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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) REPORT FOR THE NIGERIA POLICE ACADEMY KANO INTERCONNECTED SOLAR-HYBRID PROJECTS UNDER THE NIGERIA DISTRIBUTED ACCESS THROUGH RENEWABLE ENERGY SCALE-UP (DARES) - REA-NEP/DARES/C/CQS/071/2025

Submitted

Federal Ministry of Environment

Mabushi, FCT, Abuja.

JUNE 2026

DRAFT FINAL ESIA REPORT

Of the Proposed Solar Power Plant and Associated Infrastructure at the Nigeria Police Academy (POLAC), Wuldi, Kano State

Under the Nigeria Distributed Access Through Renewable Energy Scale-up (DARES)

Submitted

Federal Ministry of Environment

Mabushi, FCT, Abuja.

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LIST OF ACRONYMS AND ABBREVIATIONS

APPI	Area of Potential Project Influence
ARAP	Abbreviated Resettlement Action Plan
BMP	Biodiversity Management Plan
BOD	Biochemical Oxygen Demand
COPE	Care of the People
CWD	Coarse woody debris
DRG	Debt Relief Gains
EA	Environmental Assessment
ECN	Energy Commission of Nigeria
EEP	Energizing Education Programme
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMF	Electromagnetic Field
EMS	Environmental Management Strategy
ERSED	Erosion and sediment control
ESCP	Erosion and Sediment Control Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FEPA	Federal Environmental Protection Agency
FGN	Federal Government of Nigeria
FMEnv	Federal Ministry of Environment
GPS	Global Positioning System
Ha	Hectares
HSE	Health, Safety, and Environment
HT	High Tension
ICREEE	Inter-ministerial Committee on Renewable Energy and Energy Efficiency
LGA	Local Government Area
LT	Low Tension
NACOP	National Council on Power
NEEAP	National Energy Efficiency Action Plan
NEP	Nigeria Electrification Project
NEPP	National Electric Power Policy
NERC	Nigerian Electricity Regulatory Commission
NESREA	National Environmental Standards and Regulations Enforcement Agency
NIMET	Nigerian Meteorological Agency
NML	Noise Management Level
NOx	Nitrogen oxides
NSITF	National Social Insurance Trust Fund
NUC	National University Commission
O&M	Operations and maintenance
PAPs	Project Affected Persons
PCT	Plant Community Type
PESCP	Progressive Erosion and Sediment Control Plan (aka ESCP)

PMP	Project Management Plan
POLAC	Nigeria Police Academy
REA	Rural Electrification Agency
SE4All	Sustainable Energy for All
Sp./spp.	Species/species (plural)
SWMP	Soil and Water Use Management Plan
TCN	Transmission Company of Nigeria
TCP	Traffic Control Plans
TMP	Traffic Management Plan
TWA	Time Weighted Average
VLMP	Vegetation and Land Management Plan
WMP	Waste Management Plan
WPMP	Weed and Pest Management Plan

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EXECUTIVE SUMMARY

ES01: Introduction

Nigeria has made expanding electricity access a national priority, leading to the launch of the Nigeria Electrification Project (NEP) in 2018. Implemented by the Rural Electrification Agency with support from the World Bank and African Development Bank, NEP deployed mini-grids and solar systems, providing power to over seven million people and encouraging private sector participation.

Despite this progress, many Nigerians especially in rural areas still lack reliable electricity, making the goal of universal access by 2030 challenging. To address this gap, the Nigeria Distributed Access through Renewable Energy Scale-Up (DARES) Project was introduced as a follow-up initiative. Backed by $750 million in funding, DARES aims to reach over 13 million people by scaling up mini-grids and solar home systems, while using innovative financing and risk-reduction strategies to attract more private investment.

The project builds on NEP's successes while tackling persistent barriers such as high costs and limited financing. It supports Nigeria's clean energy and climate goals by promoting renewable energy solutions and reducing dependence on fossil fuels. Implemented by the Rural Electrification Agency, DARES is designed to accelerate progress toward universal, sustainable electricity access. In line with Nigeria's Environmental Impact Assessment Act, the proposed project has undergone an EIA process to ensure informed decision-making and compliance with environmental regulations.

This ESIA aims to promote environmental protection and sustainable development by identifying and minimizing potential negative impacts early in the project planning phase. It evaluates potential environmental, socio-economic, and cultural effects of the proposed installation activities and recommends mitigation measures. Key objectives include generating data for the Environmental Impact Statement (EIS), establishing baseline environmental conditions, assessing potential risks and impacts, and developing a cost-effective Environmental Management Plan (EMP) to manage impacts throughout the project lifecycle.

The scope of the study covers a comprehensive assessment process, including describing project activities, reviewing relevant laws and standards, analyzing existing documentation (such as the NEP Environmental and Social Management Framework), conducting site surveys, collecting field data on environmental and socio-economic conditions, engaging stakeholders, identifying and evaluating impacts, and preparing mitigation measures and reports supported by laboratory analysis.

The study area is the Nigeria Police Academy located in Wudil, Kano State (11.833°N, 8.467°E). The site is situated near key landmarks such as Wudil Central Mosque, the Emir of Wudil Palace, Kofar Fada, Wudil Town, and Kano University of Science and Technology (KUST) Wudil, all within a few kilometers of the project area.

The applicable legal and institutional framework to the proposed Project includes, but is not necessarily limited to the following:

- EIA Act CAP E12 LFN 2004
- National Policy on the Environment, 1989 (revised in 1999 and 2017)
- World Bank Safeguard Policies on Environmental Assessment
- National Environmental (Energy Sector) Regulations, 2014
- National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991, S.I.9
- National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations, 1991, S. I. 15

- National Environmental (Sanitation and Wastes Control) Regulations, 2009
- National Environmental (Noise Standards and Control) Regulations, 2009
- Kano State Ministry of Environment Laws on Environmental Protection
- Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes and their Disposal
- The United Nations Framework Convention on Climate Change
- Declaration of the United Nations Conference on Human Environment
- International Labour Organisation (ILO): ILO-OSH 2001 - Guidelines on Occupational Safety and Health (OSH) Management Systems

ES 02: Project Justification

The chapter outlines the expected benefits and value of the project, including enhanced academic and research activities, reduced operational costs, improved campus security through solar-powered lighting, and capacity building via a renewable energy training centre. It emphasizes broader socio-economic gains such as job creation, local economic stimulation, and strengthened institutional collaborations. The sustainability of the project is discussed across technical, environmental, economic, and social dimensions, highlighting robust design, reduced dependence on fossil fuels, long-term cost savings, and structured stakeholder engagement mechanisms. The involvement of experienced contractors, institutional oversight, and adherence to environmental and social management frameworks are identified as key factors supporting the project's long-term viability.

In addition, Chapter Two examines site selection and technological alternatives, confirming the suitability of the chosen 9.6-hectare site within the academy based on accessibility, topography, environmental considerations, and security. Among the alternatives assessed, photovoltaic (PV) solar technology and lithium-ion battery storage were selected due to their efficiency, cost-effectiveness, and lower environmental impact compared to other options. The chapter also evaluates project alternatives, including the "no project" and "delayed" scenarios, both of which are deemed unviable due to continued energy challenges and economic implications. Consequently, the "go-ahead" option is identified as the most beneficial, offering significant environmental, social, and economic advantages and aligning with national development and clean energy goals.

ES 03: Project Description

The Nigerian Police Academy (POLAC) is a federal security training institution located in Wudil, Kano State. The campus hosts academic, administrative, residential, training, and operational facilities that operate across extended hours. Cooling and ventilation systems are the dominant load driver, consistent with the warm semi-arid climate of Kano.

These Public Institutions Projects when implemented will provide beneficial impact for Nigerians such as: a. Better healthcare delivery and sanitation, as well as reduced mortality rate; b. Improved quality of tertiary education systems in line with international best practice, as well as training of staff and students in renewable energy technology; c. Providing overall socio-economic benefits not just for the power, education and healthcare sectors but also providing a measure to ensure Nigeria achieves its targets as contained in Nigeria's Nationally Determined Contributions (NDCs) under the Paris Agreement; d. Achieving the broader objectives of Policies of the Nigerian Government such as the 2023 Nigeria Health Sector Renewal Investment Initiative (NHSRII) and the Nigeria Education Sector Renewal Initiative (NESRI) program – which also aims to promote Science Technology Engineering and Mathematics (STEM), etc.

ES04: The Baseline Environment

The study adopted a multidisciplinary approach that combined field sampling, stakeholder consultations, and literature review to characterize the biophysical, socio-economic, and health conditions of the Nigeria Police Academy. Data collection was conducted using standardized methods and equipment for air quality, noise, soil, vegetation, and wildlife assessments, supported by laboratory analysis and statistical evaluation. Quality assurance and control measures were strictly implemented throughout the study to ensure the reliability and accuracy of results, in line with regulatory requirements and international best practices.

The findings indicate that the project area is characterized by a Sudan savanna ecosystem with a tropical continental climate, featuring distinct wet and dry seasons, high temperatures, and moderate rainfall. Seasonal climatic variation in Kano is marked by a prolonged dry season (October–May) and a shorter wet season (June–September). During the dry season, especially between November and February, the Harmattan period is characterized by dusty north-easterly winds, reduced visibility, low humidity, and elevated particulate matter concentrations. Conversely, the wet season experiences relatively lower temperatures, increased humidity, and reduced dust levels due to rainfall scavenging effects. Average annual rainfall ranges from approximately 800–1000 mm, while mean daily temperatures commonly vary between 26°C and 38°C, with peak temperatures occurring during March and April.

Ambient air quality in the area is generally good, with monitored gaseous pollutants remaining below national and international permissible limits. Measured concentrations of carbon monoxide (CO) ranged between 0.4–1.8 ppm, sulphur dioxide (SO_2) between 0.002–0.008 ppm, nitrogen dioxide (NO_2) between 0.003–0.015 ppm, and hydrogen sulphide (H_2S) was largely negligible (<0.001 ppm). Particulate matter concentrations recorded average values of approximately 18–42 µg/m³ for PM_{10} and 8–20 µg/m³ for $PM_{2.5}$, with higher concentrations observed during the dry Harmattan season due to increased dust transport and anthropogenic activities such as vehicular movement and biomass burning. Noise levels across sampled locations ranged from about 42–68 dB(A), remaining within acceptable regulatory limits for institutional and residential environments.

Soil analysis shows predominantly sandy to loamy soils with moderate fertility and acceptable levels of heavy metals within regulatory limits. Soil pH ranged from slightly acidic to neutral (approximately 6.2–7.4), while organic matter content was generally low to moderate, reflecting the semi-arid ecological conditions. Concentrations of heavy metals such as lead (Pb), cadmium (Cd), chromium (Cr), and zinc (Zn) were within permissible standards and showed no evidence of significant contamination. Seasonal variations in soil moisture and nutrient availability were observed, with improved soil moisture retention and vegetation productivity during the rainy season.

Vegetation is mainly composed of grasses, shrubs, and drought-resistant trees such as acacia, neem, and baobab, although human activities like farming, grazing, fuelwood harvesting, and deforestation have altered the natural ecosystem. Vegetation density and greenness increase significantly during the rainy season, while dry-season conditions result in sparse ground cover and increased susceptibility to erosion and bush burning. Wildlife in the area is typical of savanna environments, including small mammals, reptiles, and bird species adapted to semi-arid conditions, with some species facing conservation concerns due to habitat degradation and human pressures.

Socio-economic and health assessments reveal a stable and moderately developed community with good access to healthcare and basic infrastructure, though livelihoods are largely dependent on agriculture and informal economic activities. The population is predominantly young to middle-aged, with relatively good sanitation facilities and mixed income levels. While electricity access exists, supply is

unreliable, leading to reliance on alternative energy sources such as generators and solar systems. Community perceptions of the proposed solar power project are overwhelmingly positive, with expectations of improved power supply, economic benefits, and minimal environmental or health risks. However, the study highlights the need for enhanced stakeholder awareness, continuous environmental monitoring across both wet and dry seasons, and attention to social issues such as gender-based vulnerabilities to ensure sustainable project implementation.

ES 05: Potential and Associated Impacts

This chapter evaluates the potential environmental and social impacts associated with the proposed solar power plant across its full lifecycle pre-construction, construction, commissioning, operation, and decommissioning phases. The assessment follows a structured methodology involving impact identification, screening using interaction matrices, and evaluation through a risk assessment framework. Impacts are classified based on their nature (positive or negative), duration, reversibility, and significance using established criteria such as magnitude and receptor sensitivity. Overall, while the project is expected to deliver substantial environmental and socio-economic benefits, certain adverse impacts may arise, particularly during construction and operational stages, requiring appropriate mitigation measures.

The study identifies several positive impacts, including improved electricity supply, reduced reliance on fossil fuels, lower greenhouse gas emissions, enhanced air quality, and increased economic opportunities. The project will also contribute to improved quality of education, increased productivity, job creation, and capacity building through a renewable energy training centre. However, potential negative impacts were identified across different phases. During pre-construction and construction, these include vegetation loss, soil degradation, air and noise pollution, increased traffic, occupational hazards, and social risks such as gender inequality and possible rise in social vices. Operational impacts are generally less severe but include occupational health and safety risks, minor waste generation (including e-waste), and potential groundwater abstraction. Decommissioning may lead to loss of employment and temporary environmental disturbances.

The assessment concludes that most adverse impacts are of minor to moderate significance and are largely short-term, localized, and reversible when appropriate mitigation measures are implemented. Key risks identified include fire and explosion hazards, electrocution, and workplace accidents, particularly related to electrical systems and battery storage. Cumulative impacts on traffic, noise, and groundwater are considered low due to the scale and nature of the project.

ES06: Mitigation Measures Impacts

This chapter presents the mitigation measures proposed for the actual and potential impacts associated with the proposed solar-based power plant project at the Nigeria Police Academy. A comprehensive risk assessment matrix, as illustrated in Figure 6.1, was utilized to determine the mitigation requirements for each identified impact. The assessment considered factors such as frequency, severity, sensitivity, spatial scale, longevity, political implications, economic consequences, legal considerations, reputation/image concerns, and communication or public complaints.

Appropriate mitigation measures were developed to minimize adverse environmental, social, occupational health, and safety impacts during the construction, operation, and decommissioning phases of the project. Dust suppression measures such as periodic water spraying, covering of loose materials,

and vehicle speed control shall be implemented to reduce particulate emissions. The mandatory use of Personal Protective Equipment (PPE), including helmets, gloves, reflective jackets, safety boots, goggles, and nose masks, shall be enforced for all personnel on site. A structured waste management system emphasizing waste segregation into recyclable, hazardous, and non-hazardous categories shall also be adopted, while spill prevention and control measures, including spill kits and designated fuel storage areas, shall be provided to prevent soil and groundwater contamination.

In addition, erosion control measures such as proper drainage, stabilization of exposed surfaces, controlled excavation, and revegetation of disturbed areas shall be implemented to minimize land degradation and sediment runoff. Traffic management measures, including designated access routes, speed limits, warning signage, parking controls, and traffic marshals where necessary, shall also be established to ensure safe movement of vehicles and equipment within and around the project area. The implementation of these mitigation measures, alongside continuous environmental monitoring and stakeholder engagement, will support environmentally sustainable and socially responsible project execution.

ES 07: Environmental and Social Management Plan

An Environmental and Social Management Plan (ESMP) is made up of several interrelated components that collectively ensure that the environmental and social impacts of a project are effectively managed throughout its lifecycle. Central to the ESMP are the mitigation measures**,** which outline specific actions to avoid, minimize, or compensate for adverse impacts identified during the assessment process. These measures are supported by a monitoring plan, which defines the parameters to be measured, the frequency of monitoring, performance indicators, and the responsible parties, thereby enabling continuous evaluation of the effectiveness of the mitigation strategies. Closely linked to this are the institutional arrangements**,** which clearly define roles, responsibilities, and reporting structures among the project proponent, contractors, supervising agencies, and regulatory authorities to ensure accountability and proper implementation.

The ESMP also includes environmental and social management procedures**,** such as codes of conduct, occupational health and safety (OHS) guidelines, waste management systems, and emergency response plans, which provide standardized approaches for managing risks on-site. In addition, a stakeholder engagement plan is incorporated to facilitate continuous consultation and communication with affected communities and other stakeholders, while a grievance redress mechanism (GRM) ensures that complaints are received, addressed, and resolved in a transparent and timely manner. To enhance effective implementation, the ESMP provides for capacity building and training, ensuring that all personnel and stakeholders are adequately equipped with the knowledge and skills required for environmental and social management.

Furthermore, the ESMP establishes a reporting and documentation framework for recording monitoring results, incidents, and corrective actions, thereby supporting compliance and continuous improvement. A critical component of the ESMP is the cost of implementation, which outlines the financial resources required for mitigation measures, monitoring activities, training programs, stakeholder engagement, and institutional support across all project phases. This budget ensures that ESMP activities are adequately funded and realistically implemented. Finally, the ESMP is integrated into project design and contractual agreements**,** making compliance with environmental and social requirements a binding obligation. Altogether, these components form a comprehensive and practical framework for managing environmental and social risks in a structured, accountable, and sustainable manner.

ES 08: Stakeholder Engagement and the Grievance Redress Mechanism

Stakeholder engagement and the grievance redress mechanism as key elements of the ESIA process. It explains that stakeholder consultations are essential for identifying environmental and social concerns and ensuring that the project is implemented in an inclusive and transparent manner. A Stakeholder Engagement Plan (SEP) guides how stakeholders are identified, informed, and engaged throughout the project lifecycle. This process includes consultations such as meetings, interviews, and focus group discussions, with special attention given to vulnerable groups to ensure their voices are heard.

The engagement process aims to inform stakeholders about the project, gather their input, and incorporate their views into project planning and decision-making. Information disclosure is a major part of this process, with ESIA documents made publicly available both physically and online in line with regulatory requirements. This ensures stakeholders can review the project details, provide feedback, and contribute meaningfully, thereby promoting transparency and trust between the project team and the community.

Consultations revealed that stakeholders generally support the project because of its potential to improve electricity access, enhance economic opportunities, and strengthen public services. However, concerns were raised about land acquisition, compensation, environmental impacts during construction, and the need for local employment. These concerns have been incorporated into mitigation strategies and project design improvements. The socioeconomic assessment further shows that the host communities largely depend on agriculture and small-scale trading, with limited access to basic infrastructure such as electricity, healthcare, and clean water. Vulnerable groups, including women and low-income households, were identified, and the project aims to ensure equitable access to its benefits. Overall, the findings indicate that the project is suitable and beneficial if proper environmental and social measures are implemented.

The chapter concludes with the Grievance Redress Mechanism (GRM), which provides a structured system for handling complaints from stakeholders. It allows grievances to be submitted, recorded, reviewed, and resolved within defined timelines, with provisions for escalation if necessary. The GRM also includes confidential procedures for sensitive issues such as gender-based violence. By ensuring transparency, accountability, and timely resolution of concerns, the GRM strengthens trust and supports the long-term sustainability of the project.

ES09: Conclusion and Recommendations

The ESIA for the proposed solar power plant at the Nigeria Police Academy, Wudil, Kano, was conducted to ensure compliance with Nigerian regulations, international standards, and stakeholder expectations. The study integrates environmental and social considerations into project planning and implementation, aligning with the Nigerian EIA Act and the World Bank's Environmental and Social Safeguard Standards. It aims to support informed decision-making and promote sustainable development by identifying potential impacts and addressing them proactively.

The assessment involved extensive stakeholder consultations, which helped capture community concerns and ensure transparency throughout the project lifecycle. Baseline environmental and social conditions were established through field surveys, data collection, and literature reviews, providing a benchmark for future monitoring. The study also analyzed the interaction between project activities and the existing environment to identify potential environmental and socio-economic impacts. Based on these findings, appropriate mitigation measures were developed using best practices and health, safety,

and environmental standards.An Environmental and Social Management Plan (ESMP) was prepared to guide the implementation of mitigation measures and ensure effective monitoring of environmental parameters such as air quality, noise levels, and groundwater conditions. The Rural Electrification Agency (REA) will be responsible for ensuring compliance with regulatory standards set by the Federal Ministry of Environment and the World Bank.

