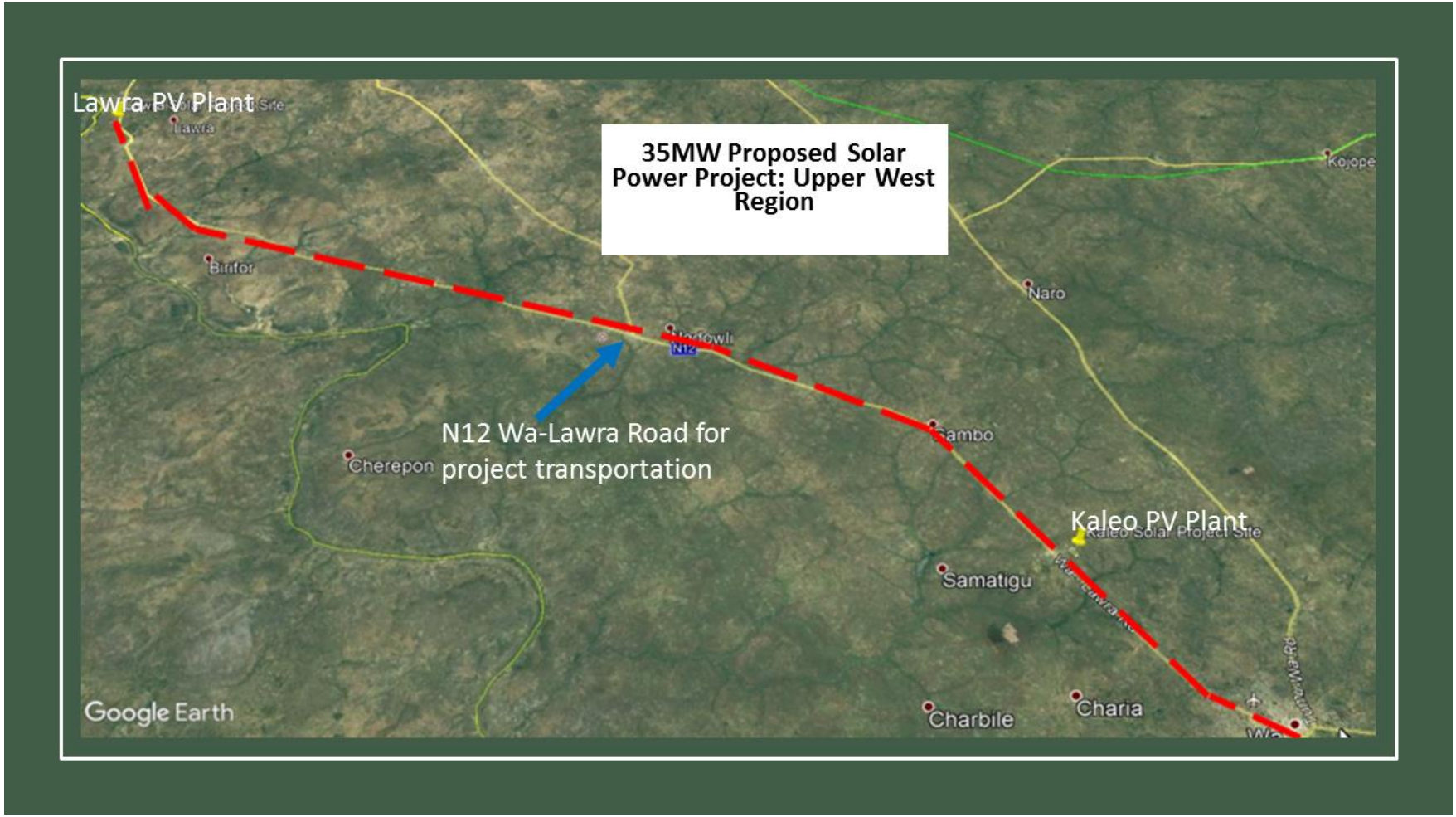


Figure 4-3: Google Map of Project Transport Route from Wa

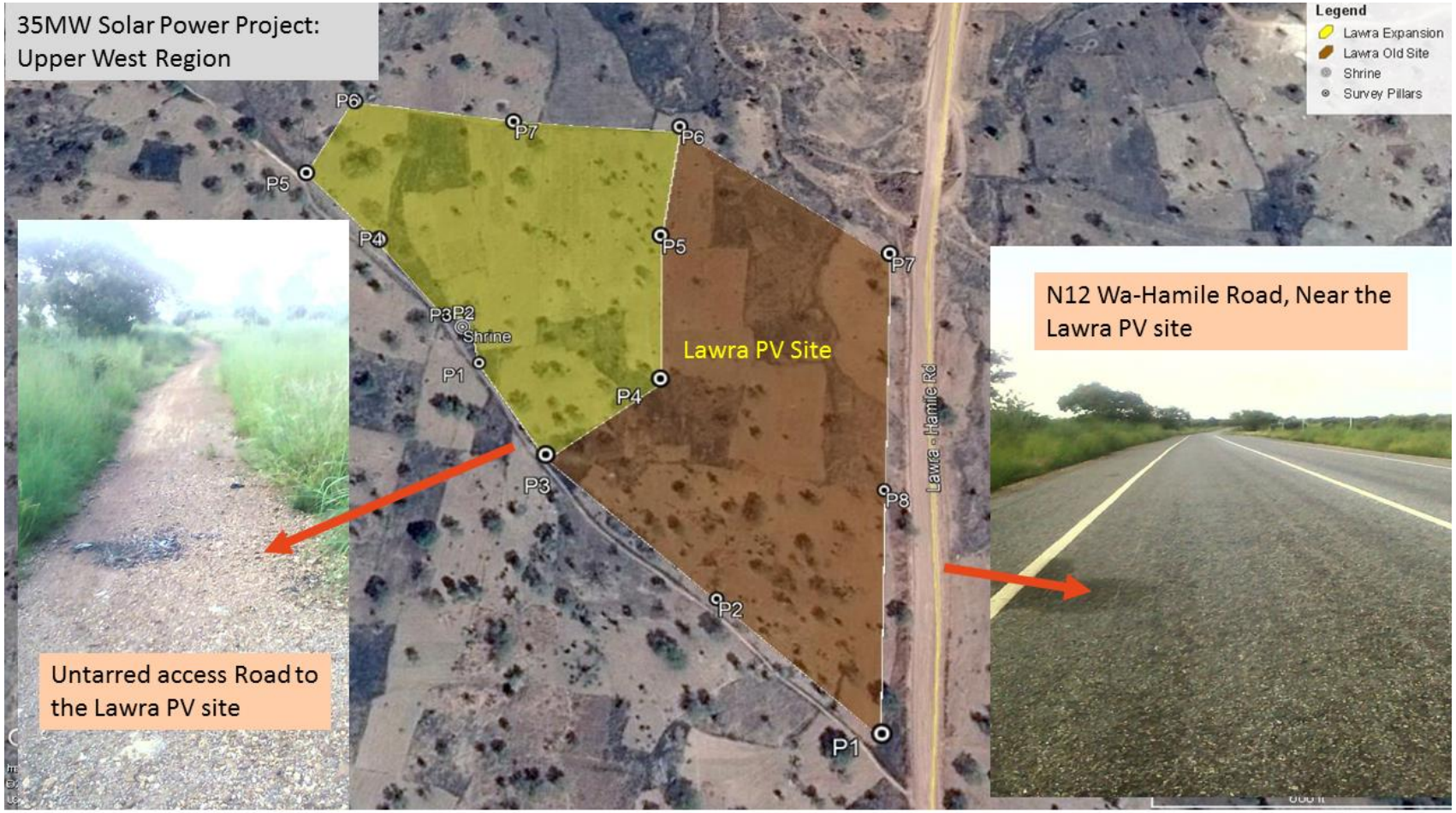


Figure 4-4: Access Route to Lawra PV Site

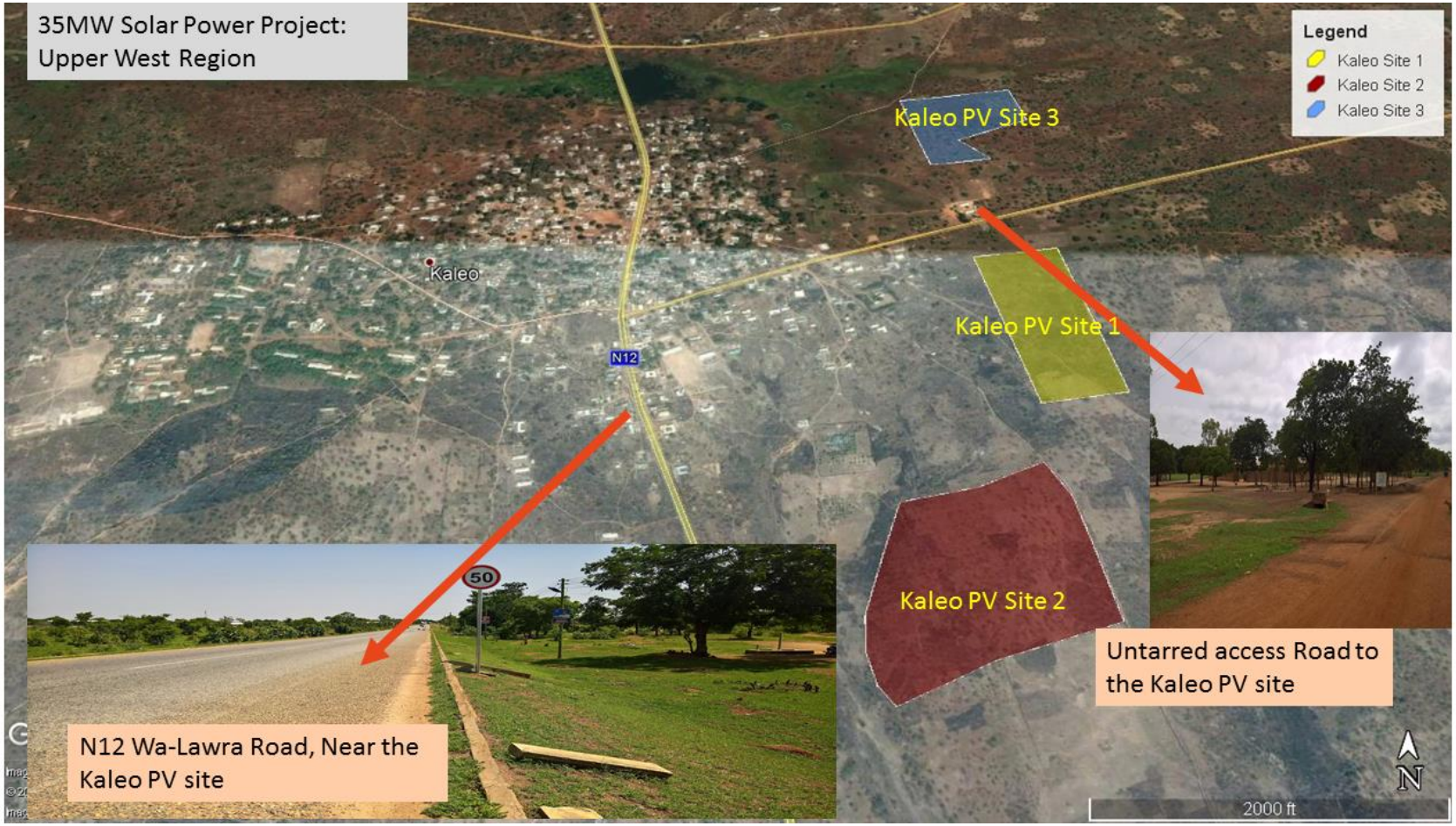


Figure 4-5: Access Route to Kaleo PV Site

4.3. Physical Environment

4.3.1. Greenhouse Gases

According to the Second Biennial Update Report submitted to the UNFCC in September 2018, Greenhouse gas (GHG) and Short-lived Climate Pollutant (SLCP) inventory was conducted for the period 1990-2016 using the latest 2006 IPCC guidelines. The total national greenhouse gas emissions are estimated at 31.5 million tonnes carbon dioxide equivalent (MtCO2e) in 2016 representing 65% increase compared to 2000 emissions. The increasing trends in the overall emissions is attributed to the rising population and the economic diversification measures. The Energy sector contributes 50.2% of the total 2016 GHG emissions. Within the Energy sector, road transport and electricity generation are the two dominant sources of GHG emissions. GHG emissions from Agriculture, Forestry and Other Land Uses (AFOLU) is the second dominant source (36.4%) of the total GHG emissions in the same year. Emissions from the Waste and Industrial Process and Product Use (IPPU) sectors contributed respectively to 10.1% and 3.3% of the total emissions. Some of the selected top levels and trends key categories of the emissions and removals are: (a) forest land remaining forest land, (b) lands converted to cropland, (c) lands converted to grassland, (d) road transportation, (e) energy industries etc.

In terms of gas species, Carbon Dioxide (CO_2) is the most dominant greenhouse gas totalling 16.22 Mt in 2016, of which road transportation and electricity generation account for 42.7% and 31.1% respectively. Methane (CH_4) emissions levels of 0.32 Mt is the second dominant greenhouse gas and the highest short-lived climate pollutant. Majority of the CH_4 emissions come from livestock (48.3%), wastewater treatment and discharge (19%) and solid waste disposal (16.9%). Emissions levels of the rest of the greenhouse gases are as follows: Nitrous oxides (N_2O), (0.025 Mt), Perfluorocarbon (PFCs) (0.613 $MtCO_2e$) and Hydrofluorocarbon (HFCs) (0.033 $MtCO_2e$).

4.3.2. Atmospheric & Climatic Conditions

The climate in the project affected districts of Nadowli-Kaleo and Lawra, all in the Upper West Region are similar and is classified by Gmet Classification as having a Tropical Savannah Climate (Aw). There are two seasons, the dry and the wet seasons. The wet season commences from early April and ends in October. Between October and March there is virtually no rain and this long dry season is made harsh by the dry north-easterly Harmattan winds. The dry season, characterized by the cold and hazy harmattan weather, starts from early November and ends in the latter part of March when the hot weather begins, with intensity and ends only with the onset of the early rainfall in April. The temperature of the region is between a low of 15^0C at night time during the harmattan season and a high of 40^0C in the day during the hot season. This unfavourable climatic condition promotes only rain fed agriculture and has been the major underlying reasons for the chronic food insecurity that is a major problem facing the District. This climatic condition calls for the construction of dams and dug puts to support irrigation agriculture to reduce migration of the youth to the southern parts of the country in search of employment.

In order to properly represent the climate spanning the project sites, climatic data was obtained from the Wa Weather Station: 654040 (DGLW) [13], located on Latitude: 10.05, Longitude: -2.5 and Altitude: 323. Data for humidity, temperature and rainfall within the project area from 2010 to August 2018 is presented in *Table 4-3* to *Table 4-5* and also presented diagrammatically in Figure *4-6* and Figure *4-9*.

Table 4-3: Data on Mean Humidity in Project Area (%)

Month	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
January	19.5	24.1	28	25	36.7	25.9	21.1	20.6	20.2
February	29.2	39	28	30	23	31.3	20.1	19.5	32.6
March	32.5	43	32	53.3	38.7	29.9	36.8	42.1	51.4
April	55.6	53.1	55.6	64.7	59.3	45.7	51.2	52.5	57.3
May	67.3	66.8	65.1	64.4	67.8	54.3	68.2	64.7	69.9
June	68.9	71	75.6	65.3	74.8	70	70.1	73.5	74.5
July	72.3	79.2	78.4	76.7	74	77.3	76.5	74.8	79.9
August	77.3	81.9	79	79.5	76.5	82.1	79.1	79	80.1
September	78.8	78.8	82.7	78.7	79.3	81.3	79.6	77.4	
October	72.7	68.8	76.3	70.3	69.4	No Data	65	60.1	
November	53	49.9	57.5	54.6	60.6	29	46.3	36.9	
December	31.8	32.6	32.6	28.5	33.8	26.4	27.2	25.5	

Figure 4-6: Data on Mean Humidity in Project Area

[13] http://www.tutiempo.net/en/Climate/Wa/08-2010/654040.htm

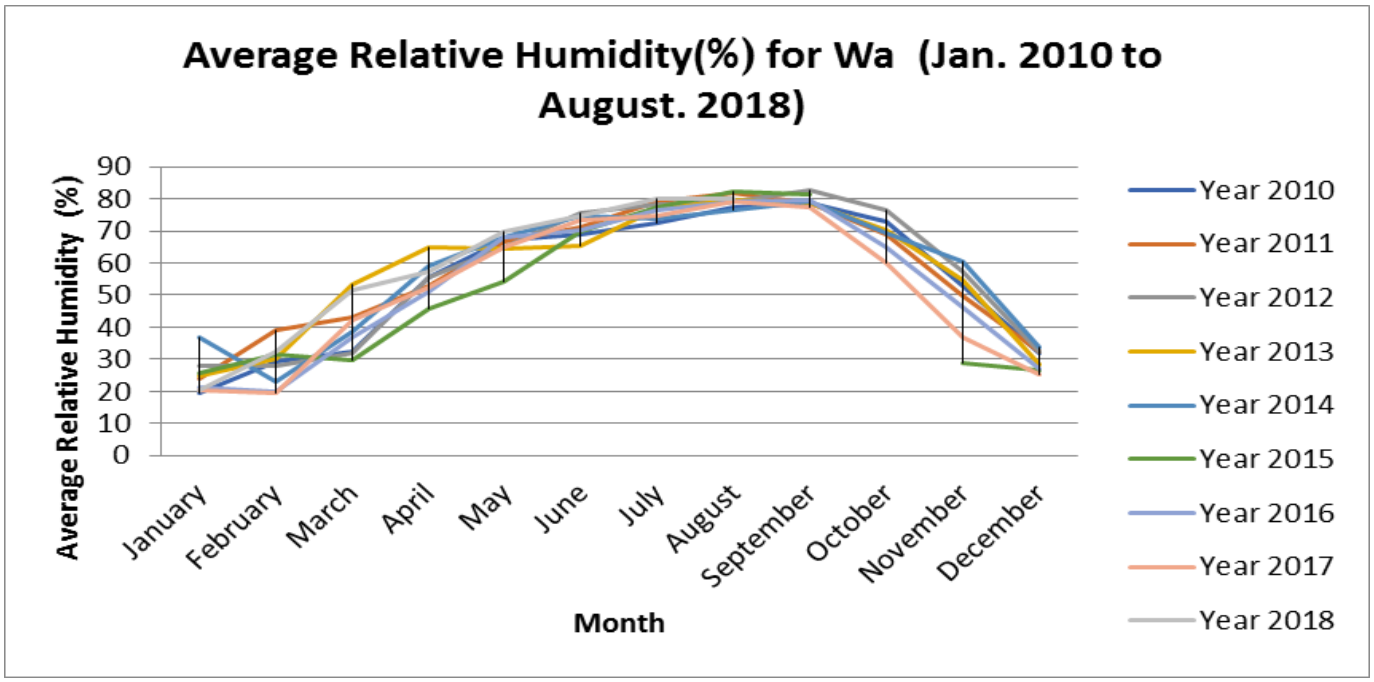


Figure 4-7: Average Relative Humidity in Project Area

Table 4-4: Data on Climatic Temperature Levels in Project Area

PERIOD	2010	2011	2012	2013	2014	2015	2016	2017	2018
January	36.7	33.8	27.7	28.5	28	28.7	28.7	29.6	28.4
February	37.9	35.6	30.2	30.3	30.8	32.1	31.1	31.2	31.1
March	38.7	38.1	32.4	31.6	31	32.4	33.6	32.8	31.4
April	36.2	36	31	29.8	31	32.4	32.5	31.8	31.2
May	34.3	33.3	29.1	29.6	29.4	31.6	29.6	29.9	29.2
June	32.5	32.4	26.8	29	27.7	28.5	28.1	28.1	28
July	31.3	29.6	26.3	26.3	27.5	27	26.8	27.3	26.6
August	30.2	29.3	26	25.8	26.8	26.2	26.3	26.3	26.3
September	30.1	31.3	25.8	26.4	26.3	26.6	26.5	27.1	
October	32.1	33.1	27.2	28.1	28.3	No Data	29.2	29	
November	36	35.4	28.3	29.9	28.6	31.6	30.5	29.7	
December	35.7	34.2	28.9	28.2	29	26.7	28.3	29	

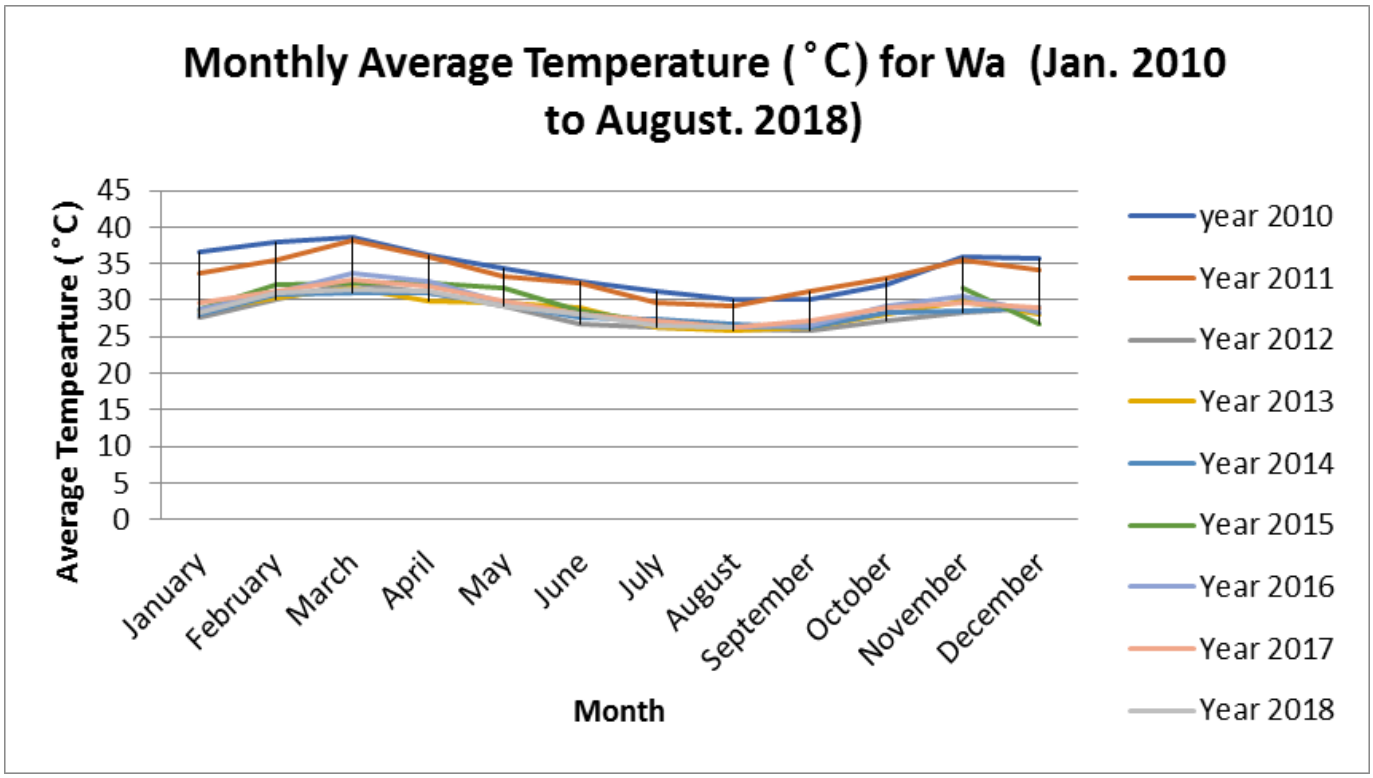
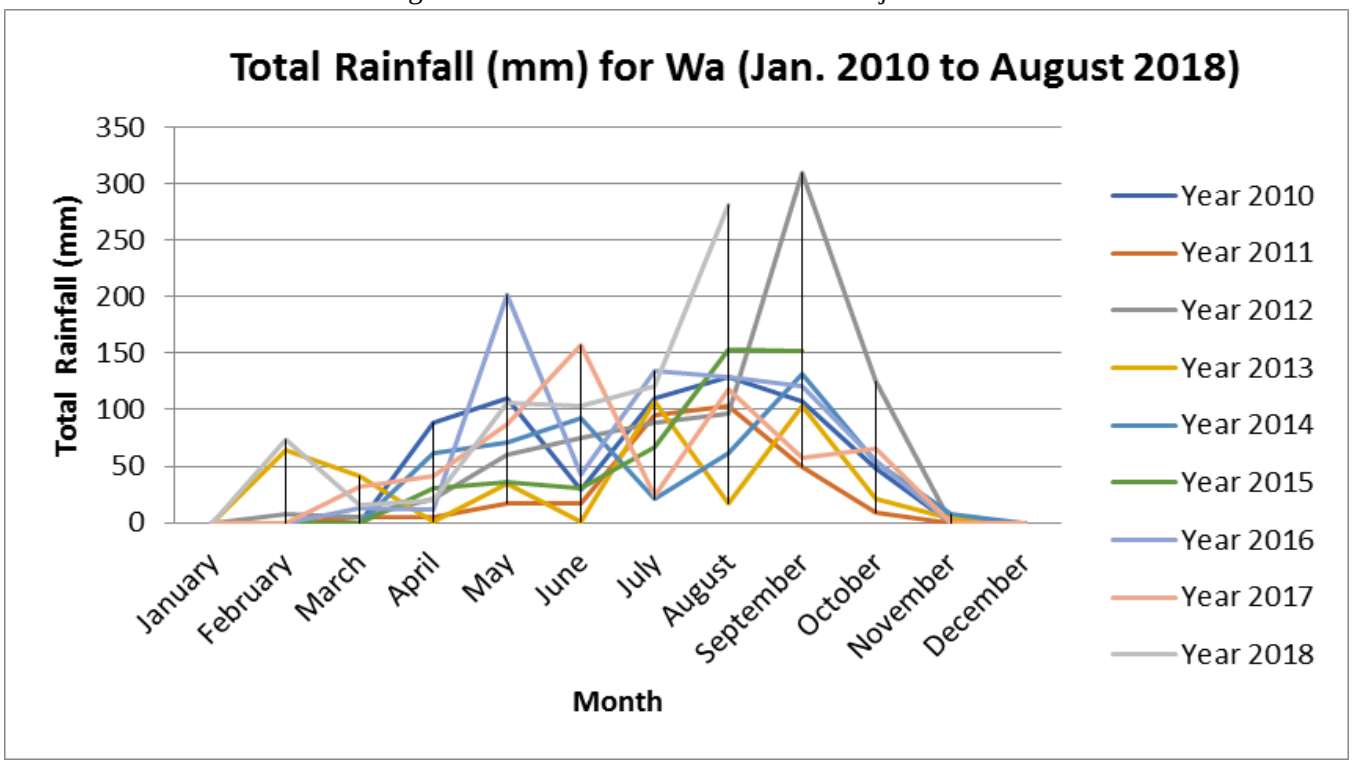


Figure 4-8: Data on Climatic Temperature Levels in Project Area

Table 4-5: Data on Rainfall Levels in Project Area

Month	2010	2011	2012	2013	2014	2015	2016	2017	2018
January	0	0	0	0	0	0	0	0	0
February	0	0	7.11	64.26	0	0	0	0	73.92
March	0	5.08	5.08	41.16	0	0	13.17	32.01	15.49
April	87.88	5.33	21.07	0.51	62.23	30.22	12.19	41.14	19.82
May	110	17	60.2	34.03	70.88	36.06	201.18	87.64	105.67
June	28.71	16.8	74.68	0.51	92.97	30.23	43.19	156.71	103.62
July	110.3	95.2	88.4	106.92	20.57	67.32	134.11	24.14	120.65
August	129.3	103	97.04	16.52	61.47	152.91	128.78	117.61	280.93
September	107.4	49.5	309.64	103.89	132.07	152.15	120.65	57.9	
October	48.26	9.14	124.46	20.56	53.6	No Data	55.12	65.02	
November	0	0	0	3.3	8.13	0	0	0	
December	0	0	0	0	0	0	0	0	

Figure 4-9: Data on Rainfall Levels in Project Area



4.3.3. Ambient Noise

Pre-construction or background sound surveys of day-time and night time noise levels were carried out within the environs of the project site and the selected areas in the project communities where noise was likely to be an impact during the constructional and operational phases of the project cycle. A limited survey of day time noise levels for duration of five (5) days were carried out in December 2011 and updated in May 2018. The integrating meter used conforms to the latest edition of American National Standards Institute (ANSI) S1.43. The entire instrumentation system was calibrated in accordance with the manufacturer's recommended procedure before and after each test series.

Sound level measurements were made in A-weighted decibels (dBA) with the microphone about 1.2m to 1.5m above the ground before 9 a.m. when construction will not have started and between 11 a.m. – 5 p.m. when construction will be underway. The meter was set for slow response and the data recorded represented the time average of the meter readings at that location. Measurements were made at more than 7.5m away large reflecting surfaces. The levels were influenced largely by moving vehicles in the project area. Recorded noise levels during the survey are shown in Table 4-6. Noise levels were all largely within the permissible EPA values.

Table 4-6: Results of noise monitoring levels

Measuring positions	Measured values (average), dB(A)		Peak values, dB(A)		Permissible Noise level dB(A)
	< 9 a.m.	11 a.m. – 5 p.m.	< 9 a.m.	11 a.m. – 5 p.m.	06:00-22:00
December 2011					
Kaleo SPP Site 1	33.5	41.6	39.6	53.1	60 [14]
Kaleo Township	40.9	55.3	49.2	69.3	65 [15]
Lawra SPP Site	36.1	41.1	49.0	51.5	60
Lawra Township	44.4	54.4	55.4	63.9	65
May 2018					
Kaleo SPP Site 1	31.3	35.4	34.6	45.7	60 [16]
Kaleo Township	32.4	54.3	41.2	68.7	65 [17]
Lawra SPP Site	30.2	31.1	35.0	44.5	60
Lawra Township	45.2	50.3	54.4	59.9	65

Times of survey: Time: 8.00 a.m. - 5.00 p.m. Instrument used: TES Sound level Meter

4.3.4. Air Quality

For this environmental assessment, measurement of suspended particulate matter concentrations within the selected communities for air quality monitoring was established over a four (4) day period in December 2011 and updated in May 2018 at various times of the day for monitoring purposes. Static sampling methods were employed for this exercise, since the standards/guideline limits were founded upon static sampling. All measurements were taken downwind of the suspected sources of generation of the dusts. The Casella AMS 950 Air Monitoring System was used for the monitoring of particulate matter concentrations (PM_{10}). The values recorded have been averaged for each of the site and presented in

Table 4-7. High PM levels were observed basically due to the dusty nature of the access roads at the time near the sampling points. This informed that the upgrade of access roads, especially those leading to the project sites, is critical for the maintenance of the PV Modules. Currently, the main access road, which is N12 Wa - Hamile road, is tarred and asphalted and can be classified as a first-class road and data obtained in May 2018 shows very levels of Particulate matter within EPA permissible values.

Table 4-7: Results of Air Quality Analysis

[14] Area with some commercial or light industry
[15] Area with some light industry
[16] Area with some commercial or light industry
[17] Area with some light industry

Measuring positions	**Time weighted Average µg/m³**		**Measured values (Maximum), Particulate Matter (µg/m³)**		**EPA Permissible level µg/m³**
	< 9 a.m.	11 a.m. – 5 p.m.	< 9 a.m.	11 a.m. – 5 p.m.	
December 2011					
Kaleo Site	182	285	818	1359	150
Kaleo Town	132	195	710	1055	150
Lawra Site	260	296	973	1723	150
Lawra Town	158	292	744	1177	150
May 2018					
Kaleo Site	145	187	450	387	150
Kaleo Town	120	185	287	350	150
Lawra Site	90	115	125	159	150
Lawra Town	98	100	110	135	150

Times of Survey: Time: 8.00 a.m. - 5.00 p.m. Instrument used: Casella AMS 950 Air Monitoring System

4.3.5. Topography & Drainage

The topography of the District is low lying and undulating at altitudes ranging between 150m-300m above sea level though some parts average 600m. For the designated site for the Kaleo Solar Power plant, the terrain is generally flat and has a rectangular shape which is regarded as suitable for PV application. This is similar to the topography of the Nadowli-Kaleo District which is mainly low lying and undulating at altitudes ranging between 150m-300m above sea level though some parts average 600m. Indeed, the only major stream in the Nadowli-Kaleo District is the Bakpong and several ephemeral streams, flow into the Black Volta. These limited number of rivers and stream coupled with the seasonal drought seriously hampers dry season farming resulting in low output levels and food insecurity that is experienced almost every year.

For the designated site for the Lawra Solar Power Plant, the terrain is not completely flat showing small bumps and slight slope descending towards North with 2.5-3% in average. The slope shall be considered in the design by adjustment of the row to row spacing. The site has trapezoid shape with its longer side long the road and a triangular edge to the South. The Lawra Municipal is gently rolling with a few hills ranging between 180 and 300M above sea level.

4.3.6. Geology & Soils

According to existing evidence, the Republic of Ghana does not have a particularly high earthquake risk. Epicenters have not been observed in the project areas so far. An assessment of the geological hazard of the project sites was made by the ESIA Team through literature review. No landslides, avalanche and other adverse geological actions and other geological disasters exist in all three project sites. No phenomenon of mineral resources overlaid with the construction project exists in the exploration depth in the site area. The overall stability of the site is good relatively, and suitable for the construction of the PV power plant. Based on the sparse information available, it is considered reasonable to assume a horizontal peak ground acceleration of 0.2g for design purposes; 80% of this value will be assumed for the vertical ground acceleration.

Currently, there has not been any detailed geological and soil investigations at any of the sites. Information therefore provided thus subsequently pertains to the general geological information in the affected districts. The EPC contractor is expected to carryout detailed investigation of the soil conditions for each of the sites to cover all the requirements for design of all relevant works as well as the borrow pits (for verification of the suitability and adequacy) where materials for embankment formation will be obtained and submit a report to the VRA for approval. The soil investigation shall be carried out in accordance with BS 5930:1999 or any other approved standard. A copy of the soil investigation report shall be submitted to the EPA for informational purposes, if so required.

In the Lawra Municipal, the rock formation is essentially birimian with dotted outcrops of granite. The District mineral potential is largely unexplored. Some reconnaissance work indicates the presence of minor occurrences of manganese, traces of gold and diamond, Iron ore and clay. Because of a well- developed fracture pattern in the rocks, the potential for obtaining ground water in the District is very high which makes it suitable for all year farming. Borehole drilling activities in the early 1980s confirmed the presence of the granite and birimian rocks in the District. The soils in the District consist mostly of laterite soils. These are developed from the birimian and granite rocks which underlie the area. There are also strips of alluvial soils along the flood plains of the Black Volta as well as sandy loams along some of its tributaries. The general nature of the soils, coupled with the traditional land use practices and type of rainfall, tend to have adverse effect on crop production resulting in persistent short fall in food production.

In the Nadowli-Kaleo District where the Kaleo community is situated, three main types of underlying rocks are found. These are Birimian and granite to the west and some parts of the east and basement complex to the east. These rocks hold a considerable quantity of water, which is a good potential for the drilling of boreholes and sinking of wells. Current studies have revealed a large mineral deposit which is a potential for mining activities. The soil types are laterite, sandy and sandy loam (savanna ochrosols). They are generally poor in organic matter and nutrients because of the absence of serious vegetative cover due to bush burning, overgrazing, over cultivation and protracted erosion. Consequently, the soils are heavily leached. Relatively fertile soils (sandy loams) occur to the east of the District around Issa and Tabiesi and support crops such as yams, cereals, legumes and rice. On the hand soils in the west are generally poor and support limited agricultural activity. This situation is responsible for the seasonal migration from the west to east for farming purposes and partly responsible for the skewed distribution of socio-economic services.

4.3.7. Water Resources

There is no water body located within the designated sites at Kaleo. The nearest water body is the Kaleo Community dam, located close to the N12 Highway, just outside the Kaleo township towards Lawra (See Plate 4-10). The relative location of the dam to the project site is shown in Figure *4-1*. The designated Solar Power Plant site at Lawra is about 3km from the main river in the district (See Plate 4-11), the Black Volta, to the west which forms the boundary between the District and the

Republic of Burkina Faso. The Black Volta has several tributaries in the Lawra District; notable amongst them are the Kamba/Dangbang, Nawer, Duodaa and Kokoligu-baa.

Plate 4-10: Kaleo Community Dam, nearest waterbody to Kaleo PV Project Site

Plate 4-11: Black Volta, nearest waterbody to Lawra PV Project Site

With respect to groundwater availability, the Lawra and Kaleo area as indicated is underlain by rocks of the Birimian and intrusive Granitoids. The predominant geology of the area is composed of various composition of granites. Productive zones of groundwater in the area are located within the saprolite (weathered zones) or fracture zones of the bedrock. Data provided by the Water Resources Commission indicate that the average borehole yield is about 53.3 L/min (3.2 m3/hour). Figure 4-10 provides an overview of the regional trends in borehole yield and is therefore not accurate at local scale.

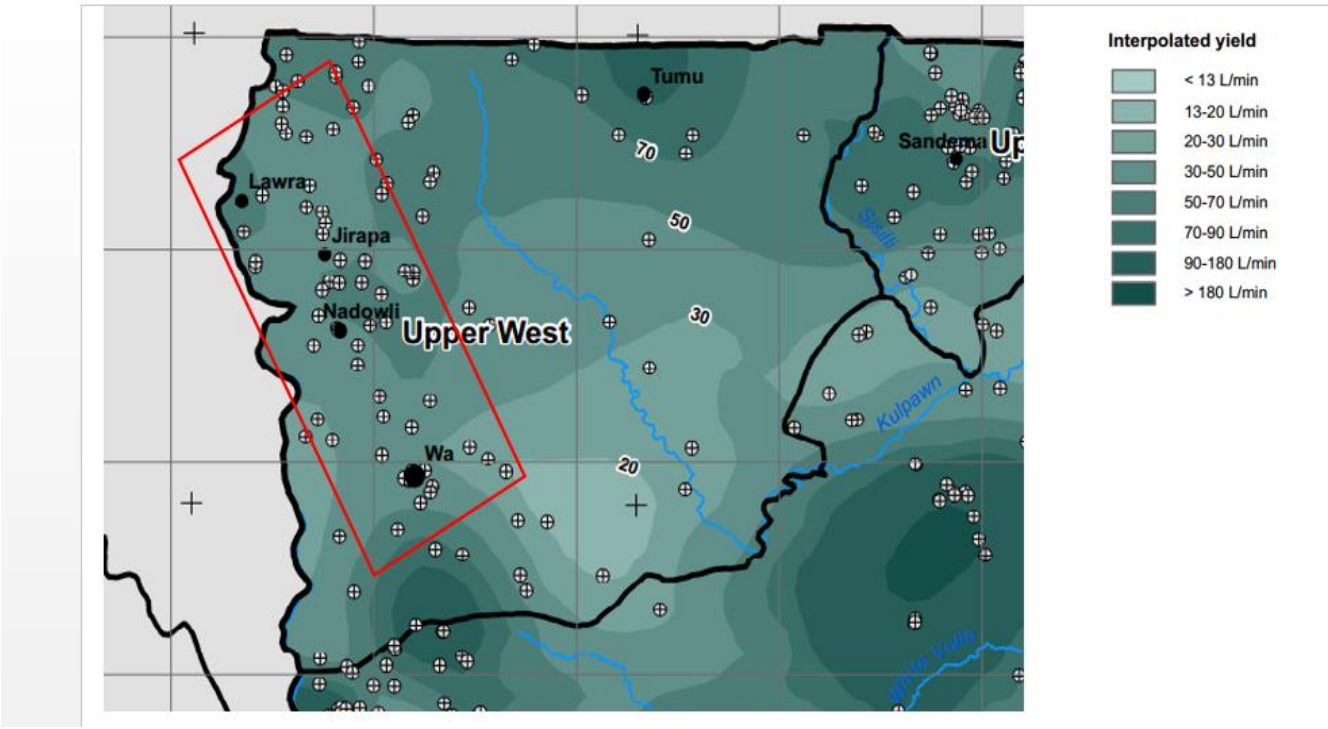


Figure 4-10: Interpolated borehole yield map with area of interest located within red margin.

4.4. Biological Environment

Detailed literature review and field assessment of the biological environment was done to prepare the earlier EIA Reports. VRA further engaged the Forest Services Division, Lawra Office, in May 2018 to undertake a quantification and listing of identified flora and fauna within the various PV project sites as well as the impacted section of the Lawra Forest Reserve. The baseline survey was:

- To provide clear listing and quantification of fauna and flora identified. In particular, flora which is source of livelihood should be quantified as well as current productive use of the sites, even if it is marginal.
- Identified fauna and flora species to be listed in a table with indication on frequency, environmental relevance and level of endangerment.
- Clear identification and quantification of impact of the transmission line through the forest reserve

The report by the FSD, dated August 2018, is attached as Appendix 5. The findings of the study are provided below.

4.4.1. Flora

The vegetation of the project areas is generally the Guinea Savanna Zone with light undergrowth and scattered medium sized trees. It is mostly characterized by short grasses. Trees and wildlife resources have been assessed at the Lawra Station Forest Reserve as well as the four (4) off-reserve

areas within the Lawra and Kaleo townships. Table 4-8 provides a summary of the flora species enumerated at the PV Sites at Kaleo and Lawra.

Table 4-8: Quantification & Listing of Tree Species At UWR-SPP1 PV Sites

Name of site	Total number of trees enumerated	Total number of species enumerated	Dominant species
Kaleo Site 1	153	11	Sheanut tree / Dawadawa /Neem tree
Kaleo Site 2	761	22	Sheanut tree / Dawadawa / Neem tree / Cassia
Kaleo Site 3	228	13	Sheanut tree / Dawadawa /Neem tree
Lawra Solar Site	193	7	Neem tree / Stum / Goozie / Sheanut tree / Dawadawa
Lawra Forest Reserve	105	8	Leocarpus / Teak
Total	**1,442**		

All the five (5) sites enumerated are degraded and characterized by annual bush fires, continuous farming, and animal grazing etc. A total of 1,442 trees were enumerated at all the sites. At the Lawra Station Forest Reserve, 105 trees comprising of 8 species were identified, with the dominant species being Leocarpus and Teak which are not endangered species. Again, total of 1,337 trees of 29 species were enumerated at the four (4) off reserve areas, with the dominant species being Dawadawa and Sheanut trees. The major trees which are also economic ones are Sheabutter (42.65%) and Dawadawa (13.87%). The neem tree (10.26%) is basically used for fuel wood and is also medicinal. These trees provide a major source of income to households particularly women who play important roles in the provision of household needs. These economic trees provide a potential for the establishment of processing industries to increase employment opportunities for the people. Fire is a common feature here, and the more successful tree species have adapted to the annual fires by having thick barks. It is also characterized by several species of grasses which survive the fires by way of their rhizomes and fibrous roots that remain buried in the soil during the sweeping fires.

4.4.2. Fauna

Due to closeness of the sites to human settlement coupled with continuous farming activities and annual bushfire, few wildlife resources are identified at the project sites and those identified are listed in Table 4-9. The fauna of the project area has been extensively affected by over-exploitation, alteration and fragmentation of habitat resulting from especially bushfire, human settlements, and agricultural activities. Livestock were common. Some birds were found perching on the trees and in an interview, community members confirmed that the identified birds are occasionally seen in this area.

Table 4-9: Faunal species on Project Sites

Name of Animal/Bird	Local name	Scientific name
Domestic Animals		
Cattle	Naboo	Bos Taurus
Donkey	Bonya	Eqnus asinus
Goat	Buo	Capra aegagrus hircus
Sheep	Piroo	Ovis aries
Guinea fowls	Kpeiroo	Numida meleagris
Pigs	Dobaa	Sus
Rabbits	sounyaa	Oryctolagus curiculus
Wild Animals		
Flying squirrel	Kye	Ammalierus spp
Ground squirrel	Kye	Eimaceus spp
Royal python	Zip	Python sebae
Hedgehog	Zaapo	Atelerix albiventris
Giant rat	Dauuo	Cricetomy gambianus
Patas monkey	Aglre	Cercopithecus patas
Birds		
Red wood pecker	Saakonkoliraa	Melanerpes carolins
Hooded crow	Galingaa	Cervus cormix
Rock dove	Janee	Columba livia
Condor	Dakyeraa	Vulture gryphus
Albatross	Zuiel	Phoebitria
Sparrow	Sylaa	Passer domesticus
Black vulture	Zugire	Coragyps attratus

4.4.3. Environmental Sensitive Areas

All areas declared by law as national parks, watershed reserves, wildlife reserves and sanctuaries including sacred groves are categorized as environmentally sensitive areas. Within the context of the definitions outlined, the Lawra Station Forest Reserve can be categorized as an environmental sensitive area in the project area of influence. A 4.5km of a new sub-transmission line is to be constructed to interconnect the PV Site at Lawra to the existing 34.5 kV Domwini – Lawra Line. It is noted that about 0.5Km section of this new line shall traverse through the Lawra Station Forest Reserve. Out of this the transmission line will cover 0.25ha (150m) in the Lawra Station Forest Reserve and the remaining 350m falls within Off-reserve areas. The transmission line will pass through the reserve between BP 5- BP 6. The general condition of the reserve is poor and the trees to be affected will be mainly used for firewood. A total of 105 trees comprising 8 species were identified in the Lawra Station Forest Reserve. The dominant species include Leocarpus and Teak which are not endangered species.

The Lawra Station Forest Reserve has only been harvested once and that was in the early 1980s. The natural reserve scores a condition class of 2, i.e. "Good" and the plantation is on the average considered to be 3, i.e. "Fairly Good". There is considerable potential for regeneration. Except some few ha of the lower ground where the trees naturally thin out and bare ground appears, the rest is developed through natural regeneration. The Lawra Station Forest Reserve is not rich in terms of animal numbers. Those found include Cricetomys gambianus (Rat), Eimaceus spp. (Ground squirrels), Animalurus spp. (Flying squirrels), Ptilopachus petrosus (stone partridges) and Erythrocebus potas (Patas monkey). Others like rabbits also exist in considerable numbers. Non-timber forest products existing in the reserve include medicainla plants, grass for fodder and roofing, poles yam stakes, pestles, etc., and edible fruits such as Diospyros mespiliformis, Detarium senegalensis, Soba senegalensis,Vitex dooniana, Zamaria Africana, Itarum senegalensis, Adansonia digitata and Vitellaria paradoxa.

The Lawra Station Forest Reserve provides a lot of benefits to the local people. As an objective for establishing the plantation crop, this portion of the reserve should still be managed to produce firewood and poles. The reserve also serves to control of accelerated erosion in the area and effect of rainstorm on building of adjacent communities. The presence of abundant bees in the area also provides for the opportunity for the production of honey. The reserve serves as habitat for wild animals. Other benefits include the presence of edible fruits, bushmeat, vegetables, medicinal plants/herbs, water, fodder and materials (grasses and poles) for constructing shelter. The forest helps sustain crop yields and provide both formal employment (office staff) and informal employment. However, no revenue accrues to Lawra District Assembly since timber harvesting is scarcely done.

4.5. Socio-economic and Cultural Environment

A socio-economic survey of the project-affected communities of Kaleo and Lawra Communities was carried out on the field during the environmental assessment. As earlier indicated, the Kaleo and Lawra communities are located respectively in the Nadowli-Kaleo and Lawra districts, all in the Upper West Region of Ghana. The compilation of data for the project communities and their respective districts were done through site visits, use of survey instruments, extensive literature review and consultations with community elders, representatives from the District Assemblies, project affected persons (PAPs) and institutions. The socio-economic profiles of these communities and districts regarding aspects and characteristics that could be affected by the construction and operation of the Solar Photovoltaic Plants are discussed below.

4.5.1. Nadowli-Kaleo District

Location & Size

The Nadowli-Kaleo District is centrally located in the Upper West region of Ghana. It lies between latitude 11' 30' and 10' 20' north and longitude 3' 10' and 2'10' west. It is bordered to the south by Wa Municipal, west by Burkina Faso, north by Jirapa District and to the east by the DaffiamaBussie Issa District. It covers a total land area of 2,742.50km^2 and extends from the Billi Bridge (4km from Wa) to the Dapuori Bridge (almost 12km from Jirapa) on the main Wa -Jirapa-Hamile road and also from West to east it extends and bordered by Daffiama Bussie Issa District. The distance between the District and the regional capital covers about 40 km. The location of the District promotes in international trade between the District and neighbouring Burkina Faso.

Governance

The Nadowli-Kaleo District Assembly was carved out of the then Nadowli District Assembly in June 2012 under LI 2101. The assembly is empowered as the highest political and administrative body in the District charged with the responsibility of facilitating the implementation of national policies. Under Section 10 of the Local Government Act 1993 (Act 426), the Assembly exercises deliberative, legislative and executive functions in the District. By this act, the assembly is responsible for the overall development of the District by way of the preparation of development plans and budget related to the approved plans.

In line with the Local Government Act 1993 (Act 426), the District Assembly is composed of the District Chief Executive, the Members of Parliament and Assembly members. Traditionally however, the Kaleo Community is under the Kaleo-Naah who the Paramount Chief of the area is also.

Population & Housing Characteristics

According to the 2010 population census, the Nadowli- Kaleo District had a total population of 63,141. This population compared with the 2000 census figure of indicates a growth rate of 1.5% per annum as depicted in Table 4-10. Using the 2010 population as the base year and an annual growth rate of 1.9% the population in the District is currently estimated at 66,809. By the 2010 figures, the population of Kaleo was 7,324, representing 11.6% of the total district population. It is important to

note that population figure of 1984 and 2000 includes to the then Nadowli-Kaleo district and 2010-2013 includes the new Nadowli-Kaleo district which intends explains for the reduction of the population figures.

Table 4-10: Population Growth and Trend

Year	Male	Female	Total Population	Growth Rate
1984	30799	34730	65,529	
2000	39375	43341	82,716	1.5%
2010	29,539	33,602	63,141	1.9%
Projected figure				
2011	30,100	34,240	64,340	1.9%
2012	30,672	34,891	65,563	
2013	31,255	35,554	66,809	

Source: Population and Housing Census, 2010

The age structure shows a high percentage of males than females in the age groups from 0-19 years and more females than males for the group 20 -69 years. In 2000 the male proportion for age group 70-85 years and older was higher than for females. But for 2010 females continue their domination for the age group 70 -85 years and older

Table 4-11: Age and Sex Structure

Age Group	Male	Female
0-4	5,494	4,106
10-14	5,275	4,091
20-24	5,708	5,946
30-34	4,454	5,905
40-44	3,405	4,178
50-54	2,267	3,453
60-64	1924	2,189
70-74	1012	2,007
80-84+	922	4,106
Total	**29,539**	**33,602**

Source: Population and Housing Census, 2010

The 2010 estimated population of Nadowli-Kaleo district is comprise of 29,539 males and 33,602 females giving a male / female ratio of 88:100 as compared with the national male / female ratio of 97.9:100. The predominance of women calls for policies to address women's problems in the district. This is more imperative because though women especially those in the deprived areas are a

vulnerable group their productive abilities cannot be underestimated. From the above it could be discerned that the district has an age dependency ratio of 1:1 .04 meaning that if all the people in the labour force were working, 100 workers would have 104 dependants. However, since only 96% of the labour forces are working, the economic dependency ratio of the district stands at 1: 1.12 meaning that 100 workers have 112 dependants compared with the national ratio of 1:0.871.

For the Nadowli-Kaleo District, the population density is about 31.0 persons / Km^2 living in about 167 settlements and not evenly distributed. For instance, whereas areas around Nadowli and Kaleo have densities of about 50 persons / Km^2, the eastern part of the district has densities of about 15 persons / Km^2. This uneven population concentrations are due to the over concentration of socio-economic infrastructure facilities and services in the Western portion of the district to the neglect of areas in the east. The age-sex structure of the district is typical of the rural Ghanaian situation. The population pyramid has a broad base which tipper to the top. About 45% of the population is aged between 0-14 years while 49% constitutes the economic active population, the remaining 6% being aged. The high proportion of children in the district gives an indication of the need to provide child care facilities such as Day Care Centers, Primary Schools, Clinics and the like.

There is no statistical data on migration trends in the district however the situation does exist. There is seasonal out-migration by the youth especially males to the south to work thereby reducing the labour force whilst there is also intra-district migration from the west to the fertile east to farm. The out migration of the youth has serious implications for the embryonic economy of the district, as the potentials for production are lost to other districts.

Ethnicity & Religion

The Mole-Dagbani is the predominant ethnic group in the Nadowli-Kaleo District with 88.3%. Other indigenous ethnic groupings collectively constituted the remaining 11.7%. There are three main religions in the District. Christianity (comprising Catholics, Protestants, Pentecostal/Charismatic, and other denominations) leads with 44.5%, followed by Islam (35.6%) and African traditional religions (13.9%). Christians have a very strong presence in all the area councils. Catholics constitute the majority of Christians in all sub-districts with Pentecostal/Charismatic group is the second largest denomination, after Catholics. There is a slight variation between male and female adherents. Female Christians are more than their male counterparts in almost all the sub-districts. Adherents of traditional religion are sparsely located in all communities. There is religious tolerance and peaceful co-existence in the district. The homogenous nature of the ethnic and religious groupings of the population presents a great potential for the dissemination of information, education and mobilization of local resources for development.

Education

The District has a total of 177 educational institutions comprising 70 Kindergarten Schools, 66 Primary Schools, 36 Junior High Schools, 1 Technical/ Vocational School and 4 Senior High Schools. Out of this, there are 169 Public educational institutions comprising 66 Kindergarten

Schools, 63 Primary Schools, 36 Junior High Schools, 1 Technical/ Vocational School and 3 Senior High Schools. A few NGOs have played and continue to play various roles in the development of educational infrastructure in the District. There are also 8 private educational institutions comprising 4 Kindergarten Schools, 3 Primary Schools and 1 Senior High Technical School. Specifically, within the Kaleo community, there are a 1 pre-school establishment, 2 primaries/Junior High Schools, and 2 Technical/Vocational institutions and 1 Senior High School. Educational institutions in Kaleo are provided in ***Table 4-12*.**

Table 4-12: Educational Institutions in Kaleo Community in the Nadowli District

Type of Educational Institutional	Name of Educational Institutional
Pre-School	Baptiste Nursery
Primary	Kaleo L. A. Primary
	St. Dominic Primary School
Junior High School	Kaleo JHS
	St. Dominic JHS
Technical/Vocational Institutions	St. Michael Minors Seminary
	St. Basilide Vocational School
Senior High School	Kaleo secondary Technical School

By the 2010 PHC, the Literate population of the District was 51.0 percent while Not Literate is 49.0 percent. The data also indicates 64.7 percent of the literate population being literate in English and a Ghanaian language while 30.3 percent were literate in English language only. The level of literacy was higher for males (59.8%) of the total population 11 years and older than for females (43.8%). It is also observed that only a very small proportion of the population is literate in French even though the district shares boundary with a francophone country.

Health Status

There has been a significant change in the number health facilities in the District between the periods 2011 and 2013. Apart from the increased number of outreach stations the number of facilities have more than doubled with the number of outreach points increasing from 132 to 148 during the same period. Currently there are two Hospitals, one government (District Hospital) and one private (Ahmadiyya Moslem Hospital) are located in Nadowli, the District capital and Kaleo respectively. Also, in Kaleo, is the Kaleo catholic Clinic.

The disease pattern in the District has improved as compare to the past years, with the relative changes in the position of diseases as compared to the past years; the situation still reflects the national trend of disease prevalence with malaria occupying the first position of the top ten causes of OPD attendance. The current top three diseases are malaria, Acute Respiratory Infection (ARI) and Skin diseases compared to Malaria, joint pains and Pneumonia. This is a clear manifestation of poor environmental hygiene and sanitation as well as water related problems. Using 2011 as base year, the prevalence of the three top diseases increased between 7%-15% while malaria went up by

14.8%, ARI and skin diseases went up by 6.9% and 6.4% respectively. These conditions can be attributed to the poor environmental Sanitation/Personal Hygiene and quality of drinking water.

Social Networks

Various social networks exist in Kaleo. The groups basically exit to provide support, both financially and technically to members. Lists of some of the social networks existing in the Kaleo community are outlined in Table 4-13.

Table 4-13: Some social network s in Kaleo Community

Type of Network	Name of Network
Women's Group	▪ Sunta Nunta Association ▪ Imola Women Association ▪ Charia daughters Association ▪ Christians Mothers Association ▪ Ecola Women's Association
Farmer's Group	▪ Maize Growers Association
Youth's Group	▪ Kaleo Youth Parliament
Men's group	▪ Kaleo Drivers Association ▪ Kaleo Drinking Bar Association

Water and Sanitation

The District is currently served by small towns and rural water systems, which are owned and managed by communities through their water and Sanitation Management Teams. The facilities include the pipe system, boreholes and hand dug wells. While most of the facilities are publicly owned and others by private. Presently most hand dug wells are low yielding and not capable of providing water all year round and have since dried up. In view of this the District is now relying heavily on the pipe system and boreholes as the only reliable sources of water supply to communities.

There are 8 pipe systems in the district located in 8 communities, six (6) are private, belonging to health and religious institutions whilst two (2) are public managed by communities. This number has remained unchanged as compared to the number of facilities at the beginning of 2002. With respect to boreholes, there are 240 boreholes located in the communities, out of these, 119 are functional and 121 needs rehabilitation. However, 53 of the boreholes are privately owned. Compared to the number of boreholes at the beginning of 2000, the construction of new boreholes has increased by more than 30%. This achievement has had no impact on the water supply coverage in the district in view of increased number of broken-down boreholes and other that require rehabilitation.

Presently there are about 27 communities are without any form of water facility to obtain potable water. Going by the District Water & Sanitation Team standards, the calculated coverage or number of people served by functional facilities, about 59,825 people representing 67.1% of the total estimated population have access to potable water. Compared to the regional and national coverage of about 90% and 74.1% respectively the district is performing in terms of the provision of improved water supply to the people. With the advent of Community Based Rural Development Programme,

it is envisaged that most communities who have no access to potable water sources will have the opportunity to access funds to enable them get boreholes and other water systems to increase the percentage coverage in the District. Some of the major problems' prevention the expansion of water supply coverage is poverty levels of communities who are unable to provide counterpart funding for water projects as well as delays in the release of funds by development partners for implementation of water projects.

Sanitation Facilities

The existing sanitation facilities in the district include, Septic tanks, Ventilated Pit Latrines (VIP), Kumasi Ventilated Improved Pit Latrines (KVIP) and Water Closets. See table 25 below. The VIP's and Water Closets are private while the KVIP and Septic tanks are public. It is currently estimated that 11.1% of current population have access to sanitation facilities. However due to improper management and maintenance most of the facilities have been neglected and people resort to free range open defecation which poses serious environmental and sanitation problems.

In finding permanent solutions to the sanitation problems the District Assembly is now emphasizing on household toilets and hygienic education, to ensure a sense of ownership of facilities and their proper maintenance. The achievement of this objective will to a large extend improve upon the current sanitation situation in the district.

Economic Development

The Kaleo Community just like other parts of the Nadowli-Kaleo District depicts a typical rural economy dominated by the agriculture sector with the commerce and industrial sectors least developed. About 70% of the estimated population in Kaleo are farmers whilst about 20 % are traders with the remaining being in the formal sector. In the nadowli District in general, agriculture alone accounts for about 85% of the labour force while commerce/service and industry account for 14% and 1% respectively.