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CHAPTER ONE
INTRODUCTION

1.1 Background Information

The Federal Government of Nigeria (FGN) has, over the past decade, prioritized expanding access to electricity as a critical driver of economic growth, social inclusion, and sustainable development. In 2018, this commitment materialized through the Nigeria Electrification Project (NEP), financed by concessional funding from the World Bank and the African Development Bank. The NEP was designed as a flagship off-grid electrification initiative to bridge the energy access gap in rural and underserved communities. Implemented by the Rural Electrification Agency (REA), the project successfully deployed mini-grids and standalone solar systems, delivering clean and reliable electricity to over 7 million Nigerians while stimulating private-sector participation through results-based financing mechanisms.

Despite these achievements, Nigeria continues to face significant electrification challenges, with millions still lacking access to reliable power, particularly in rural and peri-urban areas. The country's ambition to achieve universal electricity access by 2030, alongside its commitments under the Paris Agreement, underscores the urgency of scaling up sustainable energy solutions. While the NEP established a strong foundation demonstrating the viability of decentralized renewable energy systems and catalyzing private investment the scale of the energy deficit requires a more aggressive and expanded intervention.

In response to this need, the Nigeria Distributed Access through Renewable Energy Scale-Up (DARES) Project was conceived as a follow-on initiative to build on the successes of the NEP. Launched by the World Bank at COP27, DARES represents a strategic effort to accelerate electrification through increased financing, innovative de-risking instruments, and enhanced private sector engagement. With a financing envelope of US$750 million, the project aims to provide electricity access to over 13 million Nigerians by significantly scaling up the deployment of mini-grids both isolated and interconnected—as well as standalone solar home systems.

The rationale for the DARES project lies in the need to deepen and expand the impact of earlier interventions while addressing persistent barriers to energy access. These barriers include high upfront capital costs, limited access to financing for developers, and the risks associated with operating in underserved markets. By leveraging public funds to crowd in private investment and applying results-based financing approaches, DARES seeks to triple the pace of electrification in Nigeria. Furthermore, the project aligns with Nigeria's broader energy transition objectives by promoting clean energy solutions that reduce reliance on fossil fuels and contribute to climate mitigation efforts.

Ultimately, DARES is positioned as a transformative initiative that not only builds on the institutional and market frameworks established under the NEP but also responds to the growing demand for sustainable and inclusive energy access. Through its implementation by the REA's existing Project Management Unit, the project ensures continuity, efficiency, and scalability, thereby reinforcing Nigeria's pathway toward universal electrification and a resilient, low-carbon energy future.

In compliance with the Environmental Impact Assessment Act 86 of 1992 (codified as EIA Act CAP E12 LFN2004) and other extant laws of the Federation of Nigeria, the proposed project is subject to the EIA process for informed decision-making and consideration.

1.2 The Applicant

The Rural Electrification Agency (REA) is a Nigerian government agency responsible for ensuring electricity reaches every part of the country. REA focuses on rural electrification projects, providing power solutions for on-grid and off-grid areas with an emphasis on renewable energy. As the Implementing Agency of the Federal Government of Nigeria, the team at REA is tasked with the electrification of rural and unserved communities across Nigeria. MISSION To provide access to reliable electric power supply for rural dwellers irrespective of where they live and what they do, in a way that would allow for a reasonable return on investment through an appropriate tariff that is economically responsive and supportive of the average rural customer. MANDATE - Promote Rural Electrification in the Country - Co-ordinate Rural Electrification Programs in the country - Administer the Rural Electrification Fund (REF) to promote, support, and provide rural electrification through Public and Private Sector Participation. The Abuja Office is located at No. 15 Constitution Avenue, Central Business District, FCT-Abuja.

1.3 Objectives of the EIA

The general objective of the ESIA is to support the goals of environmental protection and sustainable development through minimizing negative environmental impacts, as well as integrating environmental protection and economic decisions at the earliest stages of project design and planning. The ESIA will also predict possible environmental, socio-economic, and cultural consequences of the proposed installation activities as well as proffer mitigation measures to any potential adverse impacts on the environment.

Consequently, the objectives of this ESIA report are:

- To provide necessary data/evidence that will form the Environmental Impact Statement (EIS) of the proposed installation activities.
- To establish the existing environmental condition/profile of areas that shall include a qualitative and quantitative description of the physical, chemical, biological, hydrological, and social environment of the project areas.
- To review the proposed activities thereby identifying the potential impacts and associated effects of any hazards posed by the execution of the project.
- To recommend control measures to prevent and/or mitigate identified potential/associated adverse impacts of the installation activities.
- To develop and document a cost-effective Environmental Management Plan (EMP) that recommends plans and procedures to manage the consequences of the installation activities on the environment at different phases of the project.

1.4 Scope of the ESIA Study

- In line with the Terms of Reference (TOR), the scope of the ESIA study covers the following:
- Description of all actions/activities that will be carried out in the course of the Project development and implementation.
- Review of applicable local and international laws, regulations, standards and industry codes that apply to the proposed Project.
- Desktop review of relevant documents pertaining to the Project and the environment where the Project would be located. These documents include the Nigerian Electrification Project (NEP) environmental and social management framework (ESMF), amongst others.
- Perimeter survey of the Project site, including development of survey maps.
- Field data gathering covering biophysical and socio-economic components of the Project's Area of Influence.

- Consultations with relevant stakeholders including government institutions, project affected persons, University management representatives,
- Impacts identification and evaluation, and development of appropriate and practicable mitigation measures and EMP.
- Laboratory analysis of field samples and data analysis and Report preparation and disclosure.

1.5 The Study Area

The Nigeria Police Academy is in Wudil, Wudil Local Government of Kano State. The coordinates are 11.833°N and 8.467°E. The Nigeria Police Academy in Wudil, Kano State, is surrounded by several notable landmarks and geographical features. Some of these include - Wudil Central Mosque: A significant religious site located approximately 4.1 kilometers away. The Emir of Wudil Palace: A historical and cultural landmark about 1.7 kilometers from the academy. Kofar Fada: A notable location roughly 4 kilometers away. Wudil Town: The local town, providing access to various amenities and services, is about 3.9 kilometers away, and Kust Wudil: A nearby location with institutions like Kano University of Science and Technology (KUST) Wudil campus, approximately 4.1 kilometers away.

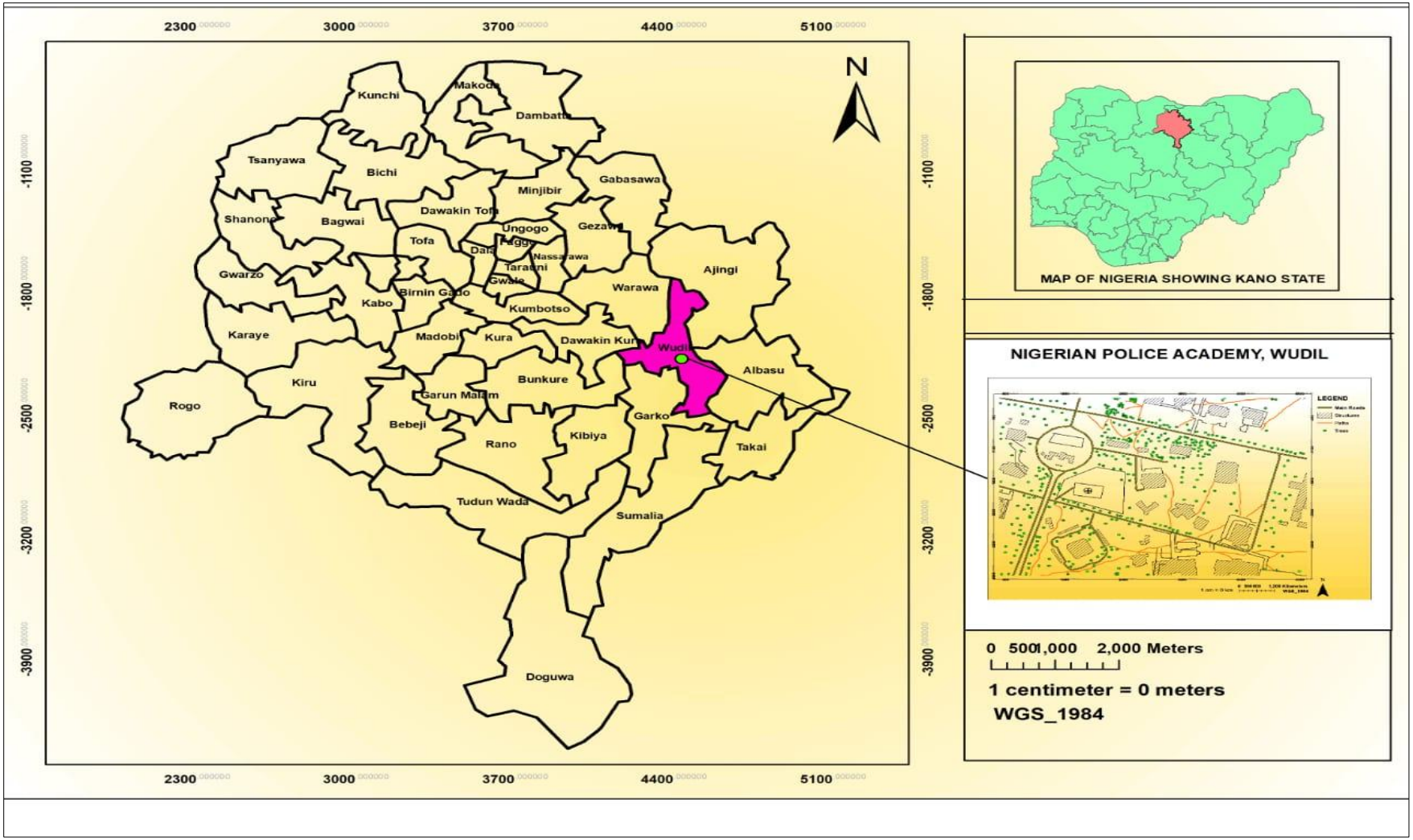

Figure 1: Map of Kano State Showing Wudil LGA

1.6. Study Approach/ Methodology in Detail

The ESIA methodology adopted a systematic and participatory approach, beginning with a reconnaissance survey to gain an understanding of site-specific conditions and potential environmental and social issues. This was complemented by a comprehensive desktop review of relevant project and programme documents to establish the regulatory, institutional, and technical context for the proposed intervention. A scoping study was conducted in consultation with the beneficiary university authorities and representatives of the host community to capture stakeholder perceptions of the project and to identify key environmental and social concerns. This engagement informed the focus of subsequent studies and ensured that locally relevant issues were adequately addressed. Field data collection was carried out to establish baseline environmental and social conditions at the proposed project sites. This included primary and secondary data gathering on noise levels, air quality, water quality, soil characteristics, ecology, and biodiversity. Samples obtained during field surveys were subjected to laboratory analysis to provide quantitative evidence for baseline conditions and impact prediction.

Based on the baseline data and stakeholder inputs, potential environmental and social risks and impacts associated with the project were identified and assessed. Appropriate mitigation and enhancement measures were then developed to address identified risks. These measures were consolidated into an Environmental and Social Management Plan (ESMP), which outlines specific actions, implementation timelines, and institutional responsibilities for managing impacts throughout the project lifecycle.

The ESIA process concluded with the compilation of the assessment report and the execution of required regulatory procedures, including disclosure of the ESIA report in line with national regulations and international best practice. The Federal Ministry of Environment (FMEnv) developed guidelines to be used by project proponents in conducting EIA, in compliance with the EIA Act. Accordingly, the ESIA process follows the steps sequentially as outlined in the procedural guideline indicated in Figure 1.2.

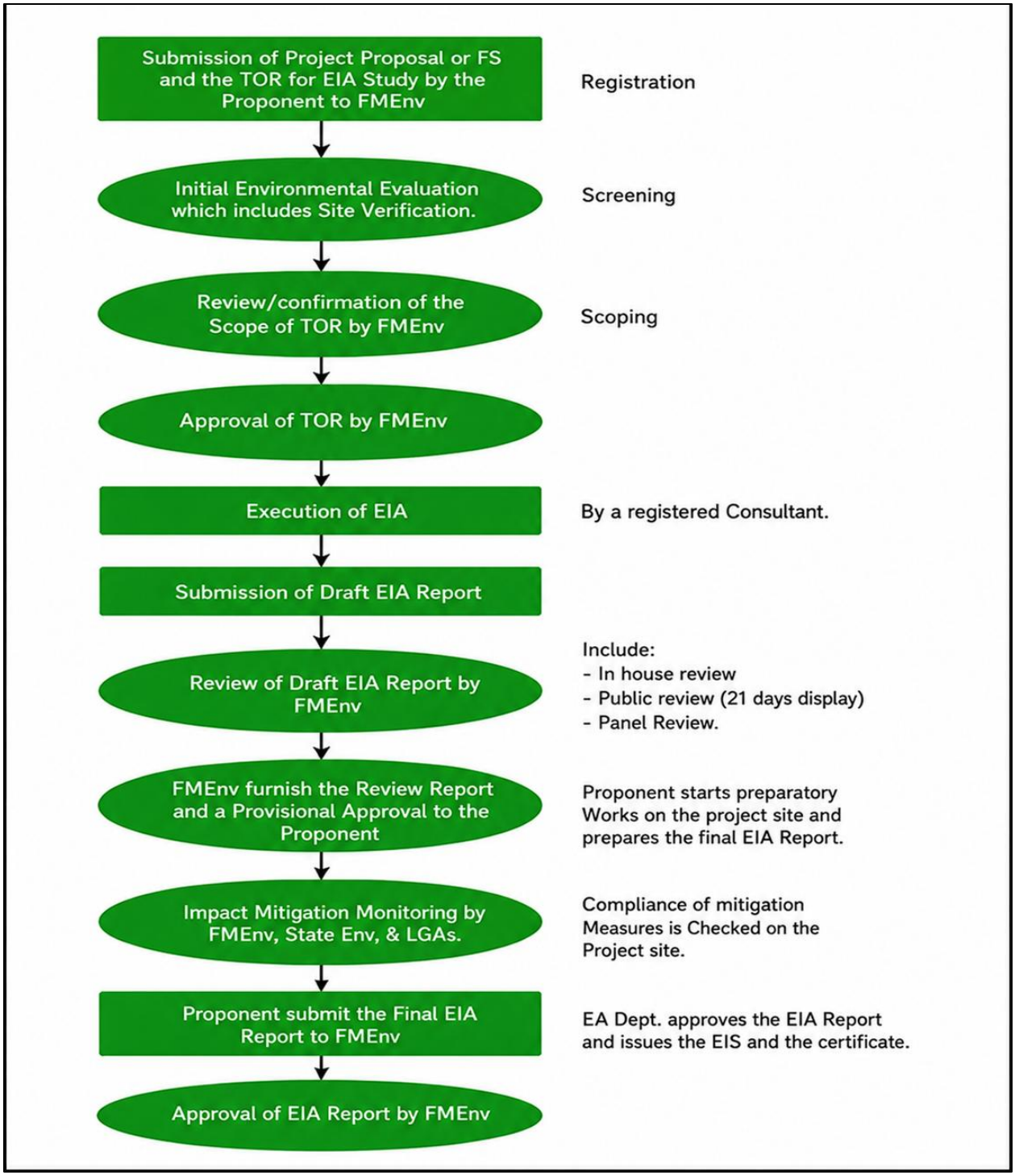

Figure 1.2: Federal Ministry of Environment Environmental Impact Assessment Process
(Source: Environmental assessment department, Federal Ministry of Environment)

17 Limitations of the ESIA Study

This is not unusual - predicting environmental effects can be complex, and some factors might not be fully understood until the project is underway. To manage this uncertainty, a robust Environmental and Social

Management Plan (ESMP) is in place. This plan will monitor the project's environmental and social performance throughout its lifecycle, allowing for adjustments as needed to mitigate any unexpected impacts.

1.8 Policy, Legal and Administrative Framework

The proposed Project is part of the Federal Government of Nigeria's Energizing Education Programme, a component of the Nigeria Electrification Project being implemented by the Rural Electrification Agency. Several laws and regulations apply to the energy sector in Nigeria. In addition to the above, several laws, regulations, policies, and instruments have been established to support environmental and social management and the EIA process in Nigeria. This section provides an overview of the relevant statutory regulations, legislation, and guidelines for the proposed Project and the ESIA study. The project shall ensure compliance with the relevant and applicable local and international regulations, policies, and standards throughout its life cycle.

1.8.1 FGN Requirements and Relevant Legislation

The Constitution of the Federal Republic of Nigeria (1999), as the national legal order, recognizes the importance of improving and protecting the environment and makes provision for it. The relevant sections are:

- **Section 20** makes it an objective of the Nigerian State to improve and protect the air, land, water, forest, and wildlife of Nigeria.
- **Section 12** establishes, though impliedly, that international treaties (including environmental treaties) ratified by the National Assembly should be implemented as law in Nigeria; and
- **Sections 33 and 34,** which guarantee fundamental human rights to life and human dignity, respectively, have also been argued to be linked to the need for a healthy and safe environment to give these rights effect.

1.8.2 Policy, Legal, and Institutional Framework

The Policy, Legal, and Institutional Framework guiding the Environmental and Social Impact Assessment (ESIA) for the proposed project is anchored on applicable national policies, laws, and institutional arrangements, as well as relevant international standards. At the national level, the framework is defined by the Federal Ministry of Environment (FMEnv**)** regulations, including the Environmental Impact Assessment Act Cap E12 LFN 2004, FMEnv Procedural Guidelines (2017), and other sectoral environmental, social, health, and safety regulations. The assessment also aligns with the objectives of the Nigeria Electrification Project and the Rural Electrification Agency's implementation framework. At the international level, the ESIA is guided by the African Development Bank Integrated Safeguards System, alongside international good practice such as the IFC Performance Standards and relevant ISO standards, ensuring that the project complies with both national regulatory requirements and global environmental and social sustainability benchmarks.

1.8.3. Policy Framework

1.8.3.1. National Environmental Policy/ National Policy on the Environment (Revised 2016)

The national environmental policy launched by Government in November 1989 revised in 2016, prescribed guidelines for achieving sustainable development in fourteen vital sectors of the nation's economy, namely: Human Population; Land Use and Soil Conservation; Water Resources Management; Forestry, Wildlife and Protected Natural Areas; Marine and Coastal Area Resources; Sanitation and Waste Management; Toxic and Hazardous Substances; Mining and Mineral Resources; Agricultural Chemicals; Energy Production; Air Pollution; Noise in the Working Environment; Settlements; Recreational Spaces, Green Belts, Monuments, and Cultural Property.

It also contains Nigeria's commitment to ensuring that the country's natural and built environment is safeguarded for the use of present and future generations. This commitment demands that efficient resource management and minimization of environmental impacts be the core requirements of all development activities. Accordingly, this Policy seeks to promote good environmental practices through environmental awareness and education. The goal of the National Policy on the Environment is to 'ensure environmental protection and the conservation of natural resources for sustainable development'. Its strategic objective is to coordinate environmental protection and natural resources conservation for sustainable development.

1.8.3.2 Social Protection Policies

Social protection policy has been on the agenda since 2004, when the National Planning Commission, supported by the international community, drafted a social protection strategy. More recently, the National Social Insurance Trust Fund (NSITF) drafted a social security strategy. The social protection policy approached social protection using a life cycle and gender lens, recognizing both economic and social risks, including, for example, job discrimination and harmful traditional practices. The policy was organised around four main themes: social assistance, social insurance, child protection and the labour market.