Food crop production in this sector largely remains subsistence with low output levels. The main activities practiced include food and cash crop production as well as animal rearing. The agriculture sector is also characterized by crop farming and livestock production. The sector is estimated to be growing at 2.1% per annum, which is below the national target of 6% per annum. Even though efforts have been made to boost the sector, production still remains at subsistence, as there are no large plantations holding in the District. The major food crops grown are millet, sorghum (guinea corn), maize, cowpea and yam. Cash crops cultivated include groundnuts, cotton, cowpea, soybeans, cassava, tiger nuts and pepper. The cultivation of cash crops has not received much attention as a result of market uncertainties. Economic trees like the shea, dawadawa, and baobab, which constitute a major source of income for women, are still wild and prone to destruction by annual bushfires.

Kaleo community lies in the guinea savannah zone and has one main rainy season for agricultural production thus from May to September. The rest of the year is dry and can only be used for dry

season gardening. However, the low development of the irrigable agriculture has limited productivity the dry seasons where farmers become dormant and have no major farming activities to undertake.

The commerce/service sector is the second largest employer of the community's labour force after agriculture. It encapsulates a wide range of tertiary activities. These include retailing and petty trading, transport and financial services and services provided by civil servants. The sector is dominated by informal small-scale trading, especially in agricultural produce and limited modern consumer products. It is characterized by family ownership.

Kaleo has one main market, which has market day every six (6) days. On non-market days, community members visit markets such as the Sankania market and Jang Market at Kla. These markets are not so brisk, as revealed by the volume of endogenous and exogenous inflows of goods to and from the markets. Nadowli, the District capital is the main commercial centre in the District and most of the settlements in the District depend on it for their shopping needs. The trading activities in the District particularly in the periodic market centres form one of the major sources of revenue to the District Assembly. Thus, the improvement of market infrastructure has the potential of boosting the District's revenue generation capacity.

Human activities particularly annual routine bush burning, indiscriminate tree felling for fuel wood, charcoal and other purposes and poor animal husbandry practices have led to deceasing the vegetation cover and increasing soil erosion and depletion of soil fertility. Inappropriate farming practices such as shifting cultivation, road construction, sand and gravel winning increases land degradation. There is growing awareness the need to maintain and sustain the environment. A manifestation of this is the existence of women groups in agro-forestry the District. Individuals have also adopted the habit of planting trees around their buildings. Developing economic trees plantations e.g. Cashew, Mangoes has also gained popularity over the years. Despite the growing awareness on environmental conservation, a lot needs to be done in view of the threat to desertification due to both human and natural factors.

The Nadowli-Kaleo District is currently served by small towns and rural water systems, which are owned and managed by communities through their water boards. The facilities include the pipe system boreholes and hand dug wells. While most of the facilities are publicly owned others are private. Presently most hand dug wells are low yielding and not capable of providing water all year round and have since dried up. In view of this the District is now relying heavily on the pipe system and boreholes as the only reliable sources of water supply to communities. There are 118 pipe systems in the Nadowli District located in 5 communities Nadowli, Kaleo, Daffiama, Nator and Megou-Mantari.I addition, the Kaleo community itself has six (6) communal wells, 8 boreholes and 3 hand-pumps for use by the community members.

The existing sanitation facilities in Kaleo community just like the Nadowli-Kaleo District include, Septic tanks, Ventilated Pit Latrines (VIP), Kumasi Ventilated Improved Pit Latrines (KVIP) and

Water Closets. The VIP's and Water Closets are private while the KVIP and Septic tanks are public. It is currently estimated that 11.1% of current population in the district have access to sanitation facilities. However due to improper management and maintenance most of the facilities have been neglected and people resort to free range open defecation which poses serious environmental and sanitation problems. In finding permanent solutions to the sanitation problems the District Assembly is now emphasizing on household toilets and hygienic education, to ensure a sense of ownership of facilities and their proper maintenance. The achievement of this objective will to a large extend improve upon the current sanitation situation in the District.

Revenue mobilization in the Nadowli-Kaleo District is done through the use of commission collectors, revenue tax forces and Unit Committees. The District depends heavily on external sources of revenue to finance most of its development projects. This problem is traceable to a plethora of problems facing the revenue collection unit of the District. Problems such as the lack of logistics for revenue collectors; inadequate civic awareness on tax obligation; public abuse and humiliation of tax collectors; tax evasion; inadequate tax collectors and limited number of revenue sources have contributed in no small measure to the abysmal local revenue mobilization of the District. This further brings to light the need for the capacity of the revenue collection unit of the District to be strengthened in terms of logistics and personnel to enable it to perform its avowed functions effectively.

There is gradual improvement in the housing sector in Kaleo as well as the remaining parts of the District. Most of the traditional house types with earth roofs are giving way to landcrete and blockhouses with zinc and aluminium roofing sheets. There has also been remarkable improvement in the quality, quantity and design of privately-owned houses. The use of cement blocks in construction of houses has increased and provision of wide windows has improved ventilation in the houses. This has positive implications on the health of the people since it will minimize the spread of diseases including Tuberculosis and other air borne diseases which is on the ascendancy in the region

The industry sector is characterized by small-scale activities and the use of labour-intensive production technology. These include basketry, cloth/smock weaving, blacksmithing, pito brewing, pottery and shea butter extraction. With training and credit interventions from the District Assembly, National Board for Small Scale Industries and some NGOs, small scale industrial activities have stepped up. Nevertheless, inadequate financial management skills, inadequacy of available credit facilities, low level of technology and inadequate socio-economic infrastructure stand as teething issues militating against the development of this sector of the economy.

Kaleo is one of the 5 communities in the district that is served by the national telephone system. Apart from institutional telephones in some offices, most public telephone booths have broken down and are incapable of providing the required services. The only reliable mobile telecommunication services the district has are Vodafone, and MTN mobile phone services which are privately operated individuals in some communities across the District. These services are however unreliable and

cannot be accessed by average income earners due to low levels of incomes. Just like in all other parts in the country, vendors of mobile phones and accessories are on the increase in the Kaleo Community. Television station available for free include Ghana Television. Paid televisions available also include Multi TV and DSTV.

Even though the Nadowli-Kaleo District has a strong tourism potential, this is yet to be developed to contribute meaningfully to the District's economy. On key historical resources in Kaleo is the burial ground of the Late Hon. Jatoe Kaleo, who died on June 6, 1998. This site is about 500 m to the Kaleo SPP site. The Late Hon. Jatoe Kaleo was one of the leading Ghanaian politicians who led Ghana into independence. He is known to be among the political gurus who stood on the same platform with the Late Dr. Kwame Nkrumah, the 1st President of Ghana, during the formal announcement of the independence of Ghana on March 6, 1957.

There are no banking institutions or microfinance in Kaleo. The small-scale operators mobilize their initial working capital from their own saving. Other sources include relatives, friends, and moneylenders. These sources give them only small capital to start with, which limits their ability to expand their businesses.

Energy especially electricity is one of the main elements that influence the rate of economic development in any locality. It is a key to production and lures investments. The importance of its availability cannot therefore be overemphasized in the development efforts of any given people. The Kaleo community is connected to the national electricity grid. Pockets of formal and informal workers currently use LPG which is obtained from Wa, the regional capital. Majority of the households rely on firewood and charcoal for cooking at the expense of the environment. Shea butter oil and kerosene are also predominantly used by households for lighting.

Transportation service provision in the District is dominated by the private sector with operators using minibuses and pick-ups in the provision of services. Non-conventional means of transport including bicycles and head loading also play a major in the carriage of goods to major marketing centers.

4.5.2. Lawra Municipal

Location & Size

The Lawra Municipal lies in the north western corner of the Upper West Region in Ghana between Long. 2°25 W and 2°45W and Lat. 10°20 and 11°00. It is bounded to the East and South by the Lambussie and Jirapa Districts and to the North and West by the Republic of Burkina Faso. The total area of the Municipal is put at 1,051.2 square km. This constitutes about 5.7% of the Region's total land area, which is estimated at 18,476 square km (figure 1 shows the Municipality in the Regional context). The Municipal is estimated to have 157 communities with 95% of the inhabitants in the rural areas. The population density is about 89 per km^2. It is the most densely populated Municipal in the region.

Governance

The administrative set-up of the Municipal Assembly consists of a secretariat headed by the Municipal Chief Executive who is the political head. The Municipal Co-ordinating Director is the administrative head and principal advisor to the Municipal Chief Executive. In line with the Local Government Act 1993 (Act 426), the Municipal Assembly is composed of the Municipal Chief Executive, the Members of Parliament and Assembly members. There are currently 44 Assembly members out of which 29 are elected members and 13 are Government Appointees. One out of the 29 elected members is a female and out of the 13 government Appointees, 5 are females. The Municipal Chief Executive (DCE) and the Member of Parliament (MP) add up to the number 44. It is the local Government Authority responsible for the overall development of the Municipal through the development and implementation of development plans, programmes and projects.

Traditional administration in the Municipal is under the Lawra Traditional Council. Another important institution, which plays a crucial role in promoting good governance, is the traditional authority. The Municipal has one paramountcy namely the Lawra Paramountcy headed by the Lawra Naa. The Paramount Chief is supported by eight divisional chiefs, 16 sub-chiefs and 32 herdsmen.

Population & Housing Characteristics

The population of Lawra Municipal, according to the 2010 Population and Housing Census, is 54,889 representing 7.8 percent of the region's total population. Males constitute 48.0 percent and females represent 52.0 percent. About 88.2 percent of the population live in rural localities. The Municipal has a sex ratio of 92.3. The population of the Municipal is youthful (under 15 years) (41.0%) depicting a broad base population pyramid which tapers off with a small number of elderly persons 60 years and above (10.1%). The total age dependency ratio for the Municipal is 93.6, the dependency ratio for males is higher (103.8) than that of the dependency ratio for females (85.1). The population of Lawra community according to the 2010 Population and Housing Census, is 6,451 representing 11.7 percent of the Municipal's total population. Male population according to the 2010PHC is 2597 and that of the female is 3494.

The Municipal has a household population of 53,753 with a total number of 9,200 households. The average household size in the Municipal is 6.0 persons per household. Children constitute the largest proportion of the household members accounting for 44.0 percent. Spouses form about 10.5 percent while other relatives constitute 8.8 percent. Extended households (head, spouse(s), children and heads relative) constitute 47.4 percent of the total number of households in the Municipal and this is followed by nuclear households (head, spouse(s) and children) (21.1%). Household population of the Lawra Community is 1441 with 795 houses.

Ethnicity & Religion

With respect to religious composition, there are basically three main religious groups in the Municipal: Christianity (61%); Traditionalists (26.3%); and Islam (6.6%). Within the

Christian fraternity, Catholics are in the majority (46.3%) followed by the Pentecostal/Charismatic (6.8%) and Protestants (6.1%) and other Christians recording 1.8 percent. There are more females than males among Catholics, Protestant, Anglican or Lutheran and Pentecostal or Charismatic religious groups. On the other hand, males are slightly higher among religious groups such as Other Christians, Islam and Traditionalist. The most predominant tribe in the Municipal is the Dagaaba with dialectical variations. There are other minor tribes such as the Hausa, Asante etc. They co-exist peacefully and inter-marry.

Education & Literacy

A total of 46 institutions are found in Lawra and the breakdown is shown in Table 4-14.

Table 4-14: Number of institutions by type and circuit in Lawra

Circuit	No. of Pre-Schools	No. of Prim School	No of JHS	Total
Lawra Central	5	5	4	14
Lawra East	9	6	4	19
Lawra West	5	5	3	13
Total	**19**	**16**	**11**	**46**

The 2010 PHC for the Lawra Municipal collected information on literacy from persons aged 11 years and older. Literacy in French Language was also elicited in the 2010 PHC because Ghana is bordered by French speaking countries and it was deemed necessary to find out what proportion of the population is literate in French. The study showed that 45.3 percent of population aged 11 years and older are literate while 54.8 percent is not literate. In terms of age groupings, the highest literate groups is 15-19 years (28.4%), followed by 11-14 years (27.6%) and the lowest is age group 65 years and more (1.9%). In the case of illiteracy, the age group 65 years and more has the highest proportion (17.7%) followed by age group 40-44 years (9.6%) and the least proportion is formed by age group 11-14 years (4.3%). Those who can read and write are concentrated in the younger age groups namely, 11-14, 15-19, 20-25 and 25-29 years. This is to be expected since they are more likely to be in schools than those in the older age groups.

Health Status

The Municipal Health Administration serves at the highest implementing agency and the headship of the Ghana Health Services in the Municipal. The Municipal is zoned into 10 Sub-Municipals which offers comprehensive Public Health Services. Eight of the 10 sub-Municipals are being served by Health Centres with the remaining 2 being RCH centres attached to the 2 main hospitals located in Lawra and Nandom townships. The St. Theresa's hospital is a CHAG institution while the Lawra hospital serves as the Municipal hospital. With the inauguration of the CHPs concept to enhance access to health care services, the Municipal which is zoned into 22 CHPS zones has 12 operational. There are 200 trained TBAs, 150 community-based surveillance volunteers and 329 CBAs. There are 15 chemical sellers in the Municipal predominantly located at the urban points and a private maternity home located in Nandom. Health service is made accessible to the population through 12 static health facilities and 109 outreach points.

The Municipal continues to experience the burden of some communicable diseases e.g. meningitis, HIV/AIDS, Malaria, Hepatitis B & C /Jaundice, and Tuberculosis. These posed additional surveillance challenge to the inadequate technical staff. No case of guinea worm has been reported over the past three years. Leprosy new cases reduced from 9 in 2009 to 5 cases in 2010. Malaria has been the main cause of OPD attendance followed by URTI, skin diseases, eye infection and pneumonia over the period under review. The contribution of malaria cases in total OPD attendance increased from 38% in 2008 to 40% in 2009. Despite numerous interventions the relativity and absolute attendance are increasing. The interface remains that the interventions are either not effective of there are other factors such as symtomic diagnoses or the enhanced access to health care as a result of the NHIS. Skin diseases, acute eye infection, Pneumonia, Hypertension and diarrhoea have maintained their positions over the period, hence, continued to be regular conditions among the top 10 causes of OPD attendances.

The HIV/AIDS pandemic has now become a developmental issue due to the alarming trend of spread in the Municipal. In the Lawra Municipal it has been reported that since 1995 to 2013, a total of 642 cases were recorded. This is attributed to many entry points to the Municipal from Burkina Faso. Out of the 642 cases, 507 cases are between 15-44 years (106 male and 401 female). If the trend continues, in a few years to come, the productive segment of the population would be wiped off leaving the very young 0-14 who had only 3 cases and the elderly, 45 - 60+ who had 132 cases.

Social Networks

Various social networks exist in Lawra. The groups basically exit to provide support, both financially and technically to members. Lists of some of the social networks existing in the Lawra community are outlined in Table 4-15.

Table 4-15: Some social networks in Lawra Community

Type of Network	Name of Network
Youth's Group	▪ Lawra Youth Club ▪ Yafid Club ▪ Nanyir Youth ▪ Wusiele Yir Youth ▪ Beboru Youth ▪ Zongo Youth
Women's Group	▪ Suntaa Nutaa ▪ Nifaa Company ▪ Songtaa Nyog ▪ Akodam Women Group ▪ Asduntabaa Group ▪ Fomwaa Women Group ▪ Fomwaa Women Group ▪ Tanye Women Group ▪ Naayior Women Group ▪ Deboru Women Group

Type of Network	Name of Network
	▪ Wusieleyir Women Group ▪ Fomwag Women Group ▪ Muslim Women Group
Men's Group	▪ Mason's Group ▪ Carpenter Group ▪ Butcher's Group ▪ Food seller's Group ▪ Grinding Mail Group

Access to Water

Access to water is relatively high as majority of the population have access to boreholes and mechanised water systems. 74% of the population have access to water supply for domestic and other uses. This notwithstanding, about 10% of the people still resort to wells and spring for water. This poses health risks as the safety of the water from wells and springs cannot be guaranteed.

Access to water looks good with the statistics. However, the dispersed settlement pattern of the Municipality makes it a challenge for many people to access water. Many people still travel long distances to fetch water beyond the standard of 500meters. It is therefore important that a lot of investments are made in providing water to communities. Access to water is relatively high as majority of the population have access to boreholes and mechanised water systems. 74% of the population have access to water supply for domestic and other uses. This notwithstanding, about 10% of the people still resort to wells and spring for water. This poses health risks as the safety of the water from wells and springs cannot be guaranteed.

Sanitation

Sanitation situation is not the best as open defecation is rampant in the Municipality. From the data available, 63% of households do not have access to toilet facilities and therefore resort to open defecation. The table below shows the types of sanitary facilities used by households.

Economic Development

Agriculture accounts for 80% of the Municipal economy. Commerce /Service and industry account for about 18.2% and 0.8% respectively. In other words, the agriculture, commerce and industry sub-sectors of the economy are all short of private sector led programmes and projects. The difference between the two (agriculture vs. commerce, service and industry) arises due to the various Governmental and NGO interventions in the agriculture (farming) and services sector. It is estimated that 83% of the population are engaged in subsistence agriculture. Food production is low due to the poor nature of the soil and unfavourable weather condition. It has become prudent for the introduction of new sources of livelihood such as irrigation, commerce etc., with the deterioration nature of soils and whether.

Most of the youth have to migrate to the southern part of the country every year either immediately after harvesting the poor yields of crops from their small size farms or after writing their Junior

Secondary School or Senior Secondary School Certificate examinations. The aim of the migration is to marshal resources for the upkeep of their families during the lean season and cater for their education if lucky to progress on the educational ladder. Animal farming, especially poultry rearing is a lucrative venture in the Municipal. Fishing also goes on along the Black Volta and its tributaries to supplement the meagre income of the families of farming communities.

The industry sub-sector is basically on a small-scale basis. Their classification can be based on the raw materials used for their end product. Agro based industry accounts for about 70% of the industries within the Municipal. *Figure 4-11* provides an analysis of the industry sub-sector. Commerce and industry account for about 18.2% and 0.8% respectively of the Municipal economy. The industrial sub-sector is basically on a small-scale basis and run by micro-entrepreneurs. The private sector of the economy would only assert itself with the existence of an industry that is closely linked to the agricultural potentials of the Municipal. Agro based industry accounts for 75% of the industry within the Municipal though underutilized. Interventions in the Municipal should therefore be concentrated in the area of agro based industry as much of the populations are engaged in this sector. This underutilization can basically be explained by the low level of entrepreneurial skills exhibited by most of these entrepreneurs. Efforts are however being made by the Municipal Assembly to ensure that these entrepreneurs are trained to explore all available potentials in this sub-sector.

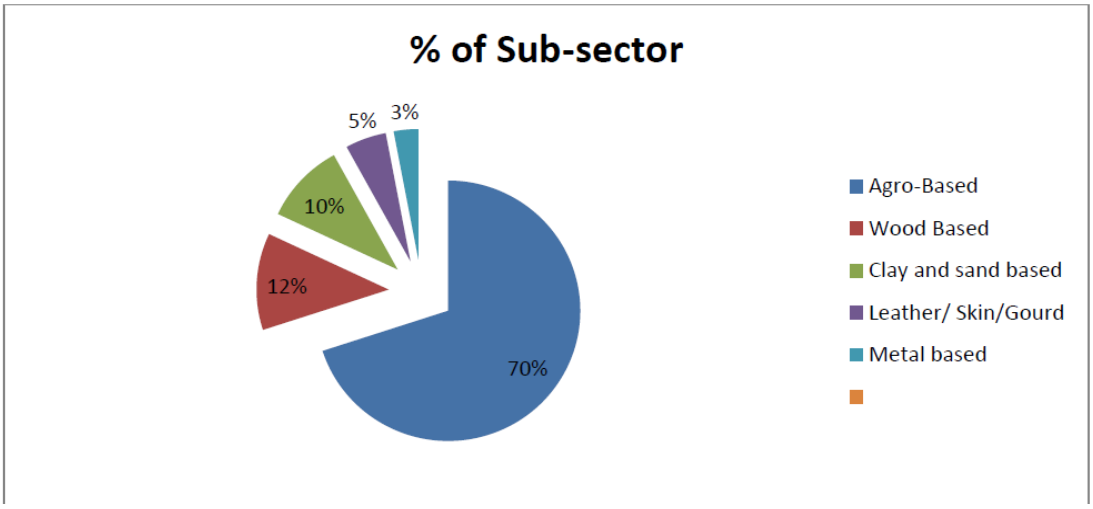


Figure 4-11: Pie Graph Showing the Percentage of Industry Sub- Sector in Lawra Municipal

The relatively increasing populations and development larger and new settlements in the Municipal is providing room for the construction of more water and sanitation facilities. Currently, there are three (3) mechanized small town water systems in the Municipal with beneficiary towns as Nandom, Babile and Lawra. There are also 452 boreholes in the Municipal out of which 39 are for schools and clinics, 29 are private and used privately, 19 are low yielding and hardly produce water during the dry season and 24 of them are bad wells and cannot produce portable water. Thirty-Nine (39) of these are also in Nandom and Lawra which have water systems and hence these boreholes virtually

lie fallow. The Municipal based on the available functioning water facilities has calculated water coverage of 87%. It is the intension of the Lawra Municipal to attain a hundred percent water coverage. This will be achieved by drilling more boreholes and construction of smaller town water supply systems.

The Energy sector has received a tremendous transformation as many more communities have been connected to the national grid while others are currently being hooked on. An estimated percentage of households with access to electricity currently stand at 24.3%. The massive extension works in the area of electricity has greatly improved the quality of life of the people as the facility is being used for other industrial works such as carpentry shop, blacksmithing, welding, vulcanizing, and fitting shops and agro processing (Shea butter and groundnut extraction). However, in spite of these efforts the 2008 GIMPA Survey revealed that the pre-dominant source of Energy for lighting in the Municipal is still kerosene or Shea-butter as shown in Table 4-16.

Table 4-16: Main source of Energy amongst households in the Lawra Municipal

Source Of Energy	Frequency	%
Kerosine/Sheabutter	167	72.8
Gas	3	1.3
Electricity	56	24.3
Battery	3	1.3
Other	3	1.3
Total	**230**	**100**

Source: 2008 GIMPA Household Survey

Currently, there is the construction of a small town water system underway in Babile and plans are in place to construct a similar project in Ko-Guo. Further plans will consider Eremon and Dowine and Boo. Several other projects including Global Water initiative by Catholic Relief Services and CARE International, Japan Embassy Water Project and the GoG Priority Water Project are all to undertake the drilling of new boreholes and also rehabilitation of malfunctioning ones. With the proposed drilling of these additional boreholes, the water situation in the Municipal will be further enhanced.

Though the water coverage looks remarkable, much is still expected since people still scramble for water especially in most communities especially in the dry season. Several other new settlements have no access to potable water. This emanates from the fact that; the settlement pattern is dispersed and the over aged nature of the water facilities. Drying up of borehole especially during the dry season also accounts for the inadequacy of potable water.

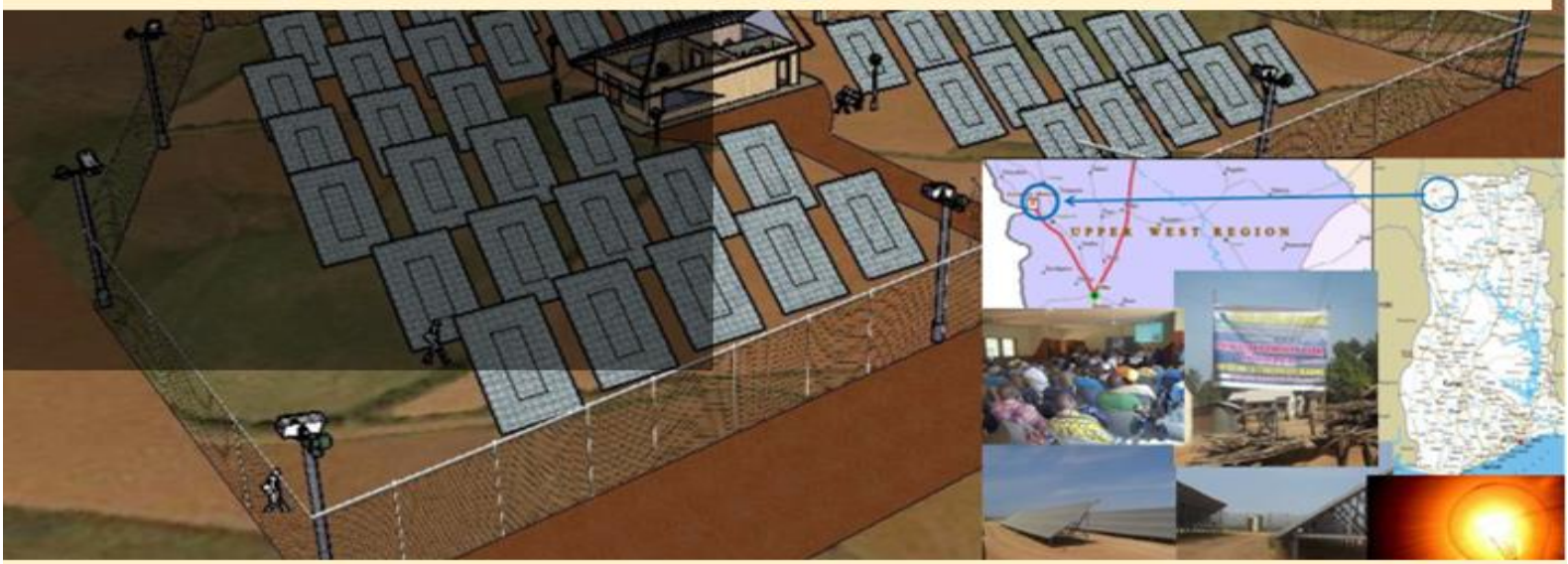
It is however well noting that, most people in the Municipal still resort to the use of fuel wood for the domestic chores due to their inability to afford electricity resulting in a further degradation of the land. It is envisaged that when the current plan to extend the national grid to about 30 more communities in the Municipal is achieved, a lot could be done in reducing drastically the degradation of the wood cover and the migration of the youth in search of non-existing jobs. The use of solar

energy in the Municipal has a great potential for the protection of the forest as tree feeling for fuel wood will be substituted with the use of solar energy. The high cost involved in the provision of electricity can be minimized with the provision of solar energy. The reason why solar energy is not widely used in the Municipal is as a result of the costly nature of solar panels and lamps and their unavailability in the local market.

Over three quarters of the 218km road length of feeder roads in the Municipals have now been reshaped or worked upon. However, the condition of trunk roads in the Municipal has been of mixed improvement. The Municipal has two (2) major trunk roads, namely; Babile-Lawra-Hamile road, Lawra-Boo and Domwini-Nandom road. Babile-Lawra-Hamile road continues to receive attention than the Lawra-Boo and Domwini-Nandom road which makes it become increasingly unmotorable due to the many pot holes and heavy corrugations on the road. The only tarred portion of the Municipal roads happened to be the township roads; i.e. both Nandom and Lawra townships. However, the Municipal is not linked by any tarred road. It is hoped that the speedy investment on the road linking the Municipal and beyond in the area of tarring could go a long way to increase the potentials of the Municipal.

There has been a massive improvement on the telecommunication front. Almost all villages and communities have access to one or either mobile network. The Municipal currently has the following telecommunication facilities, Vodafone Landlines, Vodafone, MTN, Tigo and Glo (yet to be launched). The mobile usage has been widely accepted by the citizens of the Municipal. It has equally created a lot of employment for the youth, especially in the area retailing of recharge units, transfer of units etc. There are very few landlines and many people have to resort to the use of mobile phones. Coverage of mobile phone services is limited to some areas of the Municipal and signals from major mobile services providers like one touch, MTN and Tigo can be obtained in different parts of the Municipal, but not total coverage. The communications network in Lawra Municipal is generally poor. Radio FREED, the only rural radio station, which operates in the Municipal has very limited coverage and is restricted only to the Nandom area. The effectiveness of these networks is greatly reduced due to very frequent and constant jam of the air waves.

Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



CHAPTER 5:

STAKEHOLDER CONSULTATIONS

5 STAKEHOLDER CONSULTATIONS

5.1. Introduction

A stakeholder to a project refers to any individual or group which is potentially affected directly or indirectly by the proposed project or who has an interest in the proposed Project and its potential impacts. Key stakeholders that are directly impacted (positively or negatively) by a project, include:

- Project-affected communities, individual residents as well as non-organised groups with areas of interest, vulnerable groups (i.e., elderly, people with disabilities, ethnic minorities, etc.);
- State agencies at the national, regional and local levels;
- International organizations (especially Donor agencies)
- Non-governmental and public organisations at all levels
- Project employees;
- Media.

Stakeholder engagements forms a key activity in the Environmental Impact Assessment (EIA) process. This is clearly outlined in the under Section 12(k) of the Environmental Assessment Regulation, LI 1652 of 1999, which mandates the consultation with members of the public likely to be affected by the operations of the undertaking. The rationale for any stakeholder engagement is to help to identify potential points of disagreements between stakeholders, ethnic / gender / religious / political based tensions, raised expectations by the project and emerging social problems that require attention and with which the project developer may be able to assist.

According to the International Finance Corporation (IFC) Performance Standard 1 (2012) stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts. Stakeholder engagement is an ongoing process that may involve, in varying degrees, the following elements: stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and ongoing reporting to Affected Communities. The nature, frequency, and level of effort of stakeholder engagement may vary considerably and will be commensurate with the project's risks and adverse impacts, and the project's phase of development.

VRA is committed to a technically and culturally appropriate approach to consultation and engagement with all stakeholders affected either directly or indirectly by the Project. Subsequently, a program of stakeholder engagements was developed as part of this environmental assessment to avoid any risk of apprehension associated with this project like

problem of destroying properties and extension of the allotments. The engagement process for the project was designed to meet Ghanaian legal requirements for public participation and to align as far as practically possible with good international industry best practice, based on the project timing and budget. It is also important to note that there are practical and financial limitations to the involvement of all individuals within the engagement process. Hence, public participation aims to generate issues that are representative of societal sectors, not individuals. Hence, the stakeholder engagement was designed to be inclusive of a broad range of sectors relevant to the proposed project.

5.2. Project Stakeholders

To identify stakeholders for this project, a stakeholder mapping was done to identify those critical to be consulted during the process. It largely involved identifying stakeholders located within the project's proximity as they are the most likely persons to be impacted upon, like those whose properties will be affected by the project, or those who reside in the communities. Based on this mapping assessment, the following categories of four categories of key stakeholders were identified and engaged with:

- Property Affected Persons (PAPs), including landowners within the Lawra and Kaleo as well as crop owners.
- Community members within Lawra and Kaleo, including Traditional Authorities and elected representatives.
- State Agencies within the Nadowli-Kaleo District and Lawra Municipality
- Forestry Services Division, Lawra Office
- Water Resources Commission, Accra

5.3. Summary of Stakeholders' Engagements To date

A summary of the various engagements undertaken to ensure that all the identified stakeholders gain a better understanding of the project is described below. The wide range of stakeholders engaged is because from our perspective, diversity of opinion rather than consensus building is likely to enrich ultimate decision-making, which is critical for project success.

5.3.1. Engagements with Property Affected Persons

Properties affected by the project included land as well as the various economic crops that were available on the land. VRA has subsequently identified all the PAPs and has held a series of negotiations with the heads of the land-owning families as well as the crop owners. List of Key PAPs consulted are outlined in *Table 5-1*.

Table 5-1: List of Property Affected persons Consulted Regarding Acquisition

Community	Affected Property	Persons Consulted	Title
Kaleo	Land belonging to the Nana Bayau	• Mwini Bankuro Sanjie • S. Anwabiri	▪ Family Head ▪ Elder

Community	Affected Property	Persons Consulted	Title
	Family	• Adama Bondinuba	▪ Elder
	Economic Crops	• Joseph Kofi Maliwiihi • John Badingu Putieha	▪ Crop Owner ▪ Crop Owner
Lawra	Land belonging to the Debuo Family	• Nuo-Ire Raymond • Nuo-Ire Imuo • Nuo-Ire Zom-Nang	▪ Family Head ▪ Family Elder ▪ Family Elder
	Economic Crops	• Nuo-Ire Raymond • Kuunor Sangtuo	▪ Family Head ▪ Crop Owner

Following an agreement of the cost of the land, VRA has paid in full, the entire cost of the land and land acquisition is now complete. Subsequently, the land has been acquired from the various land owners, namely Nana Bayau Family of Kaleo and the Debuo Family of Lawra and separate Memorandum of Understandings' (MoU) between VRA and the families in question were executed initially signalling intention for ownership transfer. VRA has since acquired Leases for the lands from the Lands Commission.

Following the listing and quantification of all economic crops on the project sites, VRA again processed all necessary documentations required for the payment of economic crops and prices which was then communicated and agreed with by the crop owners. The land owners and community leaders during the various stakeholder engagements advised that as part of their customs, certain rites ought to be performed before the projects commence and a list of items required made available to the VRA.

5.3.2. Engagements with Community Members

The stakeholder engagements, where required, may also include public hearings with traditional heads, opinion leaders and community members at designated areas in the communities. The Ghana EIA Regulations LI 1652 require the EPA, if relevant, to organize public hearings as part of stakeholder engagements. Section 31 of the IFC Performance Standard 1 also reiterates this requirement, by requesting clients to conduct an Informed Consultation and Participation (ICP) process that will result in the Affected Communities' informed participation. ICP involves a more in-depth exchange of views and information, and an organized and iterative consultation, leading to the client's incorporating into their decision-making process the views of the Affected Communities on matters that affect them directly, such as the proposed mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

Stakeholder engagements with community members involved the use of Public hearings to ensure maximum participation by all. Under the project, three (3) major public hearings relative to the current project sites have been undertaken. These events were organized to provide

opportunity to discuss the project with the community members and the outcomes of these are discussed below.

Local Stakeholder Hearing for the Clean Development Mechanism

The project has the prospect of contributing in a large measure to the global effort at reducing carbon reduction. Subsequently, VRA, with assistance of Lahmeyer International (project consultants), registered the SPP-UWR under the Clean Development Mechanism (CDM), a project-based mechanism for the greenhouse gas emission reduction under the Kyoto Protocol. The objectives for registering SPP-UWR with the CDM are:

- To help mitigate climate change
- To assist the country in achieving (i) sustainable development and (ii) transfer of technology know-how
- To assist the country to achieve their internationally binding emission reduction commitments

The project is to demonstrate that emissions reductions from renewable energy can earn additional income and the introduction of CDM know-how was expected to raise environmental awareness and generate interest in low carbon energy technologies. Under the CDM, a local stakeholder hearing is an important procedure which shall ensure the sustainability and transparency of the project of concern. For CDM projects, a twofold stakeholder procedure is required; embracing a local and an international stakeholder consultation. Whereas the international stakeholder consultation takes places during validation at an advanced stage of the CDM project development cycle, the outcomes of the local stakeholder hearing need to be considered in the official project documentation, the so-called Project Design Document (PDD).

It is the project developer's responsibility to invite the local stakeholders for an according stakeholder consultation. Within the PDD, it must be demonstrated that comments by local stakeholders have been invited, a summary of the comments received has been provided, and a report to the designated operational entity on how due account was taken of any comments has been received. The local stakeholder public hearings for the two project sites under the CDM were held on January 2012. This was done in collaboration with Lahmeyer International. Dates and venues for these events in the local communities are shown in the Table 5-2.

Table 5-2: Dates & Venues for CDM Local Stakeholder Hearings

Community	**Dates**	**Venue**
Kaleo	Jan. 19, 2012	St. Basilde Vocational School
Lawra	Jan. 20, 2012	Assembly Hall, Lawra District Assembly

Plate 5-1: Local stakeholder hearings at Kaleo

Plate 5-2: Local stakeholder hearings at Lawra

Pre-Construction Local Stakeholder's Events

A preconstruction stakeholder engagement events were held in November 2017 to basically inform the community members about the change of project scope, that is the elimination of the Jirapa site and the extension of that of Kaleo and Lawra communities. The dates and venues for the events are outlined in *Table 5-3*. Notice for the local stakeholder events were though public banners, advertisers' announcement in the national dailies as well as radio announcements on Westlink Radio 88.1 FM at Lawra and Tumpaani 88.5FM FM based in Nadowli for the Kaleo event.

Table 5-3: Dates & Venues for Pre-Construction Local Stakeholder Hearings

Community	**Dates**	**Venue**
Kaleo	Nov. 2, 2017	St. Basilde Vocational School
Lawra	Nov. 3, 2017	Assembly Hall, Lawra District Assembly

Identifiable stakeholder groups were invited to the events by formal letters. Participants included representatives from the institutions:

- Environmental Protection Agency,
- Lawra Municipal Assembly
- Nadowli-Kaleo District assembly
- Ghana Police Service
- Ghana National Fire Service
- Ghana Health Service
- Traditional Authorities
- Landowners
- Community Representatives
- Media Houses

The District Chief Executives of the Nadowli-Kaleo District, Honorable Katherine T. Lankono and that of Lawra Municipal Assembly, Honorable Martin Bomba-Ire, were each present at the events within their areas of jurisdictions and chaired the functions. The non-technical explanation of the project was presented by VRA through a power point presentation and the outline was as follows:

- Update on Project Status
- Outcome of Environmental Impact Assessment
- Key Mitigation initiatives
- Way forward.

Upon agreement with participants, the presentation was made in English language and translated in the local dialect i.e. Dagaari, at both the Kaleo and Lawra events. This was done by the elected

community representatives, also knowns as Assemblymen, in the areas. Furthermore, all questions and comments from the stakeholders were made in English language/ Dagaari. Hence, potential language barriers were duly considered, and it was ensured that all participants had the same level of understanding of the local stakeholder consultation. The presentation was followed by general discussions, to enable participants make inputs or have their concerns addressed as required. A summary of the main inquiries, proposals and concerns raised by the stakeholders during these various community engagements events and the responses provided are outlined in Table 5-4.

Plate 5-3: Pictures from the Kaleo Public Hearing Event

Plate 5-4: Pictures from the Lawra Public Hearing Event

Table 5-4: Issues & Responses at Community Stakeholder Engagement Events

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
CDM Engagements in 2012 at Kaleo and Lawra	1	Is the solar power replacing hydropower in the system, and if not, can the two be combined?	The stakeholders were informed that solar power will be integrated into the national grid besides hydropower. This will cause no conflict since there is no difference between the electricity depending on the type of their generation source.
	2	What is the side effect from the PV Power Plant in Kaleo?	The stakeholders were informed that there are no negative side-effects resulting from the construction and operation of the plant.
	3	Would the PV Plant cause any negative side-effects in the grid resulting in health impacts such as cancer?	The stakeholders were informed that there is clearly a separation between the PV power plant and the transmission line. However, it is also not scientifically proven that there are negative side-effects from transmission lines in terms of health impacts. As already noted, no negative side-effects are expected from the PV power plant.
	4	Is it possible to operate heavy equipment, e.g. for lifting heavy items, with solar power electricity?	The stakeholders were informed that the operation of appliances depends on the amount of power capacity which is provided. In case the power capacity is suitable, any type of electric appliance can be operated. If for instance heavy machinery was sought to be operated by the means of a small solar system, which does not provide sufficient capacity, it will not be possible. However, the PV Plant in Kaleo provides a high capacity of about 8 MW and is furthermore fed into the grid which will enable the operation of heavy equipment.
	5	There is need to guard equipment of the solar power plant since they could be stolen.	The stakeholders were assured that security measures are foreseen for the PV Plant and the whole project site. There will be fencing and other measures such as floodlights with motion control. Moreover, a sufficient amount of security staff will be required on site which will furthermore cause local employment.
	6	What are the advantages of distributing the envisaged 8 MW foreseen for the Upper West Region over three sites	The stakeholders were informed that the sites were selected according to the best resource characteristics, i.e. the sites with the best solar irradiation features were chosen. Moreover, they had to possess additional qualification

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
		instead of constructing on only one site? Moreover, how was the site selection undertaken?	such as (i) soil and topography condition, (ii) accessibility by means of road infrastructure and (iv) possibility for grid-connection. The three sites were chosen according to this requirement. Moreover it is noted that the projects require a wide area for construction. The designated site for Kaleo already covers 10.22 ha. It would have been difficult to find a suitable site to fit the whole amount of envisaged capacity
	7	Would the power generated from the PV plant would only be for the people of Kaleo? Moreover, would a reduced price be expected for the amount of electricity generated from the plant?	The stakeholders were informed that the electricity is fed into the national grid. Since it cannot be distinguished if the electricity consumed by the customers stems from hydropower, fossil-fuelled power or solar power, it cannot be distinguished that the electricity generated from the PV Power Plant in Kaleo is only consumed by the people of Kaleo. However, the people may expect a more reliable power supply. Moreover, there is additional power supply available which will contribute to the satisfaction of increasing electricity demand. Furthermore, additional electrification may be facilitated with the introduction of the PV Power Plant.
	8	Would damage to one of the modules negatively affect the remainder of the PV Plant?	The stakeholders were informed that this will not be the case. Since the plant constitutes of several independent PV modules with redundant cabling, all of the remaining equipment parts will be operating without any efficiency loss as long as they are intact.
	9	What will be the benefits from the PV power plant for people in the area which do not have a grid-connection?	There are benefits which can be expected such as the sustainable socio-economic development for the region from the project. Moreover, the PV plant provides an additional power generation capacity which responds to the growing electricity demand in the country. This facilitates furthermore the continuation of electrification endeavours from the Government. Furthermore, more areas near Kaleo are sought to be electrified via grid-connection under the currently on-going electrification program.
	10	Climate change is in fact a phenomenon and cannot be neglected. Ghana as one of	The comment was appreciated of the panel.

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
		the parties under the UNFCCC has introduced such a project and expressed the community's support of the project.	
	11	One of the participants mentioned that the highest amount of greenhouse gases is caused by industrialised countries instead of developing countries such as Ghana. Moreover, developed countries have binding greenhouse gas emission reduction targets. He wondered why there was not more engagement from industrialised countries and Ghana as a developing country seeks to realise such a project.	The stakeholders and panelists agreed that there should be more engagement and commitment from the developed countries. On the other hand, a project such as the PV Power Plant provides a good opportunity to tackle climate change in an area were the people also suffer a lot from its effects. Moreover, the introduction of the project under the CDM provides a good opportunity of a co-financing source, for know-how transfer and a sustainable socio-economic development.
	12	A participant asked if additional benefits are envisaged in the framework of the PV power plant project under VRA's corporate social responsibility.	VRA informed the stakeholders that the project already provides a number of benefits to the local community and the contribution to a sustainable socio-economic development. Hence, no additional efforts are foreseen.
	13	A participant asked if tariff reductions for the electricity generated from the PV power plant may be expected.	VRA informed the stakeholders that no price reductions may be expected since the PV Plant is generating grid-connected electricity. Moreover, although the resource which is harnessed, i.e. solar irradiation is available for free, there are still significant costs for the investment and operation of the plant. Hence, VRA will not be able to offer the electricity at a reduced price.
	14	Since the solar power plant is grid-connected, would there be electricity after sunset. It was inquired that the PV Plant	Electricity will also be available in the homes and for other customers after sunset in the usual manner. This will stem from hydropower and fossil-fuelled power. In the daytime, it will furthermore stem from solar power.

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
		will be oriented with a certain tilt towards the sun. However, the sun is moving during the daytime and the PV plant has a fixed mounting system. He asked about the efficiency of this set-up.	The stakeholders were informed that the PV panels will have a very flat tilt angle due to the rather low latitude of the location. The plant will thus catch enough irradiation although it is not a tracked system. The efficiency under the given circumstances is thus satisfying enough. The cost and benefits from a tracked system with regard to expectable efficiency increase are not justifiable.
	15	Would there be separate metering in the homes for solar power and if it would then be available free of charge?	The stakeholders were informed that also in the future the generation source from the electricity consumed in the homes will not be distinguished, i.e. only one electricity meter will be used. Since the generation of electricity from solar power also results in certain generation costs it cannot be provided free of charge.
	16	Is it possible for the line to be connected to one's house?	VRA informed that the power is to be connected to the national grid prior o distribution to individual homes
	17	An Environmental Impact Assessment (EIA) is required under CDM project development; subsequently would negative impacts be expected to be stated in the EIA report? Furthermore, would adequate compensation be paid to the former land users of the project site?	VRA's environmental specialists responded that from the current point of view no negative impacts may be expected. Moreover, the stakeholders were informed that VRA had ensured sufficient compensation to the previous land-user.
	18	Would there be a generation from the PV Plant in case of rain?	The stakeholders were informed that significantly reduced generation may be expected during rain due to the lack of direct solar radiation. However, rain may be seen as a complementary positive effect on the maintenance requirements of PV module cleaning.
	19	Is it possible to feed electricity from the PV plant into the grid since it generates direct current (DC) whereas the electricity transmitted and distributed in the grid is	The stakeholders were informed that within the PV power plant DC is converted into AC by the means of a converter. Electricity is then fed into the grid without causing any failures.

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
		alternating current (AC)?	
	20	Concerns regarding the sustainability of the project with regard to the maintenance of the project were raised. This was in relation to the solar home system project that was not successfully implemented in the late 90's / early 2000.	VRA informed the participants that the PV Plant will be under the operation of VRA. VRA will be responsible for the maintenance and will train staff accordingly in order to assure reliable operation and maintenance of the PV Plant.
	21	Concerns were raised regarding the reliability of the grid which will provide the electricity generated from the PV plant and would thus prefer an individual off-grid solution for each home.	The participants were informed that improvements on the grid are already on-going in order to strengthen the network for the connection of the PV plant and according reliable energy supply. Regarding the preference for solar home systems, the participants were informed that solar home systems require batteries as storage in order to supply electricity when no sun is shining, e.g. during the night. This is not the case if a PV plant is grid-connected.
	22	The project is considered as a good project and it is pleaded that the sustainability aspect is taken seriously. VRA should consider students for training and employment at the PV Plant.	VRA confirms that it is envisaged to consider staff from the region. Integration in technical know-how transfer and local employment shall be achieved by the project activity.
	23	What will be the benefit from the PV plant for citizens living further away from the project communities and are not connected to the grid?	VRA informed that the site of the PV plant was chosen according to its suitability in terms of (i) solar resource, (ii) site/soil conditions, (iii) grid connection as well as (iv) access to road infrastructure. Hence, the site was chosen in order to achieve the highest output from the resource, i.e. the solar irradiation, if all the prerequisites are fulfilled. This provides in the first place an advantage for citizens close to the PV plan due to more reliable electricity supply. Further, the implementation of PV plant in the national electricity system constitutes a system expansion from additional generation.

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
			Additional generation is required to satisfy the electricity demand. This comprises also the connection of more citizens to the grid under the currently on-going rural electrification program. The site selection has been accomplished based on already existing solar map data by the means of planning software. Hence, no additional weather station is erected for data collection.
	24	Would tariff reductions for the electricity generated from the PV power plant expected?	VRA informed the stakeholders that no price reductions may be expected since the PV Plant is generating grid-connected electricity. Moreover, although the resource which is harnessed, i.e. solar irradiation is available for free, there are still significant costs for the investment and operation of the plant. Hence, VRA will not be able to offer the electricity at a reduced price.
Kaleo on November 2, 2017	1.	How will the community in the project location benefit from the project?	The stakeholders were informed that the project community will inevitably become a beneficiary of the VRA Community Development Programme (CDP) which was launched in 2012 and covers areas such as Social infrastructure Projects, Environmental Protection Activities, Industrial Attachments, Education Scheme, Health, and Support for cultural activities for all VRA's operational areas.
	2.	Will there be radiation or other health hazards associated with the project?	Stakeholders were assured that the key identified impact which can result in health issues is dust during the constructional phase of the project, however, mitigation measures such as sprinkling of water will be implemented to minimize the impact. No radiation or other health hazards are envisaged during project implementation.
	3.	A copy of the Preliminary Environmental Assessment (PEA) Report should be made available to the Area council.	A copy of the PEA Report was made available to the District Chief Executive on behalf of the Nadowli Kaleo District Assembly.
	4.	Will the project provide employment opportunities for the youth?	Employment strategy adopted during the constructional phase of the Navrongo Solar Power Plant will be adopted. Under this, locals were

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
			recruited from the communities on rotation basis upon their request and during the operational phase, preference was given to community members with relevant qualifications during the recruitment of technicians for operating the Plant. Similarly, it is envisaged that similar processes could be rolled out for the local community.
	5.	What mitigation measures are in place for fumes/emissions generated from constructional equipment. Again, what happens if people contract asthma and other related ailments resulting from fumes/emissions generated from project implementation.	Different kinds of power projects such as Hydro Generation Power Plants, Thermal Power Plants, Nuclear Power Plants and Geothermal Power Plants exist. Some Power Plants are referred to as Clean Energy implying that they have very minimal impacts on the environment and this includes Solar Power Plants, thus, the project will not pose health risks to the community.
	6.	Will a resettlement demarcation or buffer zone be provided to restrict impacts of the project on community members?	A buffer zone will be created around the project site. Locals were entreated to avoid initiating bush fires and encroachment of the buffer zone.
	7.	Will local lands be protected during project operations?	The project area will be fenced; however, part of the acquired land will not be fenced to serve as a fire belt. Encroachment of the fire belt by community members should be avoided.
	8.	How will Fire Safety be managed by VRA?	As required, a fire permit will be acquired prior to project implementation. VRA usually works with the Ghana National Fire Service (GNFS) at all existing project locations. Upon commencement of physical construction, VRA will engage with the GNFS to determine the best way to effectively liaise with same.
	9.	How will VRA assist the GNFS to educate the public to prevent bush burning?	As part the requirements for the Engineering, Procurement and Construction (EPC) contractor, the GNFS will be trained on how to deal with fire resulting from such solar power projects.
	10.	Will an afforestation project be implemented as trees will be cut during	EPA provides permits for felling of trees. The details have been provided in the PEA Report. Based on the assessment, it is not envisaged that an

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
		the constructional phase of the project?	afforestation programme will be required, however, if mandated by the EPA, VRA will ensure afforestation is implemented.
	11.	Will internship opportunities be provided for students/ community members?	Industrial Attachments forms part of the VRA's Community Development Programme (CDP), hence, internships will be encouraged.
	12.	Will VRA acquire a permit from the District Assembly?	VRA has applied for a works permit from the District Assembly. The permitting process is ongoing. Subsequently, VRA has received invoices, however, payments are yet to be effected.
	13.	What is the status of consultations with the Physical Planning Department?	Consultations were conducted with the Physical Planning department in the year 2012, however, if more consultations are required, VRA is ready to do so.
	14.	What is the educational qualification required for working at a Solar Power Station?	Minimum of Higher National Diploma (HND) in an Engineering Field will be required for O&M activities at the Solar Power Station.
	15	How do the address any conflict that will arise from project implementation	Individuals should not take the law into their hands when aggrieved as this will cause not only project delays, but cost to VRA/Ghana. All grievances should be relayed through the Assemblyman, traditional authority, District Chief Executive who shall be responsible for mediating any grievance raised by the community members.
	16.	Since there are planned Solar Power Projects for the Upper East and Upper West regions, will there be a Solar Power project in the Northern Region of Ghana?	The Northern Region, just as the Upper East and Upper West Regions has good solar radiations for Solar Power Projects, however, the main challenges faced with Solar Power Projects is land acquisition due to disputes over land ownership. However, it's been noted that other companies are already planning to implement Solar Power Projects in the Northern Region, as evidenced by bill boards depicting that land has been acquired for such an activity close to Tamale.
Lawra on November 3,	1.	Will the project be implemented or unduly delayed like similar government	Project implementation is on course and funding has been received, with physical construction expected to commence by close of 2018.

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
2017		projects?	
	2.	The Lawra Naa assured VRA that Lawra is ready for development and that there is available land for expansion when required and that there will not be any disputes over land issues. Furthermore, he commended the clan which released the land for project development and entreated all local land owners to emulate the actions of the family	VRA to consider this offer in the proposed expansion of the project.
	3.	The Lawra Naa suggested that trees should be planted along the banks of the stream adjacent the project site.	Works permit has already been issued by the District Assembly mandating VRA to preserve the water body, hence, VRA will strategize to ensure that there is vegetation around the water body.
	4.	Would there be construction of accommodation facilities for project staff?	The solar project is unlike the Akosombo Hydroelectric Dam project which required construction of staff bungalows, hence, the EPC Contractor will be allowed to decide on the accommodation requirements of workers. Again, it was further explained that, currently, most projects prefer integration of the staff within the communities through renting of houses within the community as it creates more rapport between the community members and the workers, hence, this will be the most likely approach.
	5.	Would the youth be provided with opportunities for employment?	Employment strategy adopted during the constructional phase of the Navrongo Solar Power Plant will be adopted. Under this, locals were recruited from the communities on rotation basis upon their request and during the operational phase, preference was given to community members with relevant qualifications during the recruitment of technicians for operating the Plant. Similarly, it is envisaged that similar processes could be rolled out for the local community.
	6.	What will be the role of the traditional	A VRA community liaison person would be assigned to liaise with the EPC

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
		authority during project implementation?	Contactor, Lawra Naa and the District Chief Executive upon commencement of the project.
	7.	Since project entry is key in the success of a project, the EPC Contractor should be advised to observe proper entry requirements.	VRA will introduce the EPC Contractor to Lawra Naa and necessary requirements prior to project commencement are to be observed.. The District Chief Executive will also be made aware of when the project will commence and when the EPC Contactor will arrive on site.
	8.	Why is power to some communities in Lawra controlled at the Jirapa end? Again, VRA should explain the cause of the erratic power supply at Lawra?	The NEDCo Area Manager briefed the participants as follows: ▪ Currently control is given over the transmission lines depending on where the power is received, hence, if power is received from the Jirapa end, it would be controlled by them. This is a safety and security issue since If any maintenance work is to be done on the transmission line, power will have to be switched off from the source. ▪ For example, if the source of power is from the Jirapa end and workers from Lawra are required to do maintenance works then anytime, work is to be done, the workers at Lawra will have to ask those at Jirapa to switch off the power and this can pose a safety risk. ▪ Generally, the individual working is required to ensure that power is switched off, locked with the key placed in his pocket before maintenance works is done. ▪ Some communities in Lawra are being controlled by power from Jirapa end whiles others in Jirapa are being controlled by Lawra due to power source issues. ▪ Again, NEDCo acknowledged receipt of a letter submitted by the District Assembly regarding the issue and indicated that they would have to identify administrative issues that must be addressed. ▪ NEDCo however indicated that the administrative changes may not be comprehensive as there are safety implications. Again, NEDCo informed

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
			the stakeholders that anytime there is power outage without a public announcement, it implies the outage resulted from a fault and further explained that the system has a protective device that protects the lines by switching off in the event of a fault to protect the power lines and household appliances. The device protecting the transmission line to the District Assembly is in Jirapa, hence, even though a lot of maintenance works had been done on the line, there is more work to be done. ▪ Investigations are ongoing to ensure that the power outages are eliminated and assured the stakeholders of his commitment to ensuring that the power outages are eliminated. ▪ Finally, the stakeholders were entreated to assist in the elimination of bush fires in the locality during the dry season as it could result in faults in the transmission lines which will result in erratic power supply.
	9.	What will be the role of the District assembly during project implementation and how would the district assembly directly benefit from the project?	The stakeholders were assured that whenever the community benefits from the project, the District Assembly inevitably benefits. All expected fees will be paid to the District Assembly and the District Assembly will benefit from VRA's Community Development Programme (CDP) during project implementation.
	10.	Will there be any collaboration between Ghana Health Service and VRA in the Health education for workers?	VRA has a hospital and usually utlises it clinical staff to educate projects contractors, however, due to the distance, it will be more prudent to liaise with the local health services for education on effective condom usage.
	11.	Will VRA assist in constructing clinics for the communities?	Such considerations can be made upon request, if deemed as critical, under the Community Development Programme which also addresses health issues.
	12.	What is VRA going to do to ensure that the National Grid is available so that when Power from the Solar project is	It's in VRA's interest to ensure that the Grid is available to sell the power since VRA is a power generating company and is required to make profit.

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
		supplied, there will be reliable and sustainable power?	
	13.	VRA should advice the EPC contactor to avoid irresponsible sexual behavior which may result in pregnancies.	Sexual promiscuity by workers is an issue which will be discussed with the EPC Contractor during project implementation. However, in project implementation there is the need to consider both impact on the environment as well as the project. It is therefore imperative that the community members, especially the ladies, comport themselves to avoid STDs. Locals are entreated to report any of such related issues to VRA via the DCE or Lawra Naa.
	14.	Are power generation communities given priorities during periods of load shedding and provided with better tariffs?	A government policy exists on even pricing. This ensures equity in tariffs as different generating plants operate at different costs; additionally, it's easier supplying electricity to communities near generation sites than those further away from the site, hence, without equity in tariffs, communities further away from generation sites will be unduly charged.
	15.	Are there feasibility studies being conducted for mini hydroelectric power projects along the Volta river and if so what's the status of implementation?	At any given time, many projects are available for consideration, however, some projects will be prioritized over others. Feasibility studies for the Pwalugu Dam project is ongoing, additionally, the Juale dam project on the Oti river is also being explored, again there are other potential dam sites on the black Volta but due to the topography of the land when one dam is developed, some of the other potential dams may not be able to be developed. As land is flat, building a new dam will be expensive, in the northern Ghana however, VRA is not ignoring any future hydro potential.
	16.	The route to the local resort called "Meet Me There" is said to be within the project site, and this could be impacted upon communities' lifestyle. thus, what would be done?	Route to the local resort is outside the project area, however, alternative access will be provided if required.
	17	How do the address any conflict that will	Individuals should not take the law into their hands when aggrieved as this

Local Stakeholder Engagement Event	No.	Summaries of Main Inquiries, Proposals and Concerns presented by Stakeholders	Response
		arise from project implementation	will cause not only project delays, but cost to VRA/Ghana. All grievances should be relayed through the Assemblyman, traditional authority, District Chief Executive who shall be responsible for mediating any grievance raised by the community members.
	18	Will the project help improve the road that leads to the local resort?	Due to high cost of road construction, this may not be feasible, but some road development to the project site may be required
	19	Is the project being brought to Lawra by Hon. Kennedy Agyapong?	The project is a VRA project which is being funded by a loan agreement between the Government of Ghana and KfW Development Bank. However, the main consideration should be the impacts and benefits of the project to the community and not the initiators.

5.3.3. Engagements Stakeholder State Agencies

Various consultations held with key state agencies as stakeholders at the initial stage of the project in 2012 to discuss project implementation strategies. The state agencies consulted are listed below and the list of individuals consulted outlined in Table *5-5*:

- Upper West Regional Administration
- Lawra Municipal Assembly
- Nadowli-Kaleo District Assembly
- Ghana Health Service
- Ghana Education Service
- Ghana National Fire Service
- Lands Commission
- Land Use & Spatial Planning Department
- Department of Feeder Roads

Table 5-5: List of Persons Consulted at the Initial Consultation Phase

No	Name of Officer Consulted	Agency	Contact Number
1	David Adibi Yakubu	Regional Coordinating Director, Upper West Region	
2	Sandow Tiblia	Regional Director, Ghana Meteorological Agency, UWR	0200378908 / 0249230678
3	Mr. Bako	Regional Administrator, Ghana Health Service, UWR	0243661898
4	Mr. Tenge	Regional Health Information Officer, Ghana Health Service, Upper West Region	0208214746
5	Kwaku Manu Afful	Regional Fire Officer, Upper West Region	0200885961 / 0266210650
6	Anthony Gyamera	Regional Town & Country Planning Officer	0241055002
7	K. Omane-Brempong	Regional Manager, Dept. of Feeder Roads, UWR	0208170089
8	Ebenezer Tetteh	Ag. Contract Manager, Dept. of Feeder Roads, UWR	0208300266
9	Abu Kansangabata	District Chief Executive, Nadowli District Assembly	0242387445 / 0208380428
10	Bapiri Eusebius	District Fire Officer, Ghana Fire Service, Nadowli District	0208914364
11	Ignatius Noekor	Asst. Divisional Officer, Ghana Fire Service, Nadowli District	0207555673
12	Evaret Danaah	Ghana Education Service, Nadowli District	0246141702
13	Esther Abachie	Planning Officer, Nadowli District Assembly	0206767659
14	Abu Sampson	District Chief Executive, Lawra District Assembly	
15	Clifford Atanga	Dep. Coordinating Director, Lawra District Assembly	0206421307

No	Name of Officer Consulted	Agency	Contact Number
16	Frank Karib	Dep. Director, Finance & Admin., Ghana Education Service, Lawra District	0208594429
17	Naa-An Kuuyelleh	Asst. Director, Research & Statistics, Ghana Education Service, Lawra District	0208831069
18	Andrew A. Kpan	Director, Ghana Education Service, Lawra District	0207108302
19	Cornelius Beyou	MIS Officer, Ghana Education Service, Lawra District	0207307311
20	Dr. Sebastian Sandaree	Director of Health, Lawra District	0243672634
21	Roger Nabiekye	Planning Officer, Lawra District Assembly	0208767237 / 0244889861
22	Jerome Tiere	District Fire Officer, Lawra District	0209167786
23	Ernestina Nyozie	2IC District Fire Officer, Lawra District	0244252665 / 0201799944

The officials of these state agencies were briefed on the project as well as their expected roles in ensuring smooth and successful project implementation. VRA officials also discussed the various components of the project, including issues of environmental management and selection of project site, among others. In addition to informal discussions, formal letters were also submitted to some of the state agencies to solicit for relevant information for either the EA process or for smooth collaboration. The letter requested that if their outfit had any interest, concern, or special knowledge relating to potential environmental, health, occupational safety as well as social effects of the proposed undertaking, they may submit such concern to the Project Director, VRA.

Due to likely changes in personnel working at these agencies over the years, following the initial phase consultations and as indicated earlier, all the state agencies were formally invited to participate in the "Local Stakeholder Hearing for the Clean Development Mechanism" as well as the "Pre-Construction Local Stakeholder's Events" organised in 2012 and 2017 respectively, and described above, to enable them voice out their concerns and provide input not project implementation. Representatives of the state agencies represented are provided as part of the list of attendees to the various public stakeholder engagements in Appendix 6.

5.3.4. Consultations with Forest Services Division

There will be the construction of a sub-transmission line through about 0.5km section through the forest reserve at Lawra. This has the potential of compromising on the integrity of the reserve. Consultations have subsequently been held with the Forest Services Division (FSD) to help discuss modalities for ensuring that the affected forest reserve does not suffer any unreasonable degradation due to the project activities. Forest Services Division (FSD) of the Forestry Commission is charged to protect, develop and manage the country's Forest and wildlife resources.

Consultations were held with officers at the FSD Head-office in Accra, Upper West Regional office in Wa as well as the District office in Lawra to discuss modalities of the work in the reserve to ensure adherence to the conditions of MOU between VRA and FSD regarding construction and operations of bulk power transmission lines within forest reserves. A joint field visit was undertaken in May 2012 by the VRA survey team and FSD (Lawra District) to the Lawra Station Forest Reserve to inspect the 0.5 km section where the sub-transmission line would traverse. The field visit was to enable the two (2) agencies have a better understanding of the impact of the project within the reserve.

Issues agreed upon were as follows:

- VRA shall formally inform FSD of the project to enable them take relevant action.
- Copies of the line route map through the reserve should be made available to FSD.
- FSD to comprehensively assess the resource situation and tree species to be affected by the project for removal purposes and the cost of this borne by VRA to pave way for the construction of the Solar Power Project at Lawra.

Following this, VRA in May 2012 formally notified FSD of the project in requirements of the MoU. In line with the issues agreed upon, VRA further in 2018 formally engaged the Lawra District Office of Forest Services Division (FSD) to undertake baseline assessment of flora and fauna resources within the proposed project sites namely; Lawra Station Forest Reserve, Lawra Solar Site, Kaleo Site 1, Kaleo Site 2 and Kaleo Site 3. The primary purpose of the assessment was to gather information on flora and fauna resources in the proposed project areas. The frequency of the occurrence, the environmental relevance as well as the level of endangered flora and fauna resources have been determined. The list of FSD officers consulted so far is provided in Table 5-6 and going forward, there is the need to re-engage FSD with respect to project implementation within the Lawra Station Forest Reserve with respect to the harvesting of the economic trees within the reserve to protect its integrity.

Table 5-6: Officers Consulted at Forest Services Division

Name	Year	Position	Contact Details
Francis Brobbey	2018	District Forestry Manager	0244169587
Isaac Kofi Gyekye	2018	Assistant District Forestry Manager	0244836287
Mr. Basilide Elias Babasigna	2012 / 2018	Technical Officer, FSD, Lawra District	020 5891317
Mr. Alex A. Boadu	2012	Director, Operations, FSD	024 4421333
Mr. Isaac Adonten	2012	Assistant Regional Forestry Manager, Upper West Region	020 7241718
Mr. Samuel Opoku	2012	District Forestry Officer, Lawra District	024 3609450

5.3.5. Consultations with Water Resources Commission

All the PV sites are to be equipped with a borehole for operational and domestic use. The impact on water resource especially, ground water, is critical as water is required for cleaning of the PV modules on a regular basis. Estimated volume of water demand for wet cleaning of solar panels ranges from 19.5 m^3/year to 84.5 m^3/year for a duration of 20 years. There is the need to ensure that enough water is available and that there is no negative impact on the drinking water supply situation of the nearby communities which may create substantial social conflicts.

In view of the this, VRA formally requested the Water Resources Commission to provide detailed information on the actual water supply situation, the risk of depletion of ground water resources and possible (negative) impacts on village water supply. In their response letter, dated March 4, 2019, WRC advised as follows:

a. Average borehole yield is about **53.3 L/min (3.2 m^3/hour)** (HAP, 2011). Therefore, this yield can satisfy or meet the estimated volume of water demand of the company for wet cleaning of solar panels **(19.5 m^3/year to 84.5 m^3/year)**.
b. The abstraction rates will not have any negative stress on the aquifer. However, detailed **hydrogeological and geophysical investigations** should be employed to locate extensive fracture zones to increase the chances of drilling success and higher-yielding boreholes to meet demand.
c. Moreover, since the abstraction rates will not have any negative stress on the aquifer, the drinking water supply of the communities involved will not be affected negatively.

Copy of WRC letter is attached as part of Appendix 6.

5.4. Public Disclosure

According to the requirements under the Ghana EIA process (Regulation 15 (1) of LI 1652), the administrative procedure for the EIA exercise requires that the public is adequately and appropriately informed. These requirements mandate proponents to publicly disclose their Environmental reports by advertising in at least one national newspaper and a newspaper, of any circulating in the locality where the proposed undertaking is to be situated. Schedule 3 of the EIA Regulations provides the format for the public disclosure.

The IFC Disclosure Policy (1998) highlights the importance of accountability and transparency in the development process of projects. Under the "Equator Principle 10: Reporting & Transparency", clients are committed to ensure that, at a minimum, a summary of the ESIA is accessible and available online. From these, it is recognised that disclosure of information throughout the project will help to ensure accountability and transparency.

With respect to public disclosure under the EIA Study, the Draft PEA Report was publicly disclosed in the national dailies in July 2012 for comments, and a copy of this publication was provided in the Updated PEA Report. VRA in October 2017, again publicly disclosed the Final Updated PER and the associated stand-alone Non-Technical Summary (NTS) Report in the Daily Graphic and the Ghanaian Times, the two (2) most widely circulating newspapers in the country to enable the public make inputs or provide review comments, latest by November 30, 2017[18].

Copies of the PEA and NTS reports have subsequently been made available at the under-listed locations for the public to assess and provide any review comments:

- E-copy on the VRA Corporate website at www.vra.com
- EPA Head office in Accra
- EPA Upper West Regional Office in Wa
- Lawra District Assembly
- Nadowli-Kaleo District Assembly
- Paramountcy of Lawra Naa

It must be noted that no comments had been received from the public by the close of the deadline of November 30, 2017. This ESIA Report and updated NTS Report, covering the 35MW solar power plants, are to be also made available on the corporate website. Comments can be provided to the ESIA team at the address, tel./fax numbers or e-mail address provided below.

The Chief Executive
Volta River Authority
P. O. Box MB 77, Accra
Tel No: +233-302-664941-9; Fax: +233-30-2662610
Email: corpcomm@vra.com

All comments received following the release of the ESIA/NTS Report, through meetings and written correspondence will be reviewed and addressed as necessary. Going forward and as part of the disclosure processes, VRA will also give approval for KfW Group or any potential funding agency to publicly disclose the ESIA Report / NTS on their online portal.

[18] See Appendix 7 for copies of the Public Disclosure Notices

5.5. Grievance Redress Mechanism

The establishment of Grievance mechanism to receive and facilitate resolution of Affected Communities' concerns and grievances about the client's environmental and social performance is emphasized under Section 35 of the IFC Performance Standard 1 (2012). A grievance is any query, call for clarification, problems, and concerns raised by individuals or groups related to activities undertaken or processes applied by the project. When addressed these grievances are expected to ensure support, as well as help achieve results and sustainability of project activities.

A Grievance Redress Mechanism (GRM) is therefore a system by which queries or clarifications about a project are responded to, problems that arise out of implementation are resolved and grievances are addressed efficiently and effectively. An effective and efficient GRM should have multiple avenues or channels for lodging complaints, transparency, promptness and timeliness of responses and clear procedures. The grievance mechanism is a formal procedure through which communities and individuals affected by VRA's activities can formally communicate their specific concerns and grievances to the company and facilitate resolutions that are mutually acceptable by the parties and within a reasonable timeframe. The grievance procedure may be used by anyone without any concern or fear of retribution.

5.5.1. Grievance Committees

Consultations with the elected representatives of the communities, specifically the District Chief Executives of the Lawra District and Nadowli/Kaleo District Assemblies as well as elected representatives from Lawra and Kaleo communities on the Local Government, known as Assembly persons / Unit committee members was undertaken with a view of collating social information as well as informing them about the project and its impacts on the community members and to request them to represent as Grievance Committee Members.

The list of elected representatives consulted in 2012 who were also to represent as Grievance Committee Members for the three projects affected communities, with mobile phone contacts, are outlined in the Updated PER. As at November 2017, fresh elections had been conducted and new individuals had been elected. Subsequently, as at November 2017, VRA had identified the following persons as key in the two (2) project communities to perform the functions of Grievance Committees as shown in *Table 5-7*. The membership is to be updated depending on the contingencies of the time during implementation.

Table 5-7: Proposed Grievance Committee Members

Community	Name of Assemblyperson	Position	Contact number
Kaleo	• Hon. Katherine T. Lankono • Hon. Ngminnie A. Noah	• District Chief Executive • Kaleo East Assemblyman	• 0207444484 • 0247697937
Lawra	• Naa Puowele Karbo III • Martin Domotier Bomba-Ire • Hon. David Y. Kuudegi	• Lawra Naa • Municipal Chief Executive • Yagpelle Assemblyman	• 0244805521 • 0244985706 • 0208816135

Members of the Grievance Committee are expected to assist VRA in the following ways;

- Serves as a liaison between the community members and VRA
- Address misleading issues/problems if any.
- Bear witness to any damages and compensations to be paid.
- Identify and testify rightful owners of properties.

5.5.2. Grievance Redress Process

Currently, a Grievance Redress Mechanism – Operational Manual (June 2016) has been released by the Ghana EPA. The Manual seeks to ensure an efficient and transparent execution of the GRM process and was developed to provide a standardized mode of addressing grievances across board. It is therefore planned that the strategies recommended in the Operational manual is to be adopted by the VRA in project implementation. Recommended steps for grievance redress mechanism outlined in the manual are as follows:

- Receive and register grievance
- Acknowledge receipt of grievance
- Access and assign grievance for investigation
- Investigate grievance
- Select a resolution option
- Formulate and communicate response
- Institute resources or appeal mechanism
- Follow up and close out
- Monitor, report and evaluate the GRM.

The Grievance Procedure Form to be utilized by the project was provided in the Updated PER. However, the sample formats to record and register complaints as provided in the GRM-Operational Manual is now to be adopted for the project and are provided as Table 5-8 and Table 5-9. All formal grievances will receive a formal written reply within seven (7) working days. In all cases VRA will state the date of the resolution. The final response will provide additional information or, if appropriate, further instructions on proposed measures to resolve the issues. VRA will make concerted efforts to resolve grievances amicably; yet, if a grievance cannot by resolved, VRA will seek to involve other individuals or agencies, as necessary.

5.6. Next Steps in the Stakeholder Engagement Process

Based on the issues raised at the project briefings, status quo conditions of the study area and the nature of the proposed development, the key issues of concern that must be considered during project implementation are summarized as below:

- Effective Community Entry by Project Contractors
- Employment for Community Members
- Implementation of a Corporate Social Responsibility Programme
- Availability of Grievance Redress Mechanism
- Environmental Challenges
- Land Acquisition & Compensation for Loss Property
- Changes in Land Use
- Risk to Public Safety, Community Health & Security Issues
- Groundwater Abstraction and Community water demand
- Change management
- Continued Engagement During Construction & Operational Phase
- Effective Monitoring & Evaluation Process

To address the above, further consultation is planned to refresh the project information and to disclose the mitigation and other management plans upon commencement of constructional activities. The following activities are to be undertaken as part of the next steps engagements:

- Formal notification of the Lawra and Nadoli-Kakleo District Chief Executives on the date of project commencement. The letter should be copied to the traditional authorities.
- Self-introduction of EPC Contractor to the DCEs on arrival of onsite prior to project implementation.
- Self-introduction of EPC Contractor to traditional authorities in Lawra and Kaleo on arrival of onsite prior to project implementation. It's important that the platform is created for the various parties to provide information on concerns that needs to be considered during the project implementation and to agree on grievance redress mechanism in place.
- VRA / EPC Contractor must observe all necessary traditional requirements prior to project commencement.
- Continuation of stakeholder consultation and communications through project construction and implementation phases.
- The appointment of a construction community liaison officer who shall directly address issues raised by the community during the construction phase of the project;
- VRA will provide information releases to the community if new issues arise or if the community has specific concerns. Company representative contact information will be available to the public to address concerns and questions during construction as well as operations and maintenance.
- Personal consultations as requested or if warranted;

- Meetings with district and other local government authorities;
- Ongoing consultation and meetings with local communities and organizations;

In addition, VRA shall also monitor and report on the on-going stakeholder engagement efforts to ensure that the desired outcomes are being achieved, and to maintain a comprehensive record of engagement activities and issues raised. The stakeholder engagement activities should be periodically evaluated using the following indicators:

- Level of understanding of the project by stakeholders as determined through random surveys conducted in the affected communities on a bi-annual basis using a short questionnaire;
- Monthly review of grievances received and how they have been addressed, including analysis of the time taken to resolve the grievances; number of grievances resolved to the satisfaction of the original party; categorisation in themes of complaints identifying areas for improvements. This will include grievances submitted directly to VRA and those submitted to contractors; and
- Level of involvement of affected people in committees and joint activities and in the project, itself.

To measure these indicators, the following data are to be used:

- Issues and management responses linked to minutes of meetings;
- Feedback from primary stakeholder groups (through interviews with sample of affected people); and
- Grievance registers from VRA and contractors.
- These evaluation reports will be presented to the Project Team, including that the EPC Contractor, on a quarterly basis.

A summary of the results shall be provided in the Project Annual Environmental Report that will be submitted to the Ghana EPA and the Energy Commission as part of project implementation reporting.

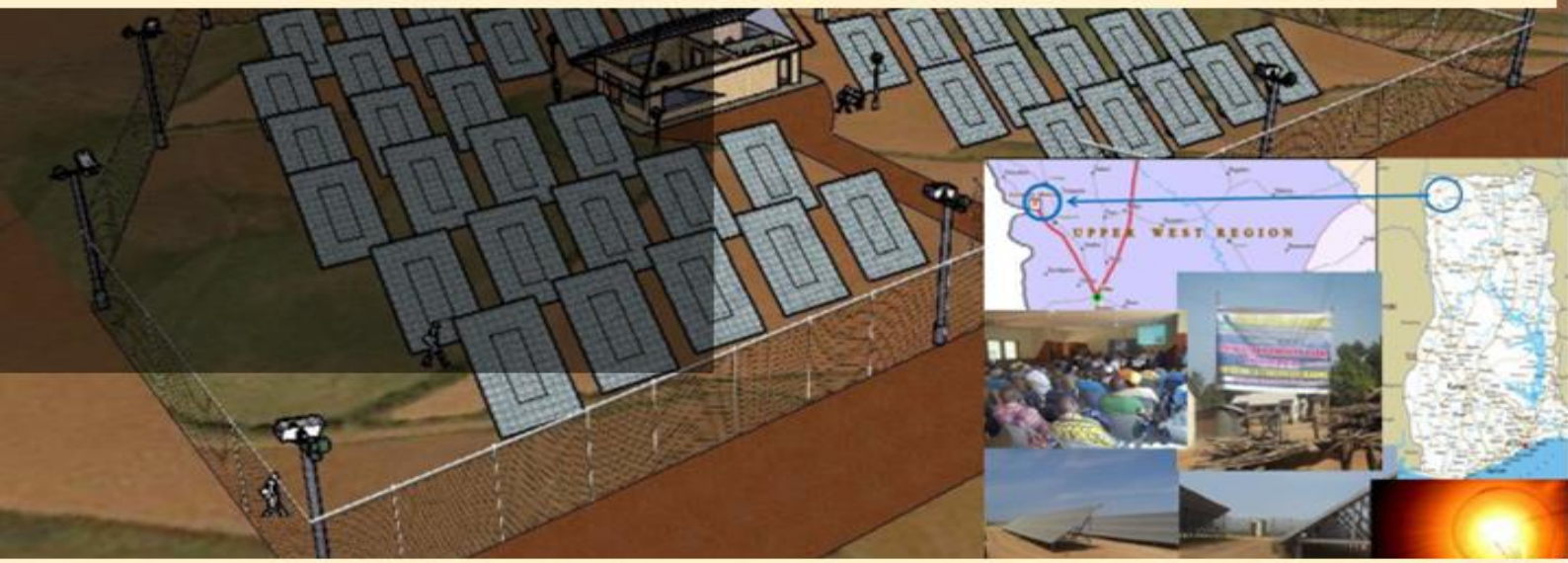
Table 5-8: Sample Format of Grievance Register

Ref. No.	Date Receipt	Particulars of Client				Particulars of Grievance				
		Name	Address	Phone No	Whether acknowledgement given at the time receipt (Yes/No)	Subject of t grievance	Office	Brief Description	Date of Acknowledgment / Date of redress	Immediate action taken

Table 5-9: Sample Form for Assessing Grievance

Ref. No	Date & description of Grievance	Grievance Prone Area Identified	Root Cause Identified	Action Required to Improve System	Planned date and Authority Responsible for Taking Action	Action Taken Date

Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



CHAPTER 6:

IMPACTS IDENTIFICATION & SIGNIFICANCE

6 IMPACTS IDENTIFICATION & SIGNIFICANCE

6.1. Overview

As required under the Ghana EA Regulations, the ESIA process is expected to identify the potential impacts, both positive and negative, of the proposed development that occurs during the pre-construction, construction, operational and decommissioning phases of the development. The following categories/attributes: nature, duration, spatial extent reversibility, direct and indirect impacts, short term and long term, positive or negative, cumulative, etc. are to be utilized in identifying project impacts in accordance with the Environmental Assessment Regulations LI 1652 (1999). To identify the potential impacts, it is important that the nature of the proposed projects is well understood so that the impacts associated with the projects can be assessed.

The process of identification and assessment of impacts is to be done based on the following:

- Determining the current environmental conditions in enough detail so that there is a baseline against which impacts can be identified and measured.
- Determining future changes to the environment that will occur if the activity does not proceed;
- Developing an understanding of the activity in enough detail to understand its consequences; and
- Identification of significant impacts which are likely to occur if the activity is undertaken.

To achieve this, a description of the 35MW Solar Power Project and associated sub-transmission line to be developed in two phases and utilising four (4) sites within Kaleo and Lawra communities has been discussed under Chapter 3 of this ESIA Report. Included is the associated 34.5kV sub transmission and water supply systems that are to be constructed under both phases. This description covered project activities from preconstruction, construction and operation and maintenance phases. The baseline environmental data providing information on the physical, ecological and socio-economic data on the geographical area of influence as well as possible receptors within the Lawra and Nadowli-Kaleo Districts that could be impacted upon during project development has also been discussed under Chapter 4. Chapter 5 outlines issues that should be considered during project development based on stakeholder (interested and affected) concerns during the various project related engagements and discussions.

6.2. Approach to Impact Assessment

A simple, clearly defined method has been used in order to accurately determine the significance of the predicted impact on, or benefit to, the surrounding natural and/or social environment. Nonetheless, it must be remembered that an impact assessment will always contain a degree of subjectivity, as it is based on the value judgment of various specialists and Environmental Assessment Practitioners. The evaluation of significance is thus contingent upon values, professional judgement, and dependent upon the environmental and community context. Ultimately, impact significance involves a process of determining the acceptability of a predicted impact to society.

The following methodology has been applied to the predication and assessment of impacts:

- **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
- **Cumulative impacts** result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. The cumulative impacts will be assessed by identifying other applicable projects, such as construction and upgrade of electricity generation, and transmission or distribution facilities in the local area that have been approved (i.e. positive EP has been issued) or is currently underway.
- **Nature of impact** - this review the type of effect that a proposed activity will have on the environment and should include "what will be affected and how?"

- **Potential Intensity**

Potential Intensity Description (negative)	**Rating**	**Score**
Potential to severely impact Human Health (morbidity/mortality) or to lead to Loss of species (fauna and/or flora)	Very High/Fatal Flaw	16
Potential to reduce faunal/flora population or to lead to severe reduction/alteration of natural process, loss of livelihoods or seve impact on quality of life, individual economic loss	High	8
Potential to reduce environmental quality – air, soil, water. Potential Loss of habitat, loss of heritage, reduced amenity	Medium	4
Nuisance	Medium-Low	2
Negative change – with no other consequence	Low	1
Potential Intensity Description (positive)	**Rating**	**Score**
Potential Net improvement in human welfare	High	8
Potential to improve environmental quality – air, soil, water. Improved individual livelihoods	Medium	4
Potential to lead to Economic Development	Medium-Low	2
Potential positive change – with no other consequence	Low	1

Note that the concept of "**irreplaceable loss of a resource**" is to be taken into account in the Potential Intensity score of an impact

- **Irreplaceability of resource** loss caused by impacts –

- High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment. For example, if the project will destroy unique wetland systems, these may be irreplaceable);
- Moderate irreplaceability of resources;
- Low irreplaceability of resources; or
- Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).

- **Spatial extent** – The size of the area that will be affected by the risk/impact:

Spatial Extent Description	Score
Site specific	1
Local (<10 km from site)	2
Regional (within 100 km of site)	3
National	4
International/Global (e.g. Greenhouse Gas emissions or migrant birds).	5

- **Duration** – The timeframe during which the risk/impact will be experienced:

The concept of "reversibility" is reflected in the duration scoring, i.e. the longer the impact endures the less likely it will be reversible.

Duration Description	Score
Temporary (less than 2 year) or duration of the construction period. This impact is fully reversible.	1
Short term (2 to 5 years). This impact is reversible.	2
Medium term (5 to 15 years). The impact is reversible with the implementatio of appropriate mitigation and management actions.	3
Long term (> 15 years but where the impact will cease after the operational lif of the activity). The impact is reversible with the implementation of appropria mitigation and management actions.	4
Permanent (mitigation will not occur in such a way or in such a time span tha the impact can be considered transient). This impact is irreversible	5

- **Reversibility of impacts -**
  - High reversibility of impacts (impact is highly reversible at end of project life, i.e. this is the most favourable assessment for the environment. For example, the nuisance factor caused by noise impacts associated with the operational phase of an exporting terminal can be considered to be highly reversible at the end of the project life);
  - Moderate reversibility of impacts;

- Low reversibility of impacts; or
- Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment. The impact is permanent. For example, the loss of a palaeontological resource on the site caused by building foundations could be non-reversible).

Using the criteria above, the impacts will further be assessed in terms of the following:

- **Probability** – The probability of the impact/risk occurring:

Probability Description	Score
Unlikely (little or no chance of occurring <10%)	0.1
Low Probability (10 - 25% chance of occurring)	0.25
Medium Probable (25 - 50% chance of occurring)	0.5
Highly probable (50 – 90% chance of occurring)	0.75
Definite (>90% chance of occurring).	1

- **Magnitude**–The anticipated severity of the impact (Intensity + Extent + Duration):
  - Extreme (extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they permanently cease);
  - Severe (severe alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
  - Substantial (substantial alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
  - Moderate (notable alteration of natural systems, patterns or processes, i.e. where the environment continues to function but in a modified manner); or
  - Slight (negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected).

- **Significance** – Will the impact cause a notable alteration of the environment? To determine the significance of an identified impact/risk, the consequence is multiplied by the probability (as shown below).

*Significance Rating = Impact Magnitude * Probability*

"Impact Magnitude" = Potential Intensity + duration + extent

Table 6-1: Guide to assessing risk/impact significance as a result of consequence and probability

Scoring	Significance rating	Description
18-26	**Fatally Flawed**	The project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating.
10 - < 18	**High**	The impacts will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making.
5 - <10	**Medium**	The impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures and will only have an influence on the decision-making if not mitigated.
2 - <5	**Low**	The impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures and will not have an influence on decision-making.
<2	**Very Low**	The impact may result in very minor alterations of the environment and can be avoided through the implementation of mitigation measures.

- **Status** - Whether the impact on the overall environment (social, biophysical and economic) will be:
  - Positive - environment overall will benefit from the impact;
  - Negative - environment overall will be adversely affected by the impact; or
  - Neutral - environment overall will not be affected.

- **Confidence** – The degree of confidence in predictions based on available information and specialist knowledge:
  - Low;
  - Medium; or
  - High.

Where appropriate, national standards will be used as a measure of the level of impact.

6.2.1. Dealing with Uncertainty

Even with a final design and an unchanging environment, impacts are difficult to predict with certainty, but in projects such as the proposed power project, where the design process is currently in progress, uncertainty stemming from on-going development of the Project design is inevitable, and the environment is typically variable from season to season and year to year. Where such

uncertainties are material to the ESIA findings, they are clearly stated and are approached conservatively ('the precautionary approach') in order to identify the broadest range of likely residual impacts and necessary mitigation measures.

Potential impacts may be assessed using tools ranging from quantitative techniques such as modelling to qualitative techniques based on expert judgment and historical information. The accuracy of these assessment tools depends on the quality of the input data and available information. Where assumptions have been made, the nature of any uncertainties associated with the assumption is discussed. For qualitative predictions/assessments, some uncertainty is removed through consultation. These uncertainties are reflected in the Confidence level scoring.

6.2.2. Mitigation and Assessing Residual Impacts

As specified in Section 12 of Part II of the ESIA Regulations, appropriate mitigation measures will be identified to eliminate, minimise or manage identified potential significant environmental effects. Impacts will be described both before and after the implementation of the proposed mitigation and management measures. It is expected that for the identified significant impacts, the project team will work with the client in identifying suitable and practical mitigation measures that are implementable. Mitigation that can be incorporated into the Project design in order to avoid or reduce the negative impacts or enhance the positive impacts will be developed. A description of these mitigation measures will also be included within the Environmental & Social Management Plan (ESMP).

Residual impacts are those impacts which remain once the mitigation measures have been designed and applied. Following the identification of mitigation measures to address significant adverse effects, an assessment of the significance of any residual effects (i.e. those remaining after mitigation) will be completed. The result is a significance rating for the residual impact.

The proposed enhancement /mitigation measures associated with the identified impacts are provided under Chapter 7 of this ESIA Report.

6.2.3. Proposed Management & Monitoring

After the completion of the assessment, proposals for monitoring requirements are to be put forward where relevant. Proposals for monitoring are to be designed to evaluate the accuracy of the impact prediction and the success of any implemented mitigation measures. Thus, the final stage in the IA Process has been the definition of the basic management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards/ guidelines; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted. This is covered in Chapter 8 under Environmental & Social Management Plan (ESMP).

6.3. Positive Project Impacts

The Project will result in significant and crucial positive environmental and economic impacts on the strategic and national level given the recent challenges the energy sector in Ghana faced

which had serious implications on Ghana's energy security as well as major economic burdens to the Ghanaian economy. Such positive impacts are important to highlight and considered before investigating the potential negative environmental impacts anticipated from the Project.

The major positive impacts of the project are listed as follows:

- Minimisation of Greenhouse Gas Emissions
- Increased employment opportunities,
- Stabilization of electricity,
- Promotion of economic growth in the country.

6.3.1. Minimisation of Greenhouse Gas Emissions

The negative environmental impacts from generating electricity through conventional fossil fuel burning at thermal power plants are very well known. This most importantly includes air pollutant emissions such as Ozone, Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Particulate Matter, and other gases which are the cause of some serious environmental concerns such as smog, acid rain, health effects, and many others. In addition, the burning of fossil fuels results in carbon dioxide emissions; a primary greenhouse gas emitted through human activities which contributes to global warming. The main human activity that emits CO_2 is the combustion of fossil fuels for electricity production and transportation. Concurrently, global climate change has become an issue of concern and so reducing greenhouse gas emissions have also emerged as primary issues to be addressed as the world searches for a sustainable energy future.

As indicated, the Second Biennial Update Report conducted for the period 1990-2016 estimated the total national greenhouse gas emissions are estimated at 31.5 million tonnes carbon dioxide equivalent (MtCO2e) in 2016 representing 65% increase compared to 2000 emissions. The Energy sector contributes 50.2% of the total 2016 GHG emissions. Within the Energy sector, road transport and electricity generation are the two dominant sources of GHG emissions. Thus, developing a renewable energy resource lessens the need to use fossil fuels. Renewable energy generation does not require fuel for turbine operation, and has no emissions directly related to electricity production. As such, its operations do not produce CO_2, SO_2, NOx or particulate matter or any other form of air pollutant. Thus, one of the direct benefits that Ghana will enjoy by developing its renewable energy resources is the minimisation of Greenhouse Gases emissions (GHG) from power generation in the country.

The Volta River Authority (VRA) originally intended to use the Clean Development Mechanism (CDM) under the Kyoto Protocol as a co-financing source for the envisaged solar photovoltaic (PV) power plants to be developed as part of its Renewable Energy Development Programme (REDP). A Project Design Document for the solar PV projects has been prepared by Lahmeyer International GmbH (LI) under the REDP. Estimates of emissions reduction for the 12MW component (8MW Kaleo/4MW Lawra) of this project is provided in Table *6-2* below:

Table 6-2: Estimates of Emission Reductions for each VRA Solar PV Plant

Solar PV	Kaleo	Lawra
Installed Capacity (kWp)	7,900	3,950
Annual Emission Reductions (tCO2e)	2,986	1,538
Total Emission Reductions (tCO2e)	29,860	15,380
Number of Crediting Years (years)	10	10

Source: Renewable Energy Development Programme Ghana: Work Package Closure – CDM PV Projects, August 2013

VRA decided not to proceed with the CDM project development for the solar PV projects in the Upper West Region as the project financing institute, KfW Group, by its rules, is not allowed to finance projects, which would be selling CDM certificates at the same time.

Constructional Phase

There are no positive impacts during the construction phase as potential for minimising greenhouse gas emissions can only be realised when project development is complete and operational.

Operational & Maintenance Phase

The proposed development represents an investment in clean, renewable energy infrastructure, which, given the challenges created by climate change, represents a positive social benefit for society, as it would indirectly reduce/eliminate considerable percentage of air pollutants emissions due to consistent use of thermal power generation to support the exiting hydropower plants. The proposed project will not consume energy, but will instead provide a new source of clean, renewable electricity national grid. As shown in *Table 6-2*, the 4MW Lawra as well as the 8MW Kaleo under Phase 1 of the project, will on average displace around 4,524 ton of CO_2 annually. Currently, these two (2) solar PV projects have been included as part of the Ghana's Nationally Determined Commitments under the "Scale up renewable energy penetration by 10% by 2030" to help the country achieve its legally-binding targets of reducing greenhouse gases for the period 2020 - 2030 following the signing and ratification of the Paris Agreement by the country. A total of 912.3 kt/year of CO2e annual savings by 2030 is estimated under the national scale up target[19]. It is expected that a review of the national targets in 2025 could consider the entire 35MW project.

The potential intensity of the project in minimising GHG emissions can be described as medium positive as it leads to improving environmental quality, spatial extent is global in nature, duration defined as long-term as it will continue as long as the project is in operation. The inclusion of the project as part of the nationally determined commitments can be described as definite and has a high positive impact as it will lead to improvement of environment due to low carbon emissions

[19] Ref: Multi-sectoral implementation plan for Ghana's Nationally Determined Contribution to the Paris Climate Agreement (Draft), October 2018

and individual livelihoods for the entire country during the 25 years of its operations. At a high confidence level, the significance of the impact can be described as **HIGH POSITIVE.**

6.3.2. Increased Employment Opportunities

The proposed project has the potential to create jobs in the local area both directly and indirectly. Details of the work force have been outlined in Chapter 3. Direct job opportunities will be available for high calibre professionals including engineers, mechanics and consultants. It is, however, unlikely that the local community will benefit from this calibre of specialised job market. Of greater relevance to the local community will be job opportunities involving unskilled and semi-skilled labour. Unskilled jobs will be offered mainly to the local people.

Since the project will require local materials for the above project activities, the local community stand to benefit from their engagement in several activities. Other employment opportunities in the project area will spring from spin-off activities including trade, accommodation, and supply of goods and services to both the skilled and unskilled labour. In addition to direct benefits from the employment of residents, the proposed project may also offer potential economic benefits through the procurement of goods and services, both at the regional and national level.

Pre-constructional & Constructional Phase

Various activities have been undertaken at the pre-constructional phases that has required some form of employment opportunities. This included the project designs, land surveying, land acquisition as well as stakeholder consultations. Construction of the project will lead to a positive impact on the employment of the area and region. During the constructional phase, this project will create job opportunities in the project area and beyond, including the international community and therefore the spatial extent will be international. Local labour sources and local resources will be utilised where possible. It is expected that many of the workers will either originate from the neighbouring area or be staying in houses and apartments in nearby communities. The potential for economic development therefore exists and this will last during the duration of the constructional phase. Subsequently, the impact of employment created during construction will be definite, thus the project has the potential to lead to job employment, and at a high confidence level, the impact can be described as **MEDIUM POSITIVE.**

Operational & Maintenance Phase

As indicated under Chapter 3, VRA staff will operate and maintain the PV Power Plants once it has been commissioned. During the operational phase, beneficiaries for employment will mainly be engineers and technicians with experience in the power sector who can provide a swift response to labour requirements with minimum training. Based on the interactions during the public hearings, it was realised that very few of these types of candidates will be available from within the local area. As a result, employment benefit for skilled labour during operational phase is expected to be experienced mainly by university graduates usually residing in urban centres such as Wa. Other employment opportunities in the project area will spring from spin-off activities including trade, accommodation, and supply of goods and services to both the skilled

and unskilled labour. Increased income generating opportunities will be experienced at the local level to varying scales, causing different degrees of economic growth.

Looking at the numbers involved, the potential intensity on employment is medium low, regional in spatial extent and of long-term duration and high probable and at a medium confidence level, the impact can be described as **MEDIUM POSITIVE** in nature.

6.3.3. Stabilization of Electricity

Developing the solar power facility to feed the national grid with approximately 35MW of power will contribute to creating a stable and reliable power supply base and helping to solve the serious domestic power supply volatility experienced in Ghana over recent years. The current primary energy generation sources in Ghana have experienced serious limitations due to low water levels and oil and gas supply constraints. Consequently, solar power facility coming on stream by 2020 will provide broader electricity supply market space as well as optimize the power generation portfolio and improving generation mix and power supply stability and reliability in Ghana.

Pre-Constructional & Constructional Phase

There are no positive impacts during the pre-constructional and constructional phases as stabilisation of electricity can only be realised when project development is completed and operational.

Operational & Maintenance Phase

Operations of the solar power facility is envisaged to contribute significantly to addressing potential power demand and supply growth in-balance and deficit in the near future, as it will play a significant role in the stabilization of power situation in Northern Ghana in specific and the country in general during the operational phase. The potential intensity can be described as medium low, spatial extend on the regional level and spatial extent to be long term. Stabilisation of electricity can be described to be definite and at a high confidence level, can be described as a **HIGH POSITIVE** impact on the country as it will lead to improvement of environment and individual livelihoods for the entire country during the 25 years of its operations.

6.3.4. Promotion of Economic Growth

Growth in the Ghanaian population is driving up electricity demand. The current access rate of electricity in Ghana is estimated at 83 percent, with 91 percent in urban and only 50 percent in rural areas. An estimated 1.2 million of households are presently without power supply. Solar energy is used in some remote off-grid locations and at a single on-grid facility (a small pilot project in the country's north)[20]. Thus, this 35MW solar project will play a significant role in stimulating economic growth, especially in the Upper West Region and neighbouring Upper East and Northern Region. The power input will contribute significantly to the national

[20] https://www.export.gov/article?id=Ghana-Energy

Electrification Programme, which has potential to promote spin-off effects on rural economy. The project also has power export potential to companies in the neighbouring countries, particularly Burkina Faso.

Pre-Constructional & Constructional Phase

There are no positive impacts during the pre-constructional and constructional phases as the promotion of economic growth can only be realised when project development is completed and operational.

Operational & Maintenance Phase

The project has the potential of reducing the cost of the power because the power generated from the project will in the long-term cost less than any other existing sources as its production cost will not increase thereafter. In effect, this implies that the project has the potential to usher the country into a low-power tariff regime. This has not only a positive effect on the cost of the energy production but will also lead to economic gains through improved competitiveness. The Project in specific will contribute to increasing energy security through reliance on an indigenous, inexhaustible and mostly import-independent energy resource.

At a high confidence level, the impact of the project in the promotion of economic growth during the 25 years of its operations can be said to be **MEDIUM POSITIVE** as it is national and of long term in nature and definite.

6.4. Negative Impacts on Physical Environment

Details of the physical environment, within Kaleo in the Nadowli-Kaleo District and Lawra in the Lawra District has been outlined in Chapter 3. Information provided include national GHG Gases Emissions, Atmospheric & Climatic Conditions, Ambient Noise, Air Quality, Topography and Drainage as well as Geology & Soils. The elements of the PV plants that has currently been carried out at this pre-construction stage have been outlined under Section 3.6. There are no negative impacts during the pre-constructional phase as no major physical activity is undertaken to result in such impacts and therefore discussions have been limited to the negative impacts on these receptors during the Constructional and Operational & Maintenance Phases.

It is considered that the proposed development is unlikely to create daylight, sunlight or overshadowing impacts beyond the boundary of the project site. The detailed design of the development would be in accordance with the relevant design criteria set out in the best practice document prepared by the Building Research Establishment (BRE) 'Site Layout Planning for Daylight and Sunlight: A Guide to Good Practice' On this basis it is proposed that no further regard be given to micro-climate issues in the EIA.

6.4.1. Impacts of Noise & Vibration

The effects of excessive noise and vibration include human welfare and physiological disruption, hearing impairment and communication problems. These may cause elevated stress levels and associated behavioural and health problems. They can also cause auditory fatigue, sleep disorders, and even contribute to learning problems in children. Vibrations can damage roadside structures, particularly makeshift or lightly constructed buildings. Noise also has the potential to disrupt wildlife habitats and movements.

The most significant health effect associated with noise of high intensity over prolonged periods or very loud intensity noise for relatively brief periods (Impact Noise) is physical damage to the ears known as Noise Induced Hearing Loss (NIHL). Noise levels in workplaces exceeding 85-dB (A) on an eight-hour Time Weighted Average (TWA) are injurious to the ears. The threshold of hearing tends to increase with length of exposure to high intensity noise. Other recognised effects of noise are irritability, headache, and sleep disturbances and increased risk of accidents due to interference with communication. In order to prevent NIHL to workers exposed to high noise intensities, maximum exposure duration is recommended according to the intensity. These are provided in *Table 6-3* and Table *6-4* below.

Table 6-3: Ghana EPA Ambient Noise Level Standards

Zone	**Description of Area of Noise Reception**	**Permissible Noise Level In dB(A)**	
		DAY 0600 - 2200	**NIGHT 2200 - 0600**
A	Residential areas with negligible or infrequent transportation	55	48
B1	Educational (school) and health (hospital clinic) facilities	55	50
B2	Areas with some commercial or light industry	60	55
C1	Areas with some light industry, places of entertainment or public assembly, and places of worship such as churches and mosques	65	60
C2	Predominantly commercial areas	75	65
D	Light industrial areas	70	60
E	Predominantly heavy industrial areas	70	70

Table 6-4: Ghana EPA guideline levels for noise exposure

Cumulative period for which intermittent noise is present in any hour	**Maximum allowable adjustment above the permissible ambient level (dB_A)**
More than 15 minutes	± 0
Exceeding 5 minutes but not exceeding 15 minutes	-5
Exceeding 1 minute but not exceeding 5 minutes	-10
Not exceeding 1 minute	-15

Noise surveys and resulting assessments are carried out in accordance with the provisions of each of the recognised standards or guidelines of the EPA. The standards and criteria offer guidance

that is intended to prevent or reduce noise pollution at the local level, by suggesting suitable daytime and night-time noise levels at the external facade of a building, or alternatively, inside the structure. The standards and guidelines also provide advice on how to minimise the adverse impacts of noise at the planning stage of a development and are an integral component in development plan policies. The control of noise in Ghana is largely accomplished through such guidance and legislation and is normally implemented by the EPA.

This section provides a summary of the potential noise and vibrational impacts of the proposed PV power plant, based on an assessment of activities that will occur during its construction and operation, prior to the inclusion of mitigation measures. The assessment with respect to ambient noise quality of the study area has been done for the following project activities:

- Construction activities including site preparation, piling work, access road widening, construction of ancillary facilities;
- Transportation of construction materials, machinery and personnel;
- Operation of DG sets; and
- Demolition activities during demobilisation phase.

The methodology of this assessment is based on the collection of a wide range of data and information from surveys and published material. It is generally accepted that predicted noise levels from the development need to be compared with existing background levels at particularly sensitive residential locations close to the site. A preliminary noise survey has been undertaken to identify impacts of noise from the proposed project. Recorded noise levels during the survey are shown in Table 4-6. Noise levels were all largely within the permissible EPA values. The noise levels were influenced largely by moving vehicles in the project area. Neighbouring infrastructure within the project sites at Kaleo and Lawra that can be affected with noise and vibrational effects are shown in Table 4-1 and Table 4-2 respectively.

Constructional Phase

The potential for noise disturbance is normally greatest during the construction phase of a project. During construction, activities such as the use of equipment, the preparation of the site and traffic movements have the potential to generate noise impacts. Heavy duty machinery and vehicular movement, friction between vehicles and the road surface, driver behaviour, vehicles' horns, resonance of traffic and piling increase ambient noise levels and vibration shall occur far beyond the immediate project corridor.

Table 6-5 outlines the possible diesel mobile equipment that might be used in the construction of roads, platforms and erection of solar panels, and typical sound power levels (LWA's) for such equipment. LWA's were sourced from the British Standard BS 5228-1:2009 code of practice for noise and vibration on construction and open sites (BSI, 2008).

Table 6-5: Noise data for construction and demolition equipment

Activity	Equipment	LWA (dBA)	LAeq (dBA) at distance "d"		
			10 m	100 m	500 m
Sound level data on site preparation					
Clearing site	Dozer (142 kW)	103	75[(a)]	55	41
	Tracked excavator (102 kW)	106	78	58	44
	Wheeled backhoe loader (62 kW)	96	68	48	34
Distributing of material	Articulated dump truck (tipping fill) (187 kW)	102	74	54	40
	Articulated dump truck (187 kW)	109	81	61	47
Earthworks	Dozer (142 kW)	109	81	61	47
	Tracked excavator (226 kW)	107	79	59	45
Loading lorries	Tracked excavator (75 kW)	107	79	59	45
	Wheeled loader (193 kW)	108	80	60	46
Rolling and compacting	Dozer (towing roller) (142 kW)	109	81	61	47
	Hydraulic vibratory compactor (tracked excavator)	106	78	58	44
	Vibratory roller (29 kW)	102	74	54	40
Sound level data on piling and ancillary operations					
Rotary bored piling - cast in situ	Compressor for mini piling (45 kW)	103	75	55	41
	Large rotary bored piling rig	111	83	63	49
	Mini piling rig (29 kW)	104	76	56	42
	Mini tracked excavator (17 kW)	96	68	48	34
	Tracked drilling rig (104 kW)	110	82	62	48
Welding / cutting steel piles	Gas cutter (cutting top of pile)	96	68	48	34
	Generator for welding	101	73	53	39
	Hand-held gas cutter	93	65	45	31
	Hand-held welder (welding piles)	101	73	53	39
Sound level data on general site activities					
Distribution of materials	Articulated dump truck (194 kW)	109	81	61	47
	Fuel tanker lorry	104	76	56	42
	Fuel tanker pumping	100	72	52	38
	Tracked excavator (41 kW)	99	71	51	37
	Wheeled backhoe loader (62 kW)	95	67	47	33
	Wheeled excavator (90 kW)	94	66	46	32
Lifting	Caged material hoist (electric)	96	68	48	34
	Lifting platform (35 kW)	95	67	47	33
	Mobile telescopic crane (260 kW)	110	82	62	48
	Tower crane (51 kW)	105	77	57	43
	Tracked mobile crane (240 kW)	103	75	55	41
	Wheeled mobile crane (275 kW)	98	70	50	36
Miscellaneous	Angle grinder (grinding steel) (2.3 kW)	108	80	60	46
Mixing concrete	Cement mixer truck (discharging)	103	75	55	41
	Concrete mixer truck (216 kW)	108	80	60	46
Power for lighting	Diesel generator (15 kW)	93	65	45	31
	Pumping water (7.5 kW)	93	65	45	31
Power for site cabins	Diesel generator	94	66	46	32
Pumping concrete	Concrete mixer truck (discharging) & concrete pump (pumping)	103	75	55	41
Pumping water	Water pump (diesel) (10 kW)	96	68	48	34

Activity	Equipment	LWA (dBA)	LAeq (dBA) at distance "d"		
			10 m	100 m	500 m
	Water tanker extracting water	107	79	59	45
Dust suppression	Dust suppression unit trailer	106	78	58	44
Sound level data on road construction works					
Earthworks	Articulated dump truck (194 kW)	109	81	61	47
	Bulldozer (250 kW)	114	86	66	52
	Tracked excavator (172 kW)	108	80	60	46
Paving	Asphalt paver (and tipper truck) (94 kW)	112	84	64	50
Road planning	Road planer (185 kW)	110	82	62	48
Rolling and compaction	Road roller (95 kW)	108	80	60	46
Trenching	Tracked excavator (27 kW)	102	74	54	40
	Wheeled excavator (51 kW)	98	70	50	36
Sound level data on demolition					
Breaking up concrete	Breaker mounted on backhoe (59 kW)	120	92	72	58
	Hand-held pneumatic breaker	111	83	63	49
	Pulverizer mounted on excavator (147 kW)	104	76	56	42
Breaking up/cutting	Gas cutter	107	79	59	45
	Tracked excavator (74 kW)	111	83	63	49
Crushing concrete	Tracked crusher (172 kW)	110	82	62	48
Dumping rubble	Articulated dump truck (dumping) (250 kW)	108	80	60	46
	Tracked excavator (loading truck) (228 kW)	113	85	65	51

Source: *Environmental & Social Impact Assessment for the proposed development of a Wind Energy Facility in Anloga Extension (Dec. 2017)*

The main impact of construction phase is disturbance as a result of increased environmental noise levels caused by traffic, earthworks, infrastructure erection and demolition. Noise from construction works can be difficult to control for several reasons, including:

- Activities are carried out in the open;
- Although transient in nature, it can cause notable disturbances when ongoing;
- Noise arises from many different activities and types of plants and the intensity and character can vary significantly at different phases of construction/decommissioning;
- Sites cannot be excluded by planning control from areas sensitive to noise.

During the construction period, the use of the types of equipment listed above, among others could generate noise in the project area. The operations on site are also not intrinsically noisy, i.e. excavation of foundation, mixing of concrete, bolting of steel work, vehicle movement for delivery of men and materials. Resulting equivalent sound pressure level (LAeq) at 10 m, 100 m and 500 m from each activity or piece of equipment is also included in
Table 6-5 and compared to the day-time Ghana EPA noise standard of 55 dBA. LAeq's were calculated assuming hemispherical propagation and by conservatively not considering atmospheric and ground attenuation. The impact of most activities reduces to below the Ghana EPA noise standard and IFC guideline for residential areas within 30 m to 350 m from the activity or piece of operational equipment. Looking at the distance of about 5km of the Lawra

Community from the project site, noise and vibrational noise will have very no effect on the community members.

For traffic noise, movements from the Tema Port to both project sites through a distance of over 800km will not have any impact on traffic noise as existing highways with heavy vehicular movements are to be utlised. The key issue with traffic noise will be the overall daily traffic movements to the project sites, especially that of Kaleo where there are many neighbouring infrastructures along the main access route. The potential therefore exists for impacts to be felt by inhabitants along the access routes, especially at Kaleo, due to this change. However, this is likely to represent a slight increase over the current traffic volumes due to the very low current number of movements. The overall total traffic volumes predicted to be low as the delivery requirements for men and materials at any one site are low and will be restricted to daytime only.

Thus, the main potential noise and vibrational impact during project construction will be from vehicle and construction noise affecting workers. At a medium confidence level, the significance rating of the impact is said to be **MEDIUM NEGATIVE**. This is because the potential intensity of noise increases over the current baseline along the access routes will be a nuisance and is medium low, spatial extent being local to regional in nature, short term in nature as it will persist over the constructional period, and definite to occur.

Operational & Maintenance Phase

During operation, the main sources of noise are likely to be the vehicular noise and vocal noise from staff. The solar power as a facility is not considered to exhibit any significant noisy operations, although the facility's inverters and transformers may produce noise, but this is not considered a serious issue, since they will not generate any significant noise. Plant operations might increase ambient noise level in few areas, mainly due to operation of the electrical components but the noise generated will not be audible at sensitive receivers. Low levels of noise will be generated during routine maintenance activities. The highest noise level to sensitive receptors will be from daily vehicular traffic movements. However, for Kaleo, the project areas are already populated, and vehicular movements are a daily event.

The closest community to the project area to the Lawra site is the Lawra township, which is over 3km away. Hence, it can be considered that the only people who could potentially be impacted by the noise are the employees working within the project site; these increased noise levels are considered occupational noises that require occupational health and safety measures. In addition to this, some reptiles and mammals, within the project area can potentially be driven away from the site due to the sound levels. However, these noise impacts are not considered to significantly harm animals nor cause impacts on a population level. Since the activities will occur under normal operating conditions and are expected to have only localized and temporary effects within the project area, the impact significance is low.

Protective instruments will be provided to the operators and workers working near the high noise generating machinery. As per Occupational Safety and Health Administration (OSHA) Standards,

the maximum allowable noise level for the workers is 90 dB (A) for 8 hours exposure a day. Therefore, adequate protective measures in the form of ear mufflers/ear plugs to the workers working in high noise areas will be provided. In addition, reduction in noise levels in the high noise machinery areas will be achieved by adoption of suitable preventive measures such as adding sound barriers, use of enclosures with suitable absorption material, etc.

These noise levels as a result of operation of the plant are minimal and therefore will not be a health concern to the workers while external noise at the boundaries of the power plants and will also not be a disturbance to the local community. At a high confidence level, the significance rating of the impact is said to be **VERY LOW** negative. This is because the potential intensity of noise will be very low, spatial extent being site specific, long term in nature as it will persist over the entire operational period and has a low probability to occur.

6.4.2. Impacts on Air Quality

Dust is particulate matter in the size range 1-75 micrometres (μm) in diameter and is produced through the action of abrasive forces on materials. Fine particulate matter (PM10) is defined as particles less than 10μm in diameter and is of the most concern regarding health effects. Construction dust is generally larger in diameter than 10μm and, therefore, does not necessarily increase existing levels of PM_{10} considerably. Particles between 10 and 75 μm in diameter are not typically associated with adverse effects on human health, their main potential effects being the soiling of surfaces. Soiling is the cumulative deposition of airborne particles on to a surface.

Dust becomes airborne due to the action of winds on material stockpiles and other dusty surfaces, or when thrown up by mechanical action, for example, the movement of tyres on a dusty road or activities such as excavating. The quantity of dust released during depends on a number of factors, including:

- the type of activities occurring;
- the area of exposed materials;
- the moisture and silt content of the materials;
- distances traveled on unpaved surfaces; and
- the mitigation measures employed.

Air quality is the highest priority of site management with respect to worker health and safety and impacts on neighbours and the general public. Respirable particulates are a public health hazard and may otherwise create considerable nuisances to the public. Air pollution may adversely affect the health of people engaged directly or indirectly in the project activities. Emission of large quantities of dust may lead to significant impacts on construction workers and the local commercial/ residents, which will be accentuated during dry weather conditions. The effects are due largely to particulates from transport emissions and constructional equipment powered by gasoline or diesel as well as silica in dust from the earth agitated by constructional equipment and vehicles plying on un-tarred roads. The resultant effects are acute respiratory disorders, lung and

heart diseases, the type of ailment depending on the size of particulates as well as the materials adsorbed on them.

For this environmental assessment, measurement of suspended particulate matter concentrations within the selected communities for air quality monitoring was established over a four (4) day period in December 2011 and updated in May 2018 at various times of the day for monitoring purposes. The values recorded have been averaged for each of the site and presented in
Table 4-7. High PM levels were observed basically due to the dusty nature of the access roads at the time near the sampling points. This informed that the upgrade of access roads, especially those leading to the project sites, is critical for the maintenance of the PV Modules. Currently, the main access road to the Lawra Site, which is N12 Wa - Hamile road, is tarred and asphalted and can be classified as a first-class road and data obtained in May 2018 shows very levels of Particulate matter within EPA permissible values.

At the present time, there are no statutory World Bank/ IFC or Ghanaian guidelines relating to either ambient concentrations of airborne dust or to rates of surface soiling by dust particles during project construction. In the absence of agreed standards for construction dust levels with the potential to cause annoyance, the emphasis of the control of construction dust should be the adoption of best practices on site. However, even where mitigation measures are employed some dust is likely to disperse off-site and has the potential to impact residents. Thus, mitigation of fugitive dust will be necessary, and control measures to be employed, together with recommendations for monitoring.

Constructional Phase

The potential for dust to be emitted during construction is strongly dependent on the type of activities taking place, on wind speed and on whether winds carry emitted particles towards sensitive receptors, such as residential properties. The presence of dust can be a nuisance to Site users, including construction workers and other nearby receptors. The levels of dust at the site are expected to be variable and dependent on the time of year, the intensity of the activity and the prevailing winds. During the construction phase, dust will be generated from increased vehicle movements from trucks driving on unpaved roads and from activities that cause disturbance of the soil.

The key construction activities likely to result in increased dust levels are site cleaning, excavation work, cutting and levelling work, movement of trucks transporting solar infrastructure to the site, movement of construction vehicles along dusty roads, clearance of vegetation, trenching, burial of cables and screwing/ piling support poles of structures into the ground. Dust emissions are exacerbated by dry weather and high wind speeds. The impact of dust also depends on the wind direction and the relative locations of dust sources and receptors.

Apart from the dust particles that will be generated, vehicular emissions that will emanate from the haulage trucks during construction is also a potential source of air pollution. Vegetation clearing, excavation and haulage of heavy machinery and construction materials to and from one

location to the other has the propensity to impact negatively on-air quality. It is however expected that such impacts will be localised especially during the rainy season but has the potential to be widespread during the dry harmattan season occurring from December – February.

Particulate matter on the neighbouring communities could increase considerably during the construction phase, especially at Kaleo. This could be caused by the removal of topsoil and vegetation, the movement of vehicles and equipment and the construction activities in general. However, impacts related to increased generation of dust during the construction phase are expected to be short term impacts and should not be significant. The increase in particulate matter on the neighbourhood would decrease gradually over the construction period.

The significance rating of the air quality impact during the constructional phase is said to be **LOW NEGATIVE**. This is because the potential intensity of impact on air quality will be Medium, spatial extent being site specific to local, temporal in nature and has a medium probability to occur.

Operational & Maintenance Phase

Plant operation would not significantly affect the air quality, as Solar project is green field project and there are no any gaseous emissions during operation phase from the proposed project. Therefore, there would be no significant air pollutants during plant operation as there is no emission. Taking account, the rural and serene nature of the project site settings, and the proposed works, it is considered that there are no significant air quality issues during the operational phase, which warrant further assessment in the EA.

6.4.3. Impacts on Topography & Drainage

The topography and drainage of the project areas have been discussed variously under Section 3.3 as well as Section 4.3. The topography of the Nadowli-Kaleo District is low lying and undulating at altitudes ranging between 150m-300m above sea level though some parts average 600m. The terrain of the three (3) project sites at Kaleo are mostly flat with a slight slope towards south. They are rectangular shaped which is regarded as suitable for PV installation. The only major stream in the Nadowli-Kaleo District is the Bakpong and several ephemeral streams, which finally flows into the Black Volta. There is no water body located within the designated sites at Kaleo. The nearest water body is the Kaleo Community dam, located close to the N12 Highway, just outside the Kaleo township towards Lawra which is actually man-made.

The terrain of the Lawra PV Site is not completely flat showing small bumps and slight slope descending towards North with 2.5-3% in average. The site has trapezoid shape with its longer side long the road and a triangular edge to the South. The Lawra District is gently rolling with a few hills ranging between 180 and 300M above sea level. The designated Solar Power Plant site at Lawra is about 3km from the main river in the district, the Black Volta, to the west which forms the boundary between the District and the Republic of Burkina Faso. The Black Volta has several tributaries in the Lawra District; notable amongst them are the Kamba/Dangbang, Nawer, Duodaa and Kokoligu-baa.

Constructional Phase

For the construction of the PV collector field, constructional activities outlined under Section 3.7.6, involving Terrain preparations which includes activities such as site Excavation, Filling, Levelling & Grading, Ground Finishing as well as construction of Internal Roads, Foundations for Buildings & Shared facilities and Fencing. Tall trees as well as smaller vegetation on the project sites will have to be removed. However, this will be specific to the project sites, covering the area of land sizes of 6.22 Ha, 4Ha and 18.39Ha in Kaleo and there are no identified micro drainage channels within this project site. The land size of 6.13 Ha is being utilised at Lawra with the nearest drainage being the Black Volta, located within 3Km and serves as boundary between Ghana and Burkina Faso. This activity shall however take place within the first six (6) months of commencement of construction. It is expected that such development will result in an imperceptible change in topographical characteristics and this change will be short term.