However, only a few of the instruments of this approach were adopted in the national implementation plan, most notably the provision of specific and limited social assistance, social insurance (such as expanding national health insurance to the informal sector) and labour market programmes (such as developing labour-intensive programmes). Moreover, in practice, programmes to date have been focused largely on conditional cash transfers and two health financing mechanisms driven by the federal government with little inter-sectoral or state-federal coordination. A significant number of actors are involved in funding and implementing social protection, including those from government, donors, international non-governmental organisations and civil society. Federal government-led social protection includes three main programmes:

- The conditional cash transfer in Care of the People (COPE) (funded initially through the debt relief gains (DRG fund) targeted at households with specific social categories (those with children of school-going age that are female-headed or contain members who are elderly, physically challenged, or are fistula or HIV/ AIDS patients).

- The health fee waiver for pregnant women and children under five (financed through the debt relief gains (DRG fund); and

- The community-based health insurance scheme, which was redesigned in 2011 because the previous scheme had design challenges.

Other social assistance programmes are implemented in an ad hoc manner by various government ministries, departments and agencies at state level, and some are funded by international donors. These include conditional cash transfer programmes for girls' education (in three states), child savings accounts, disability grants, health waivers, education support (such as free uniforms) and nutrition support. HIV and AIDS programming at state level also include social protection sub-components (although not as the primary objective), including nutrition, health and education support. Labour market programmes include Federal and State level youth skills and employment programmes, and Nigeria also has agricultural subsidies/inputs.

1.8.3.3 National Policy on Climate Change/ National Climate Change Policy for Nigeria 2021-2030

Given Nigeria's status as a fossil-fuel dependent economy with a large climate sensitive agricultural sector, the development of a climate change policy and response strategy is critical, as climate change presents a serious threat to poverty eradication and sustainable development in general. One of the key pillars of Vision 20:2020 is investment in low-carbon fuels and renewable energy. Achieving the goal of low carbon, high-growth and resilient socio-economic system for equitable and sustainable socio-economic and environmental development faces some challenges which include stability and sustainability of the enabling environment, adequate institutional and human resource capacity and availability of adequate resources to address mitigation and adaptation initiatives to address climate change. Thus, the Government needs to ensure that economic growth, resource management and climate change mitigation and adaptation can all happen simultaneously if this will be done effectively (Department of Climate Change 2017).

The National Climate Change Policy for Nigeria 2021-2030 was established to promote a low-carbon, climate-resilient and gender-responsive sustainable socio-economic development. The revised National Policy on Climate Change was to define a new holistic framework to guide the country's response to the development challenge of climate change.

1.8.3.4 The National Electric Power Policy (NEPP), 2001

In order to ensure a safe, steady, reliable and progressively improved electric power sector in Nigeria, the Electric Power Reform Implementation Committee (EPIC) was inaugurated by the BPE and resulted in Federal Executive Council (FEC) of Nigeria approving the National Electric Power Policy in September 2001, which recommended, amongst others: establishment of the electric power sector regulator and the privatisation of the electric power sector. The National Electric Power Policy (NEPP), 2001 outlines the realization of an adequate and reliable supply of electricity in three phases - the privatization of the state-own utility NEPA and the introduction of the Independent Power Producers (IPPs); increasing the competition between market participants, partial removal of subsidies, and sale of excess power to distribution companies (DISCOs); and the freedom to select suppliers by large consumers and the creation of a fully liberalized and competitive market.

In 2004, the National Integrated Power Project (NIPP) was initiated to boost power supply by the launch of gas-powered stations. The National Electric Power Policy (NEPP) of 2001 resulted in the Electric Power Sector Reform (EPSRA) Act of 2005, establishing the Nigerian Electricity Regulatory Commission (NERC). The EPSRA provided the statutory basis for the privatization of the power sector.

1.8.3.5 The National Energy Policy (NEP) 2013

The National Energy Policy (NEP) 2013 is a revised version of the NEP 2003, emphasizes the effective and efficient use of energy and proposes major areas to be considered for energy efficiency and conservation including amongst others: transportation, services/commercial sector, and energy efficient building designs.

1.8.3.6 The National Energy Efficiency Action Plans of Nigeria

The first version of the National Energy Efficiency Action Plans (NEEAP) for Nigeria (2015 2030) was approved on July 14, 2016, by the National Council on Power (NACOP). It has been formulated within the framework of United Nations' Sustainable Energy for All (SE4All) and adopted by the Inter-Ministerial Committee on Renewable Energy and Energy Efficiency (ICREEE). The NEEAP includes baseline data and information on energy efficiency activities and programmes in Nigeria, barriers to the development and promotion of energy efficiency in the country and suggested achievable energy efficiency targets, including gender disaggregated indicators, based on national potentials and socio-economic assessments. The implementation of the NEEAP is being monitored by the Federal Ministry of Power.

1.8.4 National Legal Framework

1.8.4.1 The Environmental Impact Assessment Act No. 86, 1992/Environmental Impact Assessment Act Cap E12 LFN 2004

The EIA Act makes it mandatory for any person, authority, corporate body private or public, to conduct EIA before the commencement of any new major development or expansion that may likely have significant effects on the environment. The Act sets out the EIA objectives and the procedures for consideration of EIA of certain public or private projects. The programme is a minor development, which is expected to have minimum impact on the environment. Hence, the programme is categorized as Category II (B) EIA. The EIA guidelines (procedural and sectoral) issued by the FMEnv derive from this Act and the programme proponents shall conduct their activities in conformance with these guidelines.

1.8.4.2 Electricity Act 2023

It is more accurate to refer to the Electricity Act 2023 as the replacement Act, rather than simply calling it an amendment to the EPSRA. The 2023 Act expressly repealed the EPSRA 2005 and established a more comprehensive framework governing generation, transmission, system operation, distribution, supply and trading of electricity, as well as consumer rights and renewable energy. One of its most important changes is decentralisation. States can now establish and regulate their own intrastate electricity markets, while NERC continues to regulate matters involving interstate electricity, the national grid, transmission, system operation and other federally regulated activities.

1.8.4.3 Energy Commission of Nigeria Act CAP 109 LFN 1990

The Act was promulgated to create the Energy Commission of Nigeria (ECN) with responsibility for coordinating and general surveillance over the systematic development of the various energy resources of Nigeria. Subject to this Act, the ECN is charged with responsibility for the strategic planning and co-ordination of national policies in the field of energy in all its ramifications. The mandates of ECN include statistical analysis of Electricity Generation, Transmission and Distribution.

1.8.4.4 Land Use Act of 1978 and Resettlement Procedures

The Land Use Act (Cap 202, 1990), now Cap L5 Laws of the Federation of Nigeria 2004, is the key legislation that has direct relevance to this project. Relevant sections of these laws that may relate to this project with respect to land ownership and property rights, resettlement, and compensation are summarized in this section.

The Land Use Act is the applicable law regarding ownership, transfer, acquisition, and all such dealings on Land. The provisions of the Act are vast on every parcel of Land, in every State of the Federation, under the Executive Governor of the State. He holds such parcels of land in trust for the people and government of the State.

The Act categorized the land in a state into urban and non-urban or local areas. The administration of the urban land is vested in the Governor, while the latter is vested in the Local Government Councils. At any rate, all land, irrespective of the category, belongs to the State, while individuals only enjoy a right of occupancy as contained in the Certificate of Occupancy, or where the grants are "deemed".

The concept of ownership of land as known in the Western context is varied by the Act. The Governor administers the land for the common good and the benefit of all Nigerians. The law makes it lawful for the Governor to grant statutory rights of occupancy for all purposes, grant easements appurtenant to statutory rights of occupancy, and to demand rent. The Statutory Rights of Occupancy are for a definite time (the limit is 99 years) and may be granted subject to the terms of any contract made between the state Governor and the Holder.

The Local Government Councils may grant customary rights of Occupancy for agricultural (including grazing and ancillary activities), residential and other purposes. But the limit of such grants is 500 hectares for agricultural purposes and 5,000 for grazing, except with the consent of the Governor. The local Government, under the Act, is allowed to enter, use, and occupy for public purposes any land within its jurisdiction that does not fall within an area compulsorily acquired by the Government of the Federation or of the relevant State, or subject to any laws relating to minerals or mineral oils.

The State is required to establish an administrative system for the revocation of the rights of occupancy and payment of compensation for the affected parties. So, the Land Use Act provides for the establishment of a Land Use and Allocation Committee in each State that determines disputes as to compensation payable for improvements on the land (Section 2 (2) (c)).

In addition, each Local Government is required to set up a Land Allocation Advisory Committee to advise the Local Government on matters related to the management of land. The holder or occupier of such revoked land is entitled to the value of the unexhausted development as at the date of revocation. (Section 6) (5). Where land subject to customary rights of Occupancy and used for agricultural purposes is revoked under the Land Use Act, the local government can allocate alternative land for the same purposes (section 6) (6).

If Local Government refuses or neglects, within a reasonable time, to pay compensation to a holder or occupier, the Governor may proceed to effect assessment under section 29 and direct the Local Government to pay the amount of compensation to the holder or occupier. (Section 6) (7).

Where a right of occupancy is revoked on the ground that the land is required by the Local, State or Federal Government for public purposes or for the extraction of building materials, the holder and the occupier shall be entitled to compensation for the value at the date of revocation of their unexhausted improvements. Unexhausted improvement has been defined by the Act as:

> *"anything of any quality permanently attached to the land directly resulting from the expenditure of capital or labour by any occupier or any person acting on his behalf, and increasing the productive capacity the utility or the amenity thereof and includes buildings plantations of long-lived crops or trees, fencing walls, roads and irrigation or reclamation works, but does not include the result of ordinary cultivation other than growing produce*."

Developed Land is also defined in the generous manner under Section 50(1) as follows: land where there exists any physical improvement in road development services, water, electricity, drainage, building, structure or such improvements that may enhance the value of the land for industrial, agricultural or residential purposes.

It follows from the foregoing that compensation is not payable on vacant land on which there exist no physical improvements resulting from the expenditure of capital or labour. The compensation payable is the estimated value of the unexhausted improvements at the date of revocation.

Payment of such compensation to the holder and the occupier as suggested by the Act may appear confusing, as it raises the following question: Does it refer to the holder in physical occupation of the land or two different parties entitled to compensation, perhaps in equal shares?

The correct view appears to follow from the general tenor of the Act.
First, the presumption is more likely to be the owner of such unexhausted improvements. Secondly, the provision of section 6 (5) of the Act, which makes compensation payable to the holder and the occupier according to their respective interests, gives a pre-emptory directive as to who shall be entitled to what.

Again, the Act provides in section 30 that where any dispute arises as to the amount of compensation calculated in accordance with the provisions of section 29, such disputes shall be referred to by the appropriate Land Use and Allocation Committee. It is clear from section 47 (2) of the Act that no further appeal will arise from the decision of such a committee. If this is so, then the provision is not only retrospective but also conflicts with the fundamental principle of natural justice, which requires that a person should not be a judge in his own cause.

The Act must, in making this provision, have proceeded on the basis that the committee is a distinct body quite different from the Governor or the Local Government. It is submitted, however, that it will be difficult to persuade the public that this is so since the members of the committee are all appointees of the Governor. Where a right of occupancy is revoked for public purposes within the state of the Federation, or on the grounds of the land for the extraction of building materials, the quantum of compensation shall be as follows:

- *In respect of the land, an amount equal to the rent, if any, paid by the occupier during the year in which the right of occupancy was revoked.*
- *In respect of the building, installation or improvements therein, for the amount of the replacement cost of the building, installation or improvements to be assessed based on the prescribed method of assessment as determined by the appropriate officer, less any depreciation, together with interest at the bank rate for delayed payment of compensation. With regards to reclamation works, the quantum of compensation is such cost as may be substantiated by documentary evidence and proof to the satisfaction of the appropriate officer.*
- *In respect of crops on land, the quantum of compensation is an amount equal to the value as prescribed and determined by the appropriate officer.*

Where the right of occupancy revoked is in respect of a part of a larger portion of land, compensation shall be computed in respect of the whole land for an amount equal in rent, if any, paid by the occupier during the year in which the right of occupancy was revoked less a proportionate amount calculated in relation to the area not affected by the revocation; and any interest payable shall be assessed and computed in the like manner.

Where there are any building installations or improvements or crops on the portion revoked, the quantum of compensation shall follow that outlined in paragraph (ii) above, and any interest payable shall be computed in like manner.

1.8.4.5 The Nigerian Urban and Regional Planning Act CAP N138, LFN 2004

The Urban and Regional Planning Act is aimed at overseeing realistic, purposeful planning of the country to avoid overcrowding and poor environmental conditions. In this regard, the following sections are relevant:

- **Section 30 (3)** requires a building plan to be drawn by a registered architect or town planner.
- **Section 39 (7)** establishes that an application for land development would be rejected if such development would harm the environment or constitute a nuisance to the community.
- **Section 59** makes it an offence to disobey a stop-work order. The punishment under this section is a fine not exceeding ₦10,000 (Ten thousand naira) and in the case of a company, a fine not exceeding ₦50,000.
- **Section 72** provides for the preservation and planting of trees for environmental conservation.

1.8.4.6 Harmful Waste (Special Criminal Provisions) ACT CAP H1, LFN 2004

The Harmful Waste Act prohibits, without lawful authority, the carrying, dumping or depositing of harmful waste in the air, land or waters of Nigeria. The following sections are notable:

- **Section 6** provides for a punishment of life imprisonment for offenders as well as the forfeiture of land or anything used to commit the offence.
- **Section 7** makes provision for the punishment accordingly of any conniving, consenting or negligent officer where the offence is committed by a company.
- **Section 12** defines the civil liability of any offender. He would be liable to people who have suffered injury as a result of his offending act.

1.8.4.7 The Endangered Species Act, CAP E9, LFN 2004

This Act focuses on the protection and management of Nigeria's wildlife and some of their species in danger of extinction because of overexploitation. These sections are noteworthy:

- **Section 1** prohibits, except under a valid license, hunting, capture or trade in animal species, either presently or likely, in danger of extinction.
- **Section 5** defines the liability of any offender under this Act.
- **Section 7** provides for regulations to be made necessary for environmental prevention and control as regards the purposes of this Act.
-

Most of the proposed program locations are on virgin land that serves as wildlife habitats, which will be impacted by the programme. Hence, the programme activities shall be carried out to comply with the relevant provisions.

1.8.4.8 Inland Fisheries Act, Cap I10, LFN 2004

The Inland Fisheries focused on the protection of the water habitat and its species. The following section is relevant:

Section 6 prohibits the taking or destruction of fish by harmful means. This offence is punishable with a fine of ₦3,000 or an imprisonment term of 2 years, or both. One of the integral components of solar hybrid systems is battery storage. During the operational phase of the project, there may be the possibility of battery leakages, which may leach into water bodies for project locations with flowing rivers. The chemical contents of these batteries are toxic to aquatic life (fisheries), which necessitates the relevance of this Act.

1.8.4.9 National Commission for Museums and Monuments Act, Cap. N19, LFN 2004

The Act provides for the dissolution of both the Antiquities Commission and the Federal Department of Antiquities and to create a National Commission for Museums and Monuments, with the responsibilities to establish and administer national museums, antiquities and monuments, including antiquities, science and technology, warfare, African, Black and other antiquities, arts and crafts, architecture, natural history and educational services among others. Sections 12 to 18 provide the process/steps for the declaration of antiquities as national monuments, while section 19 deals with the restriction of excavations for the purpose of finding antiquities as well as the issuance of permits and section 20 deals with accidental discoveries. In case of any accidental find, the Commission shall be notified within seven (7) days.

1.8.4.10 The Factories Act, 1987 (Factory Act cap 126, LFN, 1990)

The Factories Act, as contained in the Laws of the Federation of Nigeria 1990, seeks to legislate and regulate the conduct of health and safety in the Nigerian work environment. It was enacted in June 1987 with the objective of protecting the workers and other professionals against exposure to occupational hazards. The Director of Factories at the Federal Ministry of Employment, Labour and Productivity is responsible for the administration of the provisions or requirements of this Act. Section 13 allows an inspector to take emergency measures or request that emergency measures be taken by a person qualified to do so, in cases of pollution or nuisances. This Act deals with working conditions at work sites, including construction sites, such as those to be undertaken under the EEP III. Hence, the occupational requirements applicable to construction sites, as well as other work sites to be used by the program, shall be subject to the provisions of this Act.

1.8.4.11 Labour Act, Cap. L1, LFN 2004

This Act deals with labour issues, including payment of wages, recruitment, discipline, employee welfare, employment of women and child labour. Sections 54 to 58 which deal with employment of women, prescribed period of absence from work for nursing mothers and allows her half an hour twice a day during her working hours to attend to the baby for a period of up to six months after she resumes work. Section 55 also exempted women from night work, except when they are employed as nurses. Sections 59-64 deal with the employment of young adults.

1.8.4.12. Wages Boards and Industrial Councils Act, Cap. W1, LFN 2004

The Act provides for the establishment of a National Wages Board and Area Minimum Wages Committee for States and for Joint Industrial Councils for particular industries. It empowers the Minister to order or direct that an industrial wages board be established to perform, in relation to the workers described in the order and their employers, the functions specified in the provisions of this Act, including the minimum wage. The minimum wage is currently ₦30,000.00 per month, and all individuals contracted/employed in relation to this programme shall not earn less than the minimum wage.

1.8.4.13 Employees' Compensation Act, 2010

The Employees' Compensation Act, 2010 establishes a more comprehensive compensation scheme for employees who suffer work-related injuries, occupational diseases, disabilities or death arising out of or in the course of employment. It also provides benefits for dependants of deceased employees and is administered through the Nigeria Social Insurance Trust Fund (NSITF).

1.8.4.14 National Environmental Standards & Regulations Enforcement Agency (NESREA) Act, 2007

Administered by the Ministry of Environment, the National Environment Standards and Regulations Enforcement Agency (NESREA) Act of 2007, replaced the Federal Environmental Protection Agency (FEPA) Act. It is the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources. The following sections are worth noting:

- **Section 7** provides authority to ensure compliance with environmental laws, local and international, on environmental sanitation and pollution prevention and control through monitoring and regulatory measures.
- **Section 8 (1)(K)** empowers the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances, and other forms of environmental pollution and sanitation.
- **Section 27** prohibits, without lawful authority, the discharge of hazardous substances into the environment. This offence is punishable under this section, with a fine not exceeding 1,000,000 (One Million Naira) and an imprisonment term of 5 years. In the case of a company, there is an additional fine of ₦50,000 for every day the offence persists.

1.8.4.15 National Environmental Regulations:

Section 34 of the NESREA Act, 2007, empowers the Minister of Environment to make regulations for a safe and sustainable environment. In exercise of this power, the minister issued the national environmental

regulations covering various environmental components and sectors of development. The regulations relevant to the programme are as follows:

- National Environmental (Energy Sector) Regulations, 2014. S.I. 63.
- National Environmental (Electrical/Electronic Sector) Regulations, 2011, S.I. No. 23
- National Environmental (Wetlands, Riverbanks and Lake Shores) Regulations, 2009. S. I. No. 26.
- National Environmental (Sanitation and Wastes Control) Regulations, 2009. S. I. No. 28.
- National Environmental (Watershed, Mountainous, Hilly and Catchment Areas) Regulations, 2009. S. I. No. 27.
- National Environmental (Sanitation and Wastes Control) Regulations, 2009. S. I. No. 28.
- National Environmental (Noise Standards and Control) Regulations, 2009. S. I. No. 35.
- National Environmental (Air Quality Control) Regulations, 2013, S. I. No. 64,
- National Environmental (Soil Erosion and Flood Control) Regulations, 2010. S. I. No. 12.
- National Environmental (Surface and Groundwater Quality Control) Regulations, 2010. S. I. No. 22.
- National Environmental (Control of Vehicular Emissions from Petrol and Diesel Engines) Regulations, 2010. S. I. No. 20.

1.8.4.16. EIA Procedural Guidelines:

This procedure prescribes the steps to be followed in the EIA process from project conception to commissioning and post-commissioning impact mitigation to ensure that the program is implemented with maximum consideration of environmental factors. This ESIA study will be conducted in compliance with this guideline.

1.8.4.17 EIA Sectoral Guidelines (Infrastructures):

This provides general guidelines for EIA of projects in the infrastructure sectors of Nigeria, with specific details for sub-sectors.

1.8.4.18. FMEnv ESMP Guidelines for Solar Mini-Grid Projects in Nigeria

The ESMP Guidelines for Solar Mini-Grid Projects in Nigeria was developed as an abridged form of the EIA Procedures Guidelines with the aim of simplifying the method of preparing ESMPs for proposed solar mini-grid projects. The simplified method is to also optimise the mini-grid projects EIA timeline and the cost of development.

1.8.5 International Legislation

The International Conventions, to which Nigeria is a signatory, relevant to this programme are as follows:

- African Convention on the Conservation of Nature and Natural Resources
- Convention on Biological Diversity
- Endangered Species (Control of International Trade and Traffic)
- Conservation of Migratory Species of Wild Animals 1973
- Framework Convention on Climate Change 1992
- Convention to Combat Desertification 1994
- Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW)
- Human and Peoples' Rights on the Rights of Women in Africa 2005
- Civil and Political Rights Covenant

- Economic, Social and Cultural Rights Covenant
- Convention on the Elimination of All Forms of Violence Against Women
- Convention on the Rights of the Child

1.8.6 Institutional Framework

This section highlights the relevant institutions through which the planning and implementation of the program will be affected. Several institutions have been identified and will be involved in the overall implementation of this programme. These include:

- The Federal Government of Nigeria (FGN)
- Federal Ministry of Power
- Transmission Company of Nigeria (TCN)
- Federal Ministry of Environment (FMEnv)
- Nigerian Electricity Regulatory Commission (NERC)
- National Environmental Standards and Regulatory Enforcement Agency (NESREA)
- National University Commission (NUC)
- Relevant State Agencies: State Ministry of Lands, State Ministry of Environment and State Environmental Protection Agencies
- Local Government Authority (LGA)

The responsibilities and roles of each of the institutions are discussed below.

1.8.6.1 The Federal Government of Nigeria

Section 20 of the Constitution of Nigeria makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria. Sections 33 and 34, which guarantee fundamental human rights to life and human dignity, respectively, can also be linked to the need for a healthy and safe environment to give these rights effect. The Executive Council of the Federation approves all national policies including the National Policy on Environment.

1.8.6.2 Federal Ministry of Environment

The Federal Ministry of Environment is responsible for the overall environmental policy of the country. It has the responsibility for EIA implementation, approval and issuance of certificates. It has developed certain guidelines and regulations to protect the environment and promote sustainable development. It will monitor the implementation of mitigation measures when the project commences. They can also issue directives to the project on specific actions related to the environment in the project area. The Ministry normally involves the states and sometimes local governments in this responsibility, depending on the specific activity.

1.8.6.3 The National Environment Standards and Regulations Enforcement Agency (NESREA) ensure the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources are monitored and complied with. NESREA ensures that the operational phase of the solar power system mini-grid project complies with national environmental standards and regulations.

1.8.6.4 The National Universities Commission

The National Universities Commission (the Commission) was established in 1974 by the National Universities Commission Act CAP N81 to advise the Federal and state governments of all aspects of university education and the general development of universities in Nigeria. It is the dynamic regulatory agency acting as a catalyst for positive change and innovation for the delivery of quality university education in Nigeria. It is also the agency for channeling all external aid to the universities in Nigeria; To receive block grants from the Federal Government and allocate them as appropriate.

1.8.6.5 The Federal Ministry of Power

The Federal Ministry of Power is the policy-making arm of the Federal Government with the responsibility for the provision of power in the country. The Ministry is guided by the provisions of the Electricity Act No 28 of 1988, the National Electric Power Policy, 2001, the Electric Power Sector Reform Act, 2005, the Roadmap for Power Sector Reform, 2010, and the National Energy Policy, 2013, as described earlier in section 1.6.4. The following parastatals are under the ministry: Energy Commission of Nigeria (ECN) Nigerian Electricity Regulatory Commission (NERC), Power Holding Company of Nigeria (PHCN) Rural Electrification Agency (REA). The responsibilities of the Federal Ministry of Power are as follows:

- Initiating and formulating broad policies and programmes on the development of the power sector. Initiating concessions in the power sector. Licensing of electrical contractors and electric generating sets of 1MW capacity and below
- Conducting investigation on electrical accidents and to ensure safety in the electricity industry in Nigeria
- Conducting statutory tests and certification of electric poles (concrete, wooden, steel etc.) and other major electrical materials before they are used on the grid and networks in Nigeria
- Implementing renewable energy programmes/ initiatives (solar, wind, biomass, small hydro etc.) Coordinating activities of the power sector
- Handling policy matters relating to research and development in the power sector
- Promoting the development of hydro power plants through public-private partnership (PPP), participating in bilateral and multilateral relations affecting the power sector
- Facilitating the overall coordination of the activities of the parastatals under their supervision

1.8.6.6 Nigerian Electricity Regulatory Commission (NERC)

The Nigerian Electricity Regulatory Commission (NERC) is an independent regulatory agency. NERC was established in 2005 as part of the economic reform agenda of the Obasanjo administration. The Electric Power Sector Reform Act of 2005 was the legislation that led to the establishment of NERC.

The Commission is required to carry out the following, amongst others:

i. Monitor and regulate the activities of the electricity industry in Nigeria.
ii. Issue licenses to market participants; and

iii. Ensure compliance with market rules and operating guidelines.

In order to create an enabling investment climate for rural electrification projects, NERC established the Mini-Grid Regulation in 2016; regulatory guidelines for mini-grids less than 100 kW and a light-handed regulation for mini-grids between 100 kW und 1 MW.

1.8.6.7 Transmission Company of Nigeria (TCN)

TCN emerged from the defunct National Electric Power Authority (NEPA) as a product of the merger of the Transmission and Operations sectors on April 1, 2004. TCN was incorporated in November 2005. Being one of the 18 unbundled Business Units under the Power Holding Company of Nigeria (PHCN), TCN was issued a transmission License on 1st July 2006. It was subsequently issued two licenses on June 10, 2013, for electricity transmission and system operations.

1.8.6.8 Rural Electrification Agency

The Rural Electrification Agency was set up by Section 88 of the Electric Power Sector Reform Act 2005 as the Implementing Agency of the FGN tasked with the electrification of rural and unserved communities. The mission is to provide access to a reliable electric power supply for rural dwellers irrespective of where they live and what they do, in a way that would allow for a reasonable return on investment through an appropriate tariff that is economically responsive and supportive of the average rural customer.

1.8.6.9 Federal Ministry of Women Affairs and Social Development

Promote actions to achieve the National Gender Policies and a gender budget among policymakers. The goals of the gender policy, among others, include:

- Eliminate cultural/religious gender-based biases and harmful cultural and religious practices which rise to inequalities in gender-role relations in Nigerian society. A culture that is amenable to development must be dynamic.
- Tap the potential of women for development.
- Eliminate all forms of gender-based violence.
- Ensure equal access to women, boys and girls to both formal and informal education. Women's education is a priority because it is the key to gender equity, justice, and poverty reduction, improved skills and technological knowledge, as well as the general socioeconomic development of the nation.

1.8.6.10 State Institutions

Kano State Ministry of Environment

The Ministry of Environment is currently responsible for environmental service matters and resources in the state. Other objectives include initiating formulation, execution, and monitoring of all issues relating to all environmental matters, solid waste management, and mineral resources. A recent law passed established the Kano State Environmental Law 2021.

Kano State Ministry of Women Affairs and Social Development

The ministry seeks to empower women and youth, promote the participation of women in governance, pay attention to women in rural areas, enhance the economic self-reliance of women, create awareness, and campaign against gender-based violence, etc.

Kano State Lands and Survey

This Ministry was created for the purpose of overseeing the land resources in the state. They are also charged with the responsibility to plan, devise and implement the state policies on land and its resources.

1.8.7 Funding Agency Requirements

This programme is funded by the World Bank. Therefore, the World Bank Environmental and Social safeguard Standards will be integrated in the project cycle as well as other national and international environmental and social protection requirements, to comply with the best international practices. Both the main environmental and social requirements that the project needs to comply with are described in the following sections.

1.8.7.1 The World Bank Environmental and Social Safeguard Standards

The World Bank's policies on environmental and social safeguards are the fulcrum of its support towards sustainable poverty reduction, particularly in developing countries. The policies aimed at preventing and mitigating undue harm to the people in the ESIA of the proposed Solar Hybrid Power Plant and Associated Infrastructure in POLAC. As indicated in Table 1.1, the compliance status of the proposed along the various phases is presented below.

The framework was developed in alignment with applicable national environmental regulations and relevant Environmental and Social Framework (ESF) Environmental and Social Standards (ESS), particularly ESS1 (Assessment and Management of Environmental and Social Risks and Impacts), ESS2 (Labour and Working Conditions), ESS3 (Resource Efficiency and Pollution Prevention and Management), ESS4 (Community Health and Safety), and ESS10 (Stakeholder Engagement and Information Disclosure).

Table 1.1: Safeguard Compliance Matrix for the Proposed Project

1. Pre-Construction Phase

Aspect	Nigeria Legal Requirements	World Bank Standards Triggered	International Agreements	Key Compliance Actions
Environmental Assessment	EIA Act (Cap E12 LFN 2004)	ESS1: Assessment of Environmental & Social Risks	Paris Agreement	Conduct EIA/ESIA; obtain approval from the Federal Ministry of Environment
Land Acquisition	Land Use Act (1978)	ESS5: Land Acquisition & Resettlement	International Labour Organization (land & livelihood rights)	Secure land titles; compensate affected persons
Stakeholder Engagement	National environmental guidelines	ESS10: Stakeholder Engagement	Aarhus Convention (principles)	Public consultations; disclosure of project info
Biodiversity Screening	NESREA Act	ESS6: Biodiversity Conservation	Convention on Biological Diversity	Identify sensitive habitats; avoid critical areas
Permits & Licensing	NERC mini-grid regulation	ESS1 compliance	NA	Obtain generation/distribution permits

2. Construction Phase

Aspect	Nigeria Legal Requirements	World Bank Standards Triggered	International Agreements	Key Compliance Actions
Occupational Health & Safety	Factories Act; Labour Act	ESS2: Labor & Working Conditions	International Labour Organization conventions	Provide PPE; enforce safety procedures
Waste Management	NESREA Regulations	ESS3: Resource Efficiency & Pollution Prevention	Basel Convention	Proper disposal of hazardous waste (e.g., batteries)
Community Health & Safety	Public Health Act	ESS4: Community Health & Safety	WHO guidelines	Traffic management; site safety measures
Noise & Air Pollution	NESREA Air Quality Regulations	ESS3: Resource Efficiency & Pollution Prevention	Paris Agreement	Control emissions, dust, and noise
Cultural Heritage	National Commission for Museums Act	ESS8: Cultural Heritage	UNESCO conventions	Chance finds procedures in place

3. Operation & Maintenance Phase

Aspect	Nigeria Legal Requirements	World Bank Standards Triggered	International Agreements	Key Compliance Actions
Energy Efficiency	National Energy Policy	ESS3: Resource Efficiency	Paris Agreement	Optimize system performance; reduce losses
Waste (Batteries, Panels)	NESREA e-waste regulations	ESS3: Resource Efficiency	Basel Convention	Safe recycling/disposal systems
Labor Conditions	Labour Act	ESS2: Labor & Working Conditions	International Labour Organization	Fair wages, worker rights compliance
Community Relations	Local governance laws	ESS10: Stakeholder Engagement	NA	Maintain grievance redress mechanism
Safety & Risk Management	Nigerian Electricity Safety Code	ESS4: Community Health & Safety	NA	Routine inspection and maintenance

4. Decommissioning Phase

Aspect	Nigeria Legal Requirements	World Bank Standards Triggered	International Agreements	Key Compliance Actions
Environmental Restoration	EIA Act (closure requirements)	ESS1: Assessment of Environmental & Social Risks	Convention on Biological Diversity	Site rehabilitation and restoration
Waste Disposal	NESREA Regulations	ESS3: Resource Efficiency	Basel Convention	Dispose of solar panels, batteries safely
Worker Safety	Labour Act	ESS2: Labor & Working Conditions	International Labour Organization	Safe dismantling procedures
Community Safety	Public Health Act	ESS4: Community Health & Safety	NA	Secure site; prevent hazards post-closure
Asset Removal & Land Return	Land Use Act	ESS5: Land Acquisition & Resettlement	NA	Restore land to its original or agreed condition

1.9 Institutional Arrangements for Environmental and Social Management

REA is responsible for selecting Engineering, Procurement and Construction (EPC) contractor (through competitive process) to build, operate and maintain the proposed power plant, and also build and equip the associated training center. The selected EPC will also be considered for a ten-year operation and maintenance (O&M) contract for the power plant. In the long run, the University will be responsible for operating and maintaining the Project. REA has established a Project Management Unit (PMU) which includes experienced Environmental and Social Safeguard Specialists. The REA-PMU will provide oversight functions for the management of potential environmental and social issues associated with the Project throughout its life cycle. The PMU, in conjunction with the University's Department of Works and Physical Planning, will monitor the hired contractor's E&S performance. The implementation of mitigation measures for potential environmental and social impacts associated with the Project (at various stages) will also be monitored by FMEnv, NESREA, Kano State Ministry of Environment and other relevant regulatory agencies, as part of their statutory responsibilities. In addition, the World Bank will provide overall supervision, facilitation and coordination of the Project, and monitor Project performance indicators.

1.10. Report on the ESIA Structure

In line with the FMEnv guidelines, this report is structured as follows:

- Preliminary Sections: containing table of contents, lists of ESIA preparers, Executive Summary, amongst others.
- Chapter One: Introduction containing an overview of the proposed Project, the ESIA objectives and study approach, and applicable legal and administrative framework.
- Chapter Two: Project Location and Justification, containing a rationale for the proposed Project as well as the analysis of Project alternatives and development options.
- Chapter Three: Project Description containing the technical elements of the Project. It concisely describes the proposed Project and its geographic and temporal context, including the Project's associated infrastructure.
- Chapter Four: Description of the Environment. It details the baseline data that is relevant to decisions about the Project location, design, development, and operation.
- Chapter Five: Potential and Associated Impacts. This takes into account all relevant environmental and social risks and impacts of the proposed Project, including cumulative impacts.
- Chapter Six: Mitigation measures for the identified negative environmental and social impacts, as well as the enhancement measures for the identified positive impacts.
- Chapter Seven: is the ESMP. It summarizes the key environmental and social measures and actions, and the timeframe, including responsibility for the implementation of the recommended measures. Aso, discusses the decommissioning and remedial plan for the proposed project.
- Chapter Eight: describes the stakeholder engagement activities carried out during the ESIA and an overview of the grievance redress mechanism for the Project.
- Chapter Nine: Conclusion and Recommendations

The report also includes references and appendices.

CHAPTER TWO
PROJECT JUSTIFICATION

2.1 General

This chapter presents the justification for the proposed solar-hybrid power plant and associated infrastructure in the Nigeria Police Academy, Kano State, as part of the Federal Government of Nigeria (FGN) proposed Nigeria Electrification Project Phase III under the Rural Electrification Agency. It also includes the description of alternatives and development options considered for the proposed Project.

2.2 Need for the Project

Federal Universities in Nigeria continue to be the preferred option for a large proportion of candidates seeking admission into tertiary institutions. Despite this demand, many universities face persistent challenges due to inadequate electricity supply from the national grid. The University currently receives an average of only about two hours of grid-supplied electricity per day. As a result, most universities depend heavily on diesel-powered generators to meet their energy needs, leading to high operational costs, increased maintenance burdens, and adverse environmental impacts.

In response to the widespread power supply deficit, the Federal Government of Nigeria (FGN) is implementing the Nigeria Electrification Project (NEP), an innovative initiative aimed at expanding electricity access to off-grid and underserved areas through renewable energy solutions. The project is being implemented by the Rural Electrification Agency (REA) with co-financing from the World Bank.

A key component of the NEP is the Energizing Education Programme (EEP), which seeks to deliver dedicated, clean, and reliable electricity to Federal Universities and their affiliated Teaching Hospitals nationwide. The current phase of the programme targets seven universities and two affiliated teaching hospitals. Beyond improving energy access, the EEP also supports Nigeria's commitment to climate action by contributing to the country's Nationally Determined Contributions (NDCs) under the Paris Agreement, which aim for a 20–30 percent reduction in carbon emissions by 2030.

The proposed project under the NEP is expected to substantially alleviate the power supply challenges currently confronting the University, while generating multiple positive spill-over benefits. Associated infrastructure, including a renewable energy training centre, will enhance capacity building and support professional certification in renewable energy technologies. In addition, the provision of solar-powered street lighting will improve campus security through better illumination, thereby creating a safer and more conducive learning and working environment.

2.3 Value of the Project

The Nigeria Electrification Project (NEP) is a major initiative by the Federal Government of Nigeria, implemented by the Rural Electrification Agency with support from the World Bank, to expand access to reliable electricity, especially in underserved and off-grid communities. One of its key components is the Energizing Education Programme (EEP), which focuses specifically on providing sustainable power to federal universities and teaching hospitals. The US $150 million sovereign loan facility approved by the World Bank is part of the broader NEP financing structure. Because it is a *sovereign loan*, it is borrowed

directly by the Federal Government of Nigeria (not private entities), meaning the government is responsible for repayment. The funds are used to support large-scale electrification projects, including solar hybrid power systems, mini-grids, and infrastructure upgrades across educational institutions.

2.4 Project Benefits

The proposed Project is envisaged to have a range of associated benefits, since the importance of gaining access to reliable and steady power supply cannot be overemphasized. Some of the benefits are a function of the objectives of the Project, while others are a function of the way in which the Project is designed to meet its objectives.

- The potential benefits of the proposed Project include but are not necessarily limited to the following:

- Stimulation of academic and research activities within the University as a result of access to constant and reliable power supply, thereby promoting educational advancement.

- Increase in social interactions within the University. There will be enhanced security in the University as a result of more streetlights for illumination, which would help keep off opportunistic crimes and gender-based violence.
- Enhancement of learning in renewable energy, leading to certification as a result of training centre to be provided as part of the Project.
- Improvement in livelihood-enhancing activities within the University.
- Direct and indirect employment opportunities during Project development and operation. The employment opportunities will lead to the acquisition of new skills and the introduction of all manners of income-generating spill-over effects.
- Increase in local and regional economy through the award of contracts and the purchase of supplies for Project development.
- Increase in financial and technical collaborations between the FGN, the University, REA, World Bank, and other relevant Ministries, Departments, and Agencies (MDAs).

- Contributing to the Nigeria's NDC to cut carbon emissions by 20 % to 30 % by the year 2030, under the Paris Agreement.

2.5 Envisaged Sustainability

2.5.1 Technical Sustainability

The Project is an Energy-as-a-Service (EaaS) model, the same Energy Service Company (ESCO) responsible for the design and construction of the project will also manage its operations and maintenance (O&M) throughout the service period.

The design and construction phases will be supervised by qualified engineers from the REA and the University's Department of Works and Physical Planning to ensure compliance with technical specifications and quality standards. The EPC contractor will also develop standard operating manuals and relevant operational documentation for the Project.

In addition, adequate capacity-building and technical training will be provided to designated University personnel to support effective day-to-day operations and ensure the long-term technical sustainability of the project.