The significance rating of impact on topography and drainage during the constructional phase is said to be **MEDIUM NEGATIVE**. This is because the potential intensity of impact will be Medium, spatial extent being site specific, short term in nature and has a definite probability to occur.

Operational & Maintenance Phase

A network of storm drains shall be constructed at the PV Plant to collect and direct storm water away from the power site. During operations, drainage channels from on-site precipitation shall be in place to collect surface run off water into larger gravel filled channels at the fences where it can trickle away into the municipal drainage. It is expected that the topography and drainage during this phase will not be altered in any form.

The significance rating of impact on topography and drainage during the operational phase is said to be **VERY LOW NEGATIVE**. This is because the potential intensity of impact will be low, spatial extent being site specific, short term in nature and there is an unlikely probability to occur.

6.4.4. Impacts on Geology & Soils

The soils in the Lawra District consist mostly of laterite soils. These are developed from the birimian and granite rocks which underlie the area. With the Kaleo District, the soil types are laterite, sandy and sandy loam (savanna ochrosols). They are generally poor in organic matter and nutrients because of the absence of serious vegetative cover due to bush burning, overgrazing, over cultivation and protracted erosion. Consequently, the soils are heavily leached. Currently, there has not been any detailed geological and soil investigations at any of the sites. The soil in the Project area will however most likely not contaminated as there is no anthropogenic activity in the project area. The EPC contractor is expected to carryout detailed investigation of the soil conditions for each of the sites to cover all the requirements for design of all relevant works as well as the borrow pits (for verification of the suitability and adequacy) where materials for

embankment formation will be obtained and submit a report to the VRA for approval. The soil investigation shall be carried out in accordance with BS 5930:1999 or any other approved standard. A copy of the soil investigation report shall be submitted to the EPA for informational purposes, if so required.

The physical effects of developments can lead to changes in local topography and soil damage and erosion. This can arise from changes in ground conditions, land-lake clearance, compaction by heavy machinery during construction and soil movement, deep digging for foundation and piling, removal of vegetation, trees and hedges, etc. Such physical disturbances may lead to changes in the density of soil, its moisture retaining ability, natural drainage, and in organic matter content and also soil biota. Erosion of soil from the surface and removal or change at depth, may further lead to surface subsidence. The effects of physical disturbance of soil can have impacts upon soil microorganisms, natural flora and fauna, crops and livestock, groundwater and surface hydrology and quality, landscape and visual amenity as well as upon engineering works and buildings.

Constructional Phase

Site preparation for the establishment of the solar PV power plant, internal access road(s), temporary laydown area and associated buildings during the construction phase will require vegetation clearance, some site levelling and grading and soil compaction. During the site preparation, top soils will be stripped out and levelling the land. The proposed project site is low lying. Top soil removal, excavations, vehicular traffic impact on the un-tarred access routes, etc. has the potential to engender the sheet erosion by exposing the soil to soil erosion agents. As the topsoil removal activity will be restricted within the project boundary and will not have off-site impacts.

The project will involve the use of paints for solar PV power plant and switchyard structures during construction which if not handled and used properly, may lead to contamination of soil. Improper disposal of hydraulic fluids, diesel, lubricating oils and other used oils can also result in contamination of soil. Improper storage of construction material can also result in the unwanted dispersal of contaminants into adjoining areas. Spills could have a long-term impact on soil quality but are expected to be localized in nature. Spill control measures such as the storage and handling of chemicals and fuel in concreted areas will be implemented to minimize impacts in the event of a spill.

General construction waste generated onsite will comprise of surplus or off-specification materials such as concrete, wooden pallets, steel cuttings/filings, packaging paper or plastic, wood, metals etc. Municipal domestic wastes consisting of food waste, plastic, glass, aluminum cans and waste paper will also be generated by the construction workforce at any canteen facility/ rest area which shall be constructed for them. A small proportion of the waste generated during construction phase will be hazardous and may include used oil, hydraulic fluids, waste fuel, grease and waste oil containing rags. If improperly managed, solid waste could create impacts on the land. A considerable amount of solid and liquid waste will be generated during the

construction phase that will be managed by the contractor however improper management of these waste may impact on the soil quality.

The significance rating of the impact of the project on soils during the constructional phase can be described as **VERY LOW NEGATIVE.** Substances that will have the potential for ground contamination will be small quantities, the intensity of any such contamination may be direct, negative and low and reversible. The spatial extent of the impact will be specific only to the project site. The duration of the impact will be temporal and reversible. The probability of the impact on soil is low.

Operational & Maintenance Phase

Most impacts of Solar PV project on soil are restricted to the construction phase, which will get stabilized during operation phase. The soil conditions of the project site would be allowed to stabilize during this period after the impacts of the construction phase. The topsoil in non-built up areas would be restored and such portions of the site would be replanted with appropriate plant species to stabilize soil. There is also unlikely to be an impact on soils, and organisms living within these soils, as a result of electricity and magneticity arising from the operation of the PV Plant and the sub-transmission line system.

Substances that will have the potential for impacting on soils during the operational phase will be small quantities, the intensity of any such contamination may be direct, negative and low and reversible. Indeed, no significant impact is also expected on the soils on and around the site, due to the following management measures to be put in place:

- All solid wastes and hazardous wastes from the plant complex are collected properly collected, stored and disposed.
- Appropriate storage of oil and lubricants on site
- The entire plant site area is well drained and thus there is no leaching of any substances in case of spills, which are well confined and decontaminated.

The spatial extent of the impact will be specific only to the project site. The duration of the impact will be temporal and reversible. The probability of the impact on land quality is low. The significance rating of the impact of the project on land quality during the operational phase is therefore anticipated to be **VERY LOW NEGATIVE.**

6.4.5. Impact on Water Resources

The impacts of project on the water resources are assessed due to consumption of water during project activities and contamination of water from accidental spillage of fuel, lubricant and hazardous waste. There is no surface water body located within the designated sites both at Kaleo and Lawra. The nearest water body is the Kaleo Community dam, located close to the N12 Highway, just outside the Kaleo township towards Lawra (See Plate 4-10). The relative location of the dam to the project site is shown in Figure 4-1. The designated Solar Power Plant site at Lawra is about 3km from the Black Volta, which is the main river in the district (See Plate 4-11).

Waters of the Black Volta at Lawra is mainly utilised for irrigation purposes by peasant farmers. That at Kaleo is mainly used for domestic purposes as well as serve as source of drinking water for animals, especially cattle. The water bodies found in the project area will not serve as source of water at any stage of project development and therefore the water resource will not be affected.

Constructional Phase

It is expected that the Project throughout the construction phase will require water for potable usage (drinking, showering, etc) and non-potable usage (mainly used for minimizing fugitive dust emissions, and to some extent for cleaning of machinery and vehicles). The potable water requirements for a maximum of 50 workers onsite is not expected to exceed 10 liters per capita per day for a duration of 9 months.

Thus, the daily water consumption is likely to be around 500 liters per day - or 0.5m3 per day. In addition, water for non-potable usage will be mainly used for minimizing fugitive dust emissions and this will greatly depend on weather conditions throughout the construction period (as well as other factors),but has been estimated to be around 10m3/ day for each site. Thus, total water requirements during the construction phase are likely to be around 20.5m3/ day. The water requirements throughout the construction phase will be required temporary (for construction period only) and are considered minimal and not significant.

Water will be required during construction for some construction activities, such as dust suppression measures, and for potable water supply. It is estimated that for dust control and compaction purposes approximately an average of 20,000 litres per day of water will be required per each site. During construction, water shall be fetched by means of drilling deep wells by the EPC Contractor, the design flow is 50m3/ h, and the delivery head of water pump shall be selected in accordance with the groundwater depth. At the same time, the water required during the construction period would also be supplied from this source. The construction party shall be equipped with at least 2 water trucks to carry out water to the construction areas for concrete mixing and curing.

Construction of the PV plant and civil works involves both deep and shallow excavation to support the electrical equipment to be installed. Such constructional activities could have an impact on water quality as a result of alteration of the existing drainage characteristics of the site. Erosion, resulting from vegetation clearing and excavations can lead to downstream siltation resulting from run-offs with high sediment load. This could ultimately lead to contamination of water resources. Water pollution may also result from spillages, leaking fuel and grease from construction machines. Contamination of water resources could also result from the spillage of lubricants, oils and machine fuel during construction activities and from the disturbance of soils and dust which is washed off into local water courses. However, there is no surface water close to the any of the selected sites for the PV projects.

The main potential impacts on groundwater arise if deep excavations are required during construction that need dewatering or if fuels and oils leak or are spilt during construction and operation causing potential groundwater contaminations.

The fuels, lubricant and hazardous waste generated during all phases will be stored at a designated area which is paved with provision of secondary containment. Thus, the contamination of groundwater can happen only due to accidental spillage of fuel, lubricants and chemicals from storage areas or and during the transfer of fuels and chemicals. The soil types in the project areas are laterite, sandy and sandy loam (savanna ochrosols). They are generally poor in organic matter and nutrients because of the absence of serious vegetative cover due to bush burning, overgrazing, over cultivation and protracted erosion. Consequently, the soils are heavily leached, and any spillage could easily contaminate ground water. However, due to the low volumes of such materials, any spillage of chemicals and fuel may not cause measurable changes in the ground water quality.

Temporary ablution facilities will be required during construction (i.e. portable toilets). The EPC Contractor shall be responsible for supplying potable water for drinking purposes, waste disposal facilities and sanitary facilities during construction.

The significance rating of the impact on water environment during the constructional phase is said to be **LOW NEGATIVE**. This is because the potential intensity of impact will be Medium, spatial extent being site specific to local, short term in nature and has a medium probability to occur.

Operational & Maintenance Phase

Ground water is to be utilised from the use of the boreholes. Water is required mainly for drinking and other personal use of onsite staff (around 10 personnel on each site). Potable water requirements for the onsite workers is not expected to exceed 50 litres per capita per day - thus a daily water consumption is likely to be around 500 litres per day - or 0.5m3 per day for each site. Even though, water from the borehole will be filtered to make it fit for consumption, it is expected that water for drinking purposes will sourced mainly from local merchants during operations.

For the Phase 2 water supply, Kaleo Site 2 will have a dedicated water supply, which would be interconnected to the water supply system of Kaleo Site 1 and the community water supply as a backup. The link to the community water supply would have a valve installed and metered as well as an automatic water level sensor so any water taken from this source can be monitored and properly accounted for as part of resource use efficiency strategies of the VRA for its operation power plants.

PV panels do not use water for the generation of electricity. However, water is required for their maintenance, for the systems to maintain their maximum performance. Specifically, water is necessary for the cleaning of the panels, the amount of which greatly varies depending on the location of the system. Estimated volume of water demand for wet cleaning of solar panels ranges

from 19.5 m^3/year to 84.5 m^3/year for a duration of 20 years. This may result in competing demands with the community members. Consultations with WRC indicates that since the abstraction rates will not have any negative stress on the aquifer, the drinking water supply of the communities involved will not be affected negatively. Nevertheless, it is important to ensure that adequate water resources are available which would be able to meet the Project requirements without entailing any constraint on the existing users - such as the local community. However, based on the above it is clear that the water requirements for the Project during operation are rather minimal and would not entail any constraints on the existing users.

Operation of the power plant will also have the potential to cause impacts to water quality as a result of uncontaminated drainage such as storm water and uncontaminated runoff as well as foul water drainage such as the generation and disposal of sanitary waste from the workforce. A network of storm drains shall be constructed at the PV Plant to collect and direct storm water away from the power site. This network shall be isolated from the oil and fuel storage areas to ensure that storm water is not contaminated with oil products prior to discharge. Due to the nature of the proposed PV plant power and transmission line development, groundwater issues are not of potential significance and do not require any significant mitigation measures.

The significance rating of the impact on water environment during the operational phase is said to be **VERY LOW NEGATIVE**. This is because the potential intensity of impact will be low spatial extent being site specific, temporal in nature and unlikely to occur.

6.4.6. Impacts of Waste Generations

The construction, operations and decommissioning of projects will result in the generation of waste streams that have the protentional impact on human health and the wider environment. Improper solid waste disposal and management causes all types of pollution: air, soil, and water. Indiscriminate dumping of wastes contaminates surface and ground water supplies. Direct health risks concern mainly the workers in this field, who need to be protected, as far as possible, from contact with wastes. There are also specific risks in handling wastes from health centers.

Thus, there are potential risks to environment and health from improper handling of solid wastes. For the general public, the main risks to health are indirect and arise from the breeding of disease vectors, primarily flies and rats. Insect and rodent vectors are attracted to the waste and can spread diseases such as cholera. Uncontrolled burning of solid waste and improper incineration contributes significantly to urban air pollution. Greenhouse gases are generated from the decomposition of organic wastes in landfills, and untreated leachate pollutes surrounding soil and water bodies. Health and safety issues also arise from improper solid waste management.

Constructional Phase

In general, the following wastes are likely to be generated as a result of constructional activities:

- Clearance and excavation wastes: clearance of site vegetation and removal of soils, inert construction materials and residues, spoil, etc.

- General construction wastes: reject and excess material, drainage from wastewater and site run-off, containers etc.
- Other hazardous wastes may result from spillages from construction equipment.
- Other wastes: from offices, food preparation wastes, sanitation etc.

The Design Specification will require that that water/liquid retaining structures should be in accordance with BS 8007 "***Design of Concrete Structures for Retaining Aqueous Liquids***" as appropriate or equivalent international or Ghana standard. Due to the nature of the site and the works to be undertaken, general construction wastes and hazardous wastes are predicted to be low. Septic tanks will be installed on the site for the construction period. During the civil works, the period when the largest workforce numbers will be on site, it is possible that these tanks could supply a workforce of up to 100 people, although this total number is unlikely to occur at any one time during this period. Sewage wastes will be removed from the site and disposed of in an appropriate manner by an approved contractor.

Proposed mitigation plan suggests maximum reuse/recycle of construction waste on site or removal of waste at the site and proper disposal, which would reduce the impact significantly. The impact significance for waste generation during construction has been assessed as ***LOW NEGATIVE***. The the intensity of any such impact can be defined as a merely a nuisance and medium Low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be temporal and reversible. The probability of the impact on waste generation is medium low.

Operational & Maintenance Phase

The operation of the plant will not generate solid waste from its direct processes. Operation of the PV plant will result in the generation of general plant wastes and commercial wastes. Solid waste is expected to emanate mainly from the administration as office wastes. Again, it is expected that a limited amount of waste will be generated during this phase from vegetative matter, cans, packaging materials, insulators etc. These wastes, if not treated properly, may result in the contamination of the site, pose a health risk to workers, and/or be dumped illegally. Solid wastes generally could be an eyesore and cause environmental problems together with their associated health hazards if proper and adequate measures are not put in place to segregate, evacuate and dispose or recycle it.

Liquid waste will also be generated from the possible washing of various items that may be used. Liquid wastes arising from the plant processes include waste lubricating oils and sewage. It is, however, not anticipated that liquid wastes from the various washings will be generated in significant quantities. Accidental spillage of oil, fuel or paints will however need to be managed.

The impact significance for waste generation has been assessed as **VERY LOW NEGATIVE**. The intensity of any such impact can be defined as a merely a nuisance and Low, the spatial

extent of the impact will be specific only to the project site. The duration of the impact will be long term and reversible. The probability of the impact on waste generation is unlikely.

6.4.7. Impact on Landscape & Visual Intrusion

Landscape impact assessment is based on two principal aspects. First is the alteration of the landscape character of an area including impacts on recognised features of landscape importance either nationally or locally. The second aspect is impact on public views of the site either from residential properties or areas of public access, e.g. footpaths, and from public roads. Landscape encompasses a range of issues, including the physical features of landform and surface area, the way in which these features are perceived, and the values attached to scenery. Landscape impacts relate only to the construction and operational phase of the project. No potential impacts arise during pre-construction activity. The extent of the impact on the character of the landscape and visual impact will depend on the nature of existing land uses and whether there are any sensitive views that will be altered by the removal of vegetation (especially taller vegetation) and the PV plant, substation and fence wall.

Information on the project site, landscape, topography as well as access roads have been described under Chapter 4. The Kaleo PV project site is located on the eastern side of the Kaleo township, off the Wa - Lawra section of the N12 Highway, about 0.85 km to the east of the Kaleo – Zaa Road, which is untarred and a feeder road. The Kaleo – Zaa road runs approximately 125 m parallel to the Northern site boundary of Kaleo Site 1. From that road, the site access could be built adjutant or even within the line route corridor of 10 m (at each side of the MV lines) where NEDCo owns the right of way. Three sites of land sizes of 6.22 Ha, 4Ha and 18.39Ha are to be utilised for the Project. The terrain of the three (3) project sites are mostly flat with a slight slope towards south. All three sites serve as community footpaths. And are a common view to the community members

The Lawra site is located parallel to the N12 Lawra -Hamile road, which was untarred when the baseline studies started in 2011 but asphalted as at close of 2018. The terrain is not completely flat showing small bumps and slight slope descending towards North with 2.5-3% in average. There is an untarred road located on the southern end of the site that leads to the Black Volta, which will serve as access route prior during construction. There will therefore be no need for a new access road construction for the site. This route also provides access to the local resort called ***"Meet Me There***", and this could be impact upon communities' lifestyle. There are no settlements on this site, and the land is largely fallow with Acacia and Sheanut being the most dominant trees.

As the specific project sites for the PV installations and associated sub-transmission lines are identified as a greenfield, careful consideration will need to be taken regarding preserving the appearance and open character of the area as well as the potential impacts on landscape character and existing views. However, based on their closeness to communities it is anticipated that the general landscape character will not be altered significantly. This section identifies the anticipated

impacts on the landscape and visual characteristics of the site from the Project activities during the construction and operation phase.

Constructional Phase

All the four (4) project sites are degraded and characterized by annual bush fires, continuous farming, and animal grazing etc. A total of 1,442 trees of different sizes, comprising of mainly Dawadawa, Leocarpus, Teak, Sheanut and Neem trees, were enumerated at all the sites, including that of the Lawra Forest reserve. Site preparation activities which are to take place onsite by the EPC Contractor for the installation of PV arrays and the various Project components to include transmission cables, inverter stations, sub-station, internal roads, buildings, etc are expected to include land clearing activities, levelling, excavation, grading, etc. Construction activities would create a temporary effect on the visual quality of the site and its surroundings. The visual environment during the construction phase would include the presence of elements typical of a construction site such as equipment and machinery to include excavators, trucks, front end loaders, compactors and other.

The constructional phase may have an adverse visual impact as a result of tall construction equipment, affecting views to the site from properties and amenity sites, especially at the Kaleo site due to the presence of nearby communities. The main construction equipment that will potentially be visible during construction will be the equipment to move the power plant facilities into place. The development of the power plant will involve major earth and civil works that may impact the local topography and therefore alter the physical landscape features of the area.

The constructional activities have the potential to impact on scenic landscape values at the project site as it will involve the total removal of over 1440 trees of various species at all four sites, thus creating a plain field. However, this will not involve the removal of any sensitive views as the project sites are sparsely populated with trees and degraded.

However, there are no key sensitive visual receptors within the surrounding vicinity - such as recreational activities, environmental reserves, remarkable historical or cultural sites, water courses or other natural structures normally seen as valuable by the human perception. The impact significance for landscape and visual intrusion during construction has been assessed as **LOW NEGATIVE**. The intensity of any such impact can be defined as a merely a nuisance and Medium Low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be temporal and reversible. The probability of the impact is definite.

Operational & Maintenance Phase

The Project is expected to be visible within the immediate vicinity and up to some kilometers around the Project site only and thus is likely to create visual impacts. The maximum height of the PV mounting structures is expected to be in the range of 2-3.5 m. Only the PV substation will

comprise higher installations being typical for HV substations and sub-transmission lines - including towers of the transmission line, which will be in line with the already existing towers within the localities. The installation of a mesh fence of at least 2.50 m height around the various power plants is required for power plant's equipment protection, as also for avoiding any accident by external causes. Further, a fire buffer zone comprising of undeveloped bare land will be within the fence wall. This means the PV Panels and other infrastructure outside will be visible to external sources outside the plant.

Potentially sensitive receptors include the residents living in close by dwellings at the Kaleo Site and along the access road as well as those in passing vehicles at both Kaleo and Lawra site, however, such views would be temporary and limited to the time of passage within the area. However, being visible is not necessarily the same as being intrusive. Aesthetic issues are by their nature highly subjective. For some viewers, a PV Plant could be regarded as manmade structures with visual burdens while to others it represents a positive impact in the sense that they introduce a break in the otherwise dull and monotonous view. More importantly, as discussed earlier, there are no key sensitive visual receptors within the surrounding vicinity of the Project site - such as recreational activities, environmental reserves, remarkable historical or cultural sites, water courses or other natural structures normally seen as valuable by the human perception.

The main impact during operation is the visual impact of the photovoltaic panels during the day. The panels are geometric and reflective and will clearly stand out from the surrounding natural landscape. Besides the presence of a large area of PV panels is not expected to constitute a risk for glare since it is situated far from any airport. The impact significance for landscape and visual intrusion during operations has been assessed as **VERY LOW NEGATIVE**. The intensity of any such impact can be defined as Low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be long term as it will persists if the project is operational. There is low probability that the impact will occur due to the already built up nature of the nearby communities.

6.5. Negative Impacts on Ecological Environment

Trees and wildlife resources have been assessed at the Lawra Station Forest Reserve as well as the four (4) off-reserve areas within the Lawra and Kaleo townships. Table 4-8 and Table 4-9 provides a summary of the flora and faunal species enumerated at the PV Sites at Kaleo and Lawra. A total of 1,337 trees of 29 species were enumerated at the four (4) off reserve areas, with the dominant economic species being Dawadawa, Sheanut and Neem trees. A total land area of approximately 44.92 Ha has been acquired for the four PV sites and there are no special habitats for endangered fauna or flora. The PV sites are all degraded and characterized by annual bush fires, continuous farming, and animal grazing and there are no major habitats near the site.

About 0.5km of the sub transmission line will however traverse through the Lawra Station Forest Reserve. A total of 105 trees comprising 8 species were identified in the Lawra Station Forest Reserve. The dominant species include Leocarpus and Teak which are not endangered species.

The details are provided in Appendix 6. Work in the forest reserve shall be done in accordance with the MOU between VRA and the Forest Services Division

Due to closeness of the sites to human settlement coupled with continuous farming activities and annual bushfire, few wildlife resources are identified at the project sites. The fauna of the project area has been extensively affected by over-exploitation, alteration and fragmentation of habitat resulting from especially bushfire, human settlements, and agricultural activities. Livestock were common. Some birds were found perching on the trees and in an interview, community members confirmed that the identified birds are occasionally seen in this area.

The impacts of the project development on the ecological receptors are discussed below.

Constructional Phase

The impacts from the construction phase of the project on the local ecology have been assessed with respect to the following activities:

- Removal of vegetation from the site construction and ancillary facilities which could result in impact on agricultural, economic tree species and open grassland and the loss of connectivity between habitats or to resources within a habitat.
- Impacts from excavation and construction activity on habitats and species on burrowing species, and effect of sediment and contaminant input into surrounding water bodies; and
- Laying of access and internal roads for the project.
- Laying of transmission lines and transmission towers.

Construction activities will lead to removal of vegetation at the project site and this reduces options for nesting habitat, shelter from predators, foraging resources, shade, perching habitat and breeding sites of herpetofauna and ground dwelling birds. The is expected to occur at small enough scale to have an impact on habitat for species (birds, mammals and some reptiles) as vegetation is scattered and there is no continuous vegetation patch within the site.

Potential impacts on flora and fauna during construction will be limited to the direct loss of habitat as a result of the footprint of the plant and the construction laydown area as well as disturbance and/or damage to habitats and species as a result of construction activities e.g. through smothering of plants by dust, movement of vehicles and construction workers to and from the site. The loss of vegetation can also have a negative effect on soil quality and hamper survival of neighbouring floral species, burrowing faunal species and foraging resources for herbivores in the area. Flammable and lubricating materials may contaminate the vegetation and change the diversity of flora and fauna species. Building materials used by the construction of the solar power plant, including equipment and transportation vehicles driving along the road may contaminate the ground soil and vegetation.

The impact of the construction activities would be primarily confined to the project site. There are no sensitive habitats or plant species within the PV site as the baseline data shown none is included under protected status as per IUCN categorization. Thus, the site development works would not lead to any significant loss of important species or ecosystems. It must also be noted that in addition to payment of land, VRA is also to make payment for all economic trees that have been enumerated to the landowning families.

The impacts described above will not cause a significant change in the population of these floral species as the floral species are common to the area and have widespread distribution. Moreover, similar kind of habitats are widespread in the areas adjoining to the project site, hence loss of habitat for faunal species within the project site will not cause any substantial change in population of the faunal species as they could easily relocate to surrounding areas.

The area of habitat within the project site will be permanently lost, and the overall significance of the impact on the ecology during construction is **HIGH NEGATIVE**. The intensity of any such impact can be defined as Medium due to the low conservation value of the habitat within the site area., the spatial extent of the impact will be specific only to the project site. The duration of the impact will be long term as the loss will be long term, and will continue through the project life cycle, and the loss of habitat is definite to occur.

Operational & Maintenance Phase

Operation of the plant could potentially have an impact on flora and fauna as a result of damage due to the movement of workers and vehicles on and around the site. There shall be no emissions associated with the PV plant and long-term impacts as a result of air emissions do not pertain to the project. There are no sensitive habitats or species on the site, therefore the significance of any impact would be low. The plant site shall be fenced and therefore all operations will take place within this boundary. There will be enough turning space within the plant site for vehicles. No movements outside of the site boundary are therefore anticipated.

During operation there is a particular risk to birds mainly from operation of the high voltage overhead lines from the substation onsite to the High Voltage National Grid. Birds utilize transmission towers for nesting by placing the nests across wires or using holes in the tower itself. Birds that roost on or near solar modules can also be affected by the wiring that is connecting the module to the main grid. Birds are attracted to these modules because of the reflection of the solar panel mimicking the reflection of water bodies. The routine maintenance activities will ensure that there are no such roosting places for birds on the PV panels. In addition, sub-transmission lines already exist within the project site and new ones to be developed will be mainly within the right of way of existing ones.

Trees that can impact on the sub-transmission line would have to be cut both during the constructional as well as during the operational phases in order to protect the lines. All dangerous and potentially dangerous trees will have to be enumerated and documented by

VRA prior to felling. This is important in order to avoid field/technical personnel of FSD taking undue advantage of the situation.

Nevertheless, putting things into perspective there is some risk of avi-fauna mortality and which could occur with most human development (ranging from buildings to large scale industrial projects). However, with regards to the Project in specific it is highly unlikely that avian mortality levels would be of any concern due to the following:

- Proximity of the Project site to the existing grid with which it will connect and thus overhead lines will be minimal, thus reducing any risks of electrocution and collision of birds;
- The Project site in general is considered barren and of low ecological significance due to its natural setting and does not support endangered or rare species or sensitive avi-fauna habitats, while all recorded avi-fauna species are generally common to such habitats. In addition, such an area is considered, to some extent, disturbed by human activity and which would affect bird activity in the area.
- Other impacts on the biodiversity of the site are mainly from improper management of the site which could include improper conduct and housekeeping practices by workers (i.e. hunting of animals, discharge of hazardous waste to land, etc).

The overall significance of the impact on the ecology during operations is **VERY LOW NEGATIVE**. The intensity of any such impact can be defined as low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be short term and there is unlikely probability to occur.

6.6. Negative Impact on Historical or Cultural Heritage Resources

Cultural resources and heritage comprise tangible historical/archaeological sites, documents and artefacts together with religious/spiritual sites (sacred sites) and activities important to local communities, customary law, traditional beliefs, values and practices. The sensitivity of a cultural feature to direct impacts reflects the level of importance assigned to it. This is the product of several factors, including for features of present-day cultural value: its current role; its cultural or sacred associations, its aesthetic value; association with significant historical events or traditions and its role as a sacred site or local landmark; and in addition, for those of heritage value, its potential as a resource of archaeological data. It should be noted that the assessment of impacts and development of mitigation actions for some cultural features cannot be wholly segregated from other social impact assessments and there will be overlap in some mitigation actions.

With respect of cultural resources and heritage, the EA Study showed two (2) major sites of significance to the project, one (1) each at Kaleo and Lawra. At Kaleo, the burial ground of the Late Hon. Jatoe Kaleo, who died on June 6, 1998 is a key historical resource in the community. This burial site is on the Kaleo – Zaa Road, about 500 m to the Kaleo Site 1. The

Late Hon. Jatoe Kaleo was one of the leading Ghanaian politicians who led Ghana into independence. With respect to the Lawra site, just by the side of the untarred road located on the southern end of the site road, is a tree shrine, comprising of Ebony / Nim Tree, known as the Kulbonuo Shrine belonging to the Bayoyire Community in Kaleo. The site was acquired in such a way to avoid the shrine, however, its nearness to the project site is a recipe for future conflict with the shrine owners and will be advisable to relocate them as part of project implementation. It must be noted that the untarred road located on the southern end of the site also leads to the Black Volta, which serves as a recreational facility during public holidays for the youth of Lawra as well as the demarcation between Ghana and Burkina Faso. The untarred road will most likely also serve as access route prior during construction.

As indicated earlier, the land owners and community leaders during the various stakeholder engagements advised that as part of their customs, certain rites ought to be performed before the projects commence. VRA shall therefore initiate relevant pacification rites prior to project construction in order to ensure smooth project implementation.

The sub transmission line traverse along road way leaves or parallel to existing lines and the possibility of impacting on any existing cultural sites is most unlikely. Currently, there are no known archaeological, historical or cultural important sites along the route alignment, hence no impact on these sites is envisaged. In the case of discovery of archaeological features during any phase of the project, a chance find procedure to notify relevant authorities in line with National Museums Regulation (EI 29) of 1973 will be put in place by EPC Contractor/VRA in line with the requirements of the mitigation measures discussed in Chapter 7 and the Environmental Monitoring & Management Plan provided in Chapter 8.

Constructional Phase

During construction, potential impacts may arise from site preparation, site excavation or transportation that may disturb or damage cultural heritage. For the Kaleo site, the burial ground of the Late Hon. Jatoe Kaleo will not be impacted when using the access route of the Kaleo – Zaa Road as this road is already in use by commercial vehicle and the project does not plan to upgrade the road which may result in the relocation of this historical grave. The Kulbonuo Shrine will have to be relocated due to its nearness to the Lawra project site as it has a potential for future conflict with the shrine owners.

Throughout the construction phase and as the case with any project development that entails such construction activities there is a chance that potential archaeological remains in the ground are discovered. Thus, as with any project site, there is a potential for previously unrecorded cultural sites to lie within. As all unknown cultural heritage will be sub-surface it is only direct impacts arising from disturbance that could occur. An appropriate watching brief will be implemented to ensure that in the case of unearthing important archaeological finds during excavation, such findings will be removed and preserved accordingly, with the agreement of the authorities. It is expected that such measures for such chance find procedures are implemented in line with standard requirements by the National Museums Act,

Act 387 of 1969. Those mainly require that construction activities be halted, and the area fenced, while immediately notifying the Ghana Museums & Monuments Board (GMMB). No additional work will be allowed before GMMB assesses the found potential archaeological site and grants a clearance to resume the work. Construction activities can continue at other parts of the site if no potential archaeological remains were found. If found, same procedures above apply.

The overall significance of the impact on the Cultural resources and heritage during construction is **LOW NEGATIVE**. The intensity of any such impact can be defined as Medium low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be short term and there is high probability to occur.

Operational & Maintenance Phase

Disturbance within the project area following operation could potentially occur during the excavation works of building facilities, infrastructure, pipelines and the installation of fencing for other works. Since all the activities related to project during operational stage shall be confined to the designated site, and the nature and magnitude of the activities is too small, hence no impact on any of the archaeological properties are anticipated. In case of discovery of historical and cultural heritage or memorabilia during operations of the Solar PV power plant, necessary preservation and protection measures shall be taken in cooperation with the local authorities, including professional organizations.

It is expected that the relocation of the Kulbonuo Shrine will be completed during the constructional phase and there will be no issues on it during the operational phase. However, from experience even though one-off payments for such relocation are done, clients may be required to make irregular payments, as and when the demand is made regarding activities of the shrine.

The overall significance of the impact on the Cultural resources and heritage during operations is **VERY LOW NEGATIVE**. The intensity of any such impact can be defined as low, the spatial extent of the impact will be specific only to the project site. The duration of the impact will be short term and there is unlikely probability to occur.

6.7. Negative Impacts on Occupational Health & Safety

The development of the proposed Solar PV facility will involve a range of activities that could potentially be unsafe to workers without mitigation measures. Examples of such activities include excavation for solar PV foundations, use of drills for cutting, working at heights, trenching, etc. Such activities require the use and operation of heavy-duty earth moving equipment, machinery and vehicles.

Thus, potential public and occupational health and safety impacts will arise from the following:

- Construction activities undertaken by construction workers;
- Delivery of equipment to the site;

- Official visitors;
- Unofficial access by the public.

Constructional Phase

The construction workforce on the project, both regular and contractual working, during construction will be exposed to occupational health and safety impacts arising from construction activities of solar PV and wind hybrid plant. The transportation of heavy plant and equipment through the townships and settlements and the presence of unprotected excavations could pose potential safety problems for the local populace. Materials and equipment used for the construction work could be harmful, when not handled with care. There is the possibility of reversing heavy duty equipment, loose nail scattering on the site as result of its usage, and movement of material from one point to another. These activities could pose danger to both workers and visitors to the site. The possibility of workers or visitors to the site falling into the pits cannot be overruled. Loose scaffolds and debris falling from heights could also be harmful to workers. Other potential hazards include injury from sharpened tools and instruments and dust effect on workers.

Accidents constitute one of the most important risks in such construction activities resulting in injuries. These are likely to arise from moving machinery in the course of operation, unguarded parts of equipment and a disregard for health and safety measures. These are likely to pose risks to the workers. Injuries may also arise from road traffic accidents during haulage of construction machinery and materials to the site. This has the potential of harming both workers and road users, including pedestrians. Other sources of injuries to workers are: accidental falls from height, noise, vibration and heat, falling/swinging objects and also lubricants some of which contain solvents with potential to cause skin irritation and allergies, respiratory disorders and acute poisoning.

There are unlikely to be any significant community health and safety issues at the site, the main impact on the community is associated with the movement of heavy goods vehicles to and from the site. Without mitigation measures, all construction sites present a risk to occupational health and safety. The contractor is required to prepare a Health & Safety Plan to be reviewed and approved by VRA prior to the start of construction on site. Construction equipment will be stored at a site to be secured and guarded by the contractor.

Migration will occur to the surrounding areas as there is an opportunity for employment. Coinciding with the influx of migrant workers is typically a raise in demand for goods and services during the construction period which can result in a rapid expansion in supply chain businesses operating in the area. This will result in increases in formal employment and informal labour. This expansion may result in migration into the area. The impacts that may arise from the presence of migrant and/or expatriate employees that has been a subject of discussions during the various public hearings largely comprise the following:

- Inappropriate behaviour and lack of respect for local leadership and cultural norms on the part of expatriate workers;
- Conflict resulting in part from resentment by skilled nationals and residents if they perceive that expatriates have been hired into jobs for which they are suitably qualified;
- Disruption of local communities with an increase in crime and anti-social behaviour;
- Spread of transmissible diseases including HIV/AIDS both within the workforce and between the workforce and the local community;
- Resentment of non-local nationals by residents if they are perceived to have taken jobs that could be successfully filled by local people, or due to non-integration with the local community; and
- Increased local demand for consumer goods and housing with resulting encouragement for improved supply resulting in financial hardship and benefits for local people; and,
- Increased pressure on infrastructure, services (such as healthcare) and roads, particularly with the establishment of informal settlements.

The intensity of this impact can be said to be medium with international influence, as this impact also can affect the EPC Contractor. The duration is temporal and reversible with a probability to occur. The significance rating of the impact of the project on community health, safety and security can be described as **MEDIUM NEGATIVE**.

Operational & Maintenance Phase

Public safety, Occupational safety and health hazards associated with the project are extremely significant and must be the first priority of site management as they pose potential threat to the safety and health of the workers. These hazards could be from falling and/or swinging objects, potential collapse of towers due to rainstorms or vandalism, falling from heights and snakebites.

Due to the nature of technology involved, the operation and maintenance activities will be minimal. Nevertheless, there are potential occupational hazards regarding work force engagement in both daytime and/or night-time activities albeit on a small scale. The nature of occupational hazards will include:

- Machine/equipment injury risk;
- Occupational noise and vibration;
- Fire risk;
- Risk of exposure to electro-magnetic radiation;
- The risk of electrical shock; and
- Miscellaneous hazards.

Considering the number of workers involved at this stage, the intensity of this impact is anticipated to be low the spatial extent of the impact will be local, and the duration of the impact will be temporal and reversible. There is a low probability of the impact occurring. The significance rating of the impact of the project on community health, safety and security can be described **AS LOW NEGATIVE.**

6.8. Negative Socio-economic Impacts

The socio-economic impact assessment has involved a series of stakeholder consultations including that with community members and elders, landowners, traditional authorities and heads of key governmental agencies. The compilation of the social data in the communities was mainly coordinated by the local government representatives from the communities, popularly known as Assemblyman/woman and literature review. Public stakeholder engagements held in January 2012 and November 2017 also provided key socio-cultural information that needs to be addressed during project execution.

Although this project will realise tremendous economic benefits and other positive impacts as outlined above, it will also have negative effects on the socio-economic environment. The socio-economic negative impacts of the project will be triggered mainly by challenges in land acquisition and compensation issues, land use, increased insecurity and community conflicts, challenges of labour force management, increased accidents from traffic and transport and occupational hazards.

6.8.1. Impacts on Land Acquisition

Details of property to be acquired has been described extensively under Section 3.6 and involves all the PV project sites. Currently, leases covering the Kaleo Site 1, Kaleo Site 2 and the Lawra Sites have been executed and fully registered at the Lands Commission. The lease for the 10.18Ha Kaleo Site 3 is still under preparation. Strategies for acquisition was in line with the requirements of the Land & Resettlement Policy Framework Document and involved extensive consultations with the land-owning families. Following payment of all customary and statutory rites, access was given to enable VRA carry out its activities. These lands are free from any encumbrances.

Pre-constructional & Constructional Phase

VRA has already acquired the lands for the PV sites through voluntary means and private treaties. In addition, economic trees on these lands have also been paid for to the land-owning families. The sites are therefore not going to be accessible to the families. The land acquisition has far-reaching socio-economic impact on the lives of persons whose parcels of land are acquired. The effects of land acquisition include changes in income levels, land utilisation, land-ownership structure, farming practices, familial composition and cultural and social values, norms and bonds.

The significance rating of the impact of the project on compensation during the pre-constructional and constructional phase can be described as **HIGH NEGATIVE**. Land acquisition and economic displacement will require compensation, and this is definite. The intensity of this impact can be said to be high, negative and direct. The spatial extent of the impact will be specific to the people within the project site. The duration of the impact will be long term and irreversible and will last during the lifetime of the project. There is a definite probability of the impact on occurring.

Operational & Maintenance Phase

Land acquisition and economic displacement will require compensation. Under this project, it is planned all land acquisition processes will be completed prior to commencement of project operations. PAPs to be impacted are to be paid prior to project development and this is ongoing. Land leases covering fifty (50) year period have been executed. However, from experience, land ownership and compensation issues could persist during the operational phase of the project. If required, any outstanding payments will be made during this phase and therefore there is a probability of compensation payments during this stage, even if it is not definite. This impact can be said to be of medium low intensity, negative, direct and irreversible. The spatial extent of the impact will be specific to the people within the project site. The significance rating of the impact of the project on compensation during the operational phase can be described as low negative.

6.8.2. Impact on Land Use

The acquisition of the project enclave has direct impact as it will adversely affect land tenure and ownership and land-use planning characteristics, as land will have to be acquired from some individuals, communities and/or stools. The land acquisition process, even though was voluntary, will result loss in farm lands and affect agricultural use and loss of business for the affected individuals, families and farmers. The demarcation of the land for the project would result in some potential effects on land-use characteristics such as hunting as well on the fauna within the project environment, however, on a very minimal basis. If located on land impacted by the project, the people and houses will need to be relocated to make way for the project and new land or alternative means of subsidence or livelihood generating activities may be required.

The major activity requiring mitigation is land-use as this ultimately leads to loss of farm lands, hunting and possible land-use conflicts. Most households within the social study area have high level of dependency and communal use of lands where families and individuals are engaged in subsistence farming. Subsistence cropping is not a controlled activity by any authority. Farmers with authority from landowners use portions of lands for farming. The project is to be achieved by utilizing a total land area of 34.74 Ha at three closely sited areas at Kaleo as well as 6.13 Ha at Lawra.

The PV plant sites have been acquired by VRA for the project as well as for future expansion. The new sub-transmission line connections have been routed such that they either fall within the right-of-way of existing MV transmission line or roads and therefore will not take up any additional lands that are under use by the communities. However, the development of the transmission line will affect forest trees within the Lawra Station Forest Reserve. All proposed PV sites are used for agricultural purposes and there are no residential facilities on it, apart from the Kaleo Site 2, where 2 Fulani nomadic settlements are settled in 2 hamlets. Discussions with the landowners indicate that they will ensure these settlers relocate prior to project construction.

For the Lawra site, the use of the route to the local resort called “Meet Me There” at the Black Volta is close to the vicinity of the project site, and this could impact upon communities’ lifestyle. All three sites at Kaleo serves as route paths for the community members.

Construction Phase

For the purpose of assessment of impacts on land use of the area, following project activities leading to an alteration in land use of the area during construction phase were considered:

- Strengthening of access roads and construction of internal access roads;
- Installation of PV modules;
- Construction of Central Monitoring Station, Switching Yard and
- Establishment and operation of temporary structures such as temporary site office and store yard.

During consultation, it was learnt that the cultivable land belonged to marginal farmers. The establishment of the solar plant will convert cultivable land to industrial use for long term (25 years). Thus, the constructional activities could lead to a direct impact of physical displacement of the nomadic fulanis (with or without legal entitlement) or economic displacement from key activities such as farming, as a result of the development and associated infrastructure and this can plunge households into poverty and / or dislocate communities severing extended support networks such as childcare. These are negative because the lands will be lost to the community members, however, there will be the opportunity to embark on some specific farming/economic activities, which will be agreed upon with the Client.

Changes in land use are also envisaged for material store yard and temporary site office. However, those changes in land use will take place only during construction period (6 months). It must be noted that the project will not require new access road, and therefore there will not be any permanent changes in land use. There will be the need to provide alternative routes for the community members to ensure that community lifestyle is not affected. However, such community routes are not planned and are generated based on convenience and therefore it is expected that as the project constructional activities are ongoing, the community members themselves will identify alternate routes to utilise.

The significance rating of the impact on land use is said to be **MEDIUM NEGATIVE**. The potential intensity of this impact is medium and negative as families and farmers will lose their lands and livelihood. The spatial extent of the impact will be specific only to the project site, however, the duration of the impact will be long term and irreversible as the land will be acquired and its uses will be restricted from then on.

Operational & Maintenance Phase

As indicated, the land to be affected by the implementation of the proposed project has the following categories of land-uses: agricultural lands, potential agricultural lands or fallow agricultural lands as well as grazing of animals. The Kaleo PV sites are all located close to the community and the lands could be subject to encroachment. Due to land acquisition, farming activities or hunting will cease during the operational phase, as the acquired land will be fenced off to prevent encroachment and now be used for power operations. The project will be operational 24 hours a day, seven days a week with the proposed operational period of the

Project being 25 years. The loss to access of lands for subsistence farming will also affect income generation ability by residents.

The significance rating of the impact on land use is said to be **MEDIUM NEGATIVE**. The potential intensity of this impact is low. The spatial extent of the impact will be specific only to the project site. This impact to land use and access is definite and of long-term duration as the land will not be available for subsistence farming or for hunting. The impact of loss of income or lowered income generation is definite and will occur in the long-term.

6.8.3. Impacts on Labour and Working Conditions

Constructional Phase

The labour force during the construction of the PV Plant will be the responsibility of the EPC contractor. The EPC contractor will in turn appoint specialist subcontractors, with the VRA Local Content Policy in mind. A construction work-force of up to 100 is expected, however this is dependent on the turnkey contractor and these will be expected to work on all four sites depending on the stage of construction. The average numbers on site at any one time would be of the order of 50, and this will at any time include about 30 members of local communities that will be hired as drivers, masons, loaders, carpenters, cooks, security personnel and other assorted personnel. Professionals such as electricians, riggers, crane operators and heavy equipment operators will also be required for the construction of both the PV plant and associated sub transmission lines and these people will most likely not come from the local community but from elsewhere. About 5 VRA support staff, 5 expatriate workers and 10 Specialist staff are also expected to be on site in addition to the above.

It is envisaged that the EPC Contractor will employ as many people as possible from the surrounding Kaleo and Lawra as well as surrounding local villages and towns. Workers will be hired for periods lasting from a few days (for specific construction tasks) to the full extent of the construction period. Peak employment is estimated to be 6 months. Temporary camps may be required to house the workforce. However, the EPC Contractor is advised to hold discussions with the house owners in order to determine if the facilities will be suitable for senior level workers.

Productivity has been known to deteriorate on construction sites due to labour unrest, leading to a negative impact on the cost and quality of construction as well as the livelihood and morale of workers. Wages, bonus and other compensation disputes remains the main reason for work stoppages and accounting for working days lost. Given the important role of labour productivity and industrial action to workers and to the economy, there is the need for VRA to play an increasingly active role in mitigating the damages resulting from industrial action. The EPC contractor and subcontractors usually have contracts with a defined work scope, duration, start date, and other parameters to base their estimate. A change in a project scope of any kind usually means there will be associated productivity impacts that can be attributed to inefficiencies as well. Often, the design is incomplete, or changes are made that will impact the original estimate. A key example will be requests from VRA to keep the same completion date, despite the added scope of work. This may require overtime, second shift work, rework, additional crafts, and many other impacts to the original plan and estimate. This increase in person-hours, constraints, and other resources would affect the cost and

schedule. Employment of locals was a key issue by all stakeholders, especially traditional authorities. With this, there is the conscious need to employ locals during the constructional phase of the project to avoid any disaffection and subsequent disruption of project activities.

Another impact that may occur is the need for new or additional material, constraints, and equipment, which affect the sequence, duration, and schedule of work packages. There could also be an increase in idle time of workers waiting on material. Such changes may cause work force increases and work areas to be overcrowded with workers who now need to share and occupy the same workspace, scaffolding, or equipment with other crafts, causing a further drop in productivity.

The potential intensity of this impact occurs is described as medium low, international in nature as the EPC Contractor will be affected, but temporal in nature and with a low probability to occur, if relevant measures are not put in place. The significance of the impact on labour and working conditions during constructional phase is **LOW NEGATIVE**.

Operational & Maintenance Phase

A dedicated team of about 20 VRA engineers and technicians will be responsible for up keeping of the various solar plant during operation at both the Lawra and Kaleo sites as well as coordinate and execute maintenance activities. In addition to this number, about 10 persons from the locality will be engaged for unskilled labour required on site such as security guards, cleaners, gardeners, etc. Receptors in the Social Area of Influence (AoI) that may be able to make the most of these opportunities are those who have received experience of formal employment, gained basic education or learned English language skills. Typically, this may be youthful persons who have received some education, have experience working for the government or other international companies.

The socio-economic environment of the social study area is characterised by a low degree of livelihood productivity with some degree of diversity. The study showed low levels of educational achievement and capacity within the project area. From the literature reviewed, it is determined that majority of household respondents have only reached 2nd cycle and primary school. Based on the baseline conditions it is assumed that very few of these types of candidates will be available from within the local area. As a result, this benefit is expected to be experienced mainly by beneficiaries in urban centres such as Wa.

It should be noted that at the local level the overall lack of education, skills and capacity means that vulnerability is high, meaning a large majority would be ill equipped to maximise benefits. Experience has shown that such situations usually cause the community members to be peeved that others have been successful, with its subsequent negative attitudes to the project and the workers that have been engaged. Vandalism sometimes results from such ill feelings.

The potential intensity if this impact occurs is described as low negative, regional and temporal in nature with a low probability to occur, if relevant measures are not put in place. The

significance of the impact on labour and working conditions during operational phase is Very Low negative.

6.8.4. Impacts on Community Health, Safety and Security

The receptors for impacts on community health and safety include settlements in the proximity of the project site (within 1km and along the access road) and transmission line (within 100 m from the centreline), which will be exposed to health impacts from the project activities, in this case the Kaleo and Lawra communities. As per IFC EHS guidelines, the occupational and community health and safety hazards during the construction, operation, and decommissioning of solar power projects are generally similar to those of most large infrastructure projects. They may include physical hazards such as working at heights, working in confined spaces, electrical safety and structural safety of project infrastructure, life and fire safety, public accessibility, emergency situations and falling objects.

Constructional Phase

Possible sources of impacts to community health and safety during the construction phase include changes in environmental quality due to construction activities, increased prevalence of disease arising from the influx of construction workers as well as heavy traffic movement. Changes in baseline environmental conditions can be experienced by the local community in terms of increased nuisance levels from emissions to air, contamination of surface water or ground water and high noise levels during the construction phases, as discussed in the previous sections. An increase in dust and noise during the construction period has the potential to lead to health impacts associated with eye irritation and general disturbance to daily activities.

Again, the discharge of domestic waste effluent from sanitary facilities for construction workers may have the potential to cause contamination of surface water and groundwater in this area, if not properly supervised. However, due to adequate safeguard facility, the potential for long term impacts to community health are minor. Pollution control and mitigation measures will be implemented to reduce the likelihood of contamination of surface and groundwater from sanitary effluent (construction camps) generated during construction. The land where the solar power facilities are to be located are mostly agricultural lands, the surrounding area of which would still be used for cultivation in future. The solar power plant may restrict access or make accessibility difficult especially during the construction phase and there is need for effective engagement with community members to avert such situations which can lead to conflicts.

Approximately 50-100 workers will be employed for the construction phase from commencement and peak demand will be up to 100 workers. There shall be no labour camps established within the communities as workers shall be integrated into the communities. Influx of workers to the community may cause impacts to public health, especially an increase in prevalence of diseases as well as pressures on existing health infrastructure. There is also the possibility of increase in sexually transmitted diseases such as HIV/AIDS as a result of the expected influx of workers to the area. In addition, vector-borne diseases will be sensitivity for settlements closer to campsites for the construction phase labour, particularly due to lack of

hygienic conditions. The EPC Contractor is expected to be put in place appropriate measures for the workforce to be aware of impacts of Sexually Transmitted Diseases and HIV/AIDS as well as any common communicable diseases associated with the area.

Considering the possible changes in environmental quality, health related impacts and influx of migrant workers at the constructional phase, the intensity of this impact can be said to be medium, the duration will be over the constructional phase and therefore temporal in nature and high irreversible with a medium probability to occur. The significance rating of the impact of the project on community health, safety and security at the constructional phase can be described as **LOW NEGATIVE**.

Operational & Maintenance Phase

The only foreseen impacts in relation to community health, safety, and security are mainly limited to trespassing of unauthorized personnel into the Project site and which could result in potential risks from several hazards of the various Project components (e.g. electric shock, thermal burn hazards, exposure to chemicals and hazardous materials, etc).

Considering the works and population involved, the intensity of this impact can be said to be low, it will occur over the project operational phase and therefore duration is long term and moderately irreversible with a low probability to occur. The significance rating of the impact of the project on community health, safety and security at the operational phase can be described as **VERY LOW NEGATIVE.**

6.8.5. Traffic and Transport Impacts

Transportation and access to site has been described under Chapters 3 and 4. It is expected that the solar power materials will be brought by sea to the Tema Port. From there, it will be offloaded and brought to Accra on the N1 Highway in the southern sector, where it will be transported up north to site through to Kumasi on the N6 Highway, Techiman on the N10 Highway, and then on to the N12 Highway through Wa, the regional capital, and finally to Lawra, covering a total distance of about 860 km. PV modules are fragile equipment; however, the current off-site traffic conditions can satisfy the equipment transport requirements. Materials and equipment procured locally or nationally will be transported directly to the storage site. It must be noted that the materials will not be bulky and unwieldy. They will therefore not require any specialised vehicles.

Constructional Phase

Constructional impacts due to traffic and transport generally can occur in the form of:

- Disruption of transport links, including delays and congestion brought about by an increase in overall traffic numbers due to construction traffic movements.
- Conflict with other road users, including pedestrians and public transport (buses, taxis, etc.) as a result of delivery of equipment and plant to the site.
- Specific annoyance due to additional heavy goods vehicle movements.
- Localised disruption as a result of the constructional activities.
- Risk of accidents along delivery roads and on the site.

During construction, the materials will be transported to the site via public roads. Estimated average construction vehicle movements are 5 trucks and 10 cars per day. The nature, size and location of the development proposal, together with the characteristics of its surroundings suggest that a detailed assessment of traffic impacts will not be required. Potential impacts on traffic and transport during construction will arise as a result of additional traffic movements associated with the transportation of equipment to the plant site, from workforce movements to and from the site and as a result of the removal of wastes from the site.

There can be serious disruptions to local traffic and also accidents during the construction period. This may result from the transportation of machinery and materials to the project site and also during the stringing of the transmission lines across roads. The situation can be aggravated without carefully planned detours and road closures. The effect of traffic disruptions includes increased travel time, congestion, social stress and agitations. However, this is expected to be minimal as the traffic densities in most of the communities where the PV Plants are low.

In terms of total traffic generated by the construction phase, daily movements will be low. The requirement will only be for the delivery of workers at the start and end of each day and the construction materials during the working day, both to the depots and to the construction sites. This will present an increased safety risk but with the application of proper mitigation measures particularly the speed controls through villages, this increased risk should be minor. Administrative measures would have to be put in place to stagger the delivery of construction equipment and materials to the construction sites, and the delivery of materials and equipment would be carried out during off-peak hours.

Building materials supply to the site would be frequent for sand, stones, cement, and blocks, especially during early stages of the construction period. In addition to this are the equipment and machinery, which would be delivered to be installed at the site, via sea to Tema Port and then by road to the project site. The delivery of construction materials and equipment and machinery could create a degree of traffic and accidents in the routes to the project site.

Any traffic obstructions caused by construction activities would be temporary and moderate and conditions would return to normal once the proposed project action is completed. Taking account of the low overall total traffic movement that will occur, the intensity of this impact is anticipated to be high the spatial extent of the impact will be regional, and the duration of the impact will be temporal and reversible. There is a high probability of the impact occurring. The significance rating of the impact of the project on traffic and transports can be described as Medium Negative.

Operational & Maintenance Phase

A maximum of two pick up vehicles, one for each project locality will be available for operational purposes. A permanent workforce of approximately 20 staff is expected at the power station. It is unlikely that all operating staff will have cars; therefore, the actual increase in personal vehicle

movements is expected to be low. Repairs and maintenance purposes requiring vehicular movements by external contractors will be few and far in between will not require more than 2 vehicular movements per day for more than 5 days. Thus, vehicular movements during operation of the plant has little potential to give rise to changes in road traffic levels on the roads within the vicinity of the Power station as a result of worker vehicle movements, deliveries and the removal of wastes from the site.

The main source of potentially significant additional traffic during operation will be that of site workers vehicles. However, any increase in traffic would be barely detectable within the day-to-day variation in the project area. As such, the operation of the solar power plant will not have a material impact on the operation of the existing roads. The operational phase of the scheme is not expected to have any significant impact on road safety. Severance, vibration, visual intrusion, driver delay will not be a significant impact. Nor will the operational phase of the project have a detrimental effect on pedestrian amenity.

The significance rating of the impact of the project on traffic and transport during project operations can be described as **VERY LOW**. Taking account of the low overall total traffic movement that will occur, impacts are predicted to be low. The spatial extent of the impact will be local. The duration of the impact will be during the operational duration and long term and there is a low probability of the impact on occurring.

6.9. Potential Cumulative Impacts

For each of the impacts assessed, the ESIA is to investigate the cumulative impacts which could result from incremental impacts from other known existing and/or planned developments in the area and based on currently available information on such existing/planned developments. Within the project area and its surrounding there are no existing and/or planned developments which would result in cumulative impacts on any of the environmental or social receptors investigated as part of the ESIA. The natures of the potential impacts which have been addressed above are site-specific and relevant mitigation measures will be adopted. The assessment of cumulative impacts in that sense is not relevant.

However, impact on water resource especially, ground water, is critical as water is required for cleaning of the PV modules on a regular basis. Estimated volume of water demand for wet cleaning of solar panels ranges from 19.5 m^3/year to 84.5 m^3/year for a duration of 20 years. There is the need to ensure that enough water is available and that there is no negative impact on the drinking water supply situation of the nearby communities which may create substantial social conflicts.

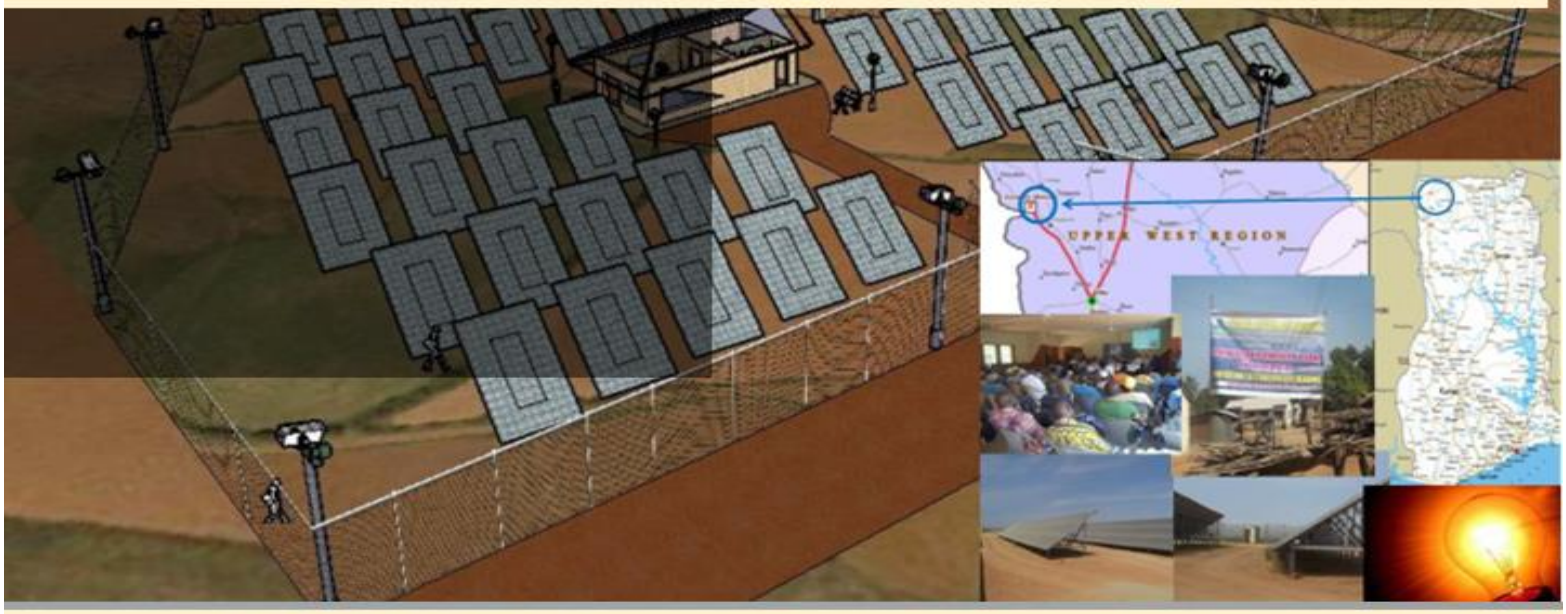
6.10. Impacts During Decommissioning Phase

The decommissioning of the PV site which would have been part of the local social fabric for many years will certainly create vacuum in the lives of the people directly and indirectly connected with it. The project is expected to have similar impacts as the construction phase during decommissioning phase. Decommissioning and dismantling operations will have impact on environment due to noise and dust arising out of it. It will also have other negative impact such as

solid waste, Occupational Health & Safety as well as Traffic & Transport. Specific strategies shall be adopted to handle each type of item to keep the impact during the actual activity low. These strategies have been discussed in brief under Chapter 9 of this Report within a contextual "Decommissioning & Dismantling Plan".