2.5.2 Environmental Sustainability

The project aligns with the Federal Government of Nigeria's (FGN) commitment to minimizing greenhouse gas (GHG) emissions as part of its broader climate change mitigation and adaptation agenda. According to the World Resources Institute Climate Analysis Indicators Tool (WRI CAIT), Nigeria's GHG emissions increased by approximately 25 percent between 1990 and 2014, representing an average annual growth of about 1 percent, while Gross Domestic Product (GDP) expanded by about 245 percent over the same period, averaging 5.5 percent annually. Although economic growth outpaced emissions growth, Nigeria's emissions intensity remained high; in 2014, GHG emissions relative to GDP were about 1.6 times the global average, highlighting significant opportunities for improvement (USAID, 2019). Consequently, the promotion and adoption of renewable energy for electricity generation, a critical driver of sustainable development, has become a central policy priority of the FGN.

Furthermore, the establishment of the Rural Electrification Agency Project Management Unit (REA-PMU), which comprises experienced Environmental and Social Safeguards Specialists, provides institutional capacity for effective oversight and environmentally responsible implementation of the project. In addition, the conduct of this ESIA at an early stage of project development, together with the commitment to implement the recommended mitigation measures and the Environmental and Social Management Plan (ESMP), demonstrates a proactive approach to preventing, minimizing, and managing potential environmental and social risks. Collectively, these measures are designed to ensure the long-term environmental sustainability of the project

2.5.3 Economic Sustainability

The Proposed Nigeria Electrification Project, implemented by the Rural Electrification Agency (REA) with financing support from the World Bank, is designed to be economically sustainable in both the short and long term through prudent project design, cost efficiency, and strong institutional arrangements.

At the project level, the deployment of solar-hybrid mini-grid systems significantly reduces dependence on diesel generators, which are characterized by high fuel, transportation, and maintenance costs. By substituting diesel-based generation with solar energy, the project delivers substantial savings in operational expenditure over its lifecycle. While initial capital investment in renewable energy infrastructure is relatively high, the long lifespan of solar PV systems and declining technology costs ensure lower levelized cost of electricity (LCOE) over time, making the systems economically competitive and financially viable.

The project also enhances institutional financial sustainability for beneficiary Federal Universities. Reliable and predictable electricity supply reduces recurrent spending on diesel procurement and generator maintenance, allowing institutions to reallocate limited financial resources toward core academic, research, and healthcare functions. Improved power availability also minimizes disruptions to academic calendars and research activities, indirectly strengthening institutional productivity and value for money.

From a macroeconomic perspective, the project supports Nigeria's broader economic sustainability objectives by reducing fossil fuel consumption, lowering foreign exchange expenditure on imported diesel, and contributing to energy security. Local content participation in system installation, operation, and maintenance further stimulates job creation and skills development, supporting local economies and reducing long-term reliance on external technical expertise.

The project's financing structure, based on concessional loans and development partner support, enhances affordability and reduces fiscal pressure on the Federal Government. The World Bank's involvement ensures robust financial appraisal, risk management, and compliance with international best practice, while the phased implementation approach allows lessons learned to be integrated into subsequent deployments, improving cost efficiency and performance.

In addition, the inclusion of capacity-building components, such as renewable energy training centres and skills transfer to local technicians, strengthens long-term economic sustainability by ensuring that system operation and maintenance can be managed locally at lower cost. This reduces downtime, extends asset life, and protects the value of the investment.

Overall, the economic sustainability of the Proposed Nigeria Electrification Project Phase II is underpinned by reduced operating costs, efficient use of public resources, long-term financial savings for beneficiary institutions, and positive spill-over effects on local and national economies. When combined with its environmental and social benefits, the project represents a cost-effective and sustainable investment that supports Nigeria's development goals and clean energy transition

2.5.4 Social Sustainability

Stakeholder consultation was undertaken as an integral part of the ESIA process to ensure that all relevant stakeholders were allowed to contribute to the Project at an early stage of development. This engagement process also helped to establish a strong foundation for building and maintaining positive relationships with stakeholders. The initial stakeholder engagement activities conducted during the ESIA are documented and presented in this report.

To ensure sustained and structured engagement throughout the Project lifecycle, a Stakeholder Engagement Plan (SEP) will be developed and implemented. In addition, the Rural Electrification Agency (REA) has established a Grievance Redress Mechanism (GRM) for the Project. The GRM provides a clear and accessible communication channel through which stakeholders can submit complaints or concerns related to the Project, and it ensures that such grievances are addressed in a timely and effective manner. Comprehensive details of the stakeholder consultations conducted to date for the proposed Project are provided in Chapter 9 of this report.

2.6 Site / Project Selection

2.6.1 Site Alternatives

The preferred site is situated about 9.6Ha within the POLAC campus. The selection of this site was guided by several key considerations, including: (i) the absence of rocky outcrops that could hinder the installation of solar panels; (ii) the lack of ecologically sensitive areas or cultural heritage resources within and around

the site; (iii) good accessibility through the existing internal road network; (iv) the feasibility of achieving a direct connection to the existing switchyard; and (v) enhanced security within the campus environment.

Furthermore, the survey revealed the following key findings:

I. Topography: The site is predominantly gently undulating with a spur in the near right middle with which gave two general slopes towards east and west. The eastern slope is steeper than that of the western side which is gentler. The maximum and minimum elevations are found to be 421.655 m and 417.335 m respectively. The difference between the highest and lowest points on the site is approximately 4.320 meters. This natural slope is favorable for drainage.

II. Site Area: The total area within the surveyed perimeter is approximately 9.595 Hectares (9595.91 sq meters).

III. Vegetation: The site is covered by farmland with a few mature trees.

IV. Obstructions: There is no seasonal stream / existing footpath / overhead low-voltage power line that traverses the site. However, a small pond was also identified in the south-central area of the project site.

V. Accessibility: The site is accessible via an existing tarred road that runs parallel to eastern and western sides of the site.

VI. Shading Analysis: The preliminary data confirms no significant nearby structures or hills that would cause substantial shading on the proposed array.

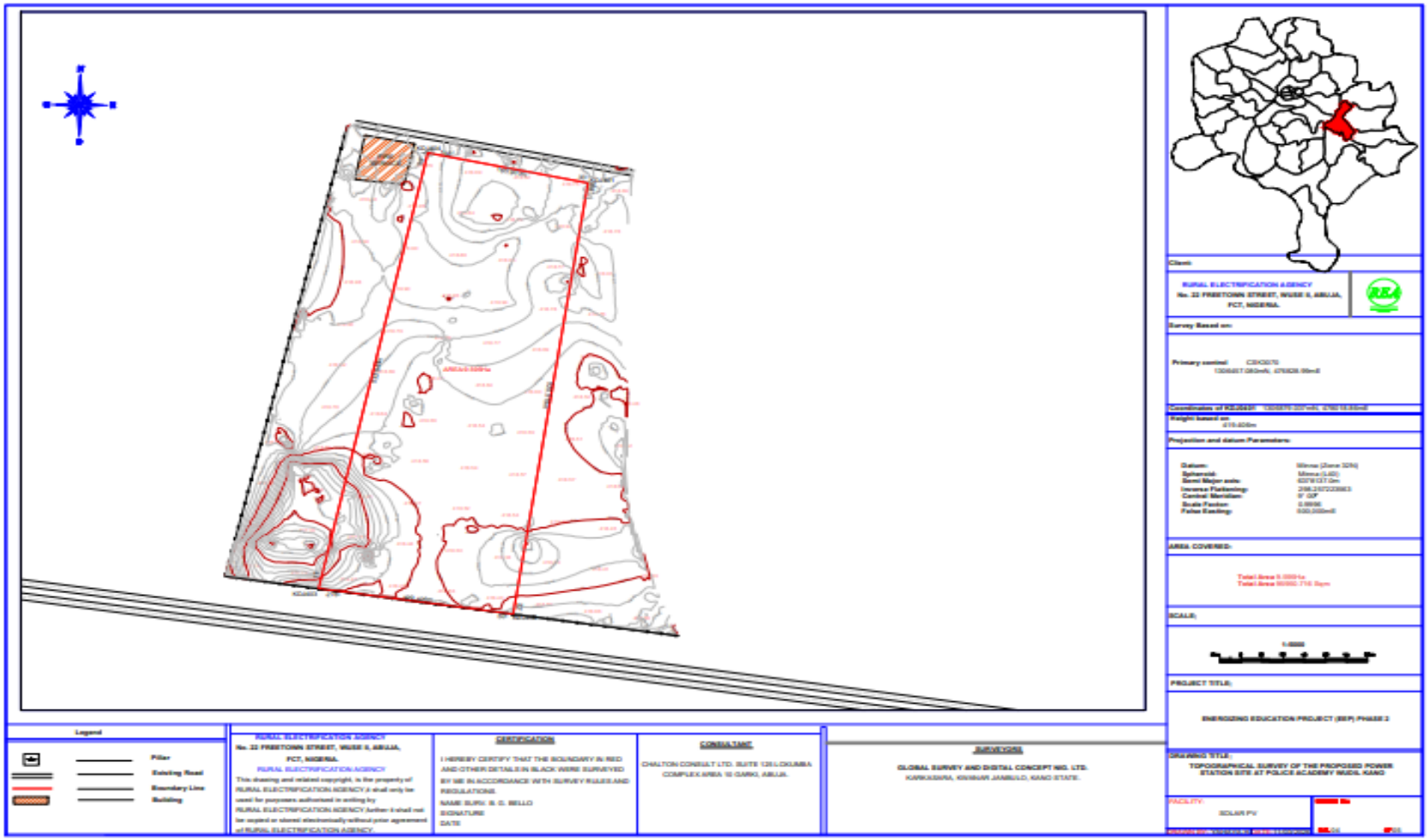

Figure 2.1: Topo map of the Selected Site

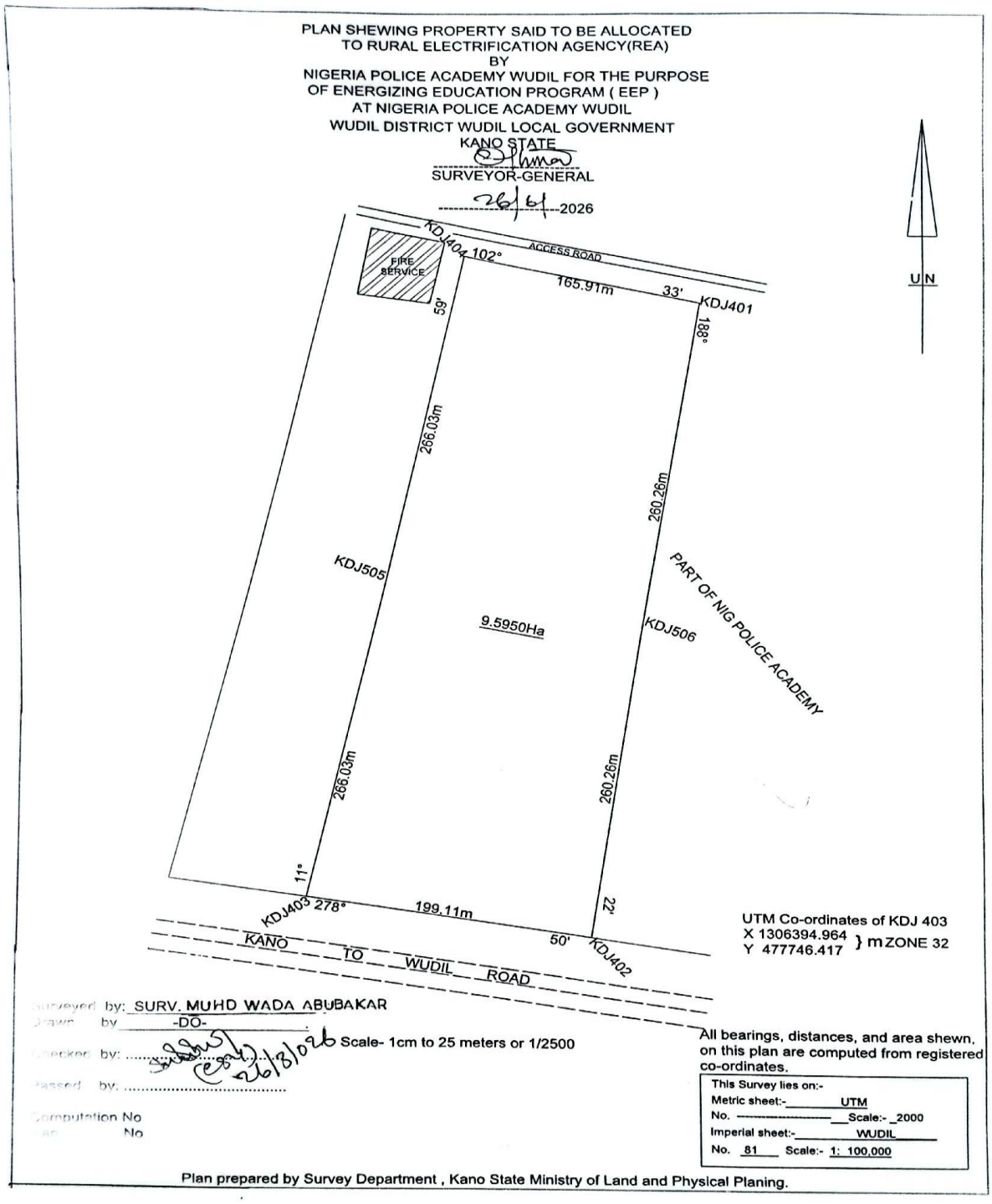

Figure 2.2: Approved Survey Map of the proposed Site within POLAC

2.6.2 Alternatives Considered within the Context of the Proposed Solar-Hybrid Power Plant

The power plant to be provided as part of proposed Project in POLAC has been conceptualized as a renewable energy source (solar technology) since that is part of the objectives of the EEP initiative (i.e. carbon emission reduction). Thus, this section specifically focuses on the alternatives considered within the proposed solar-hybrid power plant and eliminates discussion on other possible sources of power generation in Nigeria such as the use of natural gas-fired power plant, coal-fired plant, oil-fuel plant, etc.

2.6.2.1 Overview

Solar power generation is currently one of the fastest-growing areas in renewable energy. Beyond panel production, it does not emit any significant GHGs. Compared to alternative renewable generation technologies such as wind turbines or biofuel generators, solar energy is produced by converting the sun's radiation – a process void of any smoke, gas, or other chemical by-product, which makes this technology to meet the clean development mechanism of the Kyoto Protocol. This is the main driving force behind all green energy technology, as nations attempt to meet climate change obligations in curbing emissions.

The use of solar energy for the proposed power plant in POLAC will significantly avoid the generation of GHG emissions associated with fossil-fuel power plants. Thus, the proposed Project will help contribute to Nigeria's NDC on climate change. In addition, the high solar irradiation in Yobe State (as indicated in Figure 2.1) will be able to support the proposed power plant.

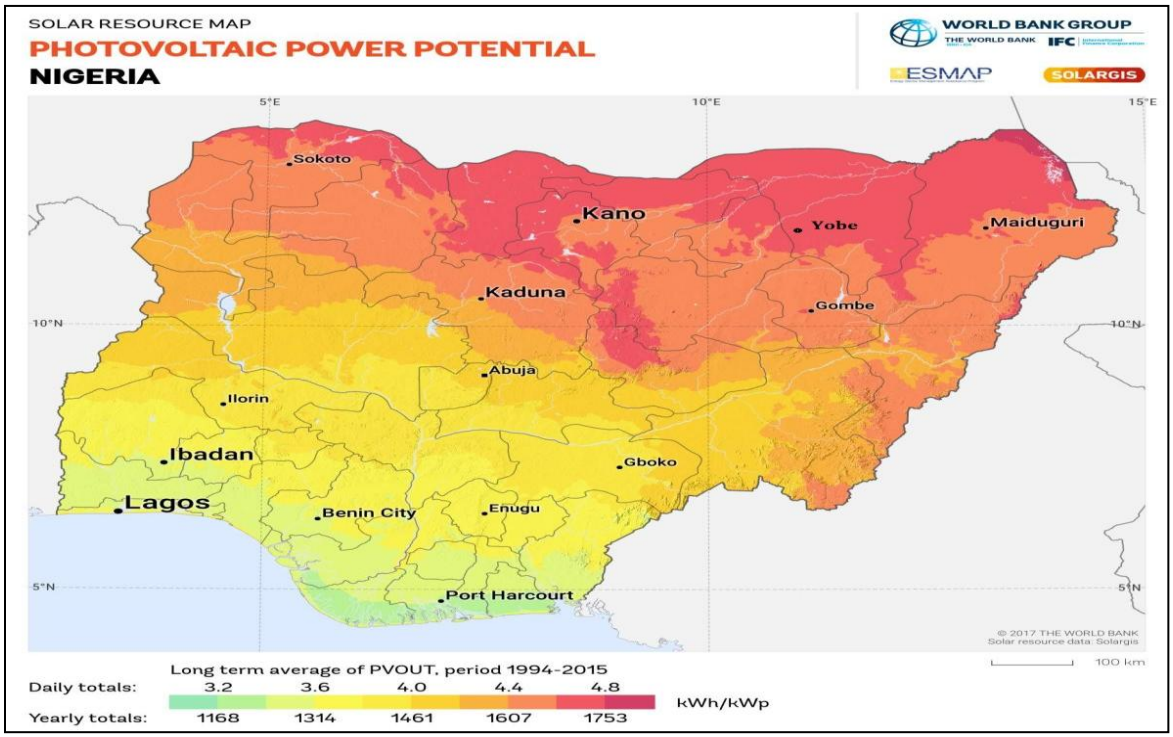

Figure 2.3: Photovoltaic power potential of Nigeria Source: © 2017 The World Bank, Solar resource data: Solargis

2.6.2.2 Solar Power Technology Alternatives

The solar technologies considered for the proposed power plant in POLAC are:

For most modern solar projects, Monocrystalline PV panel design is generally considered the best option because it offers:

- Higher efficiency (more power generation per square meter)
- Better performance in low-light conditions
- Longer lifespan (typically 25+ years)
- Lower space requirement
- Better aesthetic appearance

Table 2.1: Common PV Panel Types

Type	Efficiency	Cost	Performance	Best Use
Monocrystalline	High (18–24%)	Higher	Excellent	Commercial and institutional projects
Polycrystalline	Moderate (15–18%)	Moderate	Good	Budget-sensitive projects
Thin-Film	Lower (10–13%)	Lower	Fair	Large open areas with low structural load

Recommended Design

For a university or institutional solar project with continuous electricity demand, a grid-connected monocrystalline PV system with battery backup is usually the most suitable because it provides:

- Reliable power supply
- Reduced dependence on generators
- Higher energy output
- Lower long-term operating costs

2.6.3 Battery Types Alternative

The proposed solar-hybrid power plant in Kashere is an off-grid system, which will involve the storage of power. The batteries for the proposed power plant would be required to meet the demands of heavy cycling (charging and discharging) and irregular full recharging. Table 2.2 presents battery types and alternatives for the proposed project.

Table 2.2: ***Battery Types Alternative***

Battery Type	Technology Description	Advantages	Disadvantages	Lifespan	Maintenance Requirement	Suitability for Solar Hybrid Station
Lithium-ion Battery	Rechargeable battery with high energy density	High efficiency, fast charging, compact size, long lifespan	High initial cost, requires BMS	10–15 years	Low	Excellent for commercial and institutional systems
Lithium Iron Phosphate Battery	Advanced lithium battery with improved safety and stability	Very safe, long cycle life, high efficiency, heat tolerant	Higher upfront investment	10–15 years	Low	Highly recommended solar hybrid stations
Lead-acid Battery	Traditional rechargeable battery technology	Low cost, widely available	Short lifespan, low efficiency, regular maintenance required	3–5 years	High	Suitable for small or low-budget systems
Gel Battery	Sealed lead-acid battery using gel electrolyte	Maintenance-free, spill-resistant	Lower charging speed, moderate lifespan	5–7 years	Low	Suitable for medium-scale installations
Absorbent Glass Mat Battery	Sealed battery using absorbent glass mat separator	Reliable, maintenance-free, moderate cost	Shorter lifespan than lithium batteries	4–7 years	Low	Good for backup and moderate storage applications

Lithium-ion Battery is recommended for the following reasons: High efficiency, fast charging, compact size, long lifespan

2.7 Project Options

2.7.1 No Project Option

One of the reasons for the proposed Project in POLAC is that the current demand for electricity in the University significantly exceeds generation/supply and, and that the current power supply through the grid is unreliable and suffers interruptions. If the Project does not go ahead, access to a reliable, safe, and cheaper power supply may be difficult to realize. In addition, the potential benefits associated with the Project would not be realized. Furthermore, the no project option would mean that the University will continue to significantly rely on diesel-fuel generators for self-generation of power, considering the current situation of electricity supply to the University through the grid. This has serious economic implications for the University and would not also be in line with the FGN's efforts in achieving its carbon emission targets. Thus, the No Project option is not considered a viable option to adopt.

2.7.2 Delayed Option

This option implies that the planned Project will be delayed until a much later date. Such an option is usually taken when conditions are unfavorable to project implementation, such as in war situations, or where the

stakeholders are deeply resentful of the Project. Also, if the prevailing economic climate is not quite favorable to the Project, then the delayed project option may be feasible. But none of these conditions are applicable. Indeed, both the economic and the political environments are most favorably disposed towards the Project. The implication of the delayed project option will mean that all the preliminary work and associated efforts/costs incurred would have come to nothing. Also, because of inflationary trends, such a delay may result in unanticipated increases in project costs, which may affect the final profit accruable from the Project. The delayed option is considered unviable for the Project.

2.7.3 Go Ahead Option

Allowing the Project to proceed as planned offers multiple and far-reaching benefits. These include improvements in the quality of education, enhanced capacity for research and innovation, expanded training opportunities, and improved security within the University campus. In addition, the Project will create employment opportunities for Nigerian professionals as well as skilled and semi-skilled craftsmen. Overall, the option to implement the Project as proposed clearly outweighs the alternative options discussed above and represents the most beneficial and sustainable course of action.

CHAPTER THREE
PROJECT DESCRIPTION

3.1 Overview

As previously stated, the scope of the EEP includes the provision of an independent power plant, rehabilitation of existing electricity distribution infrastructure, provision of street lighting as well as a renewable energy training centre. Therefore, the specifications and number of some of the components to be installed for the proposed project are yet to be finalized. Each of these components as they relate to the POLAC solar hybrid power project are discussed below.

3.2 Project Location

3.2.2 Description of the Project Area of Influence

The Nigeria Police Academy Wudil is located in Wudil Local Government Area of Kano State, a region that falls within the Sudan–Sahel ecological zone of northern Nigeria. The environmental conditions around the academy are largely shaped by a tropical savannah climate characterized by high temperatures, seasonal rainfall, and semi-arid features. The terrain is generally flat to gently undulating, with sparse vegetation dominated by grasses, shrubs, and scattered drought-resistant trees typical of the savannah ecosystem.

Climatically, the area experiences two distinct seasons: a wet (rainy) season and a dry season. The rainy season usually occurs between May and September, bringing moderate rainfall that supports limited agricultural activities and temporary greening of the landscape. In contrast, the dry season extends from October to April and is marked by intense heat, low humidity, and the influence of the Harmattan; a dry, dusty wind from the Sahara Desert. Temperatures in Wudil are generally high throughout the year, often ranging between about 12°C and over 38°C, with peak heat occurring between March and May.

The natural vegetation around the academy reflects the semi-arid environment. It consists mainly of savannah grassland interspersed with thorny shrubs and scattered trees such as acacia and baobab. During the rainy season, grasses grow rapidly and provide temporary ground cover, but much of this vegetation dries up during the long dry season. Soil types in the area are typically sandy or loamy, which are prone to erosion and reduced fertility, especially under conditions of overgrazing and human activity.

Human activities also influence the environmental conditions around the academy. The surrounding communities engage in farming, livestock rearing, and small-scale trading, which contribute to land-use changes such as deforestation and soil degradation. Additionally, the broader northern Nigerian environment faces challenges such as desertification, water scarcity, and increasing temperatures due to climate change. These factors collectively shape the environmental context of the Nigeria Police Academy, making it a region characterized by fragile ecosystems and the need for sustainable environmental management practices.

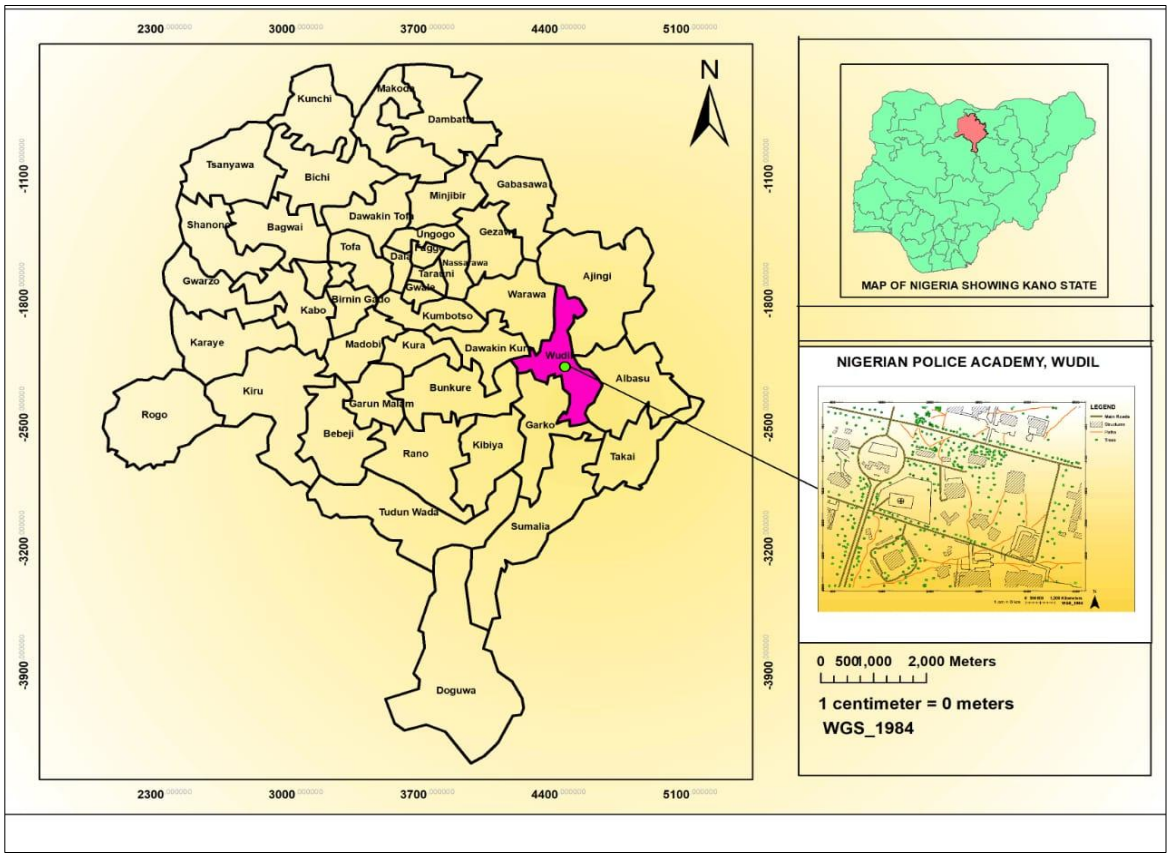

Figure 3.1: Administrative Map of Kano Showing the Project Area

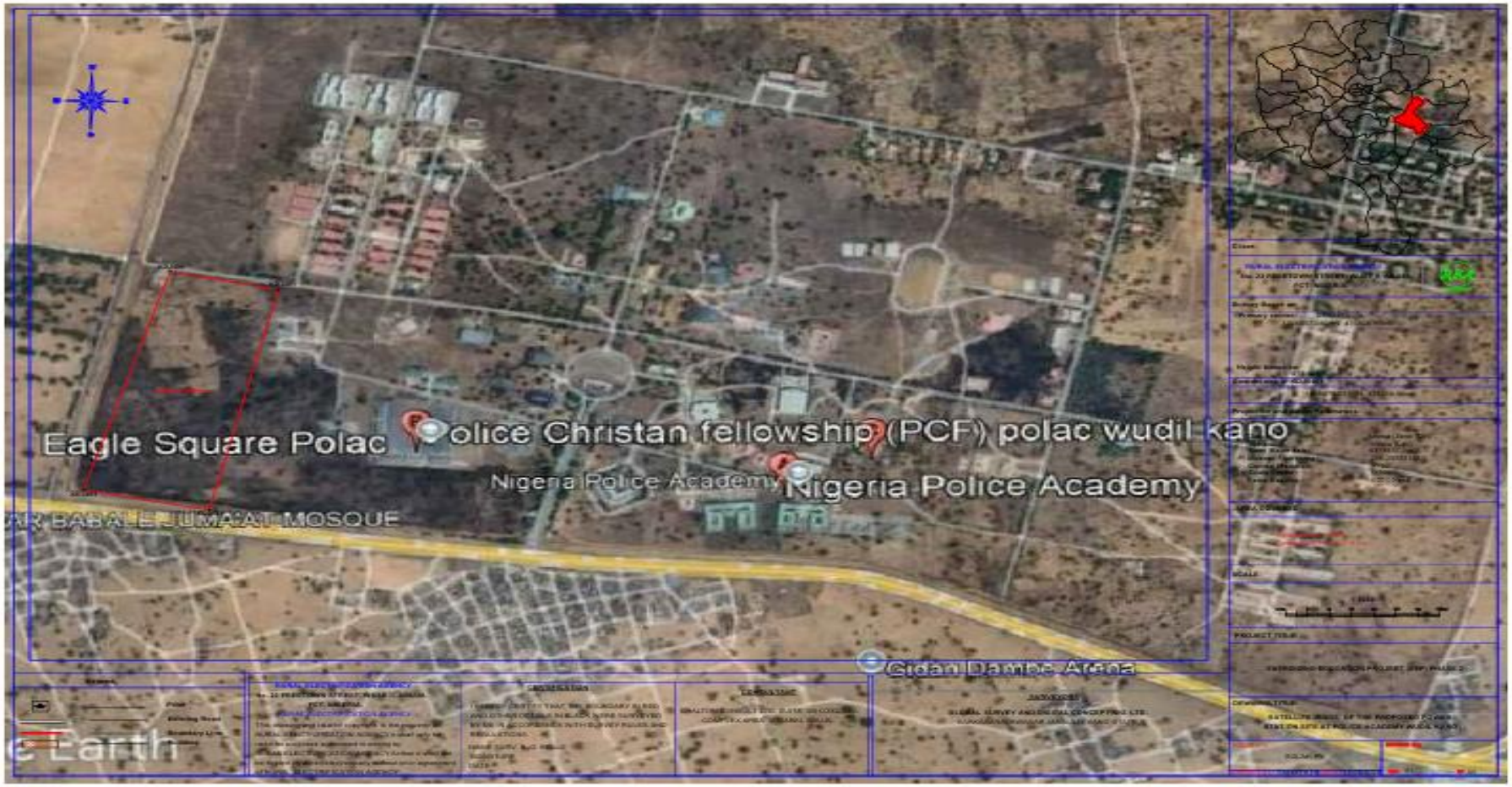

Figure 3.2: Site Aerial Overview

3.3 The Project Description

3.3.1 Proposed Solar-Hybrid Power Plant

Monocrystalline PV Panel Design

A monocrystalline PV panel design consists of several essential components that work together to convert solar energy into usable electricity efficiently and reliably. The primary component is the Photovoltaic Cell, made from high-purity monocrystalline silicon, which converts sunlight into direct current (DC) electricity through the photovoltaic effect. These cells are arranged in series and parallel configurations within the panel to achieve the required voltage and power output.

Tempered Glass Cover and Encapsulation

The solar cells are protected by a tempered glass cover, which shields the panel from environmental conditions such as rain, dust, wind, and physical impact while allowing maximum sunlight transmission. Beneath the glass is an encapsulant layer, commonly made of Ethylene Vinyl Acetate (EVA), which cushions and secures the cells in place. A protective backsheet is installed at the rear of the panel to provide electrical insulation and protect the internal components from moisture and environmental degradation.

Aluminum Frame and Junction Box

An aluminum frame surrounds the panel to provide structural strength and facilitate mounting onto support structures. At the back of the panel is a junction box containing electrical connections and bypass diodes, which help reduce power losses and prevent overheating during partial shading conditions. DC cables and connectors are used to transmit the generated electricity from the panels to other system components.

Mounting Structure and Inverter

The mounting or racking structure is another critical component of the PV system design. It supports the panels at the optimum tilt angle and orientation to maximize solar energy capture while ensuring stability against wind and other environmental loads. For hybrid solar systems, the design also includes an Inverter, which converts the DC electricity produced by the panels into alternating current (AC) suitable for use by electrical appliances and grid integration.

Battery Storage and Safety Components

Additional components include a battery storage system for storing excess energy, a charge controller to regulate battery charging and prevent overcharging or deep discharge, and combiner boxes that consolidate power from multiple PV strings. The system also incorporates earthing and lightning protection measures to ensure electrical safety, as well as monitoring systems that track energy generation, system performance, and operational efficiency.

Provision of Street Lighting

As part of the proposed project, Streetlights will be installed (where required) to ensure that different areas within the campus are well illuminated.

Renewable Energy Training Centre

Students from the campus will be allowed to access the Project site for learning and training purposes. The training center will also include a storage room, a workshop and toilet facilities.

3.4 Engineering Codes and Standards

The Project components shall be designed and installed in compliance with the relevant codes and standards of the British Standard-Europe Norms (BS–EN), the International Electrotechnical Commission (IEC), International Organization for Standardization (ISO), and the Standard Organization of Nigeria (SON). Examples of the relevant codes and standards include ISO 15673:2005 "Guidelines for the simplified design of structural reinforced concrete for buildings" and BS EN 60529:2013 "Degree of Protection by Enclosures (IP Code)", amongst others.

3.5 Project Implementation Phase

3.5.1 Pre-construction Phase Activities

Following the completion of engineering design for the Project and receipt of relevant approvals, the major activities during this phase include site clearing and preparation, and mobilization of equipment, materials and personnel to site. Clearing will involve removal of existing vegetation from the site and preparing a level working surface in readiness for construction activities.

3.5.2 Construction Phase Activities

The construction phase of the Project will include civil, mechanical and electrical works; installation of PV panels and associated plant facilities; construction of a training centre; installation of streetlights as well as underground armoured cable for power evacuation. Also, where required, an upgrade of some of the existing power distribution infrastructure within the University will be carried out.

It is envisaged that approximately 300 people would be required for construction activities. These are divided into low-skilled workers (e.g. construction labour who will make up the majority of workers), semi-skilled workers (drivers, technicians, etc.), and skilled personnel (e.g. engineers and expatriates). Most of the unskilled and semi-skilled workers would be drawn from the nearby local community (located outside the campus) to enhance the job opportunities associated with the proposed Project. A moderate level of migrant workers may also be associated with the construction phase activities (potential impacts associated with the migrant workers, as well as the proffered mitigation measures, are covered in Chapters 5 and 6). No workers' camp is planned to be established on-site during construction.

3.5.3 Commissioning Phase Activities

The commissioning phase of the proposed Project will include testing and checking individual equipment /system, as well as the associated infrastructure to ensure they have been installed correctly and can be handed over for use.

3.5.4 Operational Phase Activities

The operational phase of the Project will involve power generation and distribution to various sections of the campus as well as the preventative, corrective and predictive maintenance of the power plant and associated facilities. In addition, the training centre will be put into use to enhance learning in renewable energy.

The EPC contractor shall develop standard operating procedures (SOPs) for the operation and maintenance of solar panels, inverters, batteries, and other associated components of the Project. If need be, the SOPs shall be further reviewed and updated by the O&M contractor during operation. The day-to-day operations of the plant will involve both regular preventive and corrective maintenance carried out by the O&M Contractor in order to keep the power plant in optimal working condition throughout its operating life. Preventive maintenance follows a routine service schedule aimed at preventing faults from occurring and keeping the power plant operating at its optimum level. The frequency of the preventive maintenance would depend on a number of factors such as the technology selected, environmental conditions of the site, warranty terms and seasonal variances. It contains, for example, activities like PV panel cleaning, inverter service, and checks on structural integrity of the mounting structure.

Corrective maintenance will be carried out in response to failures, for example, the repair / exchange of damaged or faulty equipment. Maintenance will consist mostly of panel / battery replacement and other mechanical and electrical infrastructure repairs. Faulty components will be replaced as soon as the problems are identified.

The average life span of the PV power plant is 25 years which can be extended through regular maintenance. Even after the 25 years, the PV panels can still generate up to 90% of the design capacity.

3.6 Water Use and Supply

One of the key benefits of the power plant (to be provided as part of the proposed Project) in terms of resource use is the generation of electricity using freely available solar energy to produce electricity, reducing the dependence on fossil fuels; thus, reducing carbon emissions.

The use of water for construction activities will be minimal because construction works requiring cement mixing will be few on-site. Water is required mainly during the operational phase of the power plant for periodic cleaning of PV panels to prevent dust build-up (especially during the dry season), since dust can affect their performance by inhibiting the amount of irradiation that reaches the solar cells. The rate of build-up of dust on the PV panels is dependent on several factors, including soil type, local wind speed and the mounting structure used for the panels.

Manual cleaning of the PV panels with water shall be regulated as much as practicable. During the periods of rainy season, direct cleaning of the PV panels is estimated to occur not more than three times. However, during the dry season (November to April), the frequency of cleaning will depend on the rate of dust accumulation, and it is envisaged to be more than three times due to high dust generation usually experienced in the Northern part of the country.

Based on the review of similar solar power projects, each PV panel would require approximately 5 litres of water per cleaning cycle. This implies that about 33,000 litres of water will be needed for each cleaning cycle. The water required for the cleaning purposes would be obtained from the borehole that will be installed within the Project site. Based on observations noted during the field survey and the estimated quantity of water required for occasional cleaning of the PV panels, water abstraction for the Project is not

envisaged to have a significant effect on the existing groundwater aquifer of the Project area as well as the local water use. The recharge of the existing boreholes in the study area is largely due to direct precipitation.

3.7 Health and Safety Requirement

The EPC Contractor shall engage dedicated personnel competent based on appropriate education, training, and experience to manage and oversee the Health, Safety and Environment (HSE) aspects of the Project. The HSE personnel shall ensure that the Project and subcontractors operate in accordance with the applicable regulatory HSE requirements and plans; and also monitor implementation of environmental and social protection measures. Occupational health and safety (OHS) plans shall be developed and maintained by all contractors involved in the implementation of the proposed Project. The contractors shall provide OHS training that may include hazard awareness, safe work practices and emergency preparedness to ensure they are appraised to project sites rules of work, personal protection and prevent injury to fellow workers. Worker activities will be managed through appropriate planning and the application of Permit-to-Work system, Job Hazard/Safety Analysis, Personal Protective Equipment (PPE) requirements and other safety-based protocols.

Also, all contractors, as a component of their contracts, will implement HSE plans which will outline procedures for avoiding health and safety incidents and for emergency medical treatment. Contractors will be required to carry our regular safety inspections to ensure measures to manage potential OHS hazards are implemented.

For example, during the construction phase, a Health and Safety (H&S) risk assessment-based approach will be taken to manage H&S risks to workers. This would involve assessing all the various risks that are involved in each aspect of the job and educating workers on how to manage these risks. The people working around the Project area shall also be warned of the risk involved i.e. warning signs shall be erected for people to see clearly. In addition, first aid equipment and PPEs for workforce will be provided onsite throughout the construction activities. All staff, workmen, supplier and sub-contractor working on site shall be informed on the need to ensure their safety and the safety of the people working around them. Every worker will be instructed to always put on PPE whilst on site. Appropriate warning signs will be erected and checked each day. Daily health and safety tool-box meetings among workforce will be ensured. The safety briefings will be led by the onsite HSE officers. Smoking, use of alcohol or hard drugs will be strictly forbidden.