The impact due to decommissioning on power, social and environmental scenario will be guided by applicable laws and guidelines and these will be addressed as appropriate. Mitigative measures proposed for the constructional phase for the identified impacts also pertains to the decommissioning phase and will not be discussed further. Ratings of identified impacts at the phase are outlined under Table *7-1*.

Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



CHAPTER 7:

MITIGATION & ENHANCEMENT MEASURES

7 MITIGATION & ENHANCEMENT MEASURES

7.1. Overview

This Section provides information on the enhancement or mitigative measures to be put in place based on the identified impacts outlined under Chapter 6 through the consideration of the following:

- Enhancement measures, which outlined measures to be implemented to enhance already positive benefits of the project.
- Embedded or In-built Controls, which outlines mitigation measures which is built into the project during the design process as well legal requirements that must be adhered to in order for easy transfer into all contractual documents with the EPC Contractor, if required
- Mitigation of significant effects or key mitigation (pertinent measures that will be written into and enforced through the EMP for implementation to ensure that the significance of the associated impact is acceptable).
- Mitigation of non-significant effects or additional mitigation (management actions to be considered by proponent and authority).

The identified measures are to be implemented mostly by the EPC Contractor in collaboration or under the supervision of VRA at the constructional stage whilst the VRA is solely responsible for the operational stage. Based on expert experience. an evaluation of the residual, i.e. remaining, impacts after implementation of the mitigation measures, has also been undertaken and indicated.

7.2. Recommended Enhancement Measures for Positive Benefits

7.2.1 Minimisation of Greenhouse Gases

Constructional Phase

Potential for minimising greenhouse gas emissions can only be realised when project development is complete and operational, and therefore no measures can be put in place at this stage.

Operational Phase

Embedded/In-built Control

- Implementation of VRA REDP to enhance the contribution of the solar power project to reduction of greenhouse gases and its contribution to climate change impacts.
- Provision of reports on project operations to the EPA in line with the requirements of the National Climate Change Policy and the Kyoto Protocol.

Enhancement Measures

- VRA shall undertake regular and routine maintenance of solar power facilities for continuous operations of the plant to ensure it displaces energy sources from fossil fuels.

*The significance of the impact during the operational phase has been evaluated as **HIGH POSITIVE**. With the implementation of the enhancement measures proposed, it is expected that the significance of the rating will continue to be **HIGH POSITIVE.***

7.2.2 Increased Employment Opportunities

Constructional Phase

Embedded/In-built Control

- Adherence to Labour Act 2003 (Act 651) of 2003 and the Labour Regulations, 2007 (LI 1833)**.**
- Adherence in line with VRA Local Content Policy

Enhancement Measures

EPC Contractor shall:

- Prepare and implement a Labour Management Plan for the constructional phase.
- Use local employment and sourcing policies to give priorities to people within the two project communities specifically and the Nadowli-Kaleo District and Lawra Municipal in general.
- Adopt strategies under the Navrongo Solar Power Project in the recruitment of locals under this project.
- Announce job opportunities via both the electronic and print media.
- Procure food stuff and fish from the local communities, thus providing a source of income for such communities. Regarding this, food vendors from the local communities must be encouraged to sell their food to workers at designated places within the project site.

*The significance of the impact during the constructional and operational phases have both been evaluated as **MEDIUM POSITIVE**. With the implementation of the enhancement measures proposed, it is expected that the rating for both phases will have a **HIGH POSITIVE** significance.*

Operational Phase

Embedded/In-built Control

- Application of relevant national policies, labour laws and codes concerning employment conduct.
- Design and adherence to employment and workforce policies.

Enhancement Measures

- VRA shall ensure continuous electricity availability to help manufacturing sectors which are often constrained by a lack of reliable power to produce more, consume more inputs from other sectors, and hence create additional employment.

7.2.3 Stabilization of Electricity in Ghana

Operational Phase

Embedded/In-built Control

- Development and implementation of an O&M concept for all relevant aspects of work in line with the Energy Commission Act (1997), Act 541 and the Factories, Shops and Offices Act of 1970 (Act 328)
- Acquisition of valid permits in line with national requirements to prevent shut down of the solar power facility.

Enhancement Measures

VRA shall:

- Develop a system to allow a smooth transition in the architecture and operation of the present power system;
- Undertake regular and routine maintenance of the solar power facilities.
- Undertake capacity building of operational and maintenance staff for the purposes of developing their efficiency.
- Ensure operations and maintenance activities are environmentally benign; and socially equitable.

*The significance of the impact during the operational phase has been evaluated as **MEDIUM POSITIVE**. With the implementation of the enhancement measures proposed, it is expected that the significance will maintain its **MEDIUM POSITIVE** significance.*

7.2.4 Promotion of Economic Growth

Operational Phase

Embedded/In-built Control

- Implementation of CDP/CSR to enhance local economy.

Enhancement Measures

VRA shall:

- Ensure stably priced electricity for consumers to promote local businesses.
- Ensure continuous electricity availability to help in manufacturing at the local level.
- Provide job opportunities for locals and nationals to enhance their economic development.
- Sppoint a Community Relations Officer for the Upper West Region to serve as liaison between the communities and VRA.
- Engage with traditional authorities and heads of state agencies in the various districts on the modalities to apply and benefit from the CDP/CSR.
- Improve local skills through training under the CDP/CSR to maximize local employment and facilitate economic development initiatives that benefit the Lawra and

Kaleo communities as well as UWR.
- Extend its Employee Volunteerism Program to the educational institutions in Lawra and Kaleo.

*The significance of the impact during the operational phase has been evaluated as **MEDIUM POSITIVE**. With the implementation of the enhancement measures proposed below, it is expected that the impact will maintain its **MEDIUM POSITIVE** significance.*

7.3. Mitigation Measures for Negative Impacts on Physical Environment

7.3.1 Noise & Vibrational Impacts

Constructional Phase

Embedded/In-built Control
- Adherence to relevant requirements of the Factories, Shops and Offices Act of 1970 (Act 328).
- Compliance with Occupational Safety and Health requirements of the Factories & Inspectorate Division to ensure that for activities associated with high noise levels, workers are equipped with proper Personal Protective Equipment.

Mitigative Measures

The EPC Contractor shall:
- Define normal working hours (preferable 0700 Hours to 1800 hours) and that if work needs to be undertaken outside these hours, it should be limited to activities which do not generate noise.
- Operate only well-maintained equipment on-site.
- Apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc.
- Stop construction activities until adequate control measures are implemented, if noise levels were found to be excessive.
- Shut down or throttled down machinery and construction equipment that may be in intermittent use during non-work periods;
- Encourage minimal use of vehicle horns and heavy engine breaking in the project area.

*The significance rating of the noise impact at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*

Operational Phase

Embedded/In-built Control

- Adherence to relevant requirements of the Factories, Shops and Offices Act of 1970 (Act 328) as well as the Corporate Health & Safety Policy.

Mitigative Measures

VRA shall:

- Ensure that for activities associated with high noise levels, workers are equipped with proper Personal Protective Equipment (e.g. Earmuffs).
- Ensure only well-maintained equipment are operated on-site.

*The significance rating of the noise impact at the operational phase stage has been identified as **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain **LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*

7.3.2 Air Quality Impacts

Constructional Phase

Embedded/In-built Control

- Adherence to requirements of **Driver & Vehicle Licensing Authority Act, 1999 (ACT 569)** by having valid Vehicle Examination Certificate from the Driver & Vehicle Licensing Authority to minimise vehicular emissions.
- Compliance with the Factories & Inspectorate Requirements to ensure that for activities associated with high dust levels, workers are equipped with proper Personal Protective Equipment (e.g. masks, eye goggles, breathing equipment, etc);

Mitigative Measures

EPC Contractor shall:

- Apply basic dust control and suppression measures which could include:
  a) Regular watering of all active construction areas.
  b) Proper planning of dust causing activities to take place simultaneously in order to reduce the dust incidents over the construction period.
  c) Proper management of stockpiles and excavated material (e.g. watering, containment, covering, bunding).
  d) Proper covering of trucks transporting aggregates and fine materials (e.g. using tarpaulin).
  e) Adhering to a speed limit of 15km/h for trucks on the construction site.
- If dust or pollutant emissions were found to be excessive, stop construction activities until the source of such emissions have been identified and adequate control measures are implemented;
- Ensure diesel generator use is restricted to emergencies and power back-up only to minimize air emissions.

- Limit speed of vehicles on site to 10-15 km/hr.
- Prevent idling of vehicles and equipment.
- Develop a regular inspection and scheduled maintenance program for vehicles, machinery, and equipment to be used throughout the construction phase for early detection of issue to avoid unnecessary pollutant emissions.

*The significance rating of the air quality impact at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*

Operational Phase

Embedded/In-built Control

- Ensure adherence to requirements of **Driver & Vehicle Licensing Authority Act, 1999 (ACT 569)** by having valid Vehicle Examination Certificate from the Driver & Vehicle Licensing Authority to minimise vehicular emissions.

Mitigative Measures

VRA shall:

- Limit speed of vehicles on site to 10-15 km/hr.
- Prevent idling of vehicles and equipment.

*The significance rating of the air quality impact at the operational phase stage has been identified as **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain **VERY LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*

7.3.3 Topography & Drainage

Constructional Phase

Embedded/In-built Control

- Implementation of a surface water drainage system design that will effectively drain the site in line with the Ghana National Building Regulations, 1996, LI 1630 and the Ghana National Building Code, 2006.
- Adoption of a holistic approach for managing and mitigating flood risks, given the generic nature of such risks on all developments.
- Connection of a properly designed sewerage system within the site/office to the public sewer system.

Mitigative Measures

EPC Contractor shall:

- Avoid any unnecessary changes in the topography.

- Minimise to the extent possible, disruption/alteration of any micro-watershed drainage pattern.
- If required, to provide appropriate number of cross drainage channels during access road construction to maintain flow in existing natural channels.
- Carry out restoration of the worked areas immediately by backfilling, professional landscaping/levelling and planting of low grass in open areas, flowers and suitable tree species, once earthworks have been done.

*The significance rating of the topography and drainage impact at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be reduced to minor.*

Operational Phase

Embedded/In-built Control

- Ensure adherence to surface water drainage system designs in line with the Ghana National Building Regulations, 1996, LI 1630 and the Ghana National Building Code, 2006.

Mitigative Measures

- VRA shall regularly maintain surface water drainage and culverts to prevent storm water (run-off) from accumulating within the site spreading to the neighbourhood. These must effectively drain the storm water from the premise into the existing public drainage system to be developed along the access road.

*The significance rating of the topography and drainage impact at the operational phase stage has been identified as **VERY LOW NEGATIVE**. By implementing the above recommended measure, it is expected that the impact will remain **VERY LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*

7.3.4 Geology & Soils

Constructional Phase

Embedded/In-built Control

- Adherence to the requirements of the **Land Planning and Soil Conservation Act, 1957** within the designated project areas.

Mitigative Measures

EPC Contractor shall:

- Not undertake site clearance, piling, excavation and access road construction during the raining season to minimize erosion and run-off.
- Ensure that construction activities are restricted to designated work areas to avoid damage and disturbance outside of the power plant site.

- Strip and store topsoil separately from subsoil.
- Locate temporary storage tanks on impervious bases and will use drip trays during re-fuelling of equipment.
- In case of accidental/unintended spillage, immediately collect contaminated soil and stored as hazardous waste.
- Make available on site, all equipment and materials required to execute a clean-up.
- Utilize existing roads to access the site.
- Widen existing roads to have the width and turning radius to accommodate the necessary vehicles for the project.

*The significance rating of the impacts on geology and soils at the constructional stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

Operational Phase

Embedded/In-built Control

- Adherence to the requirements of the **Land Planning and Soil Conservation Act, 1957** within the power facilities.

Mitigative Measures

VRA shall:

- Take responsibility for ensuring that operational activities are restricted to designated work areas, to avoid damage and disturbance outside of the power plant site, especially the sub-transmission line component.
- In case of accidental/unintended spillage, immediately collect contaminated soil and stored as hazardous waste.

*The significance rating of the impacts on geology and soils at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measure, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

7.3.5 Water Resources

Constructional Phase

Embedded/In-built Control

- Adherence to requirements of **Drilling License & Groundwater Development Regulations, 2006, LI 1827** for the construction of a well for the abstraction of groundwater.

Mitigative Measures

EPC Contractor shall:

- Adhere to agreed arrangements for the disposal of aqueous effluents during construction and commissioning phases with VRA.
- Provide impervious storage area, especially for fuel & lubricant, hazardous waste, etc.
- Not store hazardous materials near natural drainage channels.
- Ensure that any temporary refuelling tanks are bunded.
- Have available on site, all equipment and materials necessary to execute clean up.

*The significance rating of the impacts on water resources at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

Operational Phase

Embedded/In-built Control

- Acquisition of valid Water Use Permit for abstraction of ground water as required under the provision of the Water Use Regulations, 2001 (L.I. 1692).
- Installation of automatic water level sensors inside wells

Mitigative Measures

VRA shall:

- Engage with Community members continuously on issues of water security to avoid potential conflicts.
- Regularly monitor the ground water abstraction and report on it on regular basis to the EPA.
- Maintain logbook for water consumption.
- Progressively adopt less water consuming module cleaning methods.

*The significance rating of the water resources impact at the operational phase stage has been identified as **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain **VERY LOW NEGATIVE** significance and the residual impact significance will be reduced to negligible.*

7.3.6 Waste Generation

Constructional Phase

Embedded/In-built Control

- Adherence to legal requirements such as the **National Environmental Sanitation Policy 2010** and the **Hazardous & Electronic Waste Control Management Act, 2016 (Act 917).**

- All waste arising from the works shall be deposited, treated, kept, disposed of and carried in accordance with the provisions of relevant national and local environmental protection acts and also in accordance with any additional instructions outlined by VRA.

Mitigative Measures

Solid Waste

The EPC Contractor shall,

- Store construction and demolition waste separately and be periodically collected by an authorized treatment and storage facility.
- Distribute enough properly contained containers clearly marked as "**Construction Waste**" for the dumping and disposal of construction waste.
- Distribute appropriate number of properly contained litter bins and containers properly marked as "**Municipal Waste**".
- Store all waste in a shed that is protected from the elements (wind, rain, storms, etc.) and away from natural drainage channels.
- Coordinate with relevant District assembly or hire a competent private contractor for the collection of solid waste from the site to the approved landfill.
- Provide designated areas for solid municipal waste and daily collection and period disposal should be ensured.
- Ensure that only a licensed waste collector will transport all waste arising from the works.
- Where possible, must seek ways to reduce construction waste by reusing materials.
- Not permit burning of waste.
- Implement proper housekeeping practices always on the construction site.

Waste Water

The EPC Contractor shall,

- Coordinate with respective District Assemblies to hire a private contractor for the collection of waste water from the site.
- Ensure that constructed septic tanks during construction and those to be used during operation are well contained and impermeable to prevent leakage of wastewater into soil;
- Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing.
- Prohibit illegal disposal of wastewater to the land.

Hazardous waste

The EPC Contractor shall,

- Maintain a log book for quantity and type of hazardous waste generated.
- Prohibit illegal disposal of hazardous waste to the land.
- Ensure that no unauthorized dumping of used oil and other hazardous waste is undertaken at the site.
- Ensure that containers are emptied and collected by the contractor at appropriate

intervals to prevent overflowing.

- In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste.

Hazardous Material

The EPC Contractor shall,

- Ensure that hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of hard impermeable surface, flame-proof, accessible to authorized personnel only, locked when not in use, and prevents incompatible materials from coming in contact with one another.
- Maintain a register of all hazardous materials used and accompanying Material Safety Data Sheet (MSDS) must always be present. Spilled material should be tracked and accounted for.
- Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc).
- Undertake regular maintenance of all equipment and machinery used onsite. Maintenance activities and other activities that pose a risk for hazardous material spillage (such as refuelling) must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material.
- Ensure that a minimum of 200 litres of general-purpose spill absorbent is available at hazardous material storage facility.
- Ensure that if spillage on soil occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.

*The significance rating of the impacts on waste generation at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

Operational Phase

Embedded/In-built Control

- Adherence to the **National Environmental Sanitation Policy 2010** and the **Hazardous & Electronic Waste Control Management Act, 2016 (Act 917).**
- All waste arising from the works shall be deposited, treated, kept, disposed of and carried in accordance with the provisions of relevant national and local environmental protection acts.
- Procedures for the disposal of waste will be contained in the operational site Environmental Management Plan and will be incorporated into any contract between VRA and the licensed operator.

Mitigative Measures

The VRA shall:

- Coordinate with relevant District assembly or hire a competent private contractor for the collection of solid waste from the site to the approved landfill.
- Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste";
- Provide waste oil tanks to hold the waste lubricating oils to be produced.
- Engage EPA licensed operators to remove waste oil from the site for re-use.
- Ensure foul water always go to a septic tank.
- Prohibit illegal disposal of wastewater to the land.
- Ensure disposal of waste from the septic tank in an environmentally acceptable manner by a licensed operator approved by EPA.
- Ensure that constructed septic tanks during operation are well contained and impermeable to prevent leakage of wastewater into soil;

*The significance rating of the impacts on waste generation at the operational stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

7.3.7 Landscape & Visual Intrusion

Constructional Phase

Embedded/In-built Control

- Use of appropriate colour, materials and proportioning as well as appropriate architectural detailing to assist in the respectful integration of the facades of the power facility with surrounding environment and existing buildings.

Mitigative Measures

The EPC Contractor shall:

- Ensure the construction site is left in an orderly state at the end of each work day.
- Remove in a timely manner to the greatest extent possible, construction machinery, equipment, and vehicles that are not in use and these shall be kept in locations to reduce visual impacts to the area.
- Ensure proper storage, collection, and disposal of waste streams generated
- Upon completion of construction activities, install informative signs on the Highway for commuters regarding potential for glare within the area.

*The significance rating of the impacts on landscape and visual intrusion at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

Operational Phase

Embedded/In-built Control

- Effective repairs and maintenance of the solar power facilities in line with the Ghana National Building Regulations, 1996, LI 1630 and the Ghana National Building Code, 2006.

Mitigative Measures

VRA Shall:

- Maintain informative signs on the N12 Highway for commuters regarding potential for glare within the area.
- Plant trees native to the area at the frontage of the power plant facilities to act as windbreaks, noise buffer and to reduce the visual effect of having a power plant located at the site.

*The significance rating of the impacts on landscape and visual intrusion at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

7.4. Mitigation Measures for Negative Impacts on Ecological Environment

Constructional Phase

Embedded/In-built Control

- As part of project design, appropriate routing of lines, use of bird deflectors, and pole design which minimizes electrocution risks shall be developed to reduce impacts from power lines and associated infrastructure.
- Adherence to requirements of existing conditions of MoU Between VRA and FSD regarding work in the Lawra Forest Reserve.
- Anti-poaching, trapping and hunting policy among employees should be strictly enforced.
- Detailed assessment to identify of key faunal species of importance (reptiles and mammals) to allow for their relocation. It must be noted that this has been completed through a detailed survey in May 2018 and no viable species were identified.
- Undertake work in the Lawra Station Forest Reserve in accordance with the MoU between VRA and the Forest Services Division.

Mitigative Measures

The VRA shall:

- Enumerate and document all dangerous and potentially dangerous trees within the Lawra Forest Reserve prior to felling.

The EPC Contractor shall:

- Ensure that the fencing constructed for the Project site allows for the natural movement of small faunal species within the area;
- Implement proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel and good housekeeping which include the following:
  a. Prohibit hunting at any time and under any condition by construction workers onsite
  b. Restrict activities to allocated construction areas only, including movement of workers and vehicles to allocated roads within the site and prohibit off-roading to minimize disturbances.
- Restrict vegetation disturbance and clearance to the project activity area location of laydown area, construction activities and storage areas;
- Prohibit unnecessary disturbance of neighbouring vegetation due to off-road vehicular movement, fuel wood procurement and destruction of floral resources.
- Conduct construction activity in a phased manner, in other words, construction activity should not be widespread affecting all habitats at the same time.
- Strictly enforce anti-poaching, trapping and hunting policy among contractor's workforce.
- Enhance general awareness regarding fauna through trainings, posters, etc. among the staff and labourers.

*The significance rating of the impacts on ecology at the constructional stage is said to be **HIGH NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*

Operational Phase

Embedded/In-built Control

- The use of bird deflectors, and pole design which minimizes electrocution risks shall be maintained during project operations to reduce impacts from power lines and associated infrastructure.
- Adherence to requirements of existing conditions of MoU Between VRA and FSD regarding work in the Lawra Forest Reserve.
- Enforcement of anti-poaching, trapping and hunting policy among employees.

Mitigative Measures

VRA shall:

- Ensure upright insulators on transmission poles are covered with plastic insulating caps or insulating tubing to prevent electrocution risk;
- Erect bird detractors such as moving cloth or scarecrow to prevent birds from venturing close to solar modules.
- Regularly check the vacuums or holes in the towers to avoid nesting by any of the birds;

- Enhance general awareness regarding fauna through trainings, posters, etc. among the staff.

*The significance rating of the impacts on ecology at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

7.5. Mitigation Measures for Negative Impacts on Historical or Cultural Heritage Resources

Construction Phase

Embedded/In-built Control

- Adherence to requirements of the National Museums Act, Act 387 of 1969.
- Pacification rites requirements, prior to construction, as requested by the land owners and community leaders during the various stakeholder engagements.

Mitigative Measures

The EPC Contractor shall:

- Establish an engagement platform with local community and owners/caretakers to provide the support to ensure that any identified resource does not pose a problem for project development. Emphasis should be placed on Kulbonuo Shrine belonging to the Bayoyire Community in Lawra and the burial ground of the Late Hon. Jatoe Kaleo in Kaleo,
- Ensure that the Code of Conduct, awareness raising, and training developed for construction workers to emphasizes the presence of the locations of the Kulbonuo Shrine and the burial grounds or any other resource that may be identified later in the area - this could include providing information on their locations, prohibit any improper conduct which could disturb/ damage those locations, etc.
- Properly plan construction activities to consider the identified resources locations to ensure they are protected from any potential damage. This could include for example proper movement of vehicles and machinery into/out of the site to avoid those areas, prohibit movement of vehicles near those areas during the various construction activities, etc.
- Undertake all works take place within the authorised footprint to avoid impacts to any nearby tangible and intangible heritage resources.
- Dialogue with community members on compensation and moving any identified shrine.
- Ensure strict observation of the cultural taboos.
- Implement appropriate chance find procedures in collaboration with the Ghana Museums & Monuments Board (GMMB).
- Ensure proper documentation and reporting of chance finds and submission to Ghana Museum in Accra.

*The significance rating of the impacts on historical and cultural heritage resources at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

Operational Phase

Embedded/In-built Control

- Adherence to requirements of the National Museums Act, Act 387 of 1969.

Mitigative Measures

VRA shall:

- Properly plan operation activities to consider the identified archaeological locations to ensure they are protected from any potential damage.
- Ensure that the Code of Conduct, awareness raising, and training developed for staff to emphasizes the presence of archaeological locations in the area
- Undertake all works take place within the authorised footprint to avoid impacts to any nearby tangible and intangible heritage resources.
- Ensure strict observation of the cultural taboos.
- Ensure proper documentation and reporting of chance finds and submission to GMMB in Accra.

*The significance rating of the impacts on historical and cultural heritage resources at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at a **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

7.6. Mitigation Measures for Negative Impacts on Occupational Health & Safety

Constructional Phase

Embedded/In-built Control

- Adherence to requirements of Factories, Shops and Offices Act of 1970 (Act 328).
- Adherence to requirements of VRA's "Safety, Health and Environment Standards for Contractors".
- Acquisition of a Development Permit from the relevant District Assembly, prior to construction.
- Acquisition of a Fire permit prior to project implementation to ensure fire safety.

Mitigative Measures

EPC Contractor shall:

- Develop and implement a Health & Safety Plan, an Environmental Protection Plan as well as a Quality Assurance Plan during construction.

- Provide all workers (regular and contracted) with training on Health and Safety Plan.
- Develop and disseminate international best practices regarding working conditions, health and safety and overall management practices to the workforce.
- Undertake construction activities during daytime hours and vigilance should be maintained for any potential accidents.
- Provide PPEs such as safety shoes, helmet, goggles, ear muffs and face masks to workers always.
- Ensure that cranes and other lifting equipment are operated by trained and authorised persons.
- Train personnel of the Ghana National Fire Service on how to deal with fire resulting from solar projects as part of the requirements for the Engineering, Procurement and Construction (EPC) Contract.
- Provide training for the workers on climbing techniques, and rescue of fall-arrested workers.
- Provide an up-to-date first aid box at all construction sites and a trained person should be appointed to manage it;
- Ensure that electrical and maintenance work are not carried out during poor weather and during lightning strikes.
- Provide training on vehicular safety to the transport workers;
- Undertake health education about communicable diseases as part of the induction training for workforce members.
- Undertake regular health check-ups of the work-force and reporting any major illnesses at the earlier to the local medical officer. It must be ensured that the health check-up of all migrant labours should be conducted through the District Medical Officer.
- Allow migrant labours to go back home periodically (in every two months) to avoid long stay away from their family.
- Implement a permitting system to ensure that cranes and lifting equipment is operated by trained and authorized persons only.
- Ensure that appropriate safety harnesses and lowering/raising tools are used for working at heights.
- Ensure all equipment are turned off and checked when not in use;
- Avoid construction and transportation activities as far as possible during night (6:00 pm to 6:00 am).
- Avoid obstructing water source/flow as a result of constructional activities.
- Install temporary barriers on excavated areas.
- Follow good housekeeping for construction activities, and properly dispose of all waste packaging material.
- Provide proper sanitation facilities at site offices;
- Put in place suitable measures to maintain a healthy environment for the labour force.

*The significance rating of the impacts on occupational health and safety at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures,*

*it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

Operational Phase

Embedded/In-built Control

- Adherence to requirements of the "Hazardous & Electronic Waste Control Management Act, 2016 (Act 917)" to provide for the control, management, disposal of hazardous waste, electrical and electronic waste and for related purposes.
- Implementation of VRA Health & Safety Policy in line with IFC Occupational Health and Safety (OHS) Guidelines for the solar power project.
- Acquisition of valid permit from the Factories & Inspectorate Division, Environmental Protection Agency and the Energy Commission for operating the solar power facility.
- Have in place safety or emergency management plan to account for natural disasters, accidents and any emergency situations.
- Develop and implement Standard Operation Procedures on Health & Safety measures.
- Acquisition of Fire permit.

Mitigative Measures

VRA Shall:

- Provide all workers (regular and contracted) with training on Health and Safety management system on its EHS policies and procedures.
- Place appropriate warning signs at the site where there is a risk to health and safety.
- Install a comprehensive fire detection and protection system to cover all equipment on site that could constitute a fire risk.
- Monitor health and safety performance and have an operating audit system for the facilities.

*The significance rating of the impacts on occupational health and safety at the operational phase is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

7.7. Mitigation Measures for Negative Impacts on Socio-economic Impacts

The following recommendations are proposed to mitigate identified socio-economic impacts associated with the solar power project.

7.6.1 Impacts on Land Acquisition

Constructional Phase

Embedded/In-built Control

- Adherence to requirements of its "***Land Acquisition & Resettlement Policy***

Framework" (LARF) and pay prompt, adequate and fair compensation to all project-affected persons before the start of constructional activities. Indeed, this has been completed to enable project construction to commence.

Mitigative Measures

VRA shall:

- Assign a Community Liaison Officer to liaise with the EPC Contactor, Traditional Authorities and the District Chief Executive upon commencement of the project.
- Institute appropriate grievance mechanisms to address concerns of the public
- Undertake detailed survey of project-affected persons for the purposes of compensation payment.
- Utilise existing right of way for roads and sub-transmission lines to minimise land acquisition

*The significance rating of the impacts on land acquisition at the constructional stage is said to be **HIGH NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*

Operational Phase

Embedded/In-built Control

- Institution of an appropriate grievance mechanisms to address concerns of the public

Mitigative Measures

- VRA shall appoint a Community Liaison Officer as a designated point of contact for the community

*The significance rating of the impacts on land acquisition at the operational stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

7.6.2 Impact on Land Use

Construction Phase

Embedded/In-built Controls

- Acquisition of Development Permit from the relevant District Assemblies, prior to construction.
- Effective zoning of project area by the Land Use & Spatial Planning Dept. (formerly Town and Country Planning Department).

Mitigative Measures

EPC Contractor shall:

- Restrict construction activities to within the allotted land and immediate surroundings only. After construction work, any land taken for a temporary basis for storage of material shall be restored to their original form.
- Utilise existing roads for access to the project site.
- On completion of construction activities, land used for temporary facilities, if any, should be restored to the extent possible.
- Undertake activities that will disturb land use in and around permanent project facilities.
- Utilise existing right of way to minimise land acquisition.

VRA shall:

- In consultation with local community, provide the required resource and support to ensure that accessibility to solar fields is not a problem.
- Undertake appropriate consultations with all stakeholders to raise awareness about the project. Of special importance is awareness regarding project benefits
- Institute appropriate grievance mechanisms to address concerns of the public.
- Appoint a Community Liaison Officer as a designated point of contact for the community.

*The significance rating of the impacts on land Use at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*

Operational Phase

VRA shall:

- Implement CDP/CSR activities to improve the standards of living and long-term wellbeing of the affected communities.
- Take proactive action in case required to avoid any undue confrontation with affected community.

*The significance rating of the impacts on land Use at the operational stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

7.6.3 Impacts on Labour and Working Conditions

Embedded/In-built Control

- Measures are to be designed and adhered to regarding employment and workforce policies to mitigate environmental, health and social impacts that are associated with the influx of formal and informal workers by the Contractor.
- The contractor will be required to prepare a statement of intent detailing how local employment opportunities will be addressed and the procedure for application for jobs.
- Design and adhere to employment and workforce policies.
- Application of relevant national policies, labour laws and codes concerning employment conduct.
- Local people are preferred by the project for the requirement of manpower under un-skilled category to the best possible extent. In case of non-availability of suitable workers, migrant workers will be hired to meet the manpower requirement.

Constructional Phase

The EPC Contractor shall:

- Prepare Labour Management Plan as part of HSE Plan for the construction phase.
- Ensure that local people are employed where skills permit.
- Provide adequate shelter, drinking water, toilet facilities for the workers.
- Institute appropriate grievance mechanisms to address concerns of both workers and the public.
- Ensure that no child labour is used, in accordance with international and local labour laws.
- Put in place a worker grievance mechanism including monitoring and resolving of such concerns.
- Put in place suitable measures to maintain a healthy environment for the labour force.

VRA shall:

- Appoint a Community Liaison Officer as a designated point of contact for the community.

*The significance rating of the impacts on Labour and Working Conditions at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

Operational Phase

Mitigation measures proposed for the constructional phase will be same for the operational phase.

*The significance rating of the impacts on Labour and Working Conditions at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the said recommended measures, it is expected that the impact will remain at **VERY LOW NEGATIVE** significance and the residual impact will be insignificant.*

7.6.4 Impacts on Community, Health, Safety and Security

Constructional Phase

Embedded/In-built Control

- Observation of all necessary traditional requirements during project implementation.
- Presence of Community Liaison Officer as a designated point of contact for the community.
- EPC Contractor shall provide training on vehicular safety to the transport workers;

Mitigative Measures

VRA shall:

- Give a formal notification of the Lawra and Nadoli-Kaleo District Chief Executives on the date of project commencement. The letter should be copied to the traditional authorities.
- Ensure self-introduction of EPC Contractor to the DCEs on arrival of onsite prior to project implementation.
- Ensure self-introduction of EPC Contractor to traditional authorities in Lawra and Kaleo on arrival of onsite prior to project implementation.
- Create a platform for the various parties to provide information on concerns that needs to be considered during the project implementation and to agree on grievance redress mechanism in place.
- Form Complaint redress committee to receive and facilitate resolution of concerns and grievances about the socioeconomic concerns raised by individuals or groups from the project affected communities. The main functions of the committee will be as follows:
    a. To provide a mechanism for aggrieved persons to report on problems arising because of project activities.
    b. To facilitate and prioritize the grievances of project affected persons that needs to be resolved.
    c. To ensure reporting to the aggrieved parties about the developments regarding their grievances and the decision of the project authorities
- Seek the assistance of the respective District Health Service in execution of any health education program for the workers.

EPC Contractor shall:

- Undertake constructional activities only during the day i.e. between 0700 hours to 1800 hours to minimize disturbance to the public within the proximity of the site/project especially the residential estates.
- Provide adequate security during the construction period and especially during the night when there are no constructional activities. It is important that warning/informative signs (bill boards) be erected at the site. These should indicate the operation hours and when works are likely to be started and completed.
- Ensure onsite guards are adequately trained to deal with trespassing incidents. In addition, guards must refrain from using excessive force, unless situation extremely requires so.
- Institute appropriate grievance mechanisms to address concerns of both workers and the public.
- Ensure its workforce desist from irresponsible sexual behavior during project implementation.
- Undertake sexual health education programs for its workers. through.
- Put in place mechanisms to deter the work force from engaging in cutting of trees for fuel wood, charcoal burning, and building material and for any other purposes, which has the potential of causing conflict with the communities.
- Ensure that excavated areas should be temporarily fenced to avoid access to outsiders and wildlife.
- Put in place mechanisms for the collection of all wastes generated (solid wastes, organic wastes, food remains, garbage etc.), segregate the various wastes and arrange for subsequent disposal through either efficient incineration or disposal in a sanitary landfill.
- Provide an alternative access route to the nearby local resort at the Lawra site, if required, as the route to the local resort has been identified to be outside the project area at Lawra.

*The significance rating of the impacts on Community, Health, Safety & Security at the constructional stage is said to be **LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **VERY LOW NEGATIVE** significance and the residual impact significance will be negligible.*

Operational Phase

Embedded/In-built Control

- Adherence to requirements of the "Hazardous & Electronic Waste Control Management Act, 2016 (Act 917)" to provide for the control, management, disposal of hazardous waste, electrical and electronic waste and for related purposes.
- Implementation of VRA its Health & Safety Policy in line with IFC Occupational Health and Safety (OHS) Guidelines for the solar power project.

Mitigative Measures

VRA shall:

- Provide effective security measures for the PV Plants and the project sites through fencing, enough security staff and other measures such as floodlights with motion control.
- Ensure onsite guard is adequately trained to deal with trespassing incidents. In addition, guard must refrain from using excessive force, unless situation extremely requires so
- Cultivate harmonious co-existence between itself and the local communities in the project area.

The significance rating of the impacts on Community, Health, Safety & Security at the operational stage is said to be ***VERY LOW NEGATIVE****. By implementing the above recommended measures, it is expected that the impact will remain at* ***VERY LOW NEGATIVE*** *significance and the residual impact significance will be negligible.*

7.6.5 *Traffic and Transport Impacts*

Embedded/In-built Control

- Development of a Traffic Method Statement (TMS) for the construction phase with the aim of minimizing disturbance to the nearby residents, industrial workers and general road users. The TMS will govern vehicle movements in and out of the site. The TMS will include, amongst other things details of signage requirements, transportation times etc. In addition, a health and safety management plan for all operating vehicles and machines.
- Coordination with the Ghana Highway Authority and Department of Urban Roads to minimise interference between installation and operation following guidelines of the "Road Reservation Management: Manual for Coordination" (June 2001).

Constructional Phase

EPC Contractor shall:

- Involve local authorities in defining optimum project traffic routes and times for transit.
- Control traffic on the access road to the site, especially when heavy trucks are turning in and out of the site. This will ensure that no accidents are caused by the site's activities.
- Enforce speed limits for heavy good vehicles and workforce transportation vehicles.
- Provide training in defensive driving training to drivers.
- Provide site vehicle maintenance services in order to ensure technical failures do not occur.
- Avoid densest areas of traffic, if possible, through planning and channelling of traffic.
- Install traffic safety signage at vantage points along access routes with the project sites.
- Install traffic calming measures (speed bumps and rumble strips) to slow traffic down

where heavy vehicles cross or enter busy roads.

- Engage communities on road risk and educate them through constant communications, road signals as well as with communications with the local authorities and community leaders.
- Improve and enhance community sensitization on road traffic accidents within the project area.
- Install speed control limits for the project and ensure all vehicles comply with the site driving regulations.
- Develop and implement a "No Drinking" "No Alcohol" policy on site during both construction and operation. Monitor all vehicles and ensure they have a "No Alcohol" sticker. The same must be done for all construction equipment and machines.
- Monitor all vehicles and ensure they have a "No Alcohol" sticker. The same must be done for all construction equipment and machines.
- Conduct periodic and routine alcohol checks for all site drivers and site workers.

*The significance rating of the impacts on Traffic & Transport at the constructional stage is said to be **MEDIUM NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will reduce to **LOW NEGATIVE** significance and the residual impact significance will be minor.*

Operational Phase

VRA shall:

- Limit speed of vehicles on site to 10-15 km/hr.
- Prevent idling of vehicles and equipment.
- Promote car sharing amongst staff

*The significance rating of the impacts on Traffic & Transport at the operational stage is said to be **VERY LOW NEGATIVE**. By implementing the above recommended measures, it is expected that the impact will remain at **LOW NEGATIVE** significance and the residual impact significance will be negligible.*

7.8. Mitigation of Cumulative Impacts

There are no other known large development projects in the project's area of influence, the cumulative impact has been assessed to be negligible and there are no proposed mitigative measures for this impact. As indicated, the water requirement for cleaning of modules is an important aspect to be kept in view. Water conservation measures is a must requirement for the project and should be practiced at the site. It is recommended that VRA consider incorporating into the facility design, the harvesting and storage of rain water for use on the project.

7.9. Mitigation of Impacts During Decommissioning Phase

Impacts identified during the decommission phases are listed below:

- Noise Impacts
- Air Quality Impacts
- Solid Waste
- Occupational Health & Safety Impacts
- Traffic & Transport Impacts

Mitigative measures proposed for the constructional phase for the identified impacts also pertains to the decommissioning phase and these have listed in the earlier sections and will not be discussed further.

7.10. Summary of Results of Impacts

The impact assessment methodology employed as well as the potential environmental, social, economic, health and public safety related impacts likely to be associated with all phases of the project as required has been discussed. The issues and impacts presented have been identified via the environmental status quo of the receiving environment, a review of environmental impacts from other similar projects and inputs from specialists that form part of the project team. Both associated positive and negative impacts have been identified and discussed. The rating of an impact's significance has been determined and categorised as negligible, low, medium or high. *Table 7-1* provides a summary of the evaluation of impacts (both positive and negative) at the constructional, operational and decommission phases as well as its significance rating with and without enhancement or mitigative measures.

Scores from the detailed calculations based on the defined approach outlined under the Section 6.2 to enable the EA to reach the various conclusions is provided as Appendix 9. As shown in Appendix 9, assessing the various negative impacts associated with the constructional and operational phases, the average rating of the project had a score of 3.4 and therefore the overall significance rating can be defined as **LOW NEGATIVE**.

Table 7-1: Summary of Ratings of Project Associated Impacts

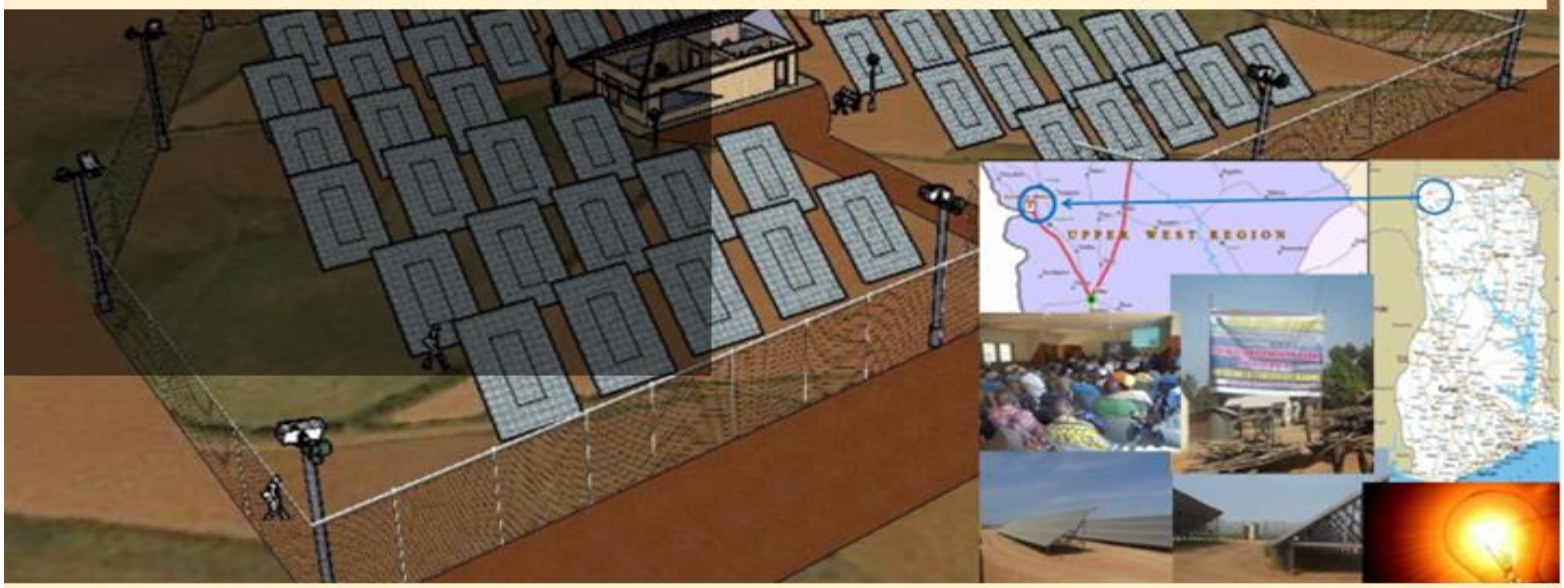
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence/ Intensity	Probability	Reversibility	Irreplaceability	Significance		Confidence Level
									Without Mitigation	*With Mitigation*	
POSITIVE IMPACTS											
Climate Change	Minimisation of GHG	Positive	International	Long Term	Medium	Definite	Low	High	High	High	High
Job Creation	Increase in Employment Opportunities	Positive	International	Temporal	Low	Definite	High	Replaceable	Medium	High	High
Electricity Availability	Stabilization of Electricity	Positive	Regional	Long Term	Medium-Low	Definite	Low	Moderate	Medium	Medium	High
Economic Growth	Promotion of Economic Growth	Positive	Local	Long Term	Medium-Low	High Probable	Low	Moderate	Medium	Medium	Low
NEGATIVE IMPACTS – CONSTRUCTIONAL PHASE											
Noise & Vibrations	Disturbance to general populace	Negative	Local	Temporal	Medium-Low	Definite	High	Low	Medium	Low	Medium
Air Quality	Increase levels of fugitive dust and vehicular emissions	Negative	Local	Temporal	Medium	Medium Probable	High	High	Low	Very Low	High
Topography & Drainage	Flood risks	Negative	Site Specific	Short Term	Medium	Definite	High	Moderate	Medium	Low	High
Geology & Soils	Soil Pollution	Negative	Site Specific	Temporal	Low	Low Probable	High	Low	Very Low	Very Low	Medium
Water Resources	Water Pollution	Negative	Local	Short Term	Medium	Medium Probable	High	High	Low	Very Low	High
Waste Generation	Increase risks to environment and health	Negative	Site Specific	Temporal	Medium-Low	Medium Probable	High	Moderate	Low	Very Low	High
Landscape & Visual Intrusion	Altered sense of place and visual intrusion from construction activities	Negative	Site Specific	Temporal	Medium-Low	Definite	Low	Low	Low	Very Low	Moderate
Ecology	Loss of habitat and listed/rare species	Negative	Site Specific	Long Term	Medium	Definite	Moderate	Moderate	High	Low	High
Historical &	Destruction / loss of	Negative	Local	Temporal	Medium-Low	High	High	Low	Low	Very	Medium

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence/ Intensity	Probability	Reversibility	Irreplaceability	Significance		Confidence Level
									Without Mitigation	*With Mitigation*	
Cultural Heritage Resources	Historical & Cultural Heritage Resources					Probable				Low	
Occupational Health & Safety	Injury to workers	Negative	International	Temporal	Medium	Medium Probable	High	Low	Medium	Very Low	Medium
Land Acquisition	Loss of Properties	Negative	Site Specific	Long Term	High	Definite	Non-reversible	High	High	Low	High
Land Use	Loss of land for personal and commercial use	Negative	Site Specific	Long Term	Medium	Definite	Low	Moderate	Medium	Low	Medium
Labour & Working Conditions	Reduction in productivity	Negative	International	Temporal	Medium-Low	Low Probable	High	Low	Low	Very Low	Medium
Community Health, Safety and Security	Injury to public	Negative	Local	Temporal	Medium Low	Medium Probable	Low	High	Low	Very Low	Medium
Traffic & Transport	Increase in traffic and road accidents	Negative	Regional	Temporal	High	High Probable	High	Low	Medium	Very Low	Medium
NEGATIVE IMPACTS – OPERATIONAL PHASE											
Noise & Vibrations	Disturbance as a result of increased environmental noise levels caused by operational equipment	Negative	Site Specific	Long Term	Low	Low Probable	High	Low	Very Low	Very Low	High
Air Quality	Poor air quality	Negative	Site Specific	Long Term	Low	Unlikely	High	Low	Very Low	Very Low	High
Topography & Drainage	Flood risks	Negative	Site Specific	Long Term	Low	Unlikely	High	Low	Very Low	Very Low	Moderate
Geology & Soils	Soil Pollution	Negative	Site Specific	Temporal	Low	Low Probable	High	Low	Very Low	Very Low	Medium
Water Resources	Water Scarcity	Negative	Site Specific	Temporal	Low	Unlikely	Moderate	Moderate	Very Low	Very Low	High
Waste	Increase in health hazard	Negative	Site Specific	Long	Low	Unlikely	High	Moderate	Very	Very	High

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence/ Intensity	Probability	Reversibility	Irreplaceability	Significance		Confidence Level
									Without Mitigation	*With Mitigation*	
Generation				Term					Low	Low	
Landscape & Visual Intrusion	Altered sense of place and visual intrusion from the PV panels and plant facilities	Negative	Site Specific	Long Term	Low	Low Probable	Low	Low	Very Low	Very Low	High
Ecology	Loss of connectivity and habitat fragmentation may result if fauna avoid the area or cannot move through the area on account of the presence of the facility	Negative	Site Specific	Temporal	Low	Low Probable	Moderate	Moderate	Very Low	Very Low	High
Historical & Cultural Heritage Resources	Destruction / loss of Historical & Cultural Heritage Resources	Negative	Local	Temporal	Low	Unlikely	High	Low	Very Low	Very Low	Medium
Occupational Health & Safety	Injury to workers	Negative	Site Specific	Long Term	Low	Low Probable	Low	Low	Very Low	Very Low	Medium
Land Acquisition	Loss of Properties	Negative	Site Specific	Long Term	Medium Low	Medium Probable	Non-reversible	High	Low Negative	Very Low	High
Land Use	Permanent loss of land for personal and commercial use	Negative	Site Specific	Long Term	Low	Definite	Low	High	Medium	Very Low	Medium
Labour & Working Conditions	Reduction in productivity	Negative	Regional	Temporal	Low	Low Probable	High	Low	Very Low	Very Low	Medium
Community, Health, Safety and Security	Injury to public	Negative	Local	Temporal	Low	Low Probable	Moderate	Low	Very Low	Very Low	Medium
Traffic &	Increase in traffic and road	Negative	Local	Long	Low	Low	High	Low	Very	Very	High

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence/ Intensity	Probability	Reversibility	Irreplaceability	Significance		Confidence Level
									Without Mitigation	*With Mitigation*	
Transport	accidents			Term		Probable			Low	Low	
NEGATIVE IMPACTS - DECOMMISSIONING PHASE											
Noise & Vibrations	Disturbance to general populace	Negative	Site Specific	Temporal	Low	Medium Probable	High	Low	Very Low	Very Low	Medium
Air Quality	Increase levels of dust	Negative	Site Specific	Temporal	Medium-Low	Medium Probable	High	High	Low	Very Low	High
Solid Waste	Increase in health hazard	Negative	International	Temporal	Medium-Low	Definite	Hugh	Low	Medium	Very Low	Hugh
Occupational Health &Safety	Injury to workers	Negative	International	Temporal	Medium-Low	Medium Probable	High	Low	Low	Very Low	Medium
Traffic & Transport	Increase in traffic and road accidents	Negative	Regional	Temporal	Medium-Low	High Probable	High	Low	Low	Very Low	Medium

Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



CHAPTER 8:

ENVIRONMENTAL MANAGEMENT & MONITORING PLAN

8 ENVIRONMENTAL MANAGEMENT & MONITORING PLAN

8.1 Introduction

The Ghanaian EIA Regulations, LI1657, requires the project proponent to prepare an environmental management plan which addresses the identified potential impacts and risks. The importance of managing social and environmental performance throughout the life of a project is also highlighted by the IFC Performance Standard-1. This section presents the Environmental and Social Management Plan (ESMP) for the Project. The purpose of this ESMP is to specify the standards and controls required to manage and monitor environmental and social impacts during construction and operation phase. To achieve this, the ESMP identifies potential adverse impacts from the planned activities and outlines mitigation measures required to reduce the likely negative effects on the physical, natural and social environment.

VRA/EPC Contractor is committed to execute all construction and operation related activities for the proposed Solar PV Project as per the best established environmental, health and safety standards and it will be aligned with upcoming project to be implemented at asset level. Mitigation measures are proposed for impacts which are identified and quantified. Some residual impact will however persist after the all mitigation measures are employed, the Environmental and Social Management Plan intends to delineate monitoring and management measures to minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures during construction and operational phase. The ESMP therefore includes proposed mitigation measures, environmental monitoring and reporting requirements, training measures, implementation schedule and cost estimates.

8.2 Regulatory Agencies

The institutional and administrative framework for the project has been outlined under Section 2.3. For the ESMP, the authorities / agencies that will be required for coordination are as below:

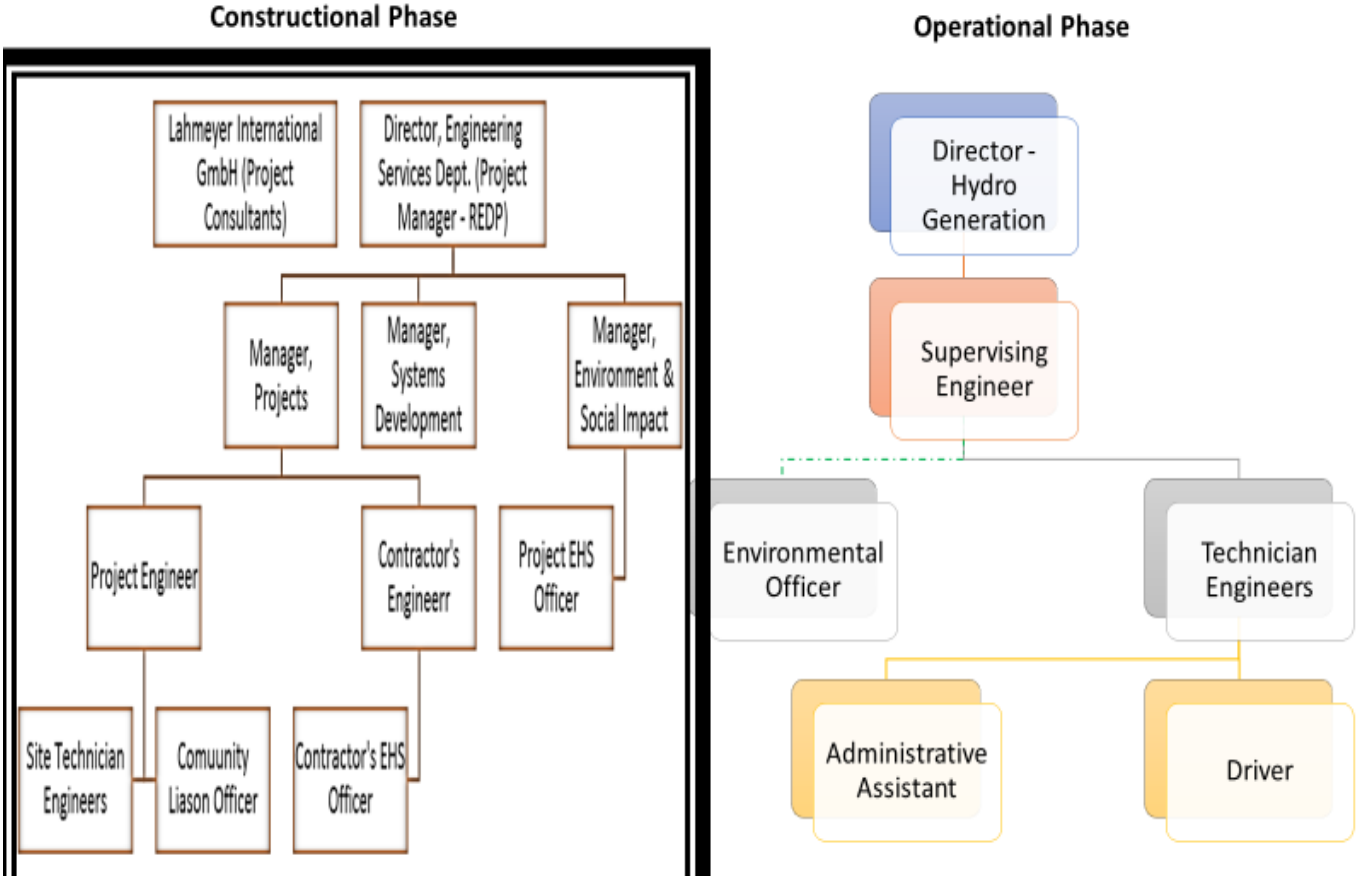
- Lawra District Assembly
- Nadowli-Kaleo District Assembly
- Forest Services Division, Lawra Office
- Water Resources Commission, (Upper West Region)
- Environmental Protection Agency (Upper West region)
- Energy Commission
- Factories Inspectorate Department

The coordination roles of these organisations have been discussed severally under various Sections of this ESIA Report.

8.3 Organizational Structure

To ensure the efficacy of ESMP, certain institutional mechanism with well-defined roles and responsibilities is essential for effective implementation of identified mitigation measures both during construction and operation phases. Environmental based organizational structure of VRA for the constructional and operational phases of the project is presented in Figure 8-1. The chart details the position of the Project EHS Officer as well as other officers of the project that play various roles in the implementation of the ESMP. In the absence of the jobholder, the relevant manager or subordinate undertakes the assigned duties or delegates as required.

Figure 8-1: Environmental Based Organisational Chart



8.4 Roles & Responsibilities

8.4.1 Volta River Authority

VRA will have ultimate responsibility for implementing the provisions of the ESMP during construction and operation phase of the project, and various person will be appointed to implement these roles. These roles will include the on-going management of environmental and social impacts, monitoring of contractor performance as well as development of mechanisms for dealing with environmental and social problems. VRA will also ensure that the activities of its contractors are conducted in accordance with good practice measures, implementation of which will be required through contractual documentation.

The Director, Engineering Services Department (ESD) and the Director, Hydro Generation Department (HGD) are the Project Managers during the constructional and operational phases respectively. These two have the overall responsibility regarding the implementation of the ESMP as well as the environmental protection procedure on site during the respective phases. The Project Manager in each case has been empowered to order the cessation of work if he feels that it is unnecessarily detrimental to the environment. For the constructional phase, Director, ESD is to be supported by the Manager-Projects and Manager-Systems Development, both of ESD as well as the Manager-Environment & Social Impact (ESI) of the Environment & Sustainable Development (E&SDD). The Manager-Projects will be directly responsible for supervising on site constructional activities and will have responsibility for activities the Project Engineer and the EPC Contractor. The Site Engineer will be responsible for supervising on site activities during the operational phase.

The Manager, ESI will appoint an EHS Officer to work with the Project Engineer as well as the Site Engineer during the constructional and operational phases respectively. The EHS Officer shall be responsible for the following:

- Ensuring project's compliance with all relevant environmental, social, health and safety regulations.
- Undertake liaison activities with communities, traditional authorities and project affected persons, etc.
- Liaising with all relevant regulatory bodies as identified in Section 8.2
- Liaising with relevant VRA departments on all health, environmental, safety and social matters connected to projects.
- Assist in the education and training of project staff in environmental, social and safety awareness.
- Make budgetary provisions for projects' environmental programmes.
- Undertake environmental and social monitoring activities for projects.
- Formulation and review of environmental and social policies and practices associated with projects.

8.4.2 Project Consultants

VRA has engaged Lahmeyer International GmbH as Project Engineer to provide technical support, including EHS, and the preparation of this ESIA has largely included key issues raised by LI during the draft review. It is expected that LI will continue to provide EHS support services during the constructional phase.

8.4.3 EPC Contractor

Currently, the procurement of an EPC Contractor has been completed. The EPC Contractor will appoint an EHS team, as part of contractual arrangements to be responsible for the implementation of the Contractors Health & Safety Plan, an Environmental Protection Plan as well as a Quality Assurance Plans. The HSE Team shall take the overall responsibility for co-ordination of the actions required for environment and social management and mitigation and for monitoring the progress of the proposed ESMP for the project.

In general, the Contractor's EHS Officer shall perform the following activities:

- Preparation of required documents on environmental and social management;
- Ensuring availability of resources and appropriate institutional arrangements for implementation of ESMP;
- Implementation of the health and safety measures;
- Collection of the statistics of health of workers;
- Providing support during routine medical check-ups of workers;
- Awareness and implementing safety programmes;
- Providing job specific induction training;
- Compliance of regulatory requirements;
- Carrying out environmental audits;
- Identify unsafe acts & conditions and suggest remedies;
- Develop safety culture and comply with VRA's HSE Policy and standards requirements;'
- Educate all employees on the use of PPEs and safe practice
- Encourage and enforce the use of PPEs
- Direct, coordinate and orient the safety activities;
- Promulgate the spread of policy, objectives, rules and/or regulations;
- Perform a thorough investigation of all accidents and review the recommendations to avoid any repetition;
- Monitoring the progress of implementation of ESMP; and
- Reviewing and updating the ESMP as and when required for its effective implementation.

8.5 Inspection, Monitoring & Audit

Inspection and monitoring of the environmental impacts of the Project activities will increase the effectiveness of ESMP. Through the process of inspection and auditing, VRA will ensure that the conditions stipulated in various permits are complied. The inspection and audits will be done by the project identified HSE staff in coordination with O&M contractors and any other external agencies identified. The entire process of inspections and audits should being documented. The inspection and audit findings are to be implemented by the site In-charge in their respective areas.