3.8 Labour Requirement

A suitable labour structure for the DARES project would involve a total workforce of about 50 to 60 people**,** depending on the scale and pace of implementation. This workforce would be distributed across skilled, semi-skilled, and unskilled categories to support different phases of the project.

Skilled labour would make up about 30–40% (20-30 workers) and include engineers, project managers, and technical specialists responsible for design, supervision, and quality control. Semi-skilled labour would account for 25–30% (15 workers)**,** mainly technicians and installers who handle system deployment. Unskilled labour would form the largest share, about 30–45% (30–35 workers)**,** supporting construction and basic site activities, especially from local communities.

3.9 Power Supply Arrangements

The Nigerian Police Academy (POLAC) is a federal security training institution located in Wudil, Kano State. The campus hosts academic, administrative, residential, training, and operational facilities that operate across extended hours. Cooling and ventilation systems are the dominant load driver, consistent with the warm semi-arid climate of Kano.

Land Requirement

Approximately 4–6 hectares are anticipated for the PV array, BESS enclosure, and balance-of-plant infrastructure, consistent with the preliminary 1.5–1.8 MWp PV assessment. However, the land acquisition for the proposed project is approximately 9.6 hectares within POLAC.

Energy Demand Profile

The load assessment indicates that POLAC has an installed connected load of approximately 2.54 MW, while the reconciled diversified peak demand is estimated at 1.5–1.7 MW after accounting for load diversity and coincidence effects. The facility's calibrated energy consumption is estimated at 8.5–9.0 MWh per day, corresponding to an annual electricity demand of approximately 3.1–3.3 GWh. Analysis of the load profile shows a firm night-time base load of 0.50–0.70 MW, reflecting essential continuous operations. The calculated load factor of 45–50% suggests moderate utilization of the installed capacity, with cooling and ventilation systems identified as the dominant energy-consuming load category, indicating that air-conditioning demand drives a significant portion of the campus electricity consumption. The energy profile is provided in Table 3.1.

Table 3.1: Energy Demand Profile

Parameter	Value	Basis
Installed Connected Load (Nameplate)	2.54 MW	Building GFA-based calculation
Reconciled Diversified Peak Demand	1.5 – 1.7 MW	PEL measurement + coincidence correction
Calibrated Daily Energy Consumption	8.5 – 9.0 MWh/day	Triangulated: PEL + billing + bottom-up
Night Base Load (Firm)	0.50 – 0.70 MW	PEL night plateau analysis
Annual Energy (Base Case)	~3.1 – 3.3 GWh/year	Annualised calibrated baseline
Load Factor	~45 – 50%	Derived from logged profile
Dominant Load Category	Cooling & Ventilation	AC dominant across all clusters

Source: Soltect 2026

Appliance Audit Overview

The table below presents the full cluster-by-cluster appliance inventory for POLAC, derived from the Kobo Toolbox-based field audit.

Table 3.2: Appliance Audit

Building Cluster	Category	Key Appliances	Connected Load (kW)	Daily Energy (kWh)
Academic Buildings	Lighting	LED Bulb/Panel	4.160	19.968
Academic Buildings	Cooling & Ventilation	AC / Ceiling Fan	150.725	724.380
Academic Buildings	Laboratory Equipment	Centrifuge, Autoclave, Incubator	4.500	14.880
Academic Buildings	Catering/Services	Refrigerator	4.000	19.200
Administrative	Lighting	LED Bulb/Panel	31.065	180.711
Administrative	Cooling & Ventilation	AC / Ceiling Fan	490.225	2,647.215
Administrative	ICT & Office	Desktop, Printers	93.700	496.620
Administrative	Others	Catering, Medical, Lab Equipment	61.500	332.100
Medical Facilities	Lighting	LED Bulb/Panel	0.300	2.160
Medical Facilities	Cooling & Ventilation	AC / Ceiling Fan	15.600	74.880
Medical Facilities	ICT & Office	Desktop, Printers	2.000	9.600
Medical Facilities	Others	Medical & Lab Equipment	8.200	48.480
Residential	Lighting	LED Bulb/Panel	27.743	99.579
Residential	Cooling & Ventilation	AC / Ceiling Fan	374.923	1,129.269
Residential	ICT & Office	Desktop, Printers	0.240	0.720
Residential	Catering/Services	Refrigerator, Electric Cooker, Freezer	79.600	238.800
Laboratories	Lighting	LED Bulb/Panel	2.060	11.688
Laboratories	Cooling & Ventilation	AC / Ceiling Fan	52.175	250.440
Laboratories	ICT & Office	Desktop, Printers	1.950	9.360
Laboratories	Others	Lab Equipment	11.900	32.800
Others / Mixed	Lighting	LED Bulb/Panel	4.717	23.360
Others / Mixed	Cooling & Ventilation	AC / Ceiling Fan	82.175	409.740
Others / Mixed	ICT & Office	Desktop, Printers	46.550	223.440
Others / Mixed	Catering/Services	Refrigerator	0.200	0.960
Utilities/Plants	Lighting	LED Bulb/Panel	0.750	3.150

Building Cluster	Category	Key Appliances	Connected Load (kW)	Daily Energy (kWh)
Utilities/Plants	Cooling & Ventilation	AC / Ceiling Fan	10.400	43.680
Utilities/Plants	ICT & Office	Desktop, Printers	1.150	4.830
Utilities/Plants	Others	Catering, Vertical Transport	8.080	48.480
CAMPUS TOTAL	—	—	1,570.588	7,100.490

Source: Soltect 2026

Key Findings from Appliance Audit

- Cooling & Ventilation is overwhelmingly the dominant load category across all clusters, accounting for approximately 65–70% of connected load in academic, administrative, and residential buildings.
- The Administrative cluster is the single largest contributor to peak demand (676.5 kW peak), driven by dense AC installations and ICT equipment across office blocks.
- The Residential cluster carries a significant night-time baseload through split AC units and refrigeration, directly influencing battery autonomy requirements.
- LED lighting is already predominant across the campus — lighting contributes only ~4% of total connected load — indicating limited further gains from lighting retrofit alone.
- Medical and laboratory loads (centrifuges, autoclaves, incubators) are relatively modest in absolute terms but are classified as critical loads requiring uninterrupted supply.
- ICT and office equipment in administrative buildings (42.2 kW estimated) represent a demand management opportunity through smart metering and equipment rationalization.

Load Distribution and 5-Year Projections

To support long-term energy planning and ensure the proposed hybrid power system remains adequate throughout its design life, future electricity demand projections were developed based on the calibrated baseline load profile and anticipated institutional growth trends. The projections consider expected increases in student population, staff strength, campus utilization, and infrastructure development over the next five years. In addition, an energy-efficiency scenario was evaluated to assess the potential impact of demand-side management measures and energy conservation initiatives on overall consumption and peak demand. The resulting scenarios provide a range of planning cases for system sizing, capacity expansion, and investment decision-making. Table 3.3 provides the estimated load distribution and a 5-year project.

Table 3.3: Load Distribution and 5-Year Projections

Scenario	Daily Energy (Year 5)	Peak Demand (Year 5)
Base Case (20% growth)	~10.2 MWh/day	~1.84 MW
Moderate Expansion (30% growth)	~11.1 MWh/day	~2.21 MW

Scenario	Daily Energy (Year 5)	Peak Demand (Year 5)
Efficiency-Adjusted Year 5	~7.2 MWh/day	~0.70 MW

Source: Soltect 2026

Proposed System Capacity

The proposed plant capacity is presented in Table 3.4:

System Component	Preliminary Estimate	Note	Justification
Solar PV Capacity	1.5 – 1.8 MWp	Monocrystalline, ground-mounted	Sized to meet the majority of the campus daytime energy demand while maximizing the available solar resource in Kano and reducing diesel fuel dependency.
Battery Energy Storage System (BESS)	~4.6 MWh nominal	Utility-scale Li-Ion (LFP chemistry)	Provides energy shifting, peak shaving, frequency support, and continuity of supply during low-solar periods and nighttime operation.
Estimated Solar Fraction	70 – 85%	Pre-simulation estimate; with adequate BESS	Reflects the anticipated contribution of solar energy to total annual consumption under an optimized hybrid configuration with sufficient storage capacity.
Operating Mode	Islanded (Primary)	No grid export envisaged	Ensures energy independence, improved reliability, and resilience against grid outages while serving all campus loads internally.
Generator Role	Tertiary Backup	Existing fleet; black-start capability required	Retained for emergency operation, prolonged low-solar conditions, maintenance periods, and system black-start support to enhance overall system reliability.

Source: Soltect 2026

Table 3.4: Proposed System Capacity

The proposed capacities are intended to satisfy the institution's current and projected energy requirements while maximizing renewable energy penetration, minimizing operating costs, and ensuring reliable power supply under both normal and contingency operating conditions.

Proposed Technology and Energy Mix

- Solar PV: Monocrystalline silicon panels (18–24% efficiency), ground-mounted, tilt-optimised for Kano solar resource conditions.
- BESS: Utility-scale Lithium-Ion (LFP chemistry) — consistent with EEP Phases 2 & 3 precedent at comparable Nigerian institutional sites.
- EMS dispatch philosophy: Solar-first → BESS smoothing/peak shaving → diesel generators as tertiary backup only.

3.10 Waste Management

This section discusses the waste streams associated with the proposed Project and the intended management plan.

3.10.1 Overview

It is the goal of REA that the proposed Project is designed, developed and operated sustainably. Thus, effective waste management practices that comply with the relevant local requirements and international best practices shall be implemented during all phases of the proposed Project. To achieve this, all contractors engaged during the lifecycle of the Project will put in place and comply with a site waste management plan.

Waste management principles shall be based on an integrated approach which involves a combination of techniques and programs to manage waste. Source reduction is at the top of the approach, followed by reuse and recycling as preferred options to disposal. Generally, wastes associated with the proposed Project shall be managed using the following prioritized program:

Reduction at Source – The elimination or minimization of waste generation through equipment modifications and installation of pollution abatement equipment.

Reuse – Using an item for its original purpose, or similar purpose, in its original form. Wastes generated from one operation shall be put to use in other operations where they are found useful without compromising standards and safety.

Recycling – conversion of waste materials into reusable objects. This will involve using FMEnv/NESREA approved companies involved in recycling business using best available technology that meet international standards.

Residue Disposal – disposal of wastes in a government-approved dumpsite.

3.10.2 Associated Waste Streams

The waste streams associated with the proposed Project are discussed as follows:

Pre-construction Phase

The waste streams associated with the pre-construction phase of the Project include cleared vegetation (during site preparation), food waste, and general rubbish. The cleared vegetation (mostly grasses) will be removed from the site and allow to biodegrade at a portion of the site while wood from felled trees will be made available to the local community.

Construction Phase

The planned activities during the construction phase include civil, mechanical and electrical works and installation of PV panels and associated components which will be carried out by a number of construction workers. The waste streams associated with the construction activities include excavated soil, general refuse, garbage, inert construction materials, metal scraps, concrete waste, food waste, and used packaging materials. In line with the NEP ESMF, the EPC Contractor shall put in place and comply with a site waste management plan. The plan shall be developed to address all waste streams associated with the construction activities and comply with relevant regulations. The contractor shall comply with the national requirements and building rules on storage of construction materials.

Furthermore, all concrete mixing will be undertaken on an impermeable plastic lining to prevent contamination of the surrounding areas. Scrap metals generated during the construction phase will be collected for recycling in blue coloured waste receptacles for non-hazardous wastes. Excavated soil generated during the foundation work will be arranged according to the various soil layers for reuse as backfill during landscaping and site rehabilitation.

All electronic equipment shall be supplied by credible manufacturers to reduce the risk of generating waste from faulty equipment. All damaged PV panels generated during the installation activities shall be collected in a dedicated container and returned to the manufacturer outside the country for proper recycling since there is currently no recycling facility in Nigeria that handles PV panels.

Litter collection facilities shall be provided and all solid waste materials that are not identified for reuse or recycling will be placed in appropriate on-site storage containers (black-coloured waste receptacles for food waste, blue-coded bins for paper, and yellow-coded bins for general rubbish) and periodically disposed of (at least once a week throughout the construction period or on the need basis depending on the volume of the waste) at a government-approved dumpsite through a third party waste contractor approved by the state environmental agency. It is estimated that approximately 0.225 m^3 of construction debris will be produced per week.

Hazardous wastes that could be generated during the construction activities include used oil rags and spent filters from onsite diesel generator for the power source during construction. Hazardous wastes shall be stored in a manner that prevents the commingling or contact between incompatible wastes, and stored in

properly labelled, closed containers before evacuation by a third-party waste contractor approved by the state environmental agency for treatment and disposal.

Operational Phase

Solid wastes generated during the operational phase of the Project will be incorporated into the existing POLAC waste management approach (there is a dedicated site within the environment where solid wastes are collected for disposal). Approximately 2.25 cm^3 of solid waste (e.g. paper waste, food packaging, etc.) is estimated to be generated per week during the operational phase.

In line with NEP ESMF, the Command shall be encouraged to prepare e-waste management plans that account for safe end-of-life disposal of equipment from the solar-hybrid power plant. The Extended Producer Responsibility program (EPR) will be implemented for solar panels, inverters, batteries, and other electrical components to be installed for the Project. Damaged or discarded PV panels and inverters will be collected and sent to the manufacturer for recycling in line with the EPR model. Spent, damaged, or expired batteries will also be returned to the manufacturer for recycling. Alternatively, the spent batteries will be recycled by local and accredited battery recycling companies in Nigeria. These batteries shall be stored in red colored waste receptacles before they are transported to the accredited battery recycling companies. The quantity of waste batteries generated typically depends on several factors such as type, capacity, number of batteries installed, and depth of discharge.

Sanitary waste (sewage) generated during the facility operation shall be channeled to a septic tank to be installed onsite. The septic tank shall be of reinforced concrete and will be located away from any groundwater source. As at when due, the contents of the septic shall be evacuated by an accredited waste contractor for treatment at a sewage treatment plant approved by the state environmental agency.

Decommissioning

The waste streams associated with the decommissioning phase of the Project would be similar to the construction waste. These will include refuse, e-waste, general rubbish, and demolition of debris. The University shall also be encouraged to prepare e-waste management plan that accounts for safe end-of-life disposal of equipment from solar installations. Wastes will be segregated onsite, and non-reusable / recyclable wastes will be disposed of through an accredited third-party waste contractor. The summary of wastes stream associated with the Project is provided in Table 3.2.

Table 3.2: Summary of Waste Streams Associated with the Proposed Project and Handling Techniques

Waste Stream	Sources	Project Phase Construction (C), Operation (O), Decommissioning (D)	Handling Techniques
General rubbish, refuse, and putrescible wastes (food wastes)	Wood splinter, domestic waste, food packs, used bottles	C, O, D	On-site waste segregation; disposal of non-reusable waste through a third-party waste contractor approved by the Bayelsa State Environmental Protection Agency.

Cleared vegetation	During site clearing and preparation	C	Composting, collection for biomass fuel
Scrap metals	Used tubular and casings, used iron rods	C, O, D	Scrap metals will be collected for recycling
Excavated materials	Foundation works	C, D	Excavated materials generated during foundation works will be used for backfilling. Excess excavated spoil will be stockpiled and reused as part of materials for the construction of plant buildings.
Damaged/expired PV panels	PV modules	C, O, D	Return to the manufacturer for recycling using the EPR model
Expired inverters	Electrical installation	O, D	Return to the manufacturer for recycling using the EPR model
Damaged/expired Batteries	Power generation	O, D	Return to the manufacturer for recycling using the EPR model
Sanitary waste	Training center	C, O, D	Periodic evacuation of content of the septic tank

3.11 Project Schedule

The proposed Project is planned to be operational by the fourth quarter (Q4) of 2028. The tentative Project schedule is provided in Table 3.3.

Table 3.3: Tentative Project Schedule

Project Schedule	Timeline											
	2026				2027				2028			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Site allocation												
Energy demand audit												
Front-End Engineering Design												
ESIA study and Approval												
Selection of EPC Contractor and contract signing												
Civil, electrical, and mechanical design												
Procurement (manufacturing and transportation)												
Preconstruction and construction Phase Activities												
Commissioning												
Commencement of operation												

CHAPTER FOUR
ENVIRONMENTAL BASELINE DESCRIPTION

4.1 Preamble

This chapter presents the descriptions of the biophysical, socioeconomic, and health conditions of the environment, which will provide the basis for potential impact identification and appropriate mitigation measures associated with the development of the project.

4.2 Study Approach

The baseline status of the project area was obtained through consultations with the relevant stakeholders, a review of relevant literature as well as field studies. Environmental data acquisition involved a multidisciplinary approach and was conducted in line with regulatory requirements and best international practices. This approach includes literature desktop review, designing, and development of field sampling strategy; confirmation of the sampling design and locations, pre-mobilization activities (job hazard analysis, sampling equipment/materials calibrations and checks and mobilization to the field; community consultations, sample collection, handling, documentation, and storage protocols and, and demobilization from the field, transfer of sample custody to the laboratory for analysis. A summary of field sampling methods is discussed in the sub-sections below.

4.2.1 Daily Toolbox Meeting

A daily toolbox meeting was held before work to ensure that team members understood the work plan of the day and the security and safety tips. These are geared toward achieving a successful data-gathering exercise and zero incidents.

4.2.2 Baseline Data Collection

Data gathering for the biophysical and social components of the project environment was undertaken from 12th to 14th February 2026 (dry season), while the secondary data collection was obtained from existing sources, including the following:

- Stakeholders, including government agencies, community chiefs, elders, women, and youths in various communities and community-based organizations (cooperative societies, development committees, etc).
- Local experts and research, and academic organizations
- National and state data sources (population data).
- Environmental Assessment of Cobalt in Wuldi Kano 20214.

4.2.3 Sampling Design/ Protocol

The sampling maps provide spatial distributions of the sampling points within the study area (See Figure 4.1).