The EPC Contractor shall have the responsibility for auditing their staff and any subcontractors employed by them for all activities related to the work specified in their contracts. VRA will be responsible for auditing the contractors' performance against the OSHEM requirements during construction, and for auditing VRA staff performance against the site-specific Environmental Management Plan during operation.

8.6 Reporting and Documentation

VRA will develop and implement a programme of reporting through all stages of the project cycle. Delegated personnel shall require to fully complying with the reporting programme in terms of both timely submissions of reports as per acceptable level of detail. Reporting will be done in form of environmental check list, incident record register, environmental and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.) either for distribution internally or as a regulatory requirement to the EPA and Energy Commission.

The Project EHS Officer is the responsible person for ensuring that communication with regulatory agencies and stakeholders are maintained as per the requirement. All complaints and enquiries are to be appropriately dealt with and records be maintained in a Complaint/Enquiry Register by the delegated staff of HSE. All communications made to regulatory agencies should also be reported to the relevant internal departments such as Engineering Services, Environment & Sustainable Development, Hydro Generation, Technical Services Departments.

Documentation is an important step in implementing ESMP. VRA will establish a documentation and record keeping system to ensure recording and updating of documents per the requirements specified in ESMP. All monitoring and reporting documents must be kept on file, as part of VRA/Contractor documentation procedures. The documents should be kept as hardcopies as well as in electronic format. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured through access by and distribution to identified personnel.

An open-door policy must be maintained on information regarding all environmental issues; such information can be accessed by any worker for purposes of improving on work output. Inspection and audits finding along with their improvement program are to be regularly reported to the Director, ESD, who is the VRA Senior management on the project for

consideration. The same are also to be communicated within the staff working on the project.

To maintain an open communication between the staff and management on EHS and social issues the followings are to be used:

- Team Briefings
- Onsite work group meetings
- Work specific instructions
- Meeting with stakeholders

8.7 Training Programme And Capacity Building

Training is needed for effective implementation of ESMP. Environmental training and awareness program shall be established to enhance the understanding of all staff, supervisors, workers and subcontractors pertaining with ESMP and environmental impacts and mitigation measures. The Project EHS Officer of VRA, the Contractor's EHS Officer will ensure that Environmental health and safety induction training and job specific trainings are identified and given to the concerned personnel for construction activities and during operations of the solar farm.

From commencement of the work, VRA shall undertake continuous environmental education for the employees, training staff in effective waste handling and management procedures, conduct regular and frequent HIV/AID awareness for the workers. Environmental issues shall be discussed between superiors and their subordinates during the periodic meetings. Again, in collaboration with Lahmeyer International, formal training programs in all aspects of PV plant operation, maintenance and management will be developed and implemented for staff. These programs will be comprehensive and include training in environmental, health and safety procedures. This will ensure safe and efficient operation of the plant.

The project shall also produce training needs assessment matrix on an annual basis, and this shall include the relevant job functions and the different types of technical knowledge required to implement the occupational safety, health and environmental management (OSHEM) requirements of the project. This shall be achieved by:

- Identifying the issues and procedures that employees need to be trained in and the key roles that they will require training.
- Filling out a training needs matrix to ensure that training is targeted to a specific audience.
- Ensuring that, as a minimum, all workers (including new recruits) receive basic training in environmental awareness and the elements of the EMP to be developed for the PV Plants.

Also, general environmental awareness will be increased among the project teams to encourage the implementation of environmentally sound practices and compliance requirements of the project activities. This will help in minimising adverse environmental impacts, compliance with

the applicable regulations and standards, and achieving performance beyond compliance. The same level of awareness and commitment will be imparted to the contractors and sub-contractors involved in the project. Proof of various trainings to enhance environmental performance must be outlined in training reports for the project. It is important that system is put in place to ensure that if a worker misses a key training session, it is flagged up and rescheduled for a later date. Procedures for recording training needs and keeping records of attendance must always be kept by relevant staff.

To ensure the successful implementation of all the environmental management programmes, a training programme is recommended for the project Environmental Management Team and key personnel of the contractor. The first environmental training for the employees shall be combined with new recruitment training. The training programme will cover the creation of environmental awareness and occupational safety and health issues.

8.8 Environmental & Social Management Plan

An Environment and Social Management Plan has been developed following the delineation of impacts and mitigation measures. These measures will be adopted by VRA and imposed as conditions of contract of the sub-contractor employed for respective phases of this solar power project. The mitigation measures suggested during operation will be made part of the regular maintenance and monitoring schedule. The responsibility for implementation of ESMP will primarily lies with the VRA Project EHS Officer and the Manager, Environment & Social Impact will play a role of supervisor to oversee the project performance pertaining to environment, health, safety and social issues. The ESMP as developed for the project to minimize adverse impacts during different phases of project lifecycles, are given in Table 8-1.

Table 8-1: Environmental & Social Management Plan

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
PLANNING & CONSTRUCTIONAL PHASE							
▪ Increase in Noise Levels	▪ Use of adequate general noise suppressing measures.	▪ Restricting normal working hours from 8am to 6pm. ▪ Restriction of the use of vehicle horns and heavy engine breaking ▪ Erection of appropriate warning signages on noise making ▪ Monitoring of noise levels and apply adequate general noise suppressing measures, where relevant. ▪ Use of relevant PPEs for high noise levels ▪ Continued review of all site activities to establish and quantify noise activities. ▪ Operation of only well-maintained equipment on-site.	▪ To reduce and monitor construction noise	▪ No complaints from surrounding communities	▪ 45,000.00	▪ June 2019 – March 2020	▪ Contractor's EHS Officer
▪ Increase in fugitive dust and vehicular emissions levels	▪ Application of basic dust control and suppression measures	▪ Visual monitoring of the dust emissions shall be performed during earthworks and construction activities. ▪ Regular watering of all active construction areas. ▪ Prevention of idling of vehicles and equipment ▪ Limitation of speed of vehicles on site to 10-15 km/hr. ▪ Regular inspection and scheduled maintenance program for all vehicles, machinery, and equipment ▪ Appropriate signages will be erected to checking of vehicular speed on construction site ▪ Workers will be provided with appropriate PPE's e.g. masks, eye goggles, breathing equipment, etc.	▪ To minimise fugitive dust and vehicular emissions on ambient air quality to acceptable health and safety requirements	▪ Establish and quantify the effectiveness of planned management practises to minimise fugitive emissions production and vehicular emissions.	▪ 25,000.00	▪ June 2019 – March 2020	▪ Contractor's EHS Officer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
		▪ Employees shall be included in regular health check-ups and treated as appropriate ▪ Restriction of diesel generator use to emergencies and power back-up only					
▪ Flood risks due to changes in topography and drainage	▪ Develop and construct an appropriate design for surface water drainage system ▪ Avoid any unnecessary changes in the topography and any micro-watershed drainage pattern.	▪ Construction of the facility in line with approved design ▪ Site clearance, topsoil removal, compacting, cutting and filling, and foundation construction shall follow each other in order to avoid or minimize the incidence of erosion. ▪ The site when cleared shall not be left unused for a long time. ▪ Carry our restoration of the worked areas immediately by backfilling, professional landscaping/levelling and planting of low grass in open areas, flowers and suitable tree species. ▪ Provide appropriate number of cross drainage channels during access road construction to maintain flow in existing natural channels.	▪ To avoid flood risks due to constructiona l activities	▪ Minimise project associated floods	▪ Part of Project Cost	▪ June 2019 – March 2020	▪ Contractor's Engineer ▪ Project Engineer
▪ Soil Pollution	▪ Ensure adherence to the requirements of the Land Planning and Soil Conservation Act, 1957	▪ Ensure construction activities are restricted to designated work areas ▪ Constructional activities shall be restricted to the dry season. ▪ Topsoil shall be stripped and stored separately from subsoil. ▪ Drivers shall be restricted to the use of existing access roads. ▪ Existing roads will be widened to have the width and turning radius to accommodate the necessary vehicles for the project. ▪ Locate temporary storage tanks on impervious bases and use drip trays during re-fuelling of equipment.	▪ To prevent soil contaminatio n due to constructiona l activities	▪ Zero contamination of soil quality ▪ Minimal erosion inside the construction areas and surrounds.	▪ Part of Project Cost	▪ June 2019 – March 2020	▪ Contractor's Officer ▪ Project Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
		▪ Install fuel and lubricants storage containers and prevent leakages. ▪ Clean up equipment shall be supplied ▪ Contaminated soil shall be treated as hazardous material and handled as such.					
▪ Water Pollution	▪ Effective arrangements for disposal of aqueous effluents. ▪ Measures to mitigate the influence from torrential rain and runoff from rainfall and flooding should be considered in the planning.	▪ Construction of borehole should be in line with LI 1827. ▪ Provide impervious storage area for Fuel & lubricant, hazardous waste. ▪ Prevent storage of hazardous materials near natural drainage channels. ▪ Provide equipment and materials for clean ups ▪ Temporary refuelling tanks should be bunded.	To prevent contamination of water resources	▪ Zero contamination of water quality	▪ Part of Project Cost	▪ June 2019 – March 2020	▪ EPC Contractor ▪ Project Engineer
▪ Increase risks to environment and health from waste generation	▪ Practice waste reduction techniques such as Reduce, Recycle, Reuse and Recover	▪ Construction debris will be utilised for levelling of the land ▪ Unused debris shall be disposed-off to nearest Municipal waste disposal site. ▪ Random stocking of raw material, storage of debris, piling of loose soil etc. to be strictly controlled ▪ Hazardous waste (like used oil, paint tins, defected panels, etc.) shall be stored at designated place and only be sold to authorized vendors. ▪ Dispose labour waste regularly in approved waste disposal sites ▪ Wastes like wood packaging material, metal, jute, etc. will be sold to scrap dealers/ buyers. ▪ Provision of proper sanitation and sewage facility	To ensure constructional waste generation does not pollute the environment	▪ Zero contamination of soil and water from solid and liquid constructional waste	▪ Part of Project Cost	▪ June 2019 – March 2020	▪ Contractor's EHS Officer ▪ Project Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
▪ Altered sense of place and visual intrusion from construction activities	▪ Undertake appropriate design to assist in the respectful integration of the facades of the power facility with surrounding environment and existing buildings	▪ Appropriate colour and materials shall be used in architectural designs. ▪ Proper housekeeping shall be undertaken, and workforce instructed accordingly ▪ Waste shall be collected and evacuated in a timely manner and the project site will be left in an orderly state after each working day. ▪ Ensure all machines, vehicles and tools used during construction should be removed on the earliest time possible	▪ Reduce visual intrusion of construction activities project wide.	▪ Minimal visual intrusion of construction activities project wide.	▪ Part of Project Cost	▪ June 2019 – March 2020	▪ Contractor's Engineer ▪ Project Engineer
▪ Loss of habitat and listed/rare species	▪ Implement proper management measures to prevent damage to the biodiversity of the site. ▪ Minimise risks to electrocution as part of project design. ▪ Unnecessary disturbance of neighbouring vegetation due to off-road vehicular movement, fuel wood procurement and destruction of floral resources should be prohibited.	▪ Conditions of MoU b/n VRA and FSD to be strictly adhered to ▪ Undertake detailed flora and faunal assessment to inform habitat management. ▪ Dangerous and potentially dangerous trees within the Lawra Forest Reserve will be enumerated and documented by VRA prior to felling. ▪ Appropriate routing of lines, use of bird deflectors, and pole design shall be undertaken to reduce electrocution risks from power lines and associated infrastructure. ▪ Undertake trainings among the staff and labourers to enhance general awareness regarding anti-poaching, hunting ▪ Hunting at any time and under any condition by construction workers onsite shall be prohibited ▪ Conduct construction activity in a phased manner ▪ Vegetation disturbance and clearance should be restricted to the project activity area location of laydown	▪ Ensure compliance with relevant legislation in respect of habitat and vegetation forms. ▪ Avoidance of unnecessary disturbance to the site and surrounds, and to establish buffers where required.	▪ Minimal disturbance to fauna in the area ▪ Avoid loss of habitat within the designated sensitive areas.	▪ GH¢200,000	▪ June 2019 – March 2020	▪ Project Engineer ▪ Project EHS Officer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
		area, construction activities and storage areas.					
▪ Destruction / loss of Historical & Cultural Heritage Resources	▪ Properly plan construction activities to consider the identified resources locations to ensure they are protected from any potential damage. ▪ Ensure adherence to requirements of the National Museums Act, Act 387 of 1969. ▪ Proper documentation and reporting of chance find	▪ Continuous dialogue with local community and owners/caretakers to provide the support to ensure that any identified resource does not pose a problem for project development, ▪ Appropriate chance find procedures shall be implemented in collaboration with GMMB ▪ Only professional archaeologist shall be engaged to examine, document and/or remove and identified archaeological material. ▪ All works shall be executed within the authorised footprint to avoid impacts to any nearby tangible and intangible heritage resources. ▪ Strict observation of the cultural taboos shall be observed.	▪ To avoid disturbance, damage to and destruction of heritage resources ▪ To enhance gains to the science of archaeology by recording chance finds	▪ Compensation of all community members for the removal of important heritage sites ▪ No damage to any significant cultural heritage features on site	▪ GH¢150,000	▪ June 2019 – March 2020	▪ Community Liaison Officer ▪ Project EHS Officer
▪ Injury to workers	▪ Requirements of Factories, Shops and Offices Act of 1970 (Act 328) and VRA's "Safety, Health and Environment Standards for Contractors to be adhered ▪ Adopt and	▪ Fire permit to be acquired prior to project implementation to ensure fire safety. ▪ Development Permit shall be acquired from the relevant District Assembly ▪ A Health & Safety Plan, an Environmental Protection Plan as well as a Quality Assurance Plan to be developed by and implemented ▪ Provide Personal Protective Equipment (PPEs to workers always.	▪ To prevent injury to workers	▪ Zero injury	▪ GH¢500,000	▪ June 2019 – March 2020	▪ Project Engineer ▪ Contractor EHS Officer ▪ Project EHS Officer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
	implement the provisions of the Occupational Health and Safety Plan throughout the Project construction phase	▪ Health screening to be conducted for employees both before their employment and throughout the contract period on an irregular basis. ▪ Construction activities shall be undertaken during daytime hours ▪ Vigilance for any potential accidents shall be maintained ▪ Awareness training on communicable disease prevention ▪ Undertake health and safety awareness training amongst staff and workers					
▪ Loss of Properties	▪ Adhere to requirements of VRA "Land Acquisition & Resettlement Policy Framework"	▪ Survey of project-affected persons shall be undertaken for the purposes of compensation payment. ▪ Prompt, adequate and fair compensation to be paid to all project-affected persons before the start of constructional activities. ▪ Community Liaison Officer shall be appointed as a designated point of contact for the community. ▪ Institute appropriate grievance mechanisms to address concerns of the public ▪ Existing right of way for roads and sub-transmission lines shall be utilised to minimise land acquisition.	▪ Reduce land acquisition requirements where possible ▪ Effectively and transparently manage land acquisition process.	▪ Effectively and transparently manage land acquisition process. ▪ Zero grievances of non-payment from rightful land owners	▪ GH¢1.2 M	▪ June 2019 – March 2020	▪ Project Engineer ▪ Contractor EHS Officer ▪ Project EHS Officer
▪ Loss of land for personal and commercial use	▪ Effective zoning of project area by the Land Use & Spatial Planning Dept. ▪ Restriction of	▪ Appropriate consultations shall be instituted with all stakeholders to raise awareness about the project. ▪ A grievance mechanism to be implemented (i.e. complain register) and keep record of all complaints	▪ Minimise impacts on changes to land use	▪ Zero grievances complaints from land owners regarding changes in	▪ Part of Project Cost	▪ June 2019 – March 2020	▪ Community Liaison Officer ▪ Contractor Engineer ▪ Project Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
	constructional activities within the allotted land and immediate surroundings only.	from the community ▪ Development Permit to be acquired from the relevant District Assemblies, prior to construction. ▪ After construction work, any land taken for a temporary basis for storage of material shall be restored to their original form. ▪ Utilise existing right of way to minimise land acquisition. ▪ Utilisation of existing roads for access to the project site ▪ Community Liaison Officer to be appointed as a designated point of contact for the community. ▪ Land use in and around permanent project facilities should not be disturbed. ▪ Land used for temporary facilities, if any, shall be restored to the extent possible.		current land use			
▪ Reduction in productivity	▪ Prepare and adhere to a Labour Management Plan	▪ Design and adhere to employment and workforce policies. ▪ Locals shall be engaged for unskilled manpower requirements ▪ Provision of adequate shelter, drinking water, toilet facilities for the workers. ▪ Put in place suitable measures to maintain a healthy environment for the labour force ▪ Worker grievance mechanism to be instituted including monitoring and resolving of such concerns.	To ensure working conditions of employees are in line with national and international standards	Minimal grievance related to working conditions at the project site	▪ GH¢200,000	▪ June 2019 – March 2020	▪ Community Liaison Officer ▪ Contractor Engineer ▪ Project Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
		▪ Community Liaison Officer to be appointed as a designated point of contact for the community					
▪ Injury to public	▪ Requirements of Factories, Shops and Offices Act of 1970 (Act 328) and VRA's "Safety, Health and Environment Standards for Contractors to be adhered ▪ Adopt and implement the provisions of the Occupational Health and Safety Plan throughout the Project construction phase ▪ Minimizing potential conflicts with the communities. ▪ Appropriate solid waste management practice	▪ Formal notification to be given to local government/traditional authorities on the date of project commencement. ▪ Observation of all necessary traditional requirements prior to project commencement ▪ Institute public grievance mechanism including monitoring and resolving of such concerns. ▪ Create awareness amongst staff about local cultural sensitivities. ▪ Constructional activities shall be undertaken only during the day i.e. between 0700 hours to 1800 hours. ▪ Segregation of the various wastes and arrange for subsequent disposal through either efficient incineration or disposal in a sanitary landfill. ▪ Fencing of all excavated areas to avoid access to outsiders and wildlife. ▪ Provision of security and warning signages around construction site ▪ Provision of alternative access route to the nearby local resort at the Lawra site, if required. ▪ Undertake public health awareness amongst staff, especially on Sexually Transmitted Diseases and HIV/AIDS.	▪ Reduce impacts associated with the influx of people during the construction phase	▪ Influx of people and impacts during the construction phase to be appropriately managed	▪ GH¢50,000	▪ June 2019 – March 2020	▪ Community Liaison Officer ▪ Project Engineer ▪ Contractor Engineer ▪ Project EHS Officer
▪ Increase in	▪ Preparation and	▪ Traffic shall be controlled on the	▪ Reduce	▪ Zero accidents	▪ GH¢350,000	▪ June 2019 –	▪ Community

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
traffic and road accidents	implementation of a Traffic Method Statement with the aim of minimizing disturbance to the nearby residents, industrial workers and general road users.	access road to the site, especially when heavy trucks are turning in and out of the site. ▪ Drivers shall be trained in defensive driving ▪ Speed limits shall be enforced for heavy good vehicles and workforce transportation vehicles; ▪ Densest areas of traffic, if possible, shall be avoided through planning and channelling of traffic. ▪ Involvement of local authorities in defining optimum project traffic routes and times for transit ▪ Traffic calming measures (speed bumps and rumble strips) shall be installed to slow traffic down where heavy vehicles cross or enter busy roads. ▪ Installation of speed control limits for the project and ensuring all vehicles comply with the site driving regulations. ▪ Conduct periodic and routine alcohol checks for all site drivers and site workers ▪ Provision of site vehicle maintenance services in order to ensure technical failures do not occur; ▪ Install traffic safety signage at vantage points along access routes with the project sites. ▪ Develop and implement a “No Drinking” “No Alcohol” policy on site during both construction and	number of road accidents due to increased traffic during construction	from road and traffic		March 2020	Liaison Officer ▪ Contractor Engineer ▪ Project EHS Officer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
		operation. ▪ Improve and enhance community sensitization on road traffic accidents within the project area. ▪ Engage communities on road risk and educate them through constant communications, road signals as well as with communications with the local authorities and community leaders.					
OPERATIONAL PHASE							
Disturbance as a result of increased environmental noise levels caused by equipment	▪ Adherence to relevant requirements of the Factories, Shops and Offices Act of 1970 (Act 328).	▪ Equip workers with proper Personal Protective Equipment (e.g. Earmuffs) ▪ Ensure only well-maintained equipment are operated on-site;	▪ To reduce and monitor operational noise	▪ No complaints from surrounding communities	▪ 15,000.00 annually	▪ Continuous	▪ Project EHS Officer
Poor air quality	▪ Adherence to requirements of Driver & Vehicle Licensing Authority Act, 1999 (ACT 569)	▪ Limit speed of vehicles on site to 10-15 km/hr. ▪ Prevent idling of vehicles and equipment. ▪ Ensure vehicles have valid Vehicle Examination Certificate to minimise vehicular emissions.	▪ To minimise vehicular emissions on ambient air quality to acceptable health and safety requirements	▪ Establish and quantify the effectiveness of planned management practises to minimise vehicular emissions.	▪ 25,000.00 annually	▪ Continuous	▪ Project EHS Officer
Flood risks	▪ Ensure maintenance of surface water drainage system designs in line with the Ghana National	▪ Regularly maintain surface water drainage and culverts to prevent storm water (run-off) from accumulating within the site spreading to the neighbourhood.	▪ To avoid flood risks due to power operations	▪ Minimise project associated floods	▪ Part of O&M Cost	▪ Continuous	Site Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
	Building Regulations, 1996, LI 1630 and the Ghana National Building Code, 2006.						
Soil Pollution	▪ Adherence to the requirements of the Land Planning and Soil Conservation Act, 1957 within the power facilities.	▪ Restrict operational activities to designated work areas, to avoid damage and disturbance outside of the power plant site, especially the sub-transmission line component. ▪ Collect contaminated soil immediately and stored as hazardous waste.	▪ To prevent soil contaminatio n due to operational activities	▪ Zero contamination of soil quality ▪ Minimal erosion inside the operational areas and surrounds.	▪ Part of O&M Cost	▪ Continuous	Site Engineer
Water Scarcity	▪ Ensure valid Water Use Permit from Water Resources Commission for abstraction of ground water as required under the provision of the Water Use Regulations, 2001 (L.I. 1692).	▪ Engage with Community members continuously on issues of water security to avoid potential conflicts. ▪ Regularly monitor the ground water abstraction and report on it on regular basis to the EPA. ▪ Maintain logbook for water consumption. ▪ Progressively adopt less water consuming module cleaning methods. ▪ Installation of automatic water level sensors inside wells	To prevent contamination of water resources	▪ Zero contamination of water quality	▪ Part of O&M Cost	▪ Continuous	Site Engineer
Increase in health hazard due to waste generation	▪ Adherence to requirements of National Environmental Sanitation Policy 2010 and the	▪ Coordinate with respective District Assemblies to hire a private contractor for the collection of waste water from the site ▪ Ensure all waste arising from the works is deposited, treated, kept,	To ensure waste generation does not pollute the environment	▪ Zero contamination of soil and water from solid and liquid waste	▪ Part of O&M Cost	▪ Continuous	Site Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
	Hazardous & Electronic Waste Control Management Act, 2016 (Act 917). ▪ Manage waste in line with operational site Environmental Management Plan and will be incorporated into any contract between VRA and the licensed operator.	disposed of and carried in accordance with the provisions of relevant national and local environmental protection acts. ▪ Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste"; ▪ Provide waste oil tanks to hold the waste lubricating oils to be produced. ▪ Utilize EPA licensed operators for re-use of waste oil ▪ Foul water should always go to a septic tank. ▪ Waste from the septic tank should be disposed of in an environmentally acceptable manner by a licensed operator approved by EPA. ▪ Prohibit illegal disposal of wastewater to the land. ▪ Ensure that constructed septic tanks during operation are well contained and impermeable to prevent leakage of wastewater into soil;					
Altered sense of place and visual intrusion from the PV panels and plant facilities	▪ Ensure effective repairs and maintenance of the solar power facilities in line with the Ghana National Building Regulations, 1996, LI 1630 and the Ghana	▪ Informative signs shall be maintained on the N12 Highway for commuters regarding potential for glare within the area. ▪ Native trees shall be planted at the frontage of the power plant facilities to act as windbreaks, noise buffer and to reduce the visual effect of having a power plant located at the site.	▪ Reduce visual intrusion of project facilities	▪ Minimal visual intrusion of construction activities project wide.	▪ Part of O&M Cost	▪ Continuous	Site Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
	National Building Code, 2006.						
Loss of connectivity and habitat fragmentation may result if fauna avoid the area or cannot move through the area on account of the presence of the facility	▪ General awareness regarding fauna should be enhanced through trainings, posters, etc. among the staff and labourers. ▪ Adhere to requirements of existing conditions of MoU Between VRA and FSD regarding work in the Lawra Forest Reserve.	▪ Maintain the use of bird deflectors, and pole design which minimizes electrocution risks during project operations to reduce impacts from power lines and associated infrastructure. ▪ Anti-poaching, trapping and hunting policy among employees should be strictly enforced. ▪ Cover upright insulators on transmission poles with plastic insulating caps or insulating tubing to prevent electrocution risk; ▪ Install bird detractors such as moving cloth or scarecrow to prevent birds from venturing close to solar modules. ▪ Regular checking of the vacuums or holes in the towers to avoid nesting by any of the birds;	▪ Ensure compliance with relevant legislation in respect of habitat and vegetation forms. ▪ Avoidance of unnecessary disturbance to the site and surrounds, and to establish buffers where required.	▪ Minimal disturbance to fauna in the area ▪ Avoid loss of habitat within the designated sensitive areas.	▪ Part of O&M Cost	▪ Continuous	Site Engineer
Destruction / loss of Historical & Cultural Heritage Resources	▪ Adhere to requirements of the National Museums Act, Act 387 of 1969. ▪ Ensure that the Code of Conduct, awareness raising, and training developed for	▪ Activities shall be properly planned to consider the identified archaeological locations to ensure they are protected from any potential damage. ▪ All works shall be undertaken within the authorised footprint so as to avoid impacts to any nearby tangible and intangible heritage resources. ▪ Community members shall be engaged with regarding compensation and moving any identified shrine.	▪ To avoid disturbance, damage to and destruction of heritage resources ▪ To enhance gains to the science of archaeology by recording chance finds	▪ Compensation of all community members for the removal of important heritage sites ▪ No damage to any significant cultural heritage features on site	▪ Part of O&M Cost	▪ Continuous	Site Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
	personnel involved in the operation phase of the Project to emphasizes the presence of archaeological locations in the area	▪ Ensure strict observation of the cultural taboos. ▪ Documentation and reporting of chance finds and submission to GMMB in Accra.					
Injury to workers	▪ Adherence to requirements of the "Hazardous & Electronic Waste Control Management Act, 2016 (Act 917)" to provide for the control, management, disposal of hazardous waste, electrical and electronic waste and for related purposes. ▪ Implementation of a Health & Safety Policy in line with IFC Occupational Health and Safety (OHS) Guidelines for the solar power project.	▪ Acquire valid permits from Ghana National Fire Service, Factories & Inspectorate Division, Environmental Protection Agency and the Energy Commission. ▪ All workers (regular and contracted) shall be provided with training on Health and Safety management system on EHS policies and procedures. ▪ Warning signs shall be placed at appropriate sites where there is a risk to health and safety. ▪ Comprehensive fire detection and protection system shall be provided to cover all equipment on site that could constitute a fire risk. ▪ Health and safety performance shall be continuously monitored. ▪ An operating audit system for the facilities shall be put in place. ▪ Cranes and lifting equipment shall be operated by trained and authorized persons only. ▪ Appropriate safety harnesses and lowering/raising tools shall be	▪ To prevent injury to workers	▪ Zero injury	▪ GH¢30,000.00 annually	▪ Continuous	Site Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
		provided for use for working at heights.					
Loss of Properties	▪ Institution of an appropriate grievance mechanisms to address concerns of the public	▪ Community Liaison Officer shall be appointed as a designated point of contact for the community	▪ Reduce land acquisition requirements where possible ▪ Effectively and transparently manage land acquisition process.	▪ Effectively and transparently manage land acquisition process. ▪ Zero grievances of non-payment from rightful land owners	▪ Part of O&M Cost	▪ Continuous	Site Engineer
Permanent loss of land for personal and commercial use	▪ Implementation of CSR activities to improve the standards of living and long-term wellbeing of the affected communities.	▪ Proactive action shall be taken in case required to avoid any undue confrontation with affected community. ▪ Ensure the availability of wood fuel and fodder should not be affected by the project and in case if there is shortage reported due to the project then it must be supplemented by VRA. ▪	▪ Minimise impacts on changes to land use	▪ Zero grievances complaints from land owners regarding changes in current land use	▪ Part of O&M Cost	▪ Continuous	Site Engineer
Reduction in productivity	▪ Prepare and adhere to a Labour Management Plan	▪ Design and adhere to employment and workforce policies. ▪ Locals shall be engaged for unskilled manpower requirements ▪ Provision of adequate shelter, drinking water, toilet facilities for the workers. ▪ Worker grievance mechanism to be instituted including monitoring and resolving of such concerns. ▪ Community Liaison Officer to be	▪ To ensure working conditions of employees are in line with national and international standards	Minimal grievance related to working conditions at the project site	▪ Part of O&M Cost	▪ Continuous	Site Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
		appointed as a designated point of contact for the community ▪ Provisions shall be made to accommodate migrant labour within the communities. ▪ Put in place suitable measures to maintain a healthy environment for the labour force					
Injury to public	▪ Adherence to requirements of the "Hazardous & Electronic Waste Control Management Act, 2016 (Act 917)" to provide for the control, management, disposal of hazardous waste, electrical and electronic waste and for related purposes. ▪ Implementation of a Health & Safety Policy in line with IFC Occupational Health and Safety (OHS) Guidelines for the solar power project.	▪ Effective security measures shall be provided for the PV Plants and the project sites through fencing, enough security staff and other measures such as floodlights with motion control. ▪ Necessary precautions shall be taken to beef up the security of the solar park. ▪ Onsite guards shall be adequately trained to deal with trespassing incidents. In addition, guard must refrain from using excessive force, unless situation extremely requires so ▪ Cultivate harmonious co-existence between itself and the local communities in the project area.	▪ Reduce impacts associated with the influx of people during the construction phase	▪ Influx of people and impacts during the construction phase to be appropriately managed	▪ Part of O&M Cost	▪ Continuous	Site Engineer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
Increase in traffic and road accidents	▪ Implementation of a Traffic Method Statement developed for the construction phase will continue to be used for the operational phase.	▪ Continue implementation of TMS ▪ Encourage car sharing amongst staff	▪ Reduce number of road accidents due to increased traffic during construction	▪ Zero accidents from road and traffic	▪ Part of O&M Cost	▪ Continuous	▪ Project Engineer
DECOMMISSIONING							
Noise disturbance to general populace	▪ Use of adequate general noise suppressing measures.	▪ All the decommissioning activities will be done during daytime ▪ The contractor will be kept informed by the community of any noise or vibration complaints. ▪ Conduct demolition activities in line with the maximum permitted noise levels ▪ Inspection of activities during decommissioning by carrying out regular Noise level test. ▪ Emphasize on the use of noise reduction techniques such as silencers and ear mufflers to employees while onsite. ▪ Develop a regular inspection and scheduled maintenance program for vehicles and machineries in order to abate the noise produced	▪ To reduce and monitor construction noise	▪ No complaints from surrounding communities	▪ 15,000.00	▪ Decommissioning	▪ Contractor's EHS Officer
Increase levels of dust	▪ Regular watering of all	▪ Train all workers on the management of air pollution from vehicles and	▪ To minimise fugitive dust	▪ Establish and quantify the	▪ 30,000.00	▪ Decommissioning	▪ Contractor's EHS Officer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
	active construction areas.	machinery ▪ Strictly control the speed limit for all motor vehicles during the demolition exercise. ▪ Sprinkle water on dusty places onsite and on dust to reduce fugitive dust emissions ▪ Provide workers with dust masks	and vehicular emissions on ambient air quality to acceptable health and safety requirements	effectiveness of planned management practises to minimise fugitive emissions production and vehicular emissions.			
Increase risks to environment and health from waste generation	▪ Practice waste reduction techniques such as Reduce, Recycle, Reuse and Recover	▪ Develop and implement a Solid Waste Management Plan (SWMP) before decommissioning commencement in line with the governing regulations ▪ The waste streams generated should be re-used, re-cycled and reduced to the extent possible ▪ Dispose all demolition waste that cannot be recycled or reused to a licensed waste disposal site using a licensed waste handler ▪ Rehabilitate the site as appropriate using indigenous vegetation species for landscaping to restore biodiversity	To ensure constructional waste generation does not pollute the environment	▪ Zero contamination of soil and water from solid and liquid constructional waste	▪ Part of Decommissioning Cost	▪ Decommissioning	▪ Contractor's EHS Officer
Injury to workers	▪ Adherence to requirements of the "Hazardous & Electronic Waste Control Management Act, 2016 (Act 917)" to provide for the control, management, disposal of	▪ Develop and implement an Occupational Health and Safety Plan ▪ Train employees on the importance of occupational health and safety ▪ Provide workers with appropriate personal protective clothing such as helmets, safety boots, gloves, dust masks, ear mufflers and overalls. ▪ Strictly enforce the use of the Personal Protective Equipment to minimise the accidents during	▪ To prevent injury to workers	▪ Zero injury	▪ Part of Decommissioning Cost	▪ Decommissioning	▪ Contractor's EHS Officer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
	hazardous waste, electrical and electronic waste and for related purposes. ▪ Implementation of a Health & Safety Policy in line with IFC Occupational Health and Safety (OHS) Guidelines for the solar power project.	decommissioning ▪ Regular medical checks ▪ Provide fully equipped First Aid Kit and sanitary facilities on site, including water for drinking and bathing ▪ Put clear signage to restricted areas ▪ Prohibit unauthorized persons at the site during decommissioning ▪ Promote HIV/AIDs Awareness					
Increase in traffic and road accidents	▪ Preparation and implementation of a Traffic Method Statement with the aim of minimizing disturbance to the nearby residents, industrial workers and general road users.	▪ Traffic shall be controlled on the access road to the site, especially when heavy trucks are turning in and out of the site. ▪ Drivers shall be trained in defensive driving ▪ Speed limits shall be enforced for heavy good vehicles and workforce transportation vehicles; ▪ Densest areas of traffic, if possible, shall be avoided through planning and channelling of traffic. ▪ Involvement of local authorities in defining optimum project traffic routes and times for transit ▪ Traffic calming measures (speed bumps and rumble strips) shall be installed to slow traffic down where heavy vehicles cross or enter busy roads.	▪ Reduce number of road accidents due to increased traffic during construction	▪ Zero accidents from road and traffic	▪ Part of Decommissioning Cost	▪ Decommissioning	▪ Contractor's EHS Officer

Impact	Identified mitigation action	Actual action	Objective	Target	Budget GH¢	Time frame	Responsibility
		▪ Installation of speed control limits for the project and ensuring all vehicles comply with the site driving regulations. ▪ Conduct periodic and routine alcohol checks for all site drivers and site workers ▪ Provision of site vehicle maintenance services in order to ensure technical failures do not occur; ▪ Install traffic safety signage at vantage points along access routes with the project sites. ▪ Develop and implement a "No Drinking" "No Alcohol" policy on site during both construction and operation. ▪ Improve and enhance community sensitization on road traffic accidents within the project area. ▪ Engage communities on road risk and educate them through constant communications, road signals as well as with communications with the local authorities and community leaders.					

8.8.1 ESMP Review and Amendments

The ESMP act as an environment and social management tool which needs to be reviewed periodically to address changes in the organisation, process or regulatory requirements. In Ghana, as part of the EIA Regulations, a stand-alone EMP is required by the Ghana EPA eighteen (18) months into construction and thereafter, every three (3) years. This is required for environmental permitting purposes. Following a review, the Project EHS will be responsible for making the amendments in the ESMP and seeking approval from the Senior Management. The amended ESMP and permitting conditions will be communicated to all the staff.

8.9 Environmental Monitoring

8.9.1 Introduction

Monitoring will be a key activity during project implementation. The significance of monitoring stems from the fact that the inputs derived from the environmental and social assessment into the project design and planning, including mitigation measures are based largely on "predictions". It is essential that the basis for the choices, options and decisions made in formulating or designing the project and other environmental and social safeguard measures are verified for adequacy and appropriateness. Monitoring verifies the effectiveness of impact management, including the extent to which mitigation measures are successfully implemented.

Monitoring specifically helps to:

- Improve environmental and social management practices;
- Check the efficiency and quality of the EA processes; and
- Provide the opportunity to report the results on safeguards and impacts and proposed mitigation measures implementation to regulatory bodies such as the EPA and the Energy Commission.

8.9.2 Monitoring Programme

A monitoring programme has been developed to determine impacts on the physical, biological and socio-economic/cultural environments within the project's area of influence and around the proposed power plant and associated facilities. The monitoring results are expected to indicate whether the predictions of potential environmental impacts are accurate and also whether the mitigation measures proposed for the management of the impacts are appropriate and adequate. The programme will also serve as an early warning system by revealing unforeseen impacts and allowing additional corrective measures to be implemented to arrest the situation and ensure that irreversible damage is not caused. The programme is also expected to provide useful guidance for the successful planning and implementation of future solar power projects that will be undertaken by the VRA.

The VRA Environment & Sustainable Development Department currently has available a wide range of both portable hand-held and laboratory-based equipment for environmental monitoring purposes. The equipment shall be mobilised on the project for monitoring of the various environmental parameters identified. VRA as well as the Contractor's Environmental Team

members will be trained adequately to understand and appreciate the choice of parameters, sampling sites, methods of sampling/measuring and analysis and frequency of monitoring. Progress Environmental Reports (Monthly, Quarterly and Annual) are to be prepared for the project which will specifically provide information on the project environmental, health and safety activities.

The EPA has embarked on the AKOBEN Environmental Performance Rating & Public Disclosure (EPRD) Programme to measure the environmental and social performance of companies, including power generating companies. EPA is aiming at ensuring continual improvement and maintenance of good environmental performance of such companies, in order to minimize risks to environment and the communities around their sites. Consequently, the EPA has developed relevant forms for use as part of self-monitoring reports that companies are required to produce and submit to the EPA. Data types required include Plant Details, Effluent Quality, Air Emissions, Ambient Air Quality, Water Use, Energy-Use and Production & Employment. EPA is expected to undertake environmental auditing with regard to these criteria which shall be used to rate the environmental performance of companies. VRA shall ensure that parameters to be monitoring during the construction and operational phases of PV Power projects shall be in line with the requirements of the AKOBEN format.

A description of the environmental monitoring activities showing parameters, methodology, period for monitoring, location and responsibilities is presented in *Table 8-2*.

8.9.3 Monitoring Cost

For purposes of achieving a very high level of compliance with regard to implementation of all environmental commitments, the VRA/EPC Contractor shall make budgetary allocations towards all environmental programmes. Financial commitments shall be made from these allocations on program-by-program basis. Environmental monitoring at the operational stage shall largely form part of the O&M costs. Detailed budget for achieving environmental compliance shall therefore form part of VRA Corporate budget. Budget required for monitoring activities is provided as part of the *Table 8-2*.

Table 8-2: Environmental Monitoring Plan

	Monitoring Parameters	Monitoring Frequency	Methodology	Responsibility	Budget GH¢
Noise levels	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Limitation of constructional activities only during the day i.e. between 0700 hours to 1800 hours. ▪ Levels of noise within project designated site ▪ Application of adequate general noise suppressing measures. ▪ Use of relevant PPEs for high noise levels ▪ Restriction of the use of vehicle horns and heavy engine breaking ▪ Erection of appropriate warning signages on noise making ▪ Operation of only well-maintained equipment on-site.	▪ Daily ▪ As required ▪ As required ▪ Daily ▪ As required ▪ Monthly ▪ As required	▪ Use of work logbook ▪ Noise meter ▪ Std. Ops. Procedure ▪ Supply of PPEs ▪ Std. Ops. Procedure ▪ No. of Signages ▪ Maintenance Schedules	▪ Contractor's EHS Officer	▪ 15,000.00
	OPERATIONAL PHASE				
	▪ Use of appropriate PPEs for high noise levels ▪ Operation of only well-maintained equipment on-site.	▪ Daily ▪ As required	▪ Supply of PPEs ▪ Maintenance Schedules	▪ Project EHS Officer	▪ 20,000.00 annually
Air Quality	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Regular watering of all active construction areas. ▪ Regular inspection and scheduled maintenance program for all vehicles, machinery, and equipment ▪ Erection of appropriate signages to checking of vehicular speed ▪ Provision of appropriate PPE's ▪ Visual monitoring of the dust emissions ▪ Regular health check-ups and treatment of employees ▪ Limitation of speed of vehicles on site to 10-15 km/hr. ▪ Prevention of idling of vehicles and equipment ▪ Restriction of diesel generator use to emergencies and power back-up only	▪ Daily ▪ As required ▪ Monthly ▪ As required ▪ Daily ▪ As required ▪ Daily ▪ As required ▪ As required	▪ Use of Water tankers ▪ Maintenance Schedules ▪ No. of Signages ▪ Supply of PPEs ▪ Optics ▪ Medical Check Ups ▪ Speed rumps/Signages ▪ Std. Ops. Procedure ▪ Std. Ops. Procedure	▪ Contractor's EHS Officer	▪ 25,000.00

	OPERATIONAL PHASE				
	▪ Limitation of speed of vehicles on site to 10-15 km/hr. ▪ Prevention of idling of vehicles and equipment ▪ Ensure vehicles have valid Vehicle Examination Certificate to minimise vehicular emissions.	▪ Daily ▪ As required ▪ Annual	▪ Speed rumps/Signages ▪ Std. Ops. Procedure ▪ VELD Certificate	▪ Project EHS Officer	▪ 15,000.00 annually
Flood Risks	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Construction of the facility in line with approved design ▪ Immediate restoration of worked areas ▪ Provision of appropriate number of cross drainage channels	▪ As required ▪ As required ▪ As required	▪ Constructional Design ▪ Std. Ops. Procedure ▪ Drainage Channels	▪ Contractor's Engineer ▪ Project Engineer	▪ Part of Project Cost
	OPERATIONAL PHASE				
	▪ Regular maintenance of surface water drainage and culverts to prevent storm water (run-off)	▪ As required	▪ Maintenance Schedules	Site Engineer	▪ Part of O&M Cost
Soil Pollution	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Restriction of construction activities to designated work areas ▪ Restriction of constructional activities to the dry season. ▪ Avoidance of construction during raining seasons to minimize erosion and run-off ▪ Storing of stripped topsoil separately from subsoil. ▪ Restriction of drivers to the use of existing access roads. ▪ Widening of existing roads to accommodate the necessary vehicles for the project. ▪ Installation of fuel and lubricants storage containers to prevent leakages. ▪ Location of temporary storage tanks on impervious bases and use drip trays during re-fuelling of equipment. ▪ Supply of on-site clean up equipment ▪ Treatment of contaminated soil as hazardous material and handled as such.	▪ As required ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required	▪ Constructional Areas ▪ Period of work ▪ Period of work ▪ Storage areas ▪ Access roads ▪ Existing roads ▪ Storage Containers ▪ Impervious Bases/Drip Trays ▪ Clean up equipment. ▪ Std. Ops. Procedure	▪ Contractor's Officer ▪ Project Engineer	▪ Part of Project Cost
	OPERATIONAL PHASE				

	▪ Restriction of operational activities to designated work areas ▪ Treatment of contaminated soil as hazardous material and handled as such.	▪ As required ▪ As required	▪ Operational Areas ▪ Std. Ops. Procedure	Site Engineer	▪ Part of O&M Cost
Water Resources	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Registration of borehole construction with WRC. ▪ Construction of borehole should be in line with LI 1827. ▪ Prevention of storage of hazardous materials near natural drainage channels. ▪ Provision of clean ups equipment and materials on site ▪ Installation of temporary and permanent run-pass pipes during rainy flood and road barriers against rain water storm where necessary. ▪ Provision of impervious storage area for Fuel & lubricant, hazardous waste. ▪ Provision of bund for temporary refuelling tanks.	▪ As required ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required	▪ Registration Forms ▪ Std. Ops. Procedure ▪ Std. Ops. Procedure ▪ Clean-up equipment ▪ Std. Ops. Procedure ▪ Impervious Bases/Drip Trays ▪ Bunds	▪ EPC Contractor ▪ Project Engineer	▪ Part of Project Cost
	OPERATIONAL PHASE				
	▪ Engaging with Community members continuously on issues of water security to avoid potential conflicts. ▪ Regular monitoring of the ground water abstraction ▪ Regular reporting on volume of ground water abstraction to the EPA. ▪ Maintenance of logbook for water consumption. ▪ Adoption of less water consuming module cleaning methods.	▪ As required ▪ Monthly ▪ Monthly ▪ Weekly ▪ As required	▪ Meeting minutes ▪ Monitoring Report ▪ EPA Monitoring report ▪ Logbook for water consumption ▪ Facility design	Site Engineer	▪ Part of O&M Cost
Waste Generation	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Utilisation of construction debris for levelling of the land ▪ Disposal of unused debris to nearest Municipal waste disposal site. ▪ Regular disposal of labour waste at approved waste disposal sites ▪ Strict control of random stocking of raw material,	▪ As required ▪ As required ▪ As required ▪ As required	▪ Use of debris ▪ Volume of debris ▪ Volume of waste ▪ Std. Ops. Procedure	▪ Contractor's EHS Officer ▪ Project Engineer	▪ Part of Project Cost

Waste Generation	storage of debris, piling of loose soil ▪ Storage of hazardous waste at designated place ▪ Sale of hazardous waste to authorized vendors. ▪ Sale of recyclable waste to scrap dealers/ buyers. ▪ Provision of proper sanitation and sewage facility	 ▪ As required ▪ As required ▪ As required ▪ As required	 ▪ Storage areas ▪ Waste Log sheet ▪ Waste Log sheet ▪ Sewage facility		
	OPERATIONAL PHASE				
	▪ Use of a private contractor for waste water collection ▪ Presence of properly contained litter bins ▪ Provision of waste oil tanks ▪ Utilization of EPA licensed operators for re-use of waste oil ▪ Disposal of waste from the septic tank by EPA licensed operator ▪ Illegal disposal of wastewater to the land. ▪ Utilisation of well contained and impermeable septic tanks	▪ Monthly ▪ Weekly ▪ Monthly ▪ As required ▪ As required ▪ As required ▪ As required	▪ Type of Waste Contractor ▪ Labelled Bins ▪ Waste oil tanks ▪ Type of waste contractor ▪ Std. Ops. Procedure ▪ Std. Ops. Procedure ▪ Septic Tank type	Site Engineer	▪ Part of O&M Cost
Landscape & Visual Intrusion	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Usage of appropriate colour and materials in architectural designs. ▪ Proper housekeeping practices by workforce ▪ State of workplace after day's work ▪ Early removal of machines, vehicles and tools after use	▪ As required ▪ As required ▪ Daily ▪ As required	▪ Architectural designs. ▪ Std. Ops. Procedure ▪ Std. Ops. Procedure ▪ Std. Ops. Procedure	▪ Contractor's Engineer ▪ Project Engineer	▪ Part of Project Cost
	OPERATIONAL PHASE				
	▪ Informative signs regarding potential for glare within the area. ▪ Utilisation of native trees as windbreaks	▪ As required ▪ As required	▪ Informative signages ▪ Windbreaks	Site Engineer	▪ Part of O&M Cost
Flora & Fauna	**PLANNING & CONSTRUCTIONAL PHASE**				
Flora & Fauna	▪ Assessment of Flora and faunal to inform habitat management. ▪ Appropriate routing of lines to reduce electrocution risks, ▪ Use of bird deflectors to reduce electrocution risks, ▪ Pole design to reduce electrocution risks ▪ Adherence to conditions of MoU ▪ Felling of enumerated dangerous and potentially dangerous trees within the Lawra Forest Reserve	▪ As required ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required	▪ Study report ▪ Constructional Design ▪ Constructional Design ▪ Constructional Design ▪ Std. Ops. Procedure ▪ No. of Trees felled	▪ Project Engineer ▪ Project EHS Officer	▪ GH¢200,000

	▪ Onsite hunting and poaching ▪ Training of staff regarding anti-poaching, hunting ▪ Restriction of vegetation disturbance to the project activity area	▪ As required ▪ Quarterly ▪ As required	▪ Worker attitude ▪ H&S Meetings ▪ Worker attitude		
	OPERATIONAL PHASE				
	▪ Maintenance of the use of bird deflectors, and pole design which minimizes electrocution risks during project operations to reduce impacts from power lines and associated infrastructure. ▪ Enforcement of anti-poaching, trapping and hunting policy among employees ▪ Cover upright insulators on transmission poles with plastic insulating caps or insulating tubing to prevent electrocution risk; ▪ Regular checking of the vacuums or holes in the towers to avoid nesting by any of the birds;	▪ Quarterly ▪ Daily ▪ Quarterly ▪ Quarterly	▪ Bird deflectors ▪ Policy implementation ▪ Insulating caps ▪ Presence of holes	Site Engineer	▪ Part of O&M Cost
Historical & Cultural Heritage	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Institution of platform for dialogue with local community and owners/caretakers ▪ Implementation of an appropriate chance find procedures in collaboration with GMMB ▪ Engagement of professional archaeologist to examine, document and/or remove and identified archaeological material. ▪ Execution of works within the authorised footprint ▪ Strict observation of the cultural taboos. ▪ Compensation for identified owners for the removal of any cultural heritage sites and shrines.	▪ Quarterly ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required	▪ Engagement Platform ▪ Std. Ops. Procedure ▪ Contract Document ▪ Work Areas ▪ Mode of work ▪ Compensation paid	▪ Community Liaison Officer ▪ Project EHS Officer	▪ GH¢150,000
	OPERATIONAL PHASE				
	▪ Protection of identified archaeological locations to prevent potential damage. ▪ Execution of works within the authorised footprint ▪ Institution of platform for dialogue with local community and owners/caretakers ▪ Strict observation of the cultural taboos ▪ Documentation and reporting of chance find and	▪ As required ▪ As required ▪ As required ▪ As required ▪ As required	▪ State of archaeological locations ▪ Work Areas ▪ Engagement platforms ▪ Std. Ops. Procedure ▪ Chance finds	Site Engineer	▪ Part of O&M Cost

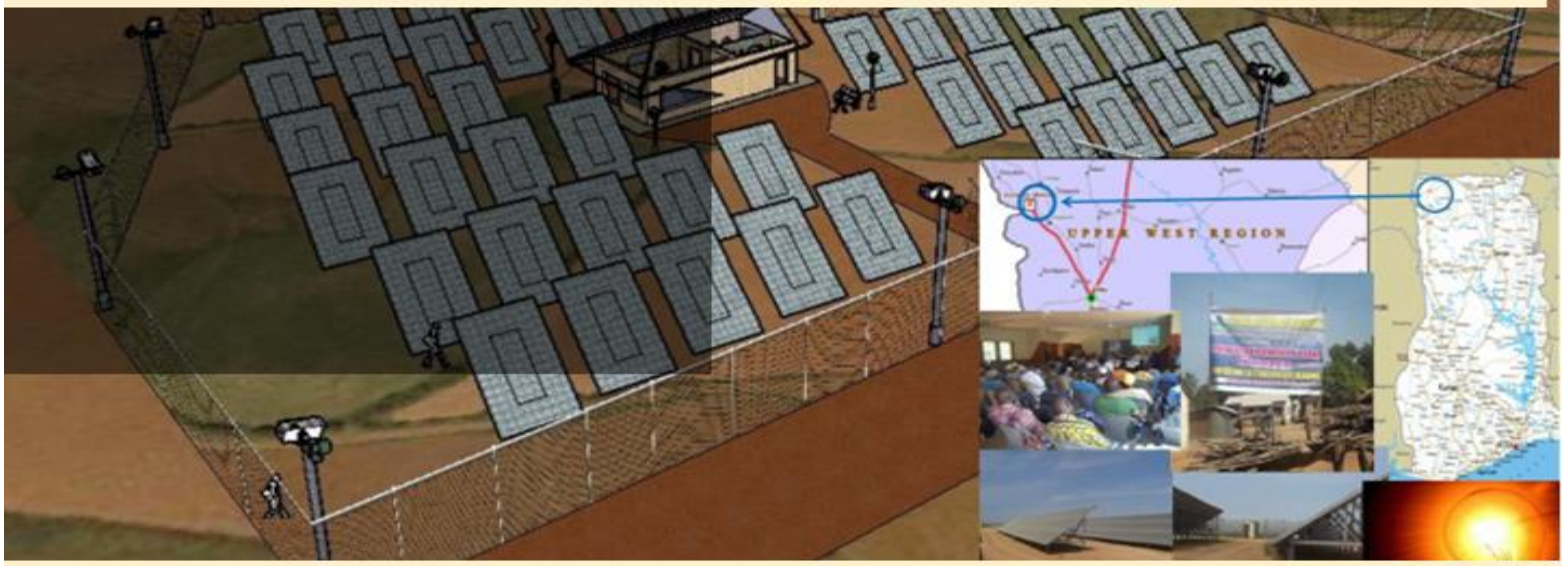
	submission to GMMB in Accra.		procedures		
	PLANNING & CONSTRUCTIONAL PHASE				
Occupational Health & Safety	▪ Implementation of a Health & Safety Plan, an Environmental Protection Plan as well as a Quality Assurance Plan ▪ Provision of PPEs to workers always. ▪ Construction activities during daytime hours ▪ Vigilance for any potential accidents shall be maintained ▪ Presence of valid Fire permit ▪ Presence of valid Development Permit ▪ Health screening of employees ▪ Training of disease prevention awareness ▪ Training on Health and safety awareness amongst staff and workers	▪ As required ▪ Monthly ▪ Daily ▪ As required ▪ Annual ▪ Annual ▪ Annual ▪ Quarterly ▪ Quarterly	▪ Std. Ops. Procedure ▪ PPEs ▪ Use of work logbook ▪ Routine Safety Checks ▪ Fire permit ▪ Development Permit ▪ Screening Report ▪ Training Report ▪ H&S Report	▪ Project Engineer ▪ Contractor EHS Officer ▪ Project EHS Officer	▪ GH¢500,000
	OPERATIONAL PHASE				
	▪ Provision of PPEs to workers always ▪ Presence of valid Fire permit ▪ Presence of valid EPA Permit ▪ Presence of valid Factories Inspectorate Certificate ▪ Training on Health and safety awareness amongst staff and workers ▪ Existing of safety warning signages ▪ Provision of Comprehensive fire detection and protection system ▪ Monitoring of Health and safety performance ▪ Existing operating safety audit system	▪ Monthly ▪ Annual ▪ Annual ▪ Annual ▪ Quarterly ▪ As required ▪ Monthly ▪ Quarterly ▪ Monthly ▪ Quarterly	▪ PPEs ▪ Fire Permit ▪ EPA Permit ▪ FI Certificate ▪ Training Report ▪ Signages ▪ Fire detection System ▪ H&S Monthly reports ▪ Audit Reports	Site Engineer	▪ GH¢30,000.00 annually
	PLANNING & CONSTRUCTIONAL PHASE				
Loss of Properties	▪ Utilisation of existing right of way to minimise land acquisition. ▪ Survey of project-affected persons for the purposes of compensation payment. ▪ Compensation payment before the start of constructional activities. ▪ Presence of Community Liaison Officer as a	▪ As required ▪ As required ▪ Annual ▪ Monthly ▪ Quarterly	▪ Line route survey ▪ List of PAPs ▪ Amount of compensation paid ▪ Presence of CLO	▪ Project Engineer ▪ Contractor EHS Officer ▪ Project EHS Officer	▪ GH¢1.2 M

	designated point of contact for the community. ▪ Implementation of appropriate grievance mechanisms to address concerns of the public	▪ As required	▪ Complaint Register		
	OPERATIONAL PHASE				
	▪ Presence of Community Liaison Officer as a designated point of contact for the community.	▪ Annual	▪ Presence of CLO	Site Engineer	▪ GH¢15,000.00 annually
Land Use	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Level of awareness amongst stakeholders on the project ▪ Institution of grievance mechanism to keep record of all complaints from the community ▪ Presence of valid Development Permit ▪ Restoration of land acquired on temporary basis for storage of material to their original form. ▪ Utilisation of existing right of way to minimise land acquisition. ▪ Utilisation of existing roads for access to the project site ▪ Presence of Community Liaison Officer as a designated point of contact for the community. ▪ Non disturbance of land use in and around permanent project facilities	▪ Monthly ▪ Quarterly ▪ Annual ▪ As required ▪ As required ▪ As required ▪ Quarterly ▪ Daily	▪ Community engagement ▪ Complaint Register ▪ Development Permit ▪ State of temporary lands ▪ Use of Right of way ▪ Use of existing roads ▪ Presence of CLO ▪ State of land around project facilities	▪ Community Liaison Officer ▪ Contractor Engineer ▪ Project Engineer	▪ Part of Project Cost
	OPERATIONAL PHASE				
	▪ Implementation of CSR activities to improve the standards of living and long-term wellbeing of the affected communities. ▪ Undertake proactive action to avoid any undue confrontation with affected community.	▪ Annual ▪ As required	▪ CSR Report ▪ Complaint Register	Site Engineer	▪ Part of O&M Cost
	PLANNING & CONSTRUCTIONAL PHASE				
	▪ Adherence to employment and workforce policies. ▪ Engagement of Locals for unskilled manpower requirements ▪ Provision of adequate shelter, drinking water, toilet	▪ Monthly ▪ Monthly ▪ Monthly	▪ Labour Policies ▪ Employment records ▪ Accommodation for	▪ Community Liaison Officer ▪ Contractor	▪ GH¢200,000

Labour & Working Conditions	facilities for the workers. ▪ Provision of accommodation of migrant labour within the communities. ▪ Presence of Community Liaison Officer as a designated point of contact for the community ▪ Implementation of worker grievance mechanism ▪ Maintenance of a healthy environment for the labour force	▪ Monthly ▪ Quarterly ▪ Quarterly ▪ As required	staff ▪ Accommodation for migrant staff ▪ Presence of CLO ▪ Compliant Register ▪ Complaint Register	Engineer ▪ Project Engineer	
	OPERATIONAL PHASE				
	▪ Same at constructional phase	▪ See above	▪ See above	Site Engineer	▪ Part of O&M Cost
Public Safety	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Notification to local government/traditional authorities on the date of project commencement. ▪ Observation of all necessary traditional requirements prior to project commencement ▪ Institution of public grievance mechanism. ▪ Creation of awareness amongst staff about local cultural sensitivities. ▪ Limitation of constructional activities only during the day i.e. between 0700 hours to 1800 hours. ▪ Segregation of the various wastes and arrange for subsequent disposal through either efficient incineration or disposal in a sanitary landfill. ▪ Fencing of all excavated areas to avoid access to outsiders and wildlife. ▪ Provision of security and warning signages around construction site ▪ Provision of alternative access route to the nearby local resort at the Lawra site, if required. ▪ Briefings to create awareness on Public health amongst staff, especially on Sexually Transmitted Diseases and HIV/AIDS.	▪ As required ▪ As required ▪ As required ▪ Quarterly ▪ Daily ▪ As required ▪ As required ▪ Daily ▪ As required ▪ Quarterly	▪ Notification Letter ▪ Pacification Rites ▪ Complaint Register ▪ Training Report ▪ Use of work logbook ▪ Waste log book ▪ Std. Ops. Procedure ▪ Warning signages ▪ Access routes ▪ Briefing report	▪ Community Liaison Officer ▪ Project Engineer ▪ Contractor Engineer ▪ Project EHS Officer	▪ GH¢50,000
	OPERATIONAL PHASE				
	▪ Provision of fencing for the PV Plants ▪ Provision of security staff	▪ Quarterly ▪ Monthly	▪ Fence ▪ Security Staff	Site Engineer	▪ Part of O&M Cost

	▪ Provision of floodlights within facility ▪ Provision of motion controls within facility ▪ Training of onsite guards to deal with trespassing incidents. ▪ Maintenance of harmonious co-existence between staff and the local communities in the project area.	▪ Monthly ▪ Monthly ▪ Annual ▪ As required	▪ Floodlights ▪ Motion Controls ▪ Training Report ▪ Std. Ops. Procedure		
Traffic & Transport	**PLANNING & CONSTRUCTIONAL PHASE**				
	▪ Implementation of TMS ▪ Implementation of traffic control measures ▪ Training of drivers in defensive driving ▪ Enforcement of speed limits for heavy good vehicles and workforce transportation vehicles; ▪ Avoidance of dense areas of traffic through planning and channelling of traffic. ▪ Involvement of local authorities in defining optimum project traffic routes and times for transit ▪ Implementation of a "No Drinking" "No Alcohol" policy on site ▪ Conduction of periodic and routine alcohol checks for all site drivers and site workers ▪ Provision of site vehicle maintenance services in order to ensure technical failures do not occur; ▪ Installation of traffic safety signage at vantage points along access routes with the project sites. ▪ Sensitisation programs for communities within the project area on road traffic and risks.	▪ Daily ▪ Daily ▪ As required ▪ Daily ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required ▪ As required	▪ Std. Ops. Procedure ▪ Speed rumps, signages, ▪ Training Report ▪ Speed limits ▪ Level of traffic ▪ Traffic routes ▪ Policy on No Drinking and No Alcohol ▪ Report on routine checks ▪ Vehicle maintenance site ▪ Traffic safety signages ▪ Sensitisation Report	▪ Community Liaison Officer ▪ Contractor Engineer ▪ Project EHS Officer	▪ GH₵350,000
	OPERATIONAL PHASE				
	▪ Implementation of TMS ▪ Use of car sharing amongst staff	▪ As required ▪ As required	▪ Std. Ops. Procedure ▪ Car sharing strategy	▪ Project Engineer	▪ Part of O&M Cost

Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



CHAPTER 9:

CONCEPTUAL DECOMMISSIONING & DISMANTLING PLANT

9 CONCEPTUAL DECOMMISSIONING & DISMANTLING PLAN

9.1 Introduction

Each of the solar power projects shall typically have a life expectancy of 20 to 25 years. The current trend in the solar energy industry has been to replace or "re-power" older solar energy projects by upgrading older equipment with more efficient PV plants and ancillary equipment. However, if not upgraded the PV plants will be decommissioned. The purpose of this conceptual Decommissioning & Dismantling Plan (D&D) is to describe the general objectives for the post project land use, and the planning processes leading to development of a Final D&D Plan.

The specific objectives in managing the decommissioning process will be;

- To ensure that rehabilitation and decommissioning are carried out in a planned sequential manner, consistent with best practice,
- To ensure that agreed post-project land-use outcomes are achieved, and
- To avoid on-going liability

The solar power facility decommissioning process shall be initiated upon the termination of the leases with the landowners. The primary reason for the leases to be terminated would be the completion of the project's useful life or the lack of a power purchase agreement with the relevant national authority at the time. VRA or the project owners at the time agree to meet with the landowner prior to the lease expiration date to ensure that the owners perform its obligations to remove its property and restore the premises. Removal of machinery, equipment, PV Modules/Inverters and all other materials related to the project is to be completed within one year of decommissioning. Thus, within twelve (12) months of initiating the decommissioning, the relevant project components will have been removed from the leased land.

9.2 Decommissioning During Construction (Abandonment of Proposed Project)

While not expected and considered to be extremely unlikely, if construction of the proposed project and associated work may not be completed, the project would be decommissioned in a manner as described in this report. Further, mitigation measures as described in the Environmental & Social Management Plan (part of the Design and Construction Report) would be implemented. As with the construction, the Project EHS will be present on site for the duration of the work.

9.3 Decommissioning After Ceasing Operation

The decommissioning of the solar power facility will follow the VRA's Health & Safety Policy along with any applicable national, and the relevant District Assembly's Regulations and standards. During decommissioning activities, the Upper West Regional Physical Planning Department and the EPA office shall have access to the site, pursuant to reasonable notice, to inspect the results of complete decommissioning. All decommissioning and restoration activities will be in accordance with all applicable state and local permits and requirements and will include the following specific activities:

- **PV Plant removal:** Cranes and/or other machinery will be used for the disassembly and removal of the PV plants. Electronic components and controls such as protection devices, switches, junction and combiner boxes, transformers, auxiliary power supply and internal cables will be removed. The solar modules and the inverters will be lowered to the ground for disassembly and transporting. These will either be transported whole for reconditioning and reuse or dissembled into salvageable, recyclable, or disposable components.
- **PV foundation removal:** PV foundations will be removed down to a level 0.914m (or as per Ghana EPA guidelines or requirements). The remaining excavation will be filled with clean sub-grade material, compacted to a density similar to surrounding sub-grade material, and finished with topsoil.
- **Underground collection cables**. All cables buried less than 0.914m or as per Ghana EPA guidelines or requirements), will be removed. All cables buried deeper than 0.914m, will be kept in place if it is determined that their presence does not adversely impact land use and they do not pose a safety hazard.
- **Access roads and parking areas:** At the discretion of the new landowners, gravel will be removed from access roads and parking areas and transported to a pre-approved disposal location. Any drainage structures will be removed and backfilled with sub-grade material (if necessary). The ground will be de-compacted (in agricultural areas only) and allowed to re-vegetate naturally.
- **Monitoring:** A monitoring and remediation period of two years immediately following the completion of any decommissioning and restoration activities will be undertaken. If agriculture impacts are identified during this period, follow-up restoration efforts will be implemented.
- **Substation:** The Project substation is generally valuable to the local transmission owner. As per the interconnection rules of NEDCo or GRIDCo, the project sub-stations shall revert to the ownership of the transmission owner and thus VRA does not intend to decommission the substation.

9.4 Restoration of Land and Water Negatively Affected By Facility

Once all the facilities are removed, the remaining work to complete the decommissioning will consist of shaping and grading of the areas to as near as practicable to the original contour prior to construction of the power facilities. All areas will be restored as near as practical to their original condition with native soils and seeded. Other than the concrete, which will remain 0.9 meters below the soil at the depth of the native bed rock or, no other residual impact is foreseen. The decommissioning will affect the agricultural practices directly around the access roads, substation locations, but only during their removal. Also, no impacts to terrestrial vegetation and wildlife are expected since all the project infrastructures will be located exclusively outside agricultural land.

The most significant risk to the aquatic environment will be when the access roads near drains or municipal drain crossings are removed. Like the construction phase, the plant decommissioning will follow a storm water protection plan that will ensure proper steps are followed to mitigate erosion

and silt/sediment runoff. As with the project's construction, noise levels around the decommissioning work will be higher than average. Proper steps will be followed to minimize this disturbance, such as working only during daylight hours. Also, as with the project's construction, road traffic in the area will increase temporarily due to crews and heavy equipment movements.

9.5 Procedures for Managing Waste and Materials

VRA shall aim to engage a contractor for this assignment, who is part of PV CYCLE, a non-profit, member-based organization which offers collective and tailor-made waste management and legal compliance services for companies and waste holders around the world. Members of PV CYCLE organizes the take-back and recycling of PV modules at end-of-life. The recycling program of PV CYCLE is a comprehensive recycling process which recovers most of the materials within the PV panel (including glass, semiconductor material, ferrous and non-ferrous metals, etc.) for reuse in new products. Such an option is to be highly considered for the PV panels at the end-of-life.

9.6 Decommissioning Notification

The process for notification of decommissioning activities will be the same as the process for notification of construction activities. EPA will be formally notified of the process to enable them to provide relevant guidance as required. A report describing the performance of the Final D&D Plan in working towards its objectives, based on monitoring results, and the extent to which it has been complied with, will be submitted to the EPA. The report will be provided to documented stakeholders and will otherwise be publicly available on request. Files and documents used to collate information regarding closure commitments, licences, approvals and other information concerning closure will be catalogued and maintained in accordance with standard VRA practices.

9.7 Conditions Of Approval

VRA will ensure that the decommissioning stage of the proposed facility is carried out in accordance with EPA/Energy Commission as well as the District Assembly's requirements and the measures/practices as described in this report. VRA understand that the EPA could requests specific decommissioning activities as a condition of approval that could include, for example:

- Providing notification regarding the plans to continue or cease the operation of the proposed facility by the end of power purchase agreement;
- Providing notification regarding the need for an application for amendment to the EPA to keep the proposed facility in operation after the end of power purchase agreement;
- Providing timelines for the start and completion of the decommissioning activities;
- Keeping this report updated to ensure that when required a portion of the facility which is not operational due to technical failure can be properly decommissioned;
- Providing site restoration measures that would ensure that the nutrient content of the soil is restored;
- Providing restoration of the site as close to a pre-construction state as feasible;

- Providing a decommissioning cost estimate as well as the methods for ensuring that the funds will be available for decommissioning and site restoration.

The D&D Plan shall be binding upon VRA or any of its successors, insofar as it constitutes a mandatory permitting requirement under each Districts' law, and each permit shall run with the land and improvements comprising the Project. Best practice requires that planning of solar power plant closure be undertaken progressively throughout the lifetime of the operational phase. As such the conceptual plan will be reviewed and detail added as it becomes available. The D&D Plan will be finalised and submitted to the relevant authorities for approval at least six months prior to closure of the site.

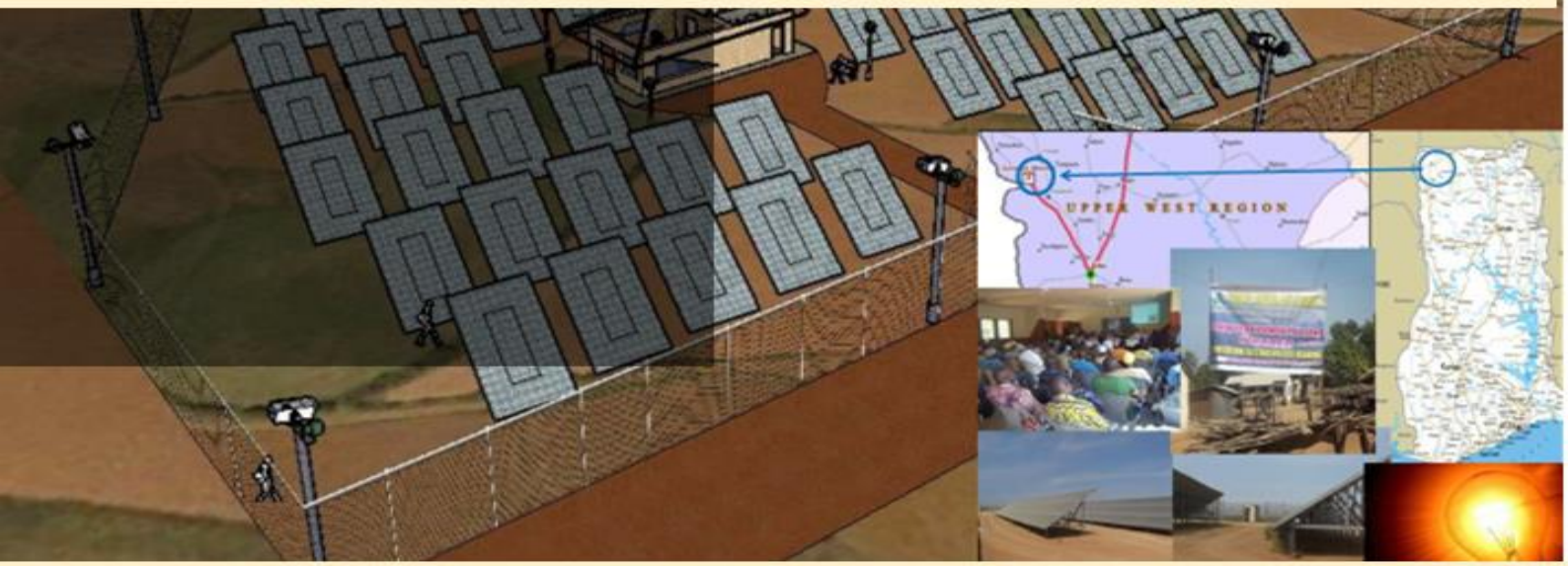
9.8 Calculations for Decommissioning Costs

In order to provide such financial assurance before the end of the useful life of the equipment, VRA agrees to deliver to relevant agencies prior to the decommission and closure phase, a financial instrument with an aggregate initial face amount equal to the decommissioning cost estimate prepared and certified by a professional engineer in accordance with national and respective local laws. Subject to such estimate and certification, the anticipated formula for calculating the estimated decommissioning cost is provided in Table *9-1*.

Table 9-1: Calculation for Decommissioning Costs

Schedule	Activity	Costs (GH ¢)	Total Costs (GH ¢)
A	PV Plant Removal	(# of man hours) x (labor rate - GHS/hour) = GHS Equipment (# of days in use) x (daily rate) = GHS	Total A
B	Concrete Foundation Removal	(# of man hours) x (labor rate - GHS/hour) = GHS Equipment (# of days in use) x (daily rate) = GHS	Total B
C	Access Road and Buried Cable Removal	(# of man hours) x (labor rate - GHS/hour) = GHS Equipment (# of days in use) x (daily rate) = GHS	Total C
D	Seeding and Re-vegetation	(# of man hours) x (labor rate - GHS/hour) = GH S Equipment (# of days in use) x (daily rate) = GHS Materials (cost per unit) x (# of units) = GHS (seed, mulch and topsoil)	Total D
E	Total Estimated Removal Cost Per Each PV Plant Site = GHS		A+B+C+D
F	Estimated Salvage Cost	Value of each PV Module = Total D = GHS Value of each ancillary component = GHS	Total F
G	Total Value for Decommissioning Project = GHS		E - F

Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



CHAPTER 10:

CONCLUSION & RECOMMENDATIONS

10 CONCLUSION & RECOMMENDATIONS

10.1. Project's Benefits

The governmental bodies in Ghana that will be directly responsible for overseeing the project at all stages have been outlined and the legal framework within which these institutions exist and their roles in the administration of the proposed solar project have also been discussed. The solar power project in particular and the REDP in general seek to foster sustainable low carbon energy provision, provision of jobs in local communities and global partnerships that ensure that the projects should have some form of local content during development and operation. Some major positive benefits of the project have been discussed under Section 6.3 and further elaborated under this Section as follows:

Environmental Benefits

The key environmental benefits will be the reduction of fossil fuels consumed by the existing thermal generation facilities, with the consequential reduction of CO_2 and other greenhouse emissions from the Natural Gas/Light Crude Oil (LCO) generators. Given the low greenhouse gas emissions from solar power, increasing its adoption is an essential strategy in efforts to combat climate change at an individual and national level. Solar energy is clean, renewable (unlike gas, oil and coal) and sustainable, helping to protect our environment. It does not pollute our air by releasing Carbon Dioxide, Nitrogen Oxide, Sulphur Dioxide or Mercury into the atmosphere like many traditional forms of electrical generation do. Therefore, solar energy does not contribute to global warming, acid rain or smog. It also actively contributes to the decrease of harmful greenhouse gas emissions. Solar plants operate silently, have no moving parts, do not release offensive smells and do not require fuel. More solar panels can easily be added in the future when the demand for more power grows. The project will therefore result in a less polluted environment and life longevity and an emission reduction.

Economic Benefits

Crude oil/natural gas prices are expected to fluctuate over the years thus, developing electrical power facilities from renewable based projects will reduce Ghana's exposure to the fluctuating price of fuel, decrease its carbon footprint and place the country as a leader in small-grid connected renewable solar generation. In addition, the increase in thermal generation capacity has led to an increasing exposure to the risk of fuel price escalations, fuel supply risks (in the case of pipeline gas), and an increase in carbon footprint. This has meant that the Ghanaian economy and electricity consumers have been exposed to high and volatile electricity prices linked to oil prices over the last ten years.

In comparison, solar power is not dependent on uncertain costs of key resource inputs such as oil. The current cost of solar-generated electricity is becoming competitive with reduction in prices of the solar components and has decreased since the technology was first introduced. This reduction in cost is expected to continue as solar energy technology matures and economies of scale are

established in the solar energy market. Beyond initial installation and maintenance, solar energy is free, and therefore reduces the exposure of the electricity power price to imported fossil fuels. In addition, one of the biggest advantages of the project is the ability to avoid the politics and price volatility that is increasingly characterizing fossil fuel markets. Thus, the key economic benefits include a generated power price from the solar facility that is independent from the price of crude, the up-skilling of the Ghanaian labour force and the contracting of a local civil construction companies and labourers. Solar energy systems are virtually maintenance free and will last for decades. Once installed, there are no recurring costs. Solar energy supports local job and wealth creation, fueling local economies.

Employment Benefits

There will be employment opportunities created for the local labour force during the construction with the attendant invaluable up-skilling of both the local labourers and client's workers. There may be over 100 employment opportunities created for the local labour force during construction, with the attendant invaluable up-skilling of both the local labourers and client's workers. It is expected that the full operational facility will require a labour force of 10-20 people. Up skilling of the workforce in construction and operation of renewable energy technologies, and training provided to employees will provide individuals with a skill set that will be highly desirable throughout the industry sector in Ghana, increasing potential opportunities available to such individuals and shall contribute to sustainable socio-economic development.

Thus, Lawra and Kaleo communities shall benefit from new jobs (mostly higher income skilled) hence employment generation for locals, increased income and contribute to national poverty reduction efforts as well as investment in areas which would otherwise have difficulty attracting new investment. Project implementation will also lead to the establishment of local markets and provide small scale business opportunities for women. The presence of higher skilled workforce in these communities will create demand for a certain standard of housing facilities. This will require putting up of new buildings or upgrading of existing once to give the community a face lift.

Political and Social Benefits

The project will illustrate the country's commitment to renewable energy generation as well as being a flagship project for the country's commitment to renewable energy generation. The success of this project will raise the confidence of investors and aid agencies to develop further solar and other renewable projects in Ghana. Ultimately this will increase the proportion of renewable energy generated indigenously and significantly reduce the dependence on imported fuel.

In Ghana, the industrial facilities and power generation facilities are mainly centered in a small part of the Country. Electricity available in Northern Ghana are transmitted over long distances from the south where over 99% of power generation is produced. This is capital intensive and result in transmission loses. The siting of the project in the Upper West Region in Northern Ghana will minimize the cost of transmission and transmission loses as well. Therefore, the presence of these

power plants will improve electrification. The location of the plant would allow it to improve voltages in the locality and can be configured with some minor modifications to ensure local agro based industries improved reliability of power. This will attract businesses and services that otherwise would have been difficult to bring to these communities.

From the various associated project consultations, it was indicated that the existing levels of employment are low within the project area and the wider site locality resulting in youth migration to Southern Ghana. The aim of these migration is to marshal resources for the upkeep of their families during the lean season of farming and cater for their education if lucky to progress on the educational ladder. Thus, any employment associated with the project will be the single biggest opportunity outside of the advantages expressed above. In addition, the development of the solar power plant within Lawra and Kaleo communities offers the opportunity for new industries in the Upper West Region due to improved reliability of power. Industrial works such as carpentry shop, blacksmithing, welding, vulcanizing, and fitting shops and agro-processing (Shea butter and groundnut extraction) that the locals are engaged in are all highly electric power dependent.

10.2. Conclusion

This ESIA Report records the results and conclusions of the environmental assessment carried out to determine the potential impacts (both adverse and beneficial) of the proposed solar power project. In assessing the various negative impacts associated with the constructional and operational phases, the average rating of the project had a score of 3.4 and therefore the overall significance rating can be defined as **LOW NEGATIVE**. Following this, the ESIA has also outlined the potential measures to avoid, reduce or remedy any associated negative impact.

Subsequently, an Environmental & Social Management Plan (EMMP) has been prepared which identifies all mitigation measures relevant to the project, including those required to ensure that all environmental regulations are met and those that have been agreed following extensive consultations with a wide range of interested parties. The ESMP also identifies the periods during which mitigation measures must be implemented, who is responsible for implementation and the longer-term monitoring requirements of the project. It shall be ensured that contractors fulfil their obligations under their contracts. To ensure compliance of the project with the EIA Report, through the framework of the ESMP, an Environmental Monitoring Plan has been developed and VRA will designate a Project EHS Officer who will be responsible for ensuring that obligations are adhered to during construction and operational phase.

In conclusion, it is affirmed that VRA is committed to ensuring continuous improvement of environmental performance to minimize the impacts of all its operations on the environment, in line with the principles of sustainable development, in addition to complying with national and international environmental protection regulations. This is an undertaking VRA is firmly committed to and shall adhere to it.

10.3. Recommendations

Based on associated impacts of the project definition, ongoing consultations as well as the experience of the study team, various mitigation measures have been recommended under Chapter 7.0 in this ESIA Report. In addition, this ESIA Study finds that the value addition characteristics of this solar power project would respond to the principles of sustainable development that aim at "socially equitable and economically viable development to improve the quality of life for all citizens of the earth, without altering the balance in the ecosystem". The benefits to be derived from the implementation of the project are immense, especially considering the challenges that electricity consumers have been exposed to high and the volatile electricity prices linked to oil prices over the last ten years. Therefore, there is assurance from all stakeholders to help ensure that this project is implemented to the benefit of the people of Ghana and with little or no damage to the environment.

VRA believes that the ESIA Report has sufficiently dealt with the significant issues on the ground. It is hoped that the report will meet the expectations of the EPA and warrant the issuance of Permit to enable VRA to commence the project. VRA commits to collaborate with EPA to jointly manage the environmental and social concerns related to the solar power plant project and shall submit progress environmental reports to the EPA as required. The study therefore recommends that the ESIA Report should be approved with the provision that the suggested mitigations measures will be adopted, and the ESMP / Monitoring Plans will be followed in the letter and spirit.

11 REFERENCES

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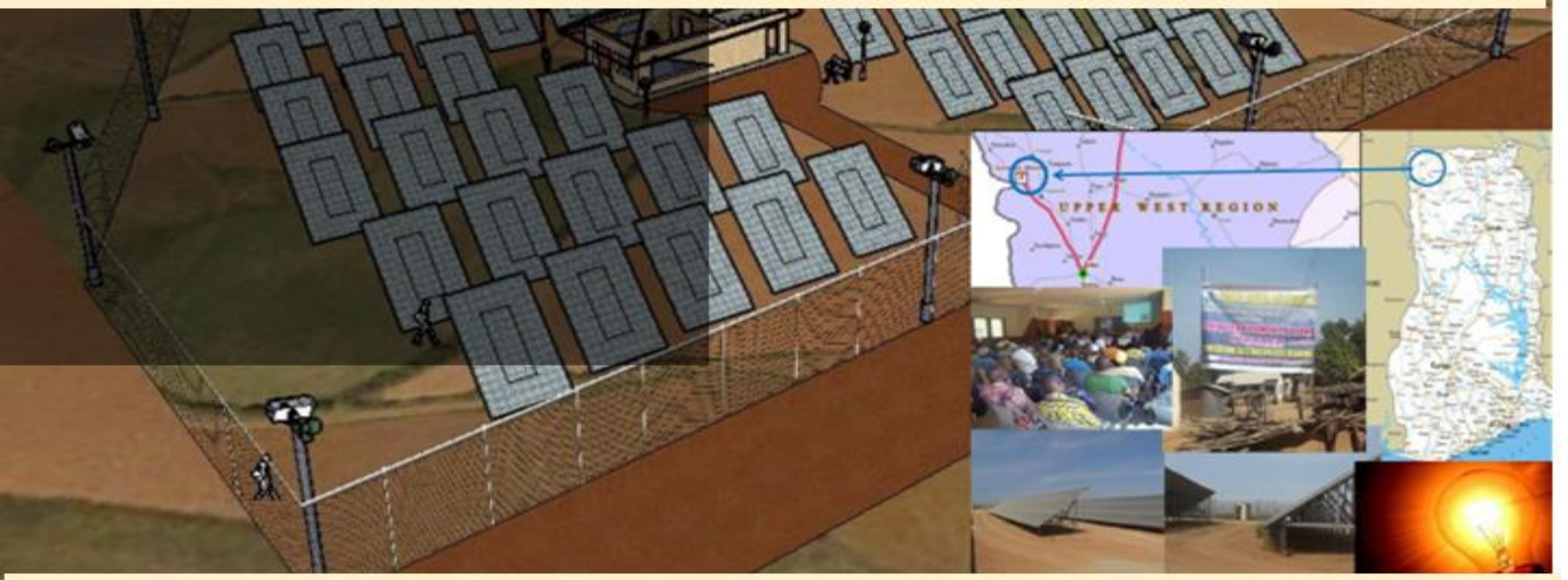
Environmental & Social Impact Assessment Report for the 35MW Solar Power Project: Upper West Regional Project Sites



APPENDIX

Appendix 1: Project's Permits
Appendix 2: Members of ESIA Study Team
Appendix 3: MoU Between VRA and Forest Services Division
Appendix 4: Project Design Drawings
Appendix 5: Flora & Faunal Assessment Report
Appendix 6: List of Persons Consulted During Stakeholder Engagements
Appendix 7: Copies of the Project Public Disclosure Notices
Appendix 8: Leases with Landowners
Appendix 9: Project Impact Calculations Sheet

APPENDIX 1:
PROJECT'S PERMIT

Tel: (0302) 664697 / 664698 / 662465
667524 / 0289673960 / 1 / 2
Fax: 233 (0302) 662690
Email: info@epa.gov.gh

Environmental Protection Agency
P. O. Box MB 326
Ministries Post Office
Accra
Website: http://www.epa.gov.gh

Permit No.CE0030770108

ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL PERMIT

ENVIRONMENTAL ASSESSMENT REGULATIONS 1999 (LI 1652)

This is to authorize

VOLTA RIVER AUTHORITY

To construct the 12 MW solar photovoltaic power project as per the attached schedule

Located at Kaleo and Lawra in the Upper West Region

Peter Abum Sarkodie
Executive Director

Date Issued: March 1, 2018
Expiry Date: August 31, 2019

NB: **This permit is only valid with the Seal of the Environmental Protection Agency and conditioned upon obtaining other permits from relevant institutions among others**

ENERGY COMMISSION

This is to certify that

VOLTA RIVER AUTHORITY

(EC/GWSL/06-13-011)

Has been granted a

SITING PERMIT

*For its proposed site to set up a Solar PV Plant at Lawra in the Upper West Region, subject to the Conditions in the Schedule**

Permit Number: **EC/SOL/SP/10-14-004**

Permit valid until: **1ST OCTOBER 2015**

A. K. Ofosu Ahenkorah (Dr.)

Executive Secretary

Date: **2ND OCTOBER 2014**

**See attached Schedule*

ENERGY COMMISSION

This is to certify that

VOLTA RIVER AUTHORITY

(EC/GWSL/06-13-011)

Has been granted a

SITING PERMIT

*For its proposed site to set up a Solar PV Plant at Lawra in the Upper West Region, subject to the Conditions in the Schedule**

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Permit valid until: **1ST OCTOBER 2015**

A. K. Ofosu Ahenkorah (Dr.)

Executive Secretary

Date: **2ND OCTOBER 2014**

**See attached Schedule*

APPENDIX 2:
MEMBERS OF ESIA STUDY TEAM

Contact Details	Qualification	Role/Study to Be Undertaken
Name: Ben A. Sackey Email: ben.sackey@vra.com Mobile: 0243344779	• BSc Biochemistry • MPhil Food Science • PG Cert. OSHEM • Cert. in PPM • Certified Env. Auditor • Certified ISO 14001 EMS Implementor • Member, IAIA	ESIA Team Leader • Undertake rapid socio-economic and environmental appraisal of project area • Lead expert responsible for data collection and literature review • Provide inputs in the determination of the Present Ecological State and Ecological Importance and Sensitivity of any ecological sensitive areas • Lead in Public Consultation Process • Due diligence for quality project reporting • Drafting Reports and Quality Assurance
Name: Godfred Ofosu-Asare Email: godfred.ofosu-asare@vra.com Mobile: 0243503588	• BSc Chemistry • MSc in Env. Science • Member, IAIA	ESIA Specialist • Environmental Management Expert / ESIA Specialist • Supervision and coordination for effective implementation of project activities. • Baseline ambient noise/air quality study • Conduct interviews and collect relevant oral accounts, including migration and settlement histories of descendant communities in the project areas • Due diligence for quality project reporting • Partake in public education/stakeholder consultations • Review and assure timely compilation and submission of all reports. • Coordinate preparation of project Environmental Scoping as well as Detailed ESIA reports
Name: Lloyd Kofi Sutherland Email: lloyd.sutherland@vra.com Mobile: 0241370926	• BSc in Biochemistry • MSc in Env. Science; • NEBOSH-IGC • Member, IAIA	ESIA Specialist • Environmental Management Expert / ESIA Specialist • Supervision and coordination for effective implementation of project activities • Baseline ambient noise/air quality study • Due diligence for quality project reporting • Partake in public education/stakeholder consultations • Review and assure timely compilation and submission of all reports. • Coordinate preparation of project Environmental Scoping as well as Detailed ESIA reports
Name: Baffo Blankson Email: baffo.blankson@vra.com Mobile: 0200366511	• Forestry Certificate • BSc Environment & Natural Resource Management, • MSc in Env. Science (ongoing)	Natural Resource Management Specialist • Responsible for supervision of data collection and literature review of biological environment • Identify floral species around environmental influences of the project

Contact Details	Qualification	Role/Study to Be Undertaken
		• Draw up a list of floral and faunal species in the study area and identifies environmental impacts. • Partake in public education/stakeholder consultations
Name: Frederick Kyei-Dompreh Email: fred.kdompreh@vra.com Mobile: 030-2660078	• BSc. (Hons) Land Economy; • MBA • Member-GhIS	Property Valuation Expert • Valuation Expert responsible for valuation of all properties • Measure, describe and record vital ethnographic objects and surface archaeological materials in project areas • Partake in public education/stakeholder consultations. • Lead in the preparation of the "Property Valuation Report".
Name: Kofi Orstin Email: kofi.ortsin@vra.com Mobile: 0244234336	• BSc. (Hons) Land Economy; • Member-GhIS	Property Valuation Expert • Valuation Expert responsible for valuation of all properties • Conduct interviews and collect relevant oral accounts, including migration and settlement histories of descendant communities in the project areas • Measure, describe and record vital ethnographic objects and surface archaeological materials in project areas • Partake in public education/stakeholder consultations • Assist in the preparation of the "Property Valuation Report".
Name: Ebenezer Kojo Antwi Email: ebenezer.antwi@vra.com Mobile: 0260438891	• BSc. Electrical Engineering • Member-GhIE	Electrical Engineer • Development of project technical feasibility report • Project design and layouts • Partake in public education/stakeholder consultations Due diligence for quality project reporting • Provide quality assurance in the preparation of project Environmental Scoping as well as detailed ESIA Reports.
Name: Linus Abenney-Mickson Email: linus.mickson@vra.com Mobile: 0208889688	• BSc. Electrical Engineering • Member-GhIE	Electrical Engineer • Development of project technical feasibility report • Project design and layouts • Partake in public education/stakeholder consultations Due diligence for quality project reporting • Provide quality assurance in the preparation of project Environmental Scoping as well as detailed ESIA Reports.
Name: Khalilu-lahi Abdulai	• BSc. Mechanical Engineering	Mechanical Engineer

Contact Details	Qualification	Role/Study to Be Undertaken
Email: abdulai.khalilu-lahi@vra.com Mobile: 0204544074	• Member-GhIE	• Development of project technical feasibility report • Project design and layouts • Partake in public education/stakeholder consultations Due diligence for quality project reporting • Provide quality assurance in the preparation of project Environmental Scoping as well as detailed ESIA Reports.
Name: Lawrence Adipah Email: lawrence.adipah@vra,com Mobile:0509180415	• MSc. In Geomatic Engineering • Diploma in Mine Surveying	Geodetic Surveyor • Coordinate surveying of project area • Production of Maps for project technical feasibility report.

APPENDIX 3:
MOU BETWEEN VRA AND FOREST SERVICES DIVISION

MEMORANDUM OF UNDERSTANDING (MOU)

BETWEEN

VOLTA RIVER AUTHORITY

AND

FOREST SERVICES DIVISION OF THE FORESTRY COMMISSION

Dated 20TH OCTOBER, 2003

THIS MEMORANDUM OF UNDERSTANDING is made the 20th day of OCTOBER 2003 **BETWEEN THE VOLTA RIVER AUTHORITY (herein referred to as VRA)** whose registered address is Electro-Volta House, 28th February Road, P. O. Box MB 77, Accra, Ghana of the one part AND the **FOREST SERVICES DIVISION (herein referred to as FSD) OF THE FORESTRY COMMISSION** whose registered address is P.O. Box GP 527, Accra.

WHEREAS:-

1. Section 10 (b) of the Volta River Development Act 1961 (Act 46) mandates the VRA to construct and operate a transmission system for the distribution of her electrical power:

2. Some of these transmission line routes will pass through national forest reserves which, the Forestry Commission Act 571 the FSD is mandated to manage:

3. The VRA is mandated under Section 12 of the Volta River Development Act 1961 (Act 46) to pay compensation to any person whose property is affected by VRA's transmission line constructional works:

4. The VRA is also mandated to collaborate and consult with other agencies in its various operations to ensure sound development:

5. The parties in pursuance of this collaboration have found it necessary to set out the separate roles and responsibilities of the partnership to strengthen the collaborative initiative between the two agencies for the efficient management of power related activities in national forest reserves:

6. The VRA and the FSD met on June 20, 2002 at the FSD Conference Room to discuss modalities for ensuring that the affected forest reserves do not sulfer any unreasonable degradation due to VRA's activities, which involves major reinforcement, expansion, and operation and maintenance of transmission and distribution lines:

7. At the end of the meeting the FSD and VRA have recognised their complementary roles for the careful management of forest reserves and the provision of cost-effective and reliable supply of electricity to the people of Ghana:

NOW THEREFORE IT IS AGREED AS FOLLOWS:

1.0 - NATURE AND EXTENT OF BUSH CLEARING AND TREE CUTTING

1.1 VRA shall inform the FSD, either through registered mail or facsimile, of any constructional activities that it intends to undertake in any forest reserve in Ghana.

1.2 VRA shall upon formal approval from the FSD, which approval shall not be unreasonably withheld, undertake line route survey for any of its proposed transmission line projects traversing through forest reserves.

1.3 The FSD shall undertake inventory of all trees that will be felled during any construction or operation and maintenance work of the VRA which passes through forest reserves.

1.4 VRA shall establish its right-of-way and access tracks for any of its proposed transmission lines traversing any of the forest reserves and advise FSD accordingly.

1.5 VRA shall make available to the FSD, a survey map of the approved right of way.

1.6 Felling of all trees in the forest reserves shall be to the specification of the VRA.

2.0 - MAINTENANCE OF RIGHT OF WAY AND ACCESS TRACKS

2.1 The VRA shall be solely responsible for carrying out periodic maintenance within the right of way and the access tracks in the forest reserves.

2.2 The VRA or its authorized representative shall give notice to the District Forest Manager, through registered mail or facsimile, of any intended routine maintenance activities within forest reserves. In the event of an emergency, notice shall be given to the District Forest Manager of the route maintenance activities as soon as practicable after they have taken place.

2.3 The FSD shall write to notify VRA by registered mail or by facsimile as soon as it is aware of any action that may affect accessibility to the right of way and access tracks.

2.4 In the event of an action by FSD that may occur under Section 2.3, FSD shall after necessary discussions and agreement with the VRA provide alternate routes to such right of way and access tracks.

2.5 VRA shall notify the FSD for the removal of any tree outside the right of way that poses danger or is likely to pose danger to the transmission line.

3.0 - PAYMENT OF REPARATION

3.1 That the FSD in consultation with the VRA shall contract a concessionaire to fell any matured economic trees within the right of way in forest reserves.

3.2 In the event of a concessionaire felling the matured economic trees, VRA shall not be responsible for paying for such trees.

3.3 That in the event of FSD's inability to contract a concessionaire to undertake the felling, VRA shall fell and pay for all matured trees, above 50 cm in diameter, within the right of way and access tracks in forest reserves at going approved Forestry Commission rates.

3.4 That the VRA shall fell and pay for all immature economic trees, between 20 to 50 cm in diameter only, within the right of way and access tracks in forest reserves at existing rates equal to the minimum size of 50 cm in diameter for the specie.

3.5 That in the event of VRA undertaking activities indicated under Section 3.3 and Section 3.4, VRA shall own the logs unless VRA directs otherwise.

3.6 That the VRA shall compensate FSD for any acquired right of way in forest reserves as may be agreed upon.

3.7 That the compensation shall be structured in such a way as to cater for any additional forest guards required to protect the forest reserves, arising out of VRA's activities.

4.0 - ENVIRONMENTAL MITIGATION PLAN

4.1 FSD shall arrange, upon approval from VRA, to employ additional forest guards to protect forest reserves if it is determined that, as a result of construction or operation and maintenance work of the VRA, there is an extraordinary increase in potential for encroachment.

4.2 FSD shall use all reasonable endeavours to ensure that activities of concessionaires do not affect VRA's operations within forest reserves.

5.0 - INFORMATION SHARING

5.1 VRA and FSD shall endeavour to share any relevant information that will help both parties to perform their functions effectively.

5.2 VRA and the FSD shall meet annually to review the implementation of the MOU.

6.0 - AMENDMENTS

6.1 This MOU may be amended upon the request by any of the parties.

6.2 In the event of any such request, the party requesting the amendment shall serve the other a written notice of the nature of the amendment.

6.3 All amendments to this memorandum shall be in writing and signed by both parties.

7.0 - FAIRNESS AND GOODFAITH

7.1 That the parties undertake to act in good faith with respect to each other's rights under this memorandum of understanding and to adopt all reasonable measures to ensure the realization of the objectives of this memorandum of understanding.

8.0 - SETTLEMENT OF DISPUTES

8.1 That the parties shall use their reasonable efforts to settle amicably all disputes arising out of or in connection with this memorandum of understanding or the interpretation thereof.

8.2 Any dispute between the parties as to matters arising pursuant to this memorandum of understanding which cannot be settled amicably within sixty (60) days after receipt by one party of the other party's request for such amicable settlement may be submitted by either party to arbitration in accordance with the Arbitration Act 1960 (Act 38).

IN WITNESS WHEREOF the parties hereto have caused this MEMORANDUM OF UNDERSTANDING to be executed the day and year first before written.

FOR AND ON BEHALF OF)
VOLTA RIVER AUTHORITY)
BY ITS CHIEF EXECUTIVE)

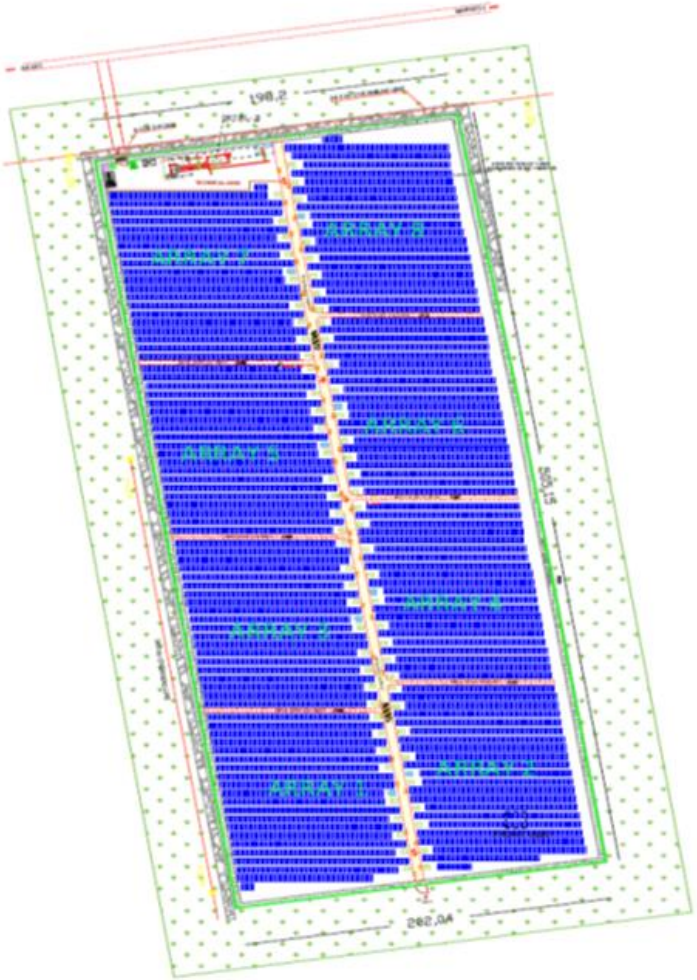
In the Presence of

FOR AND ON BEHALF OF)
FOREST SERVICES DIVISION)
BY ITS EXECUTIVE DIRECTOR)

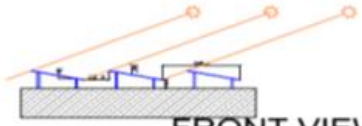
In the Presence of

APPENDIX 4:
PROJECT DESIGN DRAWINGS

RENEWABLE ENERGY DEVELOPMENT PROGRAMME (REDP)
SOLAR POWER PROJECT



ROW-TO-ROW DISTANCE



FRONT VIEW

CONTROL BUILDING

DETAIL - B

LEGEND

- PV ROW
- SUBDISTRIBUTION CABINET (INVERTERS CABINET)
- TRANSFORMER CABINET
- AUXILIARY POWER SUPPLY
- WATCHMAN HOUSE
- PV PLANT FENCE
- MV OUTDOOR SWITCHGEAR FENCE
- INTERNAL ROADS
- CABLE TRENCH
- SAFETY ZONE AROUND THE PV AREA
- PARKING AREA
- WASTE DISPOSAL
- FRESH WATER TANK
- SEPTIC TANK
- BOREHOLE - PUMP
- THERMOMETER-AMBIENT TEMPERATURE) - 1X
- THERMOMETER (MODULES TEMP.) - 2X
- LIGHTS
- PYRANOMETER (GLOBAL HORIZONTAL) - 2X
- REFERENCE CELL (INCLINED) - 2X
- ANEMOMETER - 1X
- BIG TRUCK (3m x 12m)
- SMALL TRUCK (2m x 7m)

	NAME	DATE	NOTE
REVISED			

(PRINCIPAL) CIVIL LAYOUT KALEO

VOLTA RIVER AUTHORITY
ENGINEERING SERVICES
AKUSE, GHANA

LAHMEYER INTERNATIONAL | CONSULTING ENGINEERS

	NAME	DATE
PREPARED	C. Nguyen	05.07.2013
DRAWN	C. Nguyen	05.07.2013
CHECKED	S. Pretty	05.07.2013
APPROVED	P. Rawcliffe	

SHEET SIZE: DIN A1
SUPERSEDED BY DRWG. NO.

Unit Location Plan

Scale 1 : 1,500

CAD-FILE:

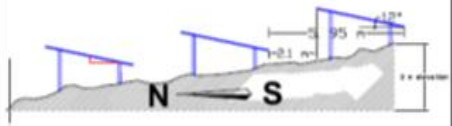
SCALE: 1:500

DRWG. NO.: LI-01

PV capacity	7,900 kWp
No of modules	28,620
Tilt angle	12 degrees

RENEWABLE ENERGY DEVELOPMENT PROGRAMME (REDP)
SOLAR POWER PROJECT

ROW TO ROW DISTANCE



DETAIL - A

CONTROL BUILDING

DETAIL - B

LEGEND

- PV ROW
- SUBDISTRIBUTION CABINET (INVERTERS CABINET)
- TRANSFORMER CABINET
- PV PLANT FENCE
- MV OUTDOOR SWITCHGEAR FENCE
- INTERNAL ROADS
- CABLE TRENCH
- AREA FOR CONSTRUCTION
- SAFETY ZONE AROUND THE PV AREA
- PARKING AREA
- WASTE DISPOSAL
- FRESH WATER TANK
- SEPTIC TANK
- BOREHOLE - PUMP
- THERMOMETER-AMBIENT TEMPERATURE) - 1X
- THERMOMETER (MODULE TEMP.) - 2X
- LIGHTS
- PYRANOMETER (GLOBAL HORIZONTAL) - 2X
- REFERENCE CELL (INCLINED) - 2X
- ANEMOMETER - 1X
- BIG TRUCK (3m x 12m)
- SMALL TRUCK (2m x 7m)

PV capacity	3,950 kWp
No of modules	14,364
Tilt angle	12 degrees

(PRINCIPAL) LAYOUT LAWRA

VOLTA RIVER AUTHORITY
ENGINEERING SERVICES
AKUSE, GHANA

LAHMEYER INTERNATIONAL

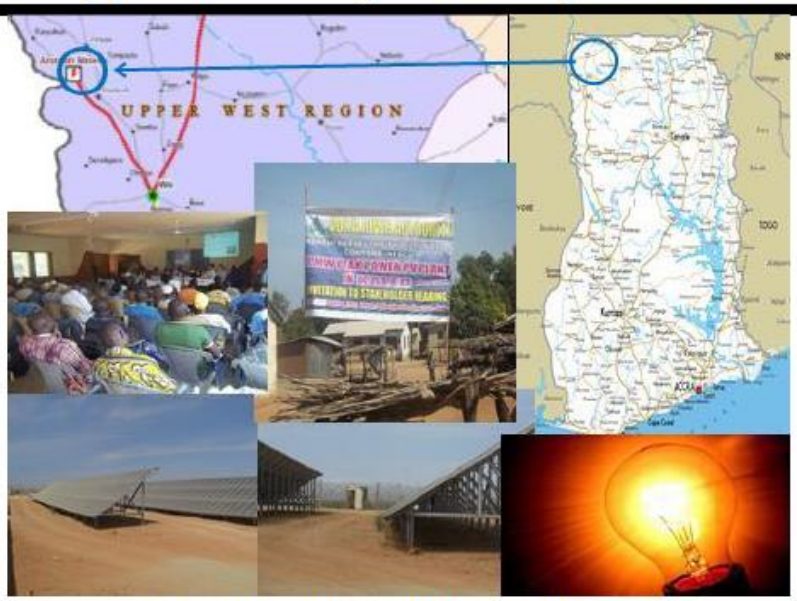
Unit Location Plan

Scale 1 : 5000

APPENDIX 5:
FLORA & FAUNAL ASSESSMENT REPORT

Solar Power Project Phase 1 (SPP1):

Upper West Regional Project Sites



Baseline Flora & Faunal Report

Prepared By

Lawra Forest District Office
Forest Services Division
P. O. Box 4
Lawra

VOLTA RIVER AUTHORITY

August 2018

EXECUTIVE SUMMARY

The Volta River Authority (VRA) in its quest to increase electricity power supply in the country is engaging in Solar Power generation to augment the existing generation capacity. They have therefore, acquired sites in Lawra and Kaleo in the Upper West Region of Ghana for the construction of a 4MV and 8MW Solar Photovoltaic Power Plants respectively.

The proposed sites for the project are in portion of the Lawra Station Forest Reserve and off-reserve areas (farmlands) in Kaleo and Lawra. The project will involve the installation of solar panels and construction of transmission lines and fauna and flora resources will be affected.

Lawra Forest District of Forest Services Division charged with the responsibility to regulate the utilization of forest and timber resources collaborated with VRA and undertook a baseline assessment of flora and fauna in the proposed project sites. Various sites were identified and named depending on the location of the site. The assessment was done in five (5) different sites namely; Lawra site, Lawra Forest Reserve, Kaleo site 1, Kaleo site 2 and Kaleo site 3.

All areas were clearly defined, and trees located inside the sites enumerated and measured at breast height for diameter determination (DBH). A total of **105** trees comprising 8 species were identified in the Lawra Station Forest Reserve. The dominant species include Leocarpus and Teak which are not endangered species. A total of **1,337** trees of 29 species were enumerated in the four (4) sites. The dominant species found in the off- reserve include dawadawa and shea nut trees.

All the four (4) sites enumerated for the proposed project in the off-reserve areas are degraded and characterized by annual bush fires, continuous farming, and animal grazing etc. This implies conversion of this areas for the proposed project will not significantly pose serious socio-economic and environmental challenges. One critical observation was that, all the sites were close to human settlement and this might have contributed to the few wildlife resources that were identified in the sites. However, domestic animals were in most instances found grazing under the trees in the sites and clearly, the interactions that existed between them cannot be under estimated.

The effect of the proposed project sites will not significantly affect the environment since the project will be carried out in a relatively small area in Lawra Station Forest Reserve and off-reserve areas in Lawra and Kaleo. The project is expected to improve socio-economic development of the catchment areas.

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APPENDIX: Results of Floral Assessment Within VRA PV Sites at Lawra and Kaleo

1. INTRODUCTION

Volta River Authority (VRA), an electricity producing company in Ghana intends to construct **4MV and 8MV** Photovoltaic (PV) plants for power project to increase electricity production to meet power demand for increasing population in the project catchment areas within Lawra and Kaleo respectively of the Upper West Region. The construction of the transmission line and other project activities will result in the felling of trees and destruction of the habitats of animals in the proposed project sites.

Lawra District Office of Forest Services Division (FSD) of the Forestry Commission charged to protect, develop and manage the country's Forest and wildlife resources within Lawra Forest District has been tasked to undertake baseline assessment of flora and fauna resources within the proposed project sites namely; Lawra Station Forest Reserve, Lawra Solar Site, Kaleo Site 1, Kaleo Site 2 and Kaleo Site 3.

The primary purpose of the assessment was to gather information on flora and fauna resources in the proposed project areas. The frequency of the occurrence, the environmental relevance as well as the level of endangered flora and fauna resources have been determined.

2. METHODOLOGY

A seven (7) member team of FSD staff comprising the District Manager, Assistant District and field staff collaborated with three (3) member staff from VRA, headed by the Manager, Environment & Social Impact, for the identification, enumeration and quantification of flora and fauna resources in the proposed project sites.

2.1 Method of Data collection

Enumeration

All the proposed sites were visited for the enumeration of flora and fauna resources in each site.

Observation

This method was used to collect information concerning the current land use of each of the sites where it was observed that most of the areas were used for animal grazing. It was also observed that almost all the sites were close to human habitation.

Interviews

This methodology was adopted to extract relevant information on the availability of wildlife resources. All identified community members were interviewed for information on available wildlife resources in the proposed project sites.

Measurement and quantification of flora.

All trees above 5 cm diameter were measured at breast height (DBH) marked and recorded. All other life forms (shrubs, herbs and grass) were quantified and recorded.

Tools and equipment's used

Measuring Tape, Diameter Tape, Cutlasses, Pens, Pencils were used

3. RESULTS AND DISCUSSIONS

3.1 Tree Enumeration

Trees and wildlife resources have been assessed in Lawra Station Forest Reserve and Off-reserve areas (Lawra and Kaleo township). A total of **One Hundred and five (105)** trees of diverse species have been enumerated in Lawra Station Forest Reserve whilst **One Thousand, three Hundred and thirty-seven (1,337)** trees of diverse species were enumerated in three (3) project sites at Kaleo and one site at Lawra. Details of the individual trees enumerated, including their environmental relevance and level of endangerment, are provided as part of the Appendix. See Plates 1 - 4 for pictures of the tree enumeration exercise.

3.2 Wildlife Resources Assessment

The under listed domestic animals were seen during the assessment;

Name	Local name	Scientific name
Cattle	Naboo	Bos Taurus
Donkey	Bonya	Eqnus asinus
Goat	Buo	Capra aegagrus hircus
Sheep	Piroo	Ovis aries
Guinea fowls	Kpeiroo	Numida meleagris
Pigs	Dobaa	Sus

Even though footprints of wild animals were seen, none was sighted during the period of the assessment. This may be due to closeness of the sites to human habitation, annual bushfires, continuous farming and animal grazing etc. Interviews by the identified community members during the assessment confirmed the presence of the wildlife listed below that are occasionally found at the site.

Scientific Name	Common name	Local Name	Family name
Ammalierus spp	Flying squirrel	Kye	Sciuridae
Eimaceus spp	Ground squirrel	Kye	Sciuridae
Python sebae	Royal python	Zip	Pythonidae
Atelerix albiventris	Hedgehog	Zaapo	Gambianus
Cricetomy gambianus	Giant rat	Dauuo	Nesomyidae
Cercopithecus patas	Patas monkey	Aglre	Cercopithecidae

Plate 1: Measuring of Tree Girth by FSD Team at Lawra PV Site

Plate 2*:* Marking of Tree by FSD Team at Lawra PV Site

Plate 3: VRA / FSD Team leaders at Kaleo PV Site

Plate 4: Tree enumeration by FSD Team at Kaleo PV Site

In addition, the following number of birds were found perching on the trees during the assessment. In an interview, community members confirmed that the said birds are also occasionally seen within the proposed sites.

Name of animal/bird	Local name	Scientific name	Number
Red wood pecker	Saakonkoliraa	Melanerpes carolins	4
Hooded crow	Galingaa	Cervus cormix	2
Rock dove	Janee	Columba livia	6
Condor	Dakyeraa	Vulture gryphus	2
Albatross	Zuiel	Phoebitria	1
Sparrow	Sylaa	Passer domesticus	5
Black vulture	Zugire	Coragyps attratus	9

3.3 Discussion

The total distance that will be covered by the transmission line is **500m**. Out of this, the transmission line will cover **150m (0.25ha)** in the Lawra Station Forest Reserve and the remaining **350m (0.58ha)** falls within Off-reserve areas. The transmission line will pass through the reserve between BP 5- BP 6. The general condition of the reserve is poor and the trees to be affected will be mainly used for firewood. A total of **One hundred and five (105)** trees comprising about eight (8) species were identified in the Lawra Station Forest Reserve. The dominant species include Leocarpus and Teak which are not endangered species.

Most of the trees enumerated are relatively small trees with average diameter of **34cm** measured at breast height. Due to annual bushfires and closeness of the reserve to human settlement, species of few wildlife resource were known based on footprints and interviews conducted during the assessment.

All the four (4) sites enumerated for the proposed project in the off-reserve areas are degraded and characterized by annual bush fires, continuous farming, and animal grazing etc. This implies conversion of this areas for the proposed project will not significantly pose serious socio-economic and environmental challenges. A total of **One Thousand Three Hundred and thirty-seven** (**1,337)** trees of diverse species were enumerated in the four (4) sites. The dominant species found in the off- reserve include dawadawa and shea nut trees. Some of the community members collects the fruits of this trees as food and for sale as a means of livelihood.

3.3.1 Socio economic impact

The installation of the solar power project will increase electricity generation capacity within the project area thereby making electricity available for socio economic development of the surrounding communities. Reliable power supply will improve; health, education, and rural industries etc. Furthermore, sustained power supply will increase employment, poverty reduction and enhance the wellbeing or livelihood of surrounding communities.

3.3.2 Environmental Impact

Even though the removal of the vegetation may slightly affect the environment in areas of carbon sequestration, soil erosion, soil fertility etc. The availability of electricity will improve sustainable use of forest resources. This will be achieved by way of reduction in the felling down of trees for charcoal production, fuel wood, among others.

4. CONCLUSION

The project will be carried out in a relatively small area in Lawra Station Forest Reserve and off-reserve areas in Lawra and Kaleo which is more or less degraded and as such trees that will be felled will not seriously affect the environment but rather improve the wellbeing of inhabitants through sustained power production for socio-economic development.

APPENDIX - Results of Flora assessment within VRA PV Sites at Lawra and Kaleo

No	NAME				Frequency					Environmental Relevance	Level of Endangered Species
	English	Local	Botanical	Family	Kaleo Plot 3	Kaleo Plot 2	Kaleo Plot 1	Lawra	Lawra Forest reserve		
1	Acacia	Acacia	*Acacia mangium*	*Fabaceae*	2	0	0	0	0	Its nitrogenous plant and helps to improve soil fertility. It is also good wood fuel	Green
2	African copaiba balsam tree	*Kakyele*	*Daniellia oliveri*	*Fabaceae*	*2*	*9*	*0*	*0*	*1*	It serves as wind break and also prevent soil erosion	*Scarlet*
3	Africa jacana	kakala	*Azflia africana*	*Leguminosae*	0	8	1	0	0	They reduce wind speed and cool the air as they lose moisture and reflect heat upwards from their leaves	Red
4	Baobab	Tuo	*Adansonia digitata*	*Malvaceae*	0	0	2	0	0	Improves soil fertility and acts as carbon sinks thereby reducing global warming.	Pink
5	Cashew	Cashew	*Anacardium occidentale*	*Anacardiaceae*	2	1	0	0	0	It serves as a means or way to stop soil erosion in coastal areas in the tropics.	Green
6	Cassia	Cassia	*Cinnamomum cassia*	*Fabaceae*	0	67	0	0	0	It is designated as an environmental weed that can affect human health or can be invasive in reducing the natural bio-diversity.	Green

No	NAME				Frequency					Environmental Relevance	Level of Endangered Species
	English	Local	Botanical	Family	Kaleo Plot 3	Kaleo Plot 2	Kaleo Plot 1	Lawra	Lawra Forest reserve		
7	Cotton	Guon	*Ceiba pentandra*	*Malvaceae*	0	5	12	0	0	It help cleanse the air by intercepting airborne particles, reducing heat, and absorbing carbon monoxide and nitrogen dioxide.	Scarlet
8	Dawadawa	Duotie	*Parkia biglobosa*	*Fabaceae*	56	72	23	38	11	Serves as wind break and improve soil fertility.	Scarlet
9	Ebony	Gaa	*Diospyros mespiliformis*	*Ebenaceae*	13	21	1	0	8	They reduce wind speed and cool the air as they lose moisture and reflect heat upwards from their leaves.	Gold
10	Gam Arabic tree	Stum	*Acacia nilotical*	*Fabaceae*	0	0	0	46	0	It serves as wind break and also prevent soil erosion	Green
11	Lannea	Sinasule	*Lannea Acida*	Anacardiaceae	0	0	0	0	11	It serves as a means or way to stop soil erosion in coastal areas in the tropics.	Green
12	Mahogany	Kog	*Khaya senegalensis*	*Meliaceae*	3	3	1	1	0	They absorb carbon dioxide as they grow and the carbon that they store in their wood helps slow the rate of global warming.	Black
13	Neem tree	Neem	*Azadirachta indica*	*Meliaceae*	19	53	18	58	0	It exhales out oxygen and keep the oxygen level in the atmosphere balanced.	Pink

No	NAME				Frequency					Environmental Relevance	Level of Endangered Species
	English	Local	Botanical	Family	Kaleo Plot 3	Kaleo Plot 2	Kaleo Plot 1	Lawra	Lawra Forest reserve		
14	Pawpaw		*Carica papaya*	*Caricaceae*	0	1	0	0	0	It's a friut tree and serve as food.	Green
15	Red berry	Sunsule	*Dichrostachya glomerata*	*Fabaceae*	16	38	2	2	0	It serves as wind break and also prevent soil erosion.	Green
16	Red-flowered silk cotton tree	Vagatie	*Bombax costatum*	*Bombacaceae*	8	47	6	0	0	They absorb carbon dioxide as they grow and the carbon that they store in their wood helps slow the rate of global warming.	Red
17	Rose wood	Liga	*Ptercarpus erinaceus*	*Fabaceae*	0	2	0	0	0	It act as carbon sinks thereby reducing global warming. As timber, medicine and wood fuel	Red
18	Sheanut tree	Tantie	*Vitellaria paradoxa*	*Sapotaceae*	94	414	85	22	0	It act as carbon sinks thereby reducing global warming.	Scarlet
19	Soapberry tree	Sansantie	*Balanites aegyptiaca*	*Balanitaceae*	0	1	0	0	0	It act as carbon sinks thereby reducing global warming.	Scarlet
20	Teak	Teak	*Tectona grandis*	*Lamiaceae*	0	2	0	0	25	It act as carbon sinks thereby reducing global warming.	Green
21	Yellow berry	Oraa	*Solanum virginianum*	*Vaccinium*	0	2	0	0	0	It serves as wind break and also prevent soil erosion.	Green

No	NAME				Frequency					Environmental Relevance	Level of Endangered Species
	English	Local	Botanical	Family	Kaleo Plot 3	Kaleo Plot 2	Kaleo Plot 1	Lawra	Lawra Forest reserve		
22	False abura	Yilla	*Mitragyna inermis*	*Rubiaceae*	0	2	0	0	0	It serves as wind break and also prevent soil erosion. Good for wood fuel	Green
23	Ficus	Kankanpla	*Ficus capensis*	*Moraceae*	0	2	0	0	0	It serves as a means or way to stop soil erosion in coastal areas in the tropics.	Green
24	Ficus	Kankanga	*Ficus microcarpa*	*Moraceae*	1	2	0	0	0	They absorb carbon dioxide as they grow and the carbon that they store in their wood helps slow the rate of global warming.	Green
25	Blood plum	Zimbrima	*Haematosta phis barteri*	*Anacardiaceae*		5	0	0	0	It acts as carbon sinks thereby reducing global warming.	Green
26	Unknown	Saalzie	*Unknown*			1	0	0	0	It act as carbon sinks thereby reducing global warming.	Green
27	Tamarindus	Puretie	*Tamarindus indica*	*Fabaceae indigenous*	2	5	2	0	0	It serves as wind break and also prevent soil erosion	Green
28	Frankincense tree	Pianwogu	*Boswellia dalzielli*	*Burseraceae*	10	0	0	0	0	They absorb carbon dioxide as they grow and the carbon that they store in their wood helps slow the rate of global warming.	Green

No	NAME				Frequency					Environmental Relevance	Level of Endangered Species
	English	Local	Botanical	Family	Kaleo Plot 3	Kaleo Plot 2	Kaleo Plot 1	Lawra	Lawra Forest reserve		
29	Anogeissus	Sitre	*Anogeissus Leiocarpus*	*Combretaceae*	0	0	0	0	46	It serves as wind break and also prevent soil erosion. Good for wood fuel	Green
30	Gardenia	Dazugu	Gardenia aqualla	Rubiaceae	0	0	0	0	2	It serves as wind break and also prevent soil erosion. Good for wood fuel	Green
31	*Unknown*	Sansah	*Unknown*	*Unknown*	0	0	0	0	1	It serves as wind break and also prevent soil erosion. Good for wood fuel	Green
32	Wattles	Goozie	*Acacia dudge*	*Mimosoideae*	0	0	0	26	0	They reduce wind speed and cool the air as they lose moisture and reflect heat upwards from their leaves	Green
TOTAL					**228**	**763**	**153**	**193**	**105**		

Star system of genetics (Appendix)

Black: Rare international and uncommon in Ghana. Highly protected.

Gold: Fairly rare both international and/or Ghana. Highly protected.

Blue: Widespread internationally but rare in Ghana or vice versa.

Scarlet: Common, but under high pressure from over exploitation, strict control and annual allowable cut.

Red: Common, but tend to be over exploited, restriction needed. Level of cut (100-200) % of AAC.

Pink: Utilizable, but not as popular to the trade present cut below AAC.

Green: No particular conservation concern.

APPENDIX 6:
LIST OF PERSONS CONSULTED DURING STAKEHOLDER ENGAGEMENTS

Kaleo

NAME OF PROJECT:..

Name of Community:..District:..Region:...................................

Date:...Time:..Venue...................................

	Name of Person	Job Title	Organization	Email	Mobile No.	Sex		Age Group		
						M	F	<30	30-49	>50
1	Bro Aaron	Teacher	ST Basilids	aaron.neeem	0540806648	✓		✓		
2	Musa Bipuah	PRO	RCC		0244594674	✓				✓
3	Sakegu Alex	Kaleo			0247638761	✓			✓	
4	Fusaini B	Kaleo			0547966055	✓			✓	
5	Mauria Duuto	Kaleo			0276961199	✓				✓
6	charles	Kaleo				✓				✓
7	Moses Bawa	chusu nuf			0545066655	✓			✓	
8	Akukari Carter	Buu			0242615847	✓			✓	
9	YENLI A. NATIHANI	Assembly member Tangasia E/A	Tangasia E/A	yenlinash@gchm.com	0208707352	✓			✓	
10										
	TOTAL									

Kaleo

NAME OF PROJECT:..

Name of Community:..District:..Region:...................................

Date:...Time:..Venue...................................

	Name of Person	Job Title	Organization	Email	Mobile No.	Sex		Age Group		
						M	F	<30	30-49	>50
1	Patrick Doumed		N.H.I.S		0247123411	✓			✓	
2	Samuel Yenduu		G.E.S.		0548484813	✓				✓
3	cletus Konbuny		M plantion		0549122811	✓				✓
4	Edward Bagniba		M Plantion		0249801770	✓				✓
5	Sylvanus Baline		Kalsegra		0275659975	✓		✓		
6	JOHN SORINOE		Kalsegra		0274530691	✓		✓		
7	margaret Tuorong		Kalsegra				✓			✓
8	Bagom Prosper	Teacher	G.E.S		0546132255	✓			✓	
9	Jacob Bagya		Kaleo			✓			✓	
10	Songliedong Shanta	Motor Rider	Daffiama		0246697738	✓			✓	
	TOTAL									

[illegible]

NAME OF PROJECT:..

Name of Community:..District:..Region:....................................

Date:..Time:..Venue....................................

	Name of Person	Job Title	Organization	Email	Mobile No.	Sex		Age Group		
						M	F	<30	30-49	>50
1	Paul Wa na		RCC		024338335	✓			✓	
2	JUSTICE A. LAMPSON		ASSEMBLY MEMBER(JANG)		0244846789	✓			✓	
3	SEIDU MOGTARI		CHIEF IMAM'S REP		054650[illegible]	✓			✓	
4	FABIAN BEZEL	TEACHER	KALEO		0248234852	✓			✓	
5	Rawlings Owusu	Supply Officer	Nadowli. D.HA		024375339	✓			✓	
6	Gordon [illegible]	DRIVER	V.RH		020[illegible]3394	✓			✓	
7	ESI		BUU				F			✓
8	Bunmaabo Libariele		Saa/Sapiin			✓				✓
9	Yaw Sang-aba		Saan/Sampina			✓			✓	
10	Alfred Sunkari		Buu		024569558	✓			✓	
	TOTAL									

Kaleo

NAME OF PROJECT:..

Name of Community:..District:..Region:....................................

Date:..Time:..Venue....................................

Page | 1

	Name of Person	Job Title	Organization	Email	Mobile No.	Sex		Age Group		
						M	F	<30	30-49	>50
1	Buona Tanyuu		Buu			✓				✓
2	Adumu Kapari		Buu			✓				✓
3	Blandina Domapielle		Kaleo		0245077384					✓
4	Alh. Issaka Salifu	Reg. Min.	R.CC		0244675885					✓
5	Adams Wahid	Assist. Director	R.C.C.	[illegible]@yahoo.com	020539[illegible]12	✓				
6	Mamuda		Kaleo				✓		✓	
7	Nicholas Moraah		Kaleo			✓			✓	
8	Angzinbiri ~~Andrews~~ Cletus		Kaleo			✓			✓	
9	PHILIP BALEGHA	DDP (RTD	PRISONS		02445761[illegible]	✓			✓	
10	Razak Abdulai		RCC		0243758168	✓		✓		
	TOTAL									

Kalec

NAME OF PROJECT:.....

Name of Community:.....District: Kalec.....Region: U. W.....

Date: 19-01-18.....Time:.....Venue: Vocational.....

	Name of Person	Job Title	Organization	Email	Mobile No.	Sex		Age Group		
						M	F	<30	30-49	>50
1	[illegible]		Kalec		024[illegible]	✓				✓
2	[illegible]	ACC	VRA [illegible]	[illegible]	[illegible]		✓		✓	
3	HON NANGWELLE V. JUS	ASSEMBLYMAN	KALSFCRA	[illegible]	0249[illegible]3926	✓			✓	
4	MOSES A.	Kalec	Kalec			✓				✓
5	[illegible]	SEC	VRA [illegible]	[illegible]	02447 .1292		✓	✓		
6	Seidu Adams	Kalec (Sub chief)	Sub. chief		0243531918	✓				✓
7	E.A. Tendam	Kalec	Sub chief		0243833503	✓				✓
8	Paul Y Adams	D.D.E	G.E.S.		0242665795	✓				✓
9	Pictan Ziem	GES	G.E.S		0207495[illegible]				✓	
10	Bayari Jane Frances	Teaching	GES		0248538678		F			✓
	TOTAL									

KALEO

Kaleo, 19 January 2012
PARTICIPANTS LIST

No	Name	Sex	Title & Institutions	Address
1	GERVASE DAKURAH	M	MANAGER NHIS, NADOWLI	NADOWLI
2	THOMAS [illegible]	M	KALEO	KALEO
3	F.K. Nandy	M	Kaleo	Kaleo Gorogyiri
4	Bigra Amatus	M	Kaleo	Kaleo St. Basilides
5	Hon Yendu Eugene	M	Ombo E/A	Box 346 Kaleo SHS
6	E.K. [illegible]	M	V.R.A	0244567577
7	Ernest [illegible]	M	V.R.A	0243735116
8	Abu Cecilia	F	Kaahaa	0269352991
9	Susana Saamaya	F	Kaleo	0547073134
10	Chris Nyaho	M	[illegible]	0392022198
11	William Bosing	M	GES	0243716728
12	Grace Baba	M	V.R.A	0242557442
13	Kuuleyi Augustine	M	Charikpong	0241760183
14	Kpazlunga	M	Kalogroo (Rep)	0247479984
15	Hikha Simon Mohamed	M	Kaleo Na. Rep	0247526171
16	Gaanaah Emilo	M	Kaleo	0245687924
17	Joseph K. Mahah	M	Kaleo	0261955001
18	Jonathan Sobng	M	Kaleo	0246160932

KALEO

No	Name	Sex	Title & Institutions	Address
19	Grace Bonowin	F	Kaleo	0246712625
20	Georgitta	F	Kaleo	Kaleo
21	Hon. K.M. Lucas	M	Charikpong cwt	0228915362
22	Beatrice Kyane	F	Yiziri	Yiziri
23	Yoghefi Nag [illegible]	M	Yusiri Naa	0241728100
24	B. Kenneth	M	Kaleo	0242680718
25	Liemba	M	Kaleo	0247485927
26	Samsone	M	Kaleo	Kaleo
27	Ignatius Areker	M	[illegible]	0207351673
28	Dieduo Timothy	M	Dater	0267393605
29	Pauline	F	Kaleo	Kaleo
30	Mensah	M	Kaleo	Kaleo
31	Angelo	M	Kaleo	Kaleo
32	Desech Mumuni	M	Kaleo	0540588366
33	Jenis [illegible]	M	Kaleo	0240774058
34	John Bosco Bakuke	M	Station Sup VRA	0208234136
35	Andrews Tellah	M	Kaleo	Kaleo
36	Patil Sauke	M	Kaleo	Kaleo
37	Hamidu Ahkeelu	M	VRA MM	0207440116

Volta River Authority

CDM Local Stakeholder Hearing
Participants List

LAHMEYER INTERNATIONAL
Kaleo PV Plant

No	Name	Sex	Title & Institutions	Address
38	Festus Sapaty	M	ST-E – VRA	Nadowli
39	Lazard Wasiu	M	MINT – VRA	Nadowli
40	Nagumo Thomas more	M	Asst. MM T	Nadowli
41	Dacinoe Romuo	M	Kaleo	Kaleo
42	A. S. Awuitei	M	Kaleo	Kaleo
43	Hon. Awuitey Erug	M	Kaleo	Kaleo
44	Karima Vitalis	M	Kaleo	0245277552
45	Bawulyi ...	M	Kaleo	0249224636
46	Yafegaja	M	Kaleo	0207673926
47	Crescentia S	F	Kaleo	0246766644
48	Baba Mao	M	Kaleo	0242684996
49	Alhaji Sam	M	VRA - NEDCo	0208412593
50	Abudu Peter	M	Kaleo	0247439371
51	S.H. Callistus	M	Loho	0244948690
52	Yahaya Mohamed	M	Social Welfare Nad	0261677237
53	Dakurah Elizabeth	F	Social Welfare Nad	0209517184
54	Kuubelerxie	M	YKA – WA	0205880288
55	Tengenaa	F	Kaleo	Kaleo
56	Hon. Amporah	M	NCCE	Nadowli

Volta River Authority

CDM Local Stakeholder Hearing
Participants List

LAHMEYER INTERNATIONAL
Kaleo PV Plant

No	Name	Sex	Title & Institutions	Address
57	Matthew the...	M	Charisambo	Charisambo
58	Dapia K	M	Biiree	Biiree
59	Anuoka J	M	Kaleo	0241668919
60	Dembere D	M	Lecho	Lecho
61	Simon... Y	M	Lecho	Lecho
62	Hon. Ebenezer	M	Sombaua	0242635208
63	Kaza Gbiri	M	Kaleo	0208401234
64	Alfred B	M	Kaleo	0245233524
65	Cristo ...	M	Kaleo	0240829577
66	Gilbert B. D.	M	Ombo	0240070536
67	Peter B. Agange	M	VRA / NEDCo	0246241955
68	...ce Toay	M	Kaleo	0541634795 Kaleo
69	Joseph X	M	Nadow	0207631442
70	Adam Saadu	M	Kaleo	Kaleo
71	Bongaa G	M	Kaleo	Kaleo
72	Musah T.	M	Ombo	
73	Philip Tanibe	M	Queen of Peace SHS	0243821664
74	Kpan A Mitchel	M	Rep. KASHTS	0248992048/0262234462
75	Mohammed Califa	M	Nadowli / MOFA	0243660749

Volta River Authority

CDM Local Stakeholder Hearing
Participants List

LAHMEYER INTERNATIONAL

Kaleo PV Plant

No	Name	Sex	Title & Institutions	Address
76	James N. Gulma	M	Ass/ Kunu	Box 42 Nadowli
77	Dagbale Sylvester	M	AS/ Dambo	Box 5 Nadowli
78	Romanus Kaninde	M	ASS/ Gbanko	0244474148 0205415488
79	Joseph Kuubeter	M	Rep - Alemadayo	Box 252 Wa
80	Fidelis Adam	M	Kaahee	[illegible]
81	Hon Sumbo John	M	Baffiama south AS	Baffiama Box 33 0540531077
82	Bong-ukong Samuel	M	Baffiama North AS	Baffiama Box 33 0271531601
83	Dongyere Eric	M	Dueong West	Dueong [illegible]
84	Deriu Noah	M	Dueong West	Dueong 0542924624
85	Augustina Pam		Kaleo	Kaleo
86	Yaba Faguni	F	Kaleo	0540879101
87	Lauren B.	M	St- Basilide's	0245277433
88	Tangzie Francis	M	St. Basilide's (Kaleo)	0243137687
89	Rose Dassah	F	Kaleo	Kaleo
90	Braimah Moha	M	Chaalo	0245007741

Date:

Name of community: Lawra

Name	Position/Title	Telephone	Signature
Kungunb Paul Dery	Unit committee Dowine	0207079025	[signature]
Naporese Thomas	Bagri	0237613216	[signature]
Peter Pedu	Tabier	0209949296	
Peregrine	Lawra	0207172522	[signature]
Biligu S. Enoch	Dis. Soc. Welf. Off	0201226614	[signature]
Hon Bauthu [illegible]	[illegible] / Chairman [illegible]	0246872168	[signature]
Abubakar Saady Bawa	Lawra	0549285273	[signature]
Kultaa Jeremiah	Youth President	0202407995	[signature]
Zizug Sumbla	Area Engineer, WL	0207665383	[signature]
Denis B. Dery	Retired Education	0205559444	[signature]
Amoe P. Kumbane	SI	0209116297	[signature]
Adam K. Saeed	NDFO	0208722118	[signature]
Samira Ahad	Sur Estate Mist.	0244471272	[signature]
Hajia A. Bintu	Lawra Zongo	0208396910	[signature]
John	Birifu	0248595240	
Silvia	Babile	0269206898	
Suvereign	Brewing	0241523178	
Winifer	Babile	0240381137	
Dada	Eremon	0240380678	
Haab Richard	Zambo Area Council	0247434037	[signature]
Hon Anyesomo Jonasco	Hon	0201977977	[signature]
Laan K Isaac	Accounts Clerk	0207575188	[signature]

Date:

Name of community:

Name	Position/Title	Telephone	Signature
Rebecca Akua Sabri	Dist Coord - NFED	0208986347	[signature]
Hon. Dege .S. Simon	Assembly man	0205184652	[signature]
Boge Benarta	Chief	0202858163	
Rita A. Nyorka	NBSSI	0243245835	[signature]
Damian Tampuri	MOFA/Dist. Vet. Officer	0205525702	[signature]
Alex Gold	D. A.	0245325833	[signature]
Asure Benjamin	LDH (Procurement officer)	0243952192	[signature]
Emest Nyahe	Zonal VRA	0203735116	[signature]
Anthony K. Bandong	Former M.P.	054 273512	[signature]
Mennah Emmanuel	Teacher	0204211711	[signature]
Niber Eric	LDA	0206764998	[signature]
TAHIRU A. ISSAHAKU	Zoomlion Ghana Ltd	0209250850	[signature]
YAKubu IDDRISU.	Lawra	0208541378	[signature]
Yussif Abubakar	Lawra	0209258016	[signature]
Nyuwiir Abassaa	Technician LDA	0208909143	[signature]

Lawra

Date:

Name of community:

Name	Position/Title	Telephone	Signature
FELIX S. SIBIRI	HEADMASTER	0248601917	
NAA BOLE NYAAH	NAA	0547848766	
Mathias	Lawra	0201556745	
Hon. Justice G. Gaanu	Assembly man	0208932222	[signature]
Naa Puowele Karbo III	Lawra Naa		
Pugyaa Pornaayel	Boguraa		
Alhaji Nyore Karbo	Lawra		
Regent Charles Karbo	Lawra	020 8396166	
Augustine Karbo	Lawra		
Sonia Karbo	Lawra		
Hon Joseph D. Halach	Zambo Kpee	0208914526	[signature]
ALFRED SOGSUO	Lawra youth club	0203837105	
LAARIDUO KUU-bona	Bagri Naa	0209831479	
Naanyo Joseph	Kuworibo Naa	0204168536	[signature]
E.K. Puriel	Headmaster	0244497270	[signature]
Yiremah	Sanbo		
Naanwige	Zambo		
Banyekane	Kazeve	0240776396	
Alex Kyaavuure	Kalsagri	0202859894	
Dome	Kalsagri		
Ernestina Gaanu	Lawra Zinkaa	020-5134291	[signature]
Hon Yuori Samphor	Zinkaa E/A	0208373440	[signature]

Lawra, 20 January 2012
PARTICIPANTS LIST

No	Name	Sex	Title & Institutions	Address
1	Pognaa Lawra	F	Pognaa Elect Lawra	Box 19 Lawra
2	John Kambi	M	Dowine Secs Chair	C/O Dowine Parish
3	[illegible]	M	Dowine	C/O Dowine Parish
4	Hon [illegible] Dowine	M	Dowine E/A	0208390233 C/O Dowine Parish
5	Hon Emmanuel Tingan	M	Nmuyiborg Eremon	c/o Eremon SH. Sch
6	[illegible]	M	Dept Feeder Roads	Box 33
7	[illegible]	M	Engr. V.R.A	Box 77 Tamale
8	Elvis Asmuyeller	M	Engr. [illegible]	Box 77 Tamale
9	Agnes Ziem	F	Pognaa Chungko	Box 166 Lawra
10	[illegible] Stephen	M	Dept of Cooperative	Box 65 Lawra (LD)
11	[illegible]	M	[illegible] Church	Box 21 Lawra
12	R.M. [illegible]	M	Nangaare	Box [illegible]
13	Hon [illegible]	M	[illegible] E/A	0240 572360
14	[illegible] Abel	M	Lawra Youth Sec	0209 15663
15	[illegible]	M	[illegible] Pognaa	020 8532168
16	Isaac Deriy	M	L.D.A	0266965419
17	Abdulai	M	L.D.A	020 7661265
18	Vida Dakura K	F	Nadowli	0207094817

No	Name	Sex	Title & Institutions	Address
57	A.K. Dekhize	M		0208373409
58	Hon Karbo Gertrude	F	Naagangn E/A	0208538157
59	Hon Aq-[illegible]	M	Tangzuor E/A	0208573288
60	Macah Valentine	M	[illegible] E/A	0267759640
61	Hon Fooaku Eric	M	Yagtuolle E/A	0245 193058
62	Fiawaye Boaz	M	Lawra	020896[illegible]
63	[illegible]	M	GIS	[illegible]
64	Kojo Quansie	—	BNI	0244405577
65	[illegible] A	M	Nabaanye E/A	0207258565
66	Varyi Martin	M	Lawra	0207528857
67	Clifford Atinga	M	DCD / LGA	0206421307
68	Kamil Issilaku	M	CIC / LDA	020 7234371
69	[illegible]	M	Zeenlion Gh. Ltd	0249257071
70	[illegible]	M	Piiayere	0209112057
71	[illegible]	M	Kaabe Tankua	0246941466
72	[illegible]	M	Kuoli Lawra	0209119704
73	B. John Bosco	M	Registrar-LTC	0209249971
74	[illegible] J.P.	M	Lawra	0205273755
75	[illegible]	M	Lawra	0245398457

No	Name	Sex	Title & Institutions	Address
38	Rabita M.	F	FOMWAG	0209211718
39	Fred Zinanta	M	N. C C E	0209061076
40	[illegible] J. Tiere	M	G.N.F.S	0209167786
41	[illegible] E. Nyone	F	GNFS	0244252665
42	Naazir	M	Alrizaaw	0246148617
43	Deribien	M	Laar	0246101767
44	Naa [illegible] III	M	Kunyukuo Chief	0209410242
45	[illegible]	M	Kunyukuo Chief elder	
46	Hon. Bongbuor A Amatie	m.	Sanghanzara foundation (sdf)	0248940736.
47	[illegible] Gandaa	M	Lawra DMF&15	0208541323
48	Adolph [illegible]	M	[illegible]	[illegible]
49	[illegible]	F	[illegible]	
50	[illegible]	F	[illegible]	
51	Azun[illegible]	F	[illegible]	
52	Edward [illegible]	M	[illegible] work's	0248950685
53	Dixon Nyaaw[illegible]	M	SSoni	0244785263
54	[illegible]	M	Korope	
55	Kader Vitus	M	Babile	0245778237
56	Nibe Yaayini	M	Tuneyiri	

Volta River Authority
CDM Local Stakeholder Hearing
Participants List
LAHMEYER INTERNATIONAL
Lawra PV Plant

No	Name	Sex	Title & Institutions	Address
19	Wononuo W	M	Pesioner	P O Box 65
20	Saabom Sebasta	M	Tabier Naa	Tabier Palace
21	[illegible]	M	[illegible]	[illegible]
22	Naa Ayuga Alfa	M	Gbani Naa	[illegible]
23	[illegible]	M	Kasali	[illegible]
24	Paul N. Tang	M	Farmer	0204229712.
25	[illegible]	M	Baazeri	Nil
26	[illegible]	M	Toyore	Toyore
27	Justina D	F	Lyssah	—
28	Maximian	M	Lyssah/Bagri	0542416542
29	[illegible]	F	[illegible]	[illegible]
30	Catsiah	F	Kasali	Kasali
31	Isidore	M	Lissa	0206965765
32	Nyuotoh Richard	M	Babile	0542419984
33	Christopher Z	M	[illegible] Naa	0207372237
34	[illegible]	M	Dazuuri	0246731521
35	Kuubeterzie	M	VRA - Wa	0205880288
36	Mary Assumpta	F	Gender Office	0202373273
37	Bambara [illegible]	M	Gov Health office	0242709194

Volta River Authority

CDM Local Stakeholder Hearing
Participants List

LAHMEYER INTERNATIONAL
Lawra PV Plant

No	Name	Sex	Title & Institutions	Address
76	Dary Janet	F	Zambo Pognaa	Zambo
77	Gyasan Archer	M	Accl, LDA	LDA, Box 23, Lawra
78	Isaac Bachuyela	M	VRA/NEDCo	Lawra
79	Henry Adoban	M	Lawra/NED	0201661622
80	Francis Nigier	M	Bagri E/A	0209122368
81	Avictuame	M	Kasaozuma	0204508881
82	Bandazo Assi	M	Kalsagri/Toal	0204921873
83	Amorin Kagree	M	Nakbayenee	0209914105
84	Kanbata Gerty	F	NISSST	0207436851
85	Aloysia Kyelegay	F	LTC	0207798155
86	Soriate Sebastian	M	Assemblyman Kuntukpu E/A	020717196
87	Amos Gyeltue	M	Assemblyman	0205984071
88	Abu Ahmed	M	VRA	0202896024
89	E K Mi...	M	VRA	0244367577
90	Assibi Peter	M	Assemblyman Yikpee E/A	0204072835

Date:
Name of community:

Name	Position/Title	Telephone	Signature
George Pirel	Headmaster, Birifol	0540532061	[signature]
Bagmiel Isaac Gyimi	Tax Administr	0275559063	[signature]
Stephen J. Maane	Lawra water	0205095732	[signature]
Augustine Sucrintome	Tolibri	[illegible]	
Cynthia Anku	Lawra	0209249558	[signature]
Elizabeth Balagyfaa	Lawra	0207413549	[signature]
Quarshie Eric Kofi	Lawra	0248526668	[signature]
Sarah Hilda	Lawra District Assembly	0207881830	[signature]
DAVID YAKUBU	Chief Director	0208413199	
Musa Bipuah		0244594074	[signature]
Christopher Nawaan	Service Personnel	0206595947	
Hanoi David	Lawra	0209663903	
Tertoh Banding	Service Personel	0242626174	
Rebecca Karbo	womens Leader	0205981078	
Hon. Botee. B. Sampson	Kalsagri E/A	020829398	
mary clare	CHR	0205956599	
Basilida Babasigna	FSD	020559121?	
Brit Zumia	Brew for Naa		
Harku Mwinboro	Unit Committee	0246326833	[signature]
Geoffrey W. Tuu	Assemblyman-Baapal	024-8762936	[signature]
Elizabeth Dare	Toyini [illegible] Queen		
Rogation T. Bayuo	Catechist (Babile)	0241752477	

Public Hearing for 8MW Solar Project in Kaleo

Date: November 2, 2017

Attendance Sheet

	Name	Conntact	Signature
1	Salifu B. Kanton	0207108448	[illegible]
2	Hon Kate Laankana	0207444484	[illegible]
3	Fabian Aberinga	0501301738	[illegible]
4	Nagumo Thomas more	0209249550	[illegible]
5	Debpuur Jacob	0200618545	[illegible]
6	NUMBO Isaac	0543112536	Thumbprint
7	Christopher Nang-bayi	0248141644	[illegible]
8	Pascal Dibaro	024854018[illegible]	[illegible]
9	Fuseini Bannaguraim	020760145[illegible]	[illegible]
10	Festus Sapaty	0208767254	[illegible]
11	Gaanaah Emilio	0248609924	[illegible]
12	Karbo S. Bruno	0208914251	[illegible]
13	Baata Victor	0205171941	[illegible]
14	Mwinibankour Kawane	0553691411	[illegible]
15	Adama Amoru Nuhu	0246987565	[illegible]
16	TOFIK SHAIBU	0546905584	[illegible]
17	John Paticha Badigu	0545131214	[illegible]
18	Damian Kputsra	0542076141	[illegible]
19	Yengah Elijah	0541106371	[illegible]
20	Jatoe Frederick	0244077829	[illegible]
21	Naah moses	0249041125	[illegible]
22	Lfm Ragbin. Z. Jonathan	0243806763	[illegible]
23	Baffu Blankson	0200366511	[illegible]
24	Tampellu Gilbert	0209708673	[illegible]
25	Salim mohanmed	0246007180	[illegible]
26	CHIA JUSTINE	0540534586	[illegible]
27	Peter Dumba	0247485929	[illegible]
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TUTORS OF VOCATIONAL SCHOOL.

Public Hearing for 8MW Solar Project in Kaleo

Date: November 2, 2017

Attendance Sheet

	Name	Conntact	Signature
1	Simon Zaabaun	0207880049	[signature]
2	SIDIK MAJEED	0244696418	[signature]
3	DERY Jotai EVANS	0245306962	[signature]
4	BANYE MARK	0241127042	[signature]
5	Raymond K-Bazaare	0201847999	[signature]
6	Gyiele B Vitus	0241970880	[signature]
7	Imoru Abdul-AZIZ	0209988769	[signature]
8	Yelbourne Richard	0207222744	[signature]
9	Nkotia-Amoah Francis	0248585828	[signature]
10	Nankwah Felicia	0247180844	[signature]
11	Ealle Adelis	0542086155	[signature]
12	Andaana Idrisu	0244810698	[signature]
13	Anjecah 'K' Emmanuel	0240774009	[signature]
14	Dauda Sam Wajaal	0241618488	[signature]
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Public Hearing for 8MW Solar Project in Kaleo

Date: November 2, 2017

Attendance Sheet

	Name	Conntact	Signature
1	Jonathan Sabogu	0246160753	[signature]
2	Stephen Mwinnoa	–	[signature]
3	ISSAH TANDAICANNO	0246742536	–
4	Abasaana Thadimil	0240737158	[signature]
5	Sunsuuya Joshua	0247185856	[signature]
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Public Hearing for 8MW Solar Project in Kaleo
Date: November 2, 2017
Attendance Sheet

	Name	Conntact	Signature
1	Kuubata Michael	0248378456	
2	Akaama Mohammed	0545648555	
3	Banye Bright	0502117827	
4	Dibbra Aiden	0247589525	
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Public Hearing for 4MW Solar Project in Lawra
Date: November 3, 2017
Attendance Sheet

	Name	Conntact	Signature
1	Alex Gala	0245325833	[signature]
2	Sowley Alfred Sasah	0206385087	[signature]
3	Joseph Dapong Pupah	0208611285	[signature]
4	George Lunni	0247953631	[signature]
5	Philip Bagyo	0208418558	[signature]
6	Emmanuel Lignule	0501301737	[signature]
7	MUO-IRE B. RAYMOND	0209941005	[signature]
8	Bedi John Bosco	0208390940	[signature]
9	E.K. Xavier	0244497270	[signature]
10	Kumbala Comfort	0207636351	[signature]
11	Yelbubra Kumbio	0206068659	[signature]
12	AMINI FUSEINI	0209168317	[signature]
13	Dery Murnuru	0207372522	[signature]
14	Issahaku Kaanil	0208234891	[signature]
15	Kuugon Muori-ini Tony	0205095958	[signature]
16	Kogyiri Caroline	0503778294	[signature]
17	Yagsenta Yatuuri Pognaa.		
18	Abu Ahmed-J	0208396021	[signature]
19	Bosuuro Ernestina	0207310661	[signature]
20	Abudulai Ibrahim	020 9064065	[signature]
21	Augustine Kyille	0544499379	[signature]
22	Faawa Kwesi	020-5380720	[signature]
23	Anyikuri Angitey	0	[signature]
24	James Naabu	0202300007	[signature]
25	Pakah Joseph	0507447027	[signature]
26	Beniman Aabeele.	0205146678	[signature]
27	Gaanu Ernestina		
28	Latuur Bang-ire	020 2625289	[signature]
29	Naasol Mary	0505765508	[signature]
30	Sanghun Prick Alex	0209280793	[signature]
31	Nyetong Bang-ib Mark	0204847091	[signature]
32	Kogyiri Peter	0205106688	[signature]
33	Dari Kalistus Songbaye	0203637179	[signature]
34	Alexis Kuuridong	0203990849	[signature]
35	Hakim Yussif	0208161620	[signature]
36	Wullu N-Yong Henry	0205779233	[signature]

WATER RESOURCES COMMISSION

Registered Office/Courier Address
No. E4 Leshie Crescent
Labone Estates
Accra-Ghana

Postal Address
P.O. Box CT 5630
Cantonments
Accra-Ghana

Our Ref: WRC/VRA/V1/125

Date: March 04 2019

Your Ref:

March 04, 2019

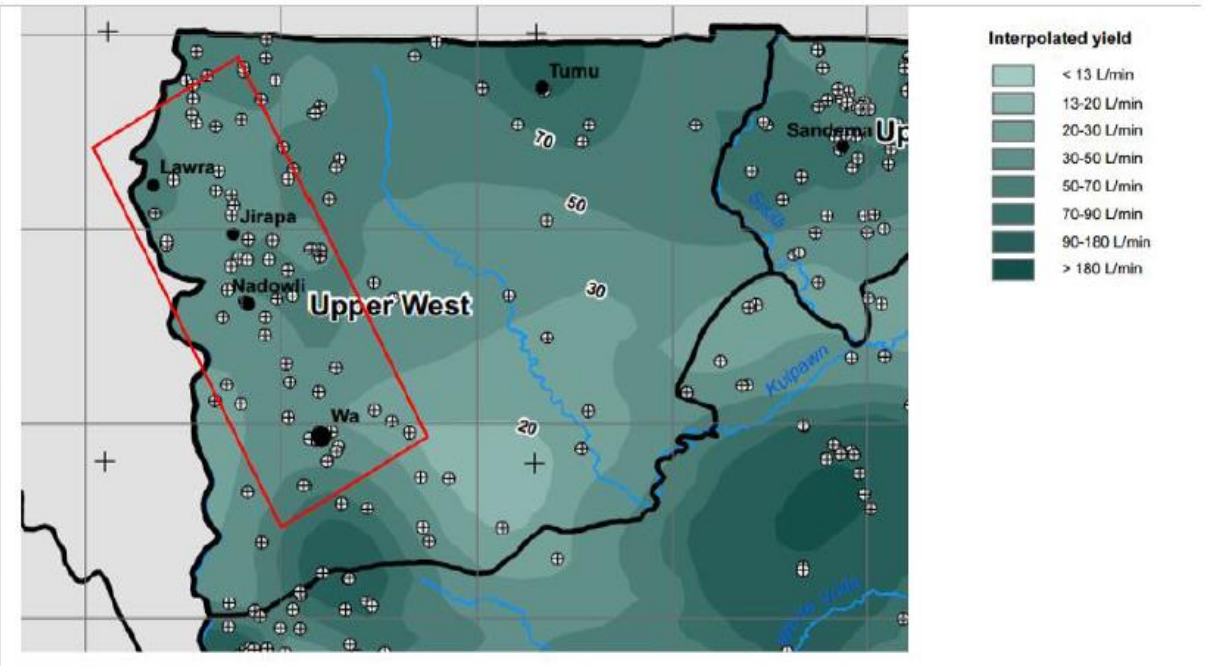
The Chief Executive
Volta River Authority
Electro-Volta House
P.O. Box MB.77
Accra

Dear Sir,

RESULTS OF THE ASSESSMENT OF THE POSSIBLE RISKS TO WATER SECURITY FOR THE CLEANING OF THE SOLAR PANELS AND THE IMPACTS ON THE DRINKING WATER SUPPLY SITUATION TO THE VILLAGES IN KALEO AND LAWRA AREAS

We write to submit the results of your institution's request to assess the possible risks to water security for the cleaning of the solar panels and the impacts on the drinking water supply situation to the villages in Kaleo and Lawra areas as follows:

1. The Lawra and Kaleo area is underlain by rocks of the Birimian and intrusive Granitoids. The predominant geology of the area is composed of various composition of granites.
2. Productive zones of groundwater in the area are located within the saprolite (weathered zones) or fracture zones of the bedrock.
3. Average borehole yield is about **53.3 L/min (3.2 m^3/hour)** (HAP, 2011). Therefore, this yield can satisfy or meet the estimated volume of water demand of the company for wet cleaning of solar panels **(19.5 m^3/year to 84.5 m^3/year).**
4. The abstraction rates will not have any negative stress on the aquifer. However, detailed **hydrogeological and geophysical investigations** should be employed to locate extensive fracture zones to increase the chances of drilling success and higher-yielding boreholes to meet demand.
5. Moreover, the abstraction rates will have no negative impact on the drinking water supply to the community at Kaleo and Lawra.



Interpolated borehole yield map with area of interest located within red margin. This map only provides an overview of the regional trends in borehole yield and is therefore not accurate at local scale (HAP, 2011).

Do not hesitate to revert to the undersigned should you require any clarification or further information on the matter,

Yours faithfully,

Ben Ampomah
Executive Secretary

cc: Director Engineering Services Department
Volta River Authority
Electro-Volta House
P.O. Box MB 77
Accra.

Tel: 233-0302-763651/765860 Fax: 233-0302-763649
Email: watrecom@wrc-gh.org Website: www.wrc-gh.org
GhanaPost Digital Address: GL-013-5504

APPENDIX 7:
COPIES OF THE PROJECT PUBLIC DISCLOSURE NOTICES

PUBLIC HEARING NOTICE

10MW NORTHERN SOLAR POWER PROJECT CLEAN DEVELOPMENT MECHANISM (CDM)

INVITATION FOR LOCAL STAKEHOLDER HEARING – NAVRONGO, KALEO, LAWRA AND JIRAPA

The Volta River Authority (VRA) is in the process of implementation of a photovoltaic (PV) plant in four communities in Northern Ghana named above. These PV plants shall harness the renewable resource of solar energy to generate electricity without the utilisation of fossil fuels. Hence the PV plant avoids greenhouse gas emissions and diversifies the electricity generation mix of the Republic of Ghana. On the one hand, this mitigates climate change and on the other hand it reduces the country's dependence on fossil fuels. Furthermore, the project will improve the electricity supply to the beneficiary communities.

Given the environmental and social benefits of the project, the VRA envisages to register the PV plant as emission reduction project under the Clean Development Mechanism (CDM), a project-based mechanism under the Kyoto Protocol.

The VRA would like to invite all local stakeholders, e.g. citizens of the area, to provide comments on the above mentioned project. The Local Stakeholder Hearings will take place on the following dates at the various locations and venues.

DAY	DATE	ACTIVITY / VENUE
Wednesday	**18.01.2012**	**CDM Stakeholder Hearing Navrongo - Mayaga Hotel**
Thursday	**19.01.2012**	**CDM Stakeholder Hearing Kaleo - St. Basilide Vocational School**
Friday	**20.01.2012**	**CDM Stakeholder Hearing Lawra - District Assembly Hall**
Saturday	**20.01.2012**	**CDM Stakeholder Hearing Jirapa - District Assembly Hall**

During the session, there will be a project presentation providing additional information and room for discussion with the attendees as well as the possibility to provide comments. The meetings will start at **09:30hrs** at all locations except Jirapa's which will start at **14:00hrs**.

We would appreciate the attendance of all stakeholders. The stakeholders who may not be able to attend the meeting are kindly invited to submit their precious comments, opinions or suggestions via e-mail to the addresses below until **January 20, 2012** or call **0204544074/0207872287** with any enquiries.

dengsd@vra.com *or* sesd@vra.com

SECRETARIAT

MINISTRY OF HEALTH

REGISTRATION & LICENSING OF ALLIED HEALTH PROFESSIONALS

It is announced for the information of all Allied Health Professionals and the general public that the Allied Health Secretariat has started an exercise to register and license **all qualified** Allied Health Professionals in the country.

The deadline for the first phase of the registration exercise is August 31, 2012.

It is anticipated that, **all qualified** practitioners, will take the opportunity offered and register during the first phase of the exercise.

It must be noted that additional registration requirements including a pass in the Professional Examination will be introduced after the first phase.

For further information, please contact the Registrar on **0302673680, 0302679051 or by email to the registrar.ahpc@gmail.com**

REGISTRAR

AUTHORITY

ADVERTISER'S ANNOUNCEMENT

Solar Power Project Phase 1 (SPP1): Upper West Regional Project Sites

The Volta River Authority (VRA) has submitted to the Environmental Protection Agency for review, a Preliminary Environmental Report (PER) for its **"Solar Power Project Phase I: Upper West Regional Sites"**, in line with the EPA Act 490, 1994, Section 12 (1) and Regulation 19 of LI 1652, 1999.

The project is to be implemented in the Kaleo, Jirapa and Lawra communities. The expected installed capacity is distributed optimally among the locations. Kaleo will produce 4MW, whereas 2MW each will be installed at the two remaining locations, allowing each location some reserve for extension.

Copies of the PER are available at the VRA Library and the EPA Library, both in Accra as well as the EPA Upper West Regional Office at Wa.

Any person(s) who have an interest, concern, or special knowledge relating to potential environmental effects of the proposed undertaking may contact or submit such concerns, etc., to:

The Chief Executive
Volta River Authority
P. O. Box MB 77
Ministries, Accra
Tel No: 233-30-2664941-9
Fax No: +233-30-2662610
Email: prunit@vra.com

AND

The Executive Director
Environmental Protection Agency
P. O. Box M 326
Accra
Tel No: +233 (0)302664697/8
+233 (0)302708175-9
Fax No: +233302 662690
Email: support@epaghana.org

Not later than 31st August, 2012

12MW SOLAR PHOTOVOLTAIC POWER PROJECT AT KALEO AND LAWRA IN THE UPPER WEST REGION OF GHANA

Preliminary Environmental Assessment Report

The Volta River Authority (VRA) proposes to develop 12MW Solar Photovoltaic Power Plants at Kaleo and Lawra in the Upper West Region of Ghana. The project, which is in line with Ghana's Renewable Energy Act, 2011 (Act 832) and known as the "Solar Power Project Phase 1: Upper West Regional Project Sites", comprises 8MW PV Power Plant at Kaleo and 4MW PV Power Plant at Lawra.

A Preliminary Environmental Assessment Report (PEAR) has been prepared for the 12MW Solar Photovoltaic Power Project. Copies of the PEAR as well as a Non-Technical Summary of the PEAR are available at the VRA Head Office in Accra, EPA Head office in Accra, EPA Upper West Regional Office in Wa and on the VRA's website (i.e. www.vra.com).

Notice of the proposed "Solar Power Project Phase 1: Upper West Regional Project Sites" is hereby served for public information, as required under the procedures for the conduct of Environmental Assessment in accordance with Regulation 16 of LI. 1652.

Any person(s) who has an interest, concern or special knowledge relating to the potential environmental and social implications of the proposed undertaking may contact or submit such concerns, etc., to:

VOLTA RIVER AUTHORITY

1. **The Chief Executive**
   Volta River Authority
   P. O. Box MB 77, Accra
   Tel No: +233-302-664941-9
   Fax: +233-30-2662610
   Email: corpcomm@vra.com

2. **The Executive Director**
   Environmental Protection Agency
   Tel No: +233-302-664697/8
   Fax No: +233-302-662690
   Email: info@epa,gov.gh

Not later than November 30th, 2017

Daily Graphic, Tues. Oct. 10, 2017: PS. 47

APPENDIX 8:
LEASES WITH LANDOWNERS

PARTICULARS REGISTERED

LANDS COMMISSION-UW/R
DOC. No 92-10-14

THIS LEASE is made the 1ST DAY OF DECEMBER, 2010

BETWEEN NUO-IRE RAYMOND (Head of **DABUO** family of **LAWRA**) of Lawra Naa's Palace in the Lawra District in the Upper West Region of the Republic of Ghana. Acting on behalf of the Dabuo family, grant alienation or disposition of any land or other property of the said family whose consent and concurrence are hereby testified by some of the Principal Members aforesaid witnessing the execution of these presents (hereinafter called **"THE LESSOR"**) which expression shall where the context so requires or admits include his successors and assigns) of the one part And **VOLTA RIVER AUTHORITY** acting on its behalf by the Chief Executive Officer, of Post Office Box MB. 77, Accra in the Greater Accra Region of the Republic of Ghana (hereinafter called **"THE LESSEE"**) which expression shall where the context so admits or require include his heirs, personal representatives and assigns) of the other part:--

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a) The Lessor is the owner of a large tract of land situated at Lawra, in the Upper West Region of Ghana (hereinafter called "the property") and particularly described in the first schedule hereto.
b) The Lessor, who are reputed to be the original settlers on the land in question, and who were said to have migrated from Burkina Faso, took possession of, and controlled the subject land, and have since been regarded as the Tendamba's (hereinafter called "the landlords").
c) The Lessee has expressed interest in a portion of the property from the Lessor.
d) The Lessor has agreed to Lease part of the property described in the second schedule, (hereinafter called "the land") on terms thereafter stated.

CERTIFIED TRUE COPY
OIC RECORDS
LAND COMMISSION SECRETARIAT
WA.

1. **NOW WITNESTH AS FOLLOWS**

IN CONSIDERATION of the rent hereinafter reserved and of the covenants condition and stipulations on the part of the Lessee to be paid performed and/or observed the Lessor **DEMISES** unto the Lessee **ALL THAT LAND** situate lying and being at Lawra and measuring, FIFTEEN POINT ONE THREE (15.13) Acres or SIX POINT ONE

LVB/LC/UWR/991/2014

PARTICULARS NOT REGISTERED

LANDS COMMISSION-UW/R
DOC: No 92-10-14

THIS LEASE is made the 1ST DAY OF DECEMBER, 2010

BETWEEN NUO-IRE RAYMOND (Head of **DABUO** family of **LAWRA**) of Lawra Naa's Palace in the Lawra District in the Upper West Region of the Republic of Ghana. Acting on behalf of the Dabuo family, grant alienation or disposition of any land or other property of the said family whose consent and concurrence are hereby testified by some of the Principal Members aforesaid witnessing the execution of these presents (hereinafter called **"THE LESSOR"**) which expression shall where the context so requires or admits include his successors and assigns) of the one part And **VOLTA RIVER AUTHORITY** acting on its behalf by the Chief Executive Officer, of Post Office Box MB. 77, Accra in the Greater Accra Region of the Republic of Ghana (hereinafter called **"THE LESSEE"**) which expression shall where the context so admits or require include his heirs, personal representatives and assigns) of the other part:--

34

REGISTRY

a) The Lessor is the owner of a large tract of land situated at Lawra, in the Upper West Region of Ghana (hereinafter called 'the property") and particularly described in the first schedule hereto.
b) The Lessor, who are reputed to be the original settlers on the land in question, and who were said to have migrated from Burkina Faso, took possession of, and controlled the subject land, and have since been regarded as the Tendamba's (hereinafter called "the landlords").
c) The Lessee has expressed interest in a portion of the property from the Lessor.
d) The Lessor has agreed to Lease part of the property described in the second schedule (hereinafter called "the land") on terms thereafter stated.

CERTIFIED TRUE COPY
...OIC RECORDS
LAND COMMISSION SECRETARIAT
WA.

1. **NOW WITNESTH AS FOLLOWS**

IN CONSIDERATION of the rent hereinafter reserved and of the covenants condition and stipulations on the part of the Lessee to be paid performed and/or observed the Lessor **DEMISES** unto the Lessee **ALL THAT LAND** situate lying and being at Lawra and measuring, FIFTEEN POINT ONE THREE (15.13) Acres or SIX POINT ONE

LVB/LC/UWR/991/2014

LANDS COMMISSION-UW/R
DOC: No 11-10-14

PARTICULARS DELIVERED

THIS LEASE

is made the 1ST DAY OF NOVEMBER, 2013

BETWEEN GEORGE JEBUNI (Head of **IKUOLA** family of **KALEO**) and c/o Tendamba's house of Kaleo in the Nadowli District in the Upper West Region of the Republic of Ghana. Acting on behalf of the Ikuola family grant alienation or disposition of any land or other property of the said family whose consent and concurrence are hereby testified by some of the Principal Members aforesaid witnessing the execution of these presents (hereinafter called **"THE LESSOR"**) which expression shall where the context so requires or admits include his successors and assigns) of the one part And **VOLTA RIVER AUTHORITY (VRA)** Acting on its behalf by the Chief Executive Officer of Post Office Box MB. 77, Accra in the Greater Accra Region of the Republic of Ghana (hereinafter called **"THE LESSEE"**) which expression shall where the context so admits or require include his heirs, personal representatives and assigns) of the other part:--

a. The Lessor is the owner of a large tract of land situated at Kaleo, Nadowli, in the Upper West Region of Ghana (hereinafter called 'the property") and particularly described in the first schedule hereto.
b. The Lessor, who are reputed to be the original settlers on the land in question, and who were said to have migrated from Burkina Faso, took possession of, and controlled the subject land, and have since been regarded as the Tendamba's (hereinafter called "the landlords").
c. The Lessee has expressed interest in a portion of the property from the Lessor.
d. The Lessor, has agreed to Lease part of the property described in the second schedule hereto (hereinafter called "the land") on terms thereafter stated.

CERTIFIED TRUE COPY
... RECORDS
LAND COMMISSION SECRETARIAT
WA.

1. **NOW WITNESETH AS FOLLOWS**

IN CONSIDERATION of the rent hereinafter reserved and of the covenants condition and stipulations on the part of the Lessee to be paid performed and observed the Lessor **DEMISES** unto the Lessee **ALL THAT PIECE OR PARCEL OF LAND** situate lying at Kaleo Residential Area and known Unnumbered Plot in the Nadowli District in the Upper West Region of the Republic of Ghana, the boundaries whereof commencing at pillar no. SGUW A161/12/1 on a bearing of 096°.06' measuring a distance of 2790'.8" feet from Survey pillar no. SGUNA 004/08/3. This bearing together with all further

LUS/NC/UWR/992/2014

THIS LEASE is made the 1ST DAY OF MARCH, 2011

BETWEEN GEORGE JEBUNI (Head of **IKUOLA** family of **KALEO**) of Tendamba's house of Kaleo in the Nadowli District in the Upper West Region of the Republic of Ghana. Acting on behalf of the Ikuola family grant alienation or disposition of any land or other property of the said family whose consent and concurrence are hereby testified by some of the Principal Members aforesaid witnessing the execution of these presents (hereinafter called **"THE LESSOR"**) which expression shall where the context so requires or admits include his successors and assigns) of the one part And **VOLTA RIVER AUTHORITY (VRA)** acting on its behalf by the Chief Executive Officer, of Post Office Box MB. 77, Accra in the Greater Accra Region of the Republic of Ghana (hereinafter called **"THE LESSEE"**) which expression shall where the context so admits or require include his heirs, personal representatives and assigns) of the other part:--

a. The Lessor is the owner of a large tract of land situated at Kaleo, Nadowli, in the Upper West Region of Ghana (hereinafter called 'the property') and particularly described in the first schedule hereto.
b. The Lessor, who are reputed to be the original settlers on the land in question, and who were said to have migrated from Burkina Faso, took possession of, and controlled the subject land, and have since been regarded as the Tendamba's (hereinafter called "the landlords").
c. The Lessee has expressed interest in a portion of the property from the Lessor.
d. The Lessor, has agreed to Lease part of the property described in the second schedule, hereto (hereinafter called "the land") on terms thereafter stated.

1. **NOW WITNESETH AS FOLLOWS**

IN CONSIDERATION of the rent hereinafter reserved and of the covenants condition and stipulations on the part of the Lessee to be paid performed and observed the Lessor **DEMISES** unto the Lessee **ALL THE LAND** situate lying and being at Kaleo Residential Area which is Unnumbered, in the Nadowli District in the Upper West Region of the Republic of Ghana, containing an approximate Area of FIFTEEN POINT THREE SIX (15.36) Acres or SIX POINT TWO (6.22) Hectares more or less and bounded on or towards the East by Lessor's land and measuring 667.4feet on that side on or towards the West Transmission Line (from Wa – Nadowli) and measuring a total

SALE OF LAND AGREEMENT

This is to acknowledge that, I JOSEPH MALIWIHI K of ..... in **KALEO** UPPER WEST REGION of Ghana, have today ..12th February 2019 released **25.16 acres** of land under the authority of the Kanpeli-yili. Family to the VOLTA RIVER AUTHORITY of Ghana for purposes of constructing a Solar farm to augment the national grid.

1. That I am the declarant herein
2. That I have in good faith with consent of the Kanpeli-yili Family released the above mentioned piece of land to VOLTA RIVER AUTHORITY to develop.
3. And to make this solemnly declaration consciously believing it to be true and correct under the witness of ERIC KWEKU DAKURAH, Principal Elder of Kanpeli-yili Family.
4. Witness to the transaction are as follows;

.....

JOSEPH KOFI MALIWIIHI
(LAND OWNER/HEAD OF FAMILY)

.....

VOLTA RIVER AUTHORITY
(BUYER)

.....

(WITNESS TO SELLER)

.....

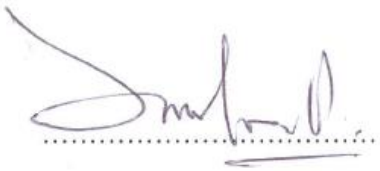
AREA MANAGER (NEDCo)
(WITNESS TO BUYER)

SALE OF LAND AGREEMENT

This is to acknowledge that, I JOHN BADINGU of Nyanga-yiri in **KALE** UPPER WEST REGION of Ghana, have today 14th February 2019 released **45.44** land under the authority of the Nyanga-yiri. Family to the VOLTA RIVER AUTHORITY of Ghana for purposes of constructing a Solar farm to augment the national grid.

1. That I am the declarant herein
2. That I have in good faith with consent of the Nyanga-yiri Family released the above mentioned piece of land to VOLTA RIVER AUTHORITY to develop.
3. And to make this solemnly declaration consciously believing it to be true and correct under the witness of Zinezung Putieha..., Principal Elder of Nyanga-yiri Family.
4. Witness to the transaction are as follows;

JOHN BADINGU PUTIEHA
(LAND OWNER/HEAD OF FAMILY)



VOLTA RIVER AUTHORITY
(BUYER)

13/2/19

(WITNESS TO SELLER)
ZINEZUNG PUTIEHA

AREA MANAGER (NEDCo)
(WITNESS TO BUYER)

APPENDIX 9:
IMPACT CALCULATIONS SHEET

Nature of Impact	Phase	Impact Criteria																				Score	Impact Significance Before Mitigation
		Potential Intensity					Spatial Extent					Duration					Probability							
		16	8	4	2	1	1	2	3	4	5	1	2	3	4	5	0.1	0.25	0.5	0.75	1		
		Very High	High	Medium	Medium Low	Low	Site Specific	Local	Regional	National	International	Temporal	Short Term	Medium Term	Long Term	Permanent	Unlikely	Low Probable	Medium Probable	High Probable	Definite		
POSITIVE IMPACTS																							
Minimisation of Greenhouse Gases	Constructional																						Not Applicable
	Operational			4					5					4					1			13	High Positive
Increase In Employment Opportunities	Constructional			1					5					1					1			7	Medium Positive
	Operational			2					3					4					0.75			6.75	Medium Positive
Stabilization of Electricity	Constructional																						Not Applicable
	Operational			2					3					4					1			9	Medium Positive
Promotion of Economic Growth	Operational			2					2					4					0.75			6	Medium Positive
NEGATIVE IMPACTS																							
Noise & Vibration	Constructional			2					2					1					1			5	Medium Negative
	Operational			1					1					4					0.25			1.5	Very Low Negative
Air Quality	Constructional			4					2					1					0.5			3.5	**Low Negative**
	Operational			1					1					4					0.1			0.6	Very Low Negative
Topography & Drainage	Constructional			4					1					2					1			7	Medium Negative
	Operational			1					1					4					0.1			0.6	Very Low Negative
Water Resources	Constructional			4					2					2					0.5			4	**Low Negative**

Nature of Impact	Phase	Impact Criteria																				Score	Impact Significance Before Mitigation
		Potential Intensity					Spatial Extent					Duration					Probability							
		16	8	4	2	1	1	2	3	4	5	1	2	3	4	5	0.1	0.25	0.5	0.75	1		
		Very High	High	Medium	Medium Low	Low	Site Specific	Local	Regional	National	International	Temporal	Short Term	Medium Term	Long Term	Permanent	Unlikely	Low Probable	Medium Probable	High Probable	Definite		
	Operational			1					2					1					0.1			0.4	Very Low Negative
Geology & Soils	Constructional			1					1					1					0.25			0.75	Very Low Negative
	Operational			1					1					1					0.25			0.75	Very Low Negative
Waste	Constructional			2					1					1					0.5			2	**Low Negative**
	Operational			1					1					4					0.1			0.6	Very Low Negative
Landscape & Visual Intrusion	Constructional			2					1					1					1			4	**Low Negative**
	Operational			1					1					4					0.25			1.5	Very Low Negative
Ecology	Constructional			4					1					4					1			9	**High Negative**
	Operational			1					1					1					0.25			0.75	Very Low Negative
Historical & Cultural Heritage Resources	Constructional			2					2					1					0.75			3.75	Low Negative
	Operational			1					1					1					0.25			0.75	Very Low Negative
Occupational Health & Safety	Constructional			4					5					1					0.50			5	Medium Negative
	Operational			1					1					4					0.25			1.5	Very Low Negative
Land Acquisition	Constructional			8					1					4					1			13	**High Negative**
	Operational			2					1					4					0.5			3.5	**Low Negative**
Land Use	Constructional			4					1					4					1			9	Medium Negative
	Operational			1					1					4					1			6	Medium Negative

Nature of Impact	Phase	Impact Criteria																				Score	Impact Significance Before Mitigation
		Potential Intensity					Spatial Extent					Duration					Probability						
		16	8	4	2	1	1	2	3	4	5	1	2	3	4	5	0.1	0.25	0.5	0.75	1		
		Very High	High	Medium	Medium Low	Low	Site Specific	Local	Regional	National	International	Temporal	Short Term	Medium Term	Long Term	Permanent	Unlikely	Low Probable	Medium Probable	High Probable	Definite		
Labour & Working Conditions	Constructional			2					5					1					0.25			2	**Low Negative**
	Operational			1					3					1					0.25			1.25	Very Low Negative
Community, Health, Safety and Security	Constructional			2					2					1					0.50			2.5	**Low Negative**
	Operational			1					2					4					0.25			1.75	Very Low Negative
Traffic & Transport	Constructional			8					3					1					0.75			9	Medium Negative
	Operational			1					2					4					0.25			1.75	Very Low Negative
Average of Summary Rating of Negative Impacts																						3.42	**Low Negative**
NEGATIVE IMPACTS - DECOMMISSIONING																							
Noise & Vibration	Decommissioning			1					1					1					0.5			1.5	Very Low Negative
Air Quality	Decommissioning			2					1					1					0.5			2	**Low Negative**
Solid Waste	Decommissioning			2					5					1					1			8	Medium Negative
Community, Health, Safety and Security	Decommissioning			2					5					1					0.50			4	**Low Negative**
Traffic & Transport	Decommissioning			2					3					1					0.75			4.5	**Low Negative**