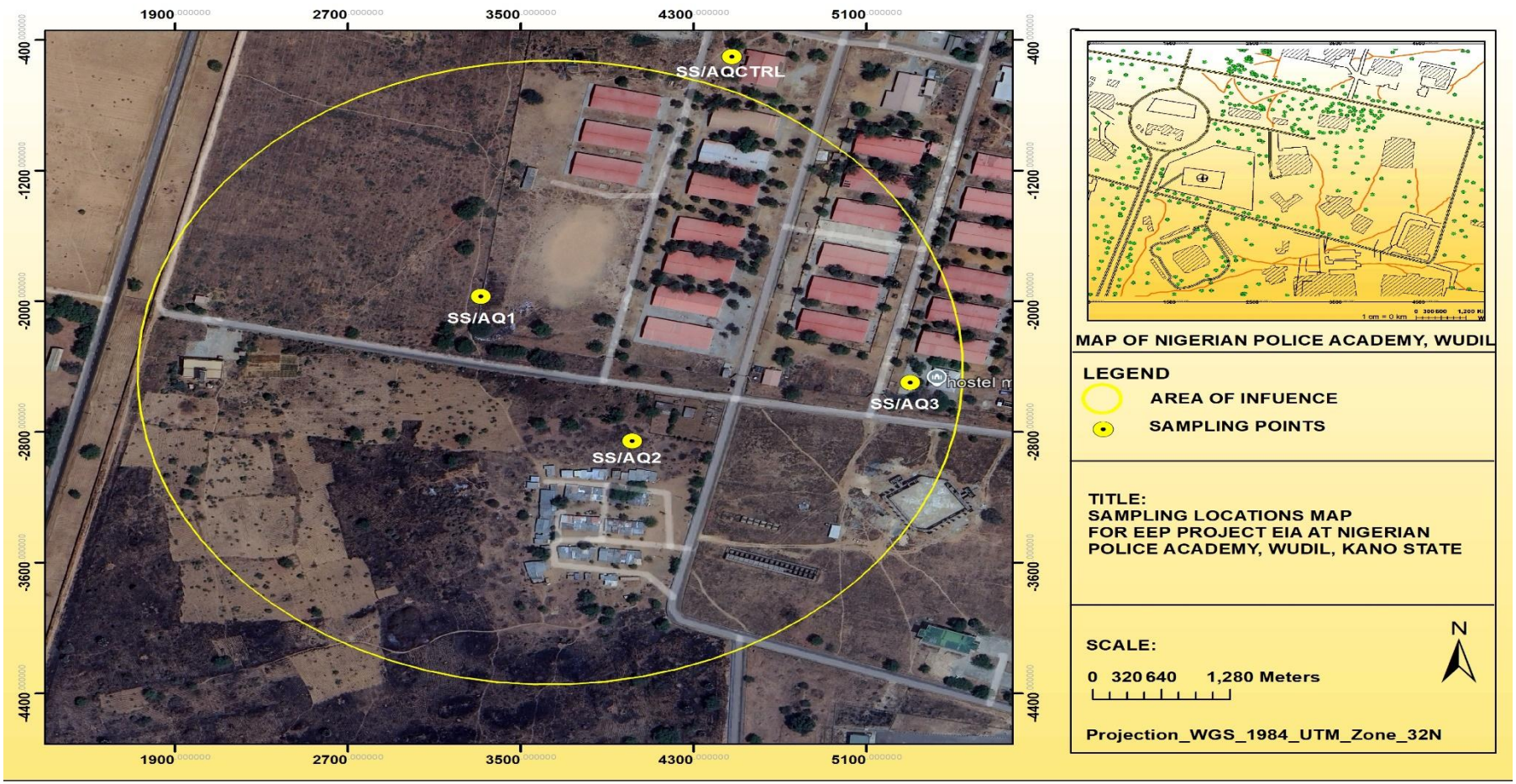

Plate 4.1: Sampling Map

Table 4.1 List of Geographical Coordinates

Sample ID	Latitude	Longitude	Environmental Matrix
AQ	N 11^0 49' 23.6784"	E 8^0 47' 48.7896"	Air /noise
AQ	N 11^0 49' 22.4981"	E 8^0 47' 59.2341"	Air /noise
AQ	N 11^0 49' 25.4772"	E 8^0 47' 58.2502"	Air /noise
AQCTL	N 11^0 49' 26.8458"	E 8^0 47' 59.8641"	Air /noise
SS1	N 11^0 49' 23.6784"	E 8^0 47' 48.7896"	Soil
SS2	N 11^0 49' 22.4981"	E 8^0 47' 59.2341"	Soil
SS3	N 11^0 49' 25.4772"	E 8^0 47' 58.2502"	Soil
SS CTL	N 11^0 49' 26.8458"	E 8^0 47' 59.8641"	Soil

4.3 Field Sampling Equipment and Methods

4.3.1 Meteorology/Air Quality and Noise Measurements

Meteorological elements, namely wind, speed, wind direction, humidity, and temperature, were measured during the fieldwork from 4 predetermined locations (See Sampling Map – Figure 4.1). Each sampling location was adequately georeferenced with a GPS. Kanomax Gas Meter with Model No.2750 was used for the measurement of the following parameters: Carbon Monoxide (CO), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Dioxide (CO_2), and Hydrogen Sulphide (H_2S). Particulate Meter (PM) with Model No. DT-9880 was used to measure suspended particulate matter (SPM). The Noise levels at each point was measured with an Extech Noise Meter (Model No.407722). The sensor of the noise meter was directed toward the source of noise and the average reading over a period of three minutes was taken to be the Noise level at each point. Plate 4.2 shows air quality and noise measurements being taken during the studies.

Plate 4.2: Air/noise Sampling

4.3.3 Soil Sampling

Topsoil (0-15cm) and bottom soil (15-30cm) samples were collected from 3 points and 1 control using a hand auger. Two (2) auger bores were homogenized to form a composite sample. Samples for microbiology were taken in 25 ml sterilized vials. Samples for physico-chemical parameters were collected in pre-cleaned 250ml amber bottles. The samples were properly labeled and preserved in ice chests at 4°C.

Plate 4.3: Soil Sampling/ field observation

4.3.5 Vegetation and Wildlife Studies

The vegetation survey was carried out along designated sampling transects/sub-transects. The location of each sampling point was confirmed using GPS. Vegetation was studied in sampling quadrats measuring 20 m x 20 m. For each sampling point, information on habitat, vegetation structure and species were recorded. Habitat data included vegetation description, latitude, longitude, and signs of wildlife. Plant species were categorized into trees (4m or more), shrubs (0.5m to 4m), and herbs (less than 0.5m). Dendrometric parameters recorded included height (m), diameter (cm) and number of trees. A pair of binoculars (Model: Helios Fieldmaster 8x40) was employed to aid in the field identification of trees. Plants were also observed for any disease symptoms/conditions.

Field observations were made at each sampling location for evidence of vertebrate wildlife. Hideouts such as crevices, leaf litter, logs etc. were probed with props to root out any hidden animals. Tree canopies were observed for birds and other arboreal animals such as squirrels and snakes. The indirect count method was employed, particularly for animals that do not readily offer themselves for observation.

4.4 Quality Assurance/Quality Control

Standard methods and procedures were strictly adhered to in the course of this study. The quality assurance program covers all aspects of the study, including sample collection, handling, laboratory analysis, data coding, statistical analysis, presenting and communicating results.

Chain of custody procedures including sample handling, transportation, logging and cross-checking in the laboratory were also implemented. Trip blanks were used to assess the quality assurance/quality control of sample preservation, packaging, shipping, and storage.

The following precautions were also observed:

- Samples were collected in bottles that have been thoroughly washed with detergent (nutrient-free) and rinsed thoroughly;
- ✓ All sampling equipment is properly protected and maintained in accordance with manufacturers' manuals;
- ✓ Sampling bottles were adequately labeled with masking tapes and indelible markers to avoid mistaken identity;
- ✓ Only analytical grade (Analar) chemicals were used and where applicable, redistilled.
- ✓ Automated equipment is calibrated prior to field sampling.

Where samples were sent to another laboratory for analysis, a duplicate copy of the samples' information was sent along with the sample to the laboratory, independent of the sample. All movements of the samples were included in the sample record. Basic information was recorded together with the results of the analysis, in a sample registry. With proper, sustained calibration of the instrument and the use of standardized observational procedures, equipment errors were brought to an acceptable minimum.

4.4.1 Sample Handling and Preservation

All the samples collected during the fieldwork were labeled clearly and secured in easily identifiable containers. Each label contained the following Information:

- Date and/or time of sampling
- Sample name and number
- Type of sample
- Type of preservative used if any.

The sampling containers, preservatives used, and holding times for the different parameters of interest for water, benthos, and plankton samples are summarized in Table 4.2.

Table 4.2: Sample Handling and Preservation Methods used during Fieldworks

S/N	Parameters	Sample Vol.	Container	Preservative	Holding Time	Container pretreatment
1.	BTEX	15ml	20ml BTEX Vial	5ml of Methanol	10days	Methanol
2.	Metals, Mn, Fe, Cu, Zn, Ag, Ni, Pb, Cd, Cr, Co, Ca, Mg, K, Na	1L	Plastic	Add 2ml Conc HNO_3 & cool 4 °C ± 2◦C	6 months	Rinsed with 1+1 HNO_3
3.	Physico-Chemical, TSS, COD, O/G, Chloride	2L	Plastic	Cool 4 °C ± 2◦C	28 Days	Rinsed with Distilled water
4.	Hydrocarbons, phenols	1.L	Glass (wide mouth, calibrated)	H_2SO_4 to 2ml & cool 4 °C ± 2◦C	28 Days	Rinsed with Solvent
5.	Zoo-/Phyto-plankton	500ml	Wide mouth plastic bottles	10% Formalin (with Rose Bengal)	-	Rinsed with Distilled water
6.	Microbiology, THB, HUB, Coliform, THF & HUF	200ml	Wide mouth plastic bottles	Cool 4 °C ± 2◦C	As soon as possible	Sterilized

S/N	Parameters	Sample Vol.	Container	Preservative	Holding Time	Container pretreatment
7.	Macrobenthos	1.0L	Plastic	10% Formalin (with Rose Bengal)	-	Rinse with distilled water

4.5 Laboratory Analysis

After the fieldwork exercises, study samples were transported to Scopex Laboratory, Port Harcourt, Rivers State, Nigeria (accredited by FMENV) for analyses**.** Samples brought to the laboratory were analyzed using standard analytical methods. The synoptic description of the laboratory methods and procedures employed for the various physical, chemical, and biological parameters, as well as the detection limits of these parameters in water and sediment samples. The summary of standard methods of environmental analysis is presented in Table 4.3.

Table 4.3: Summary of Laboratory analytical methods used for Water / Sediment Analysis

Parameters	Unit	Method
pH (H2O)		ASTM D 4972
Turbidity	(NTU)	APHA 214
Salinity	$^{0}/_{00}$	API-RP 45
Total Dissolved Solids	(mg/l)	APHA 209C
Total Solids	(mg/l)	APHA 209D
TSS	(mg/l)	APHA 209D
Electrical conductivity	(µS/cm)	APHA 209
Bicarbonate	(mg/l)	API-RP 45
Alkalinity	(mg/l)	APHA 2320-ALKALINITY-B
Acidity	(mg/L)	APHA 2310 B
Ammonia nitrogen	(mg/l)	EPA 350.2
THC	(mg/l)	APR – RP 45
Nitrite	(mg/l)	EPA 354.1
Chloride	(mg/l)	APHA 4500Cl- B
Sulphate	(mg/l)	EPA 375.4
Total Phosphorous	(mg/l) (mg/kg)	APHA 4500 P0 43-
Calcium	(mg/l) (mg/kg)	APHA 3111
Magnesium	(mg/l) (mg/kg)	APHA 3111/ASTM D 3561
Potassium	(mg/l) (mg/kg)	APHA 3111/ASTM D 3561
Cadmium	(mg/l) (mg/kg)	APHA3111
Chromium	(mg/l) (mg/kg)	APHA3111
Lead	(mg/l) (mg/kg)	APHA 3111
Manganese	(mg/l) (mg/kg)	APHA 3111
Iron	(mg/l) (mg/kg)	APHA 3111
Copper	(mg/l) (mg/kg)	APHA 3111
Zinc	(mg/l) (mg/kg)	APHA 3111
PCB	(mg/l) (mg/kg)	EPA method 625

4.6 Climate and Meteorology

In addition to the microclimatic parameters collected in the proposed project site during the fieldwork, thirty-year meteorological data (1998– 2025) of the project area were collected from the Nigerian Meteorological Agency *(Source: NIMET, 2025).,*

). Climate of the area is tropical with dry and rainy seasons respectively characterized by the hot and wet conditions associated with the movement of the Inter-Tropical Convergence Zone (ITCZ) north

and south of the equator. The ITCZ appears as a band of clouds, usually thunderstorms, circling the globe near the equator and Nigeria is located just north of the equator. When it is to the south of the equator, the north-east winds prevail producing the dry season and when in the Northern Hemisphere, the south-westerly wind prevails bringing rainfall and the rainy season. Climate of the area is tropical with the dry and rainy seasons. Its mean monthly rainfall is 14-242 mm characterized by annual level of 700 – 1800 mm and mean monthly relative humidity of 54 – 89%. The mean monthly minimum air temperature is 21.3 – 23.7 ºC with maximum of 27 – 33.7 ºC. Its mean monthly sunshine period is 3.2 – 8.4 hours per day with surface wind is 1 – 10 m/s having occasional calmness characterized by prevailing southwestern direction. All these agree with the measured meteorological data of the study area during this study.

Table 4.4: Measured Microclimatic Parameters in the Proposed Project Site Both Seasons

	Level	Air Temperature (°C)	Relative Humidity (%)	Atmospheric Pressure (mbar)	Wind	
					Speed (m/s)	Direction
Dry Season	Minimum	34.1	37.0	1004.4	1.3	NE
	Maximum	37.4	50.0	1017.2	3.1	SW
Wet Season	Minimum	32.1	34.0	1004.1	1.4	NE
	Maximum	33.4	40.0	1017.8	4.0	SW

Air Temperature

The air temperature data shows a clear seasonal variation between the dry and wet periods. During the dry season, temperatures are notably higher, with values ranging from a minimum of 34.1°C to a maximum of 37.4°C. This indicates consistently hot conditions, with extreme daytime heat being a defining characteristic of this period. In contrast, the wet season records slightly lower air temperatures, ranging from 32.1°C at minimum to 33.4°C at maximum. Although still warm, these temperatures reflect a cooling effect associated with increased cloud cover and rainfall.

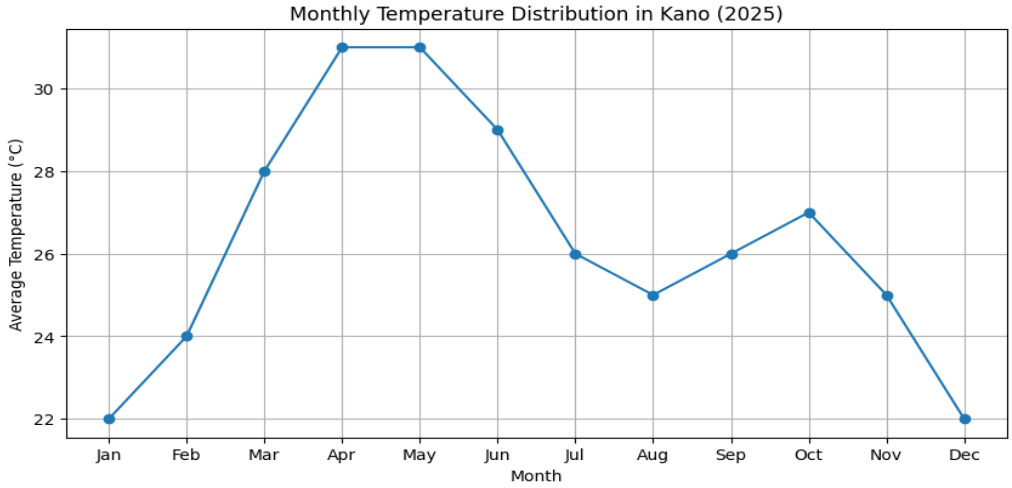

Figure 4. 2: Monthly Temperature Distribution in the Proposed Area

(Source: NIMET, 2025)

Rainfall and Relative Humidity

The atmospheric pressure data show a consistent pattern across both the dry and wet seasons, with only slight variations observed. During the dry season, atmospheric pressure ranges from a minimum of 1004.4 mbar to a maximum of 1017.2 mbar, indicating relatively stable conditions with no significant fluctuations. Similarly, in the wet season, pressure values range from 1004.1 mbar to 1017.8 mbar at maximum. This closely mirrors the dry season range, suggesting that seasonal changes have minimal impact on overall atmospheric pressure levels.

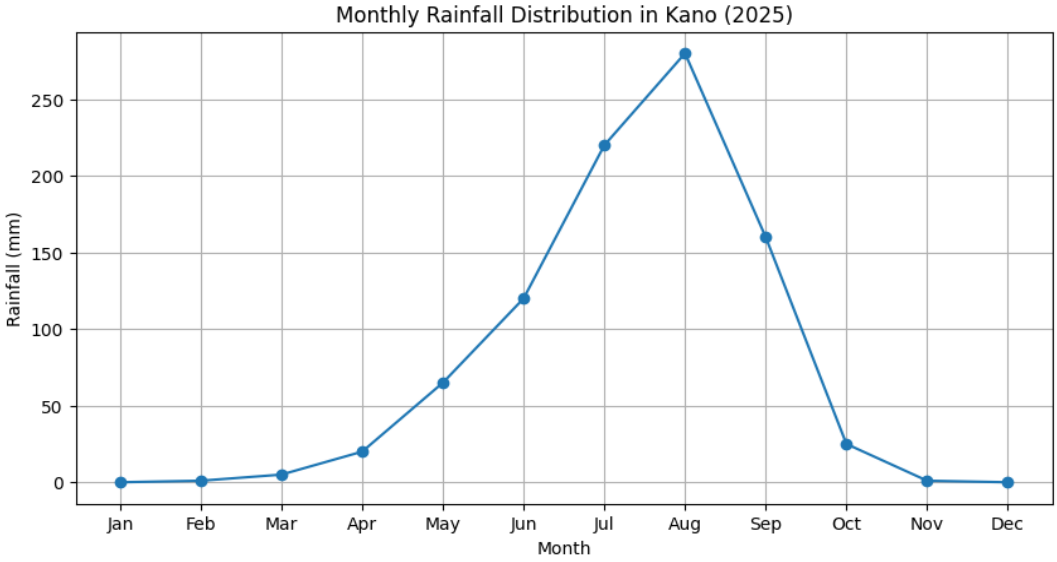

Figure 4. 3: Monthly Rainfall in the Proposed Project Area
(Source: NIMET, 2025)

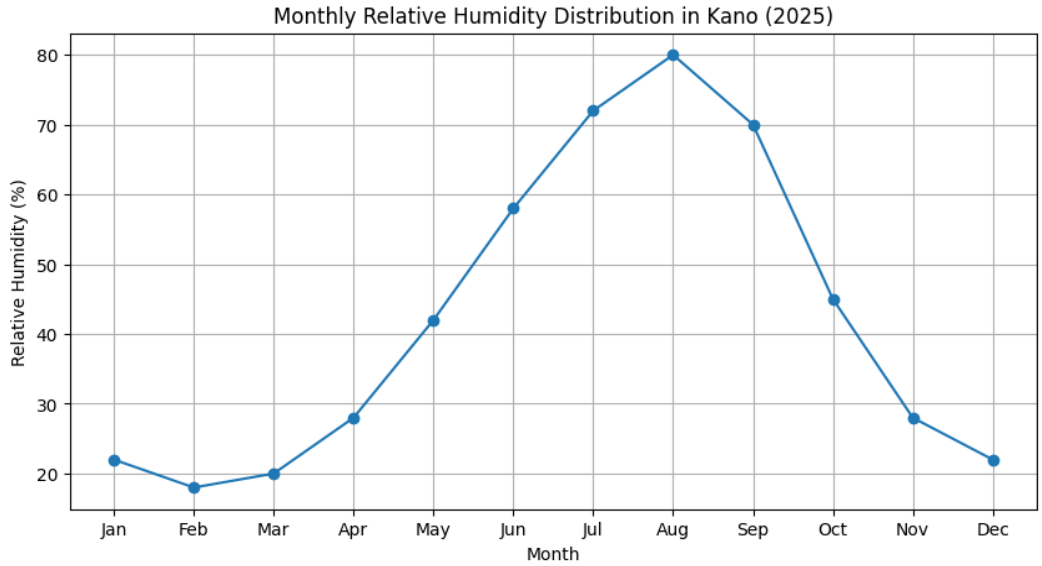

Figure 4. 4: Monthly Relative Humidity Distribution in the Proposed Area *(Source: NIMET, 2025)*

Wind Speed and Direction

The wind speed data indicate generally light to moderate wind conditions across both the dry and wet seasons, with a noticeable increase during the wet period. In the dry season, wind speeds range from 1.3 m/s at minimum to 3.1 m/s at maximum. These relatively low speeds suggest calm atmospheric conditions, which are typical of stable, dry weather. During the wet season, wind speeds show a slight increase, ranging from 1.4 m/s to a higher maximum of 4.0 m/s. This reflects more active atmospheric conditions, likely influenced by rainfall events and seasonal weather systems.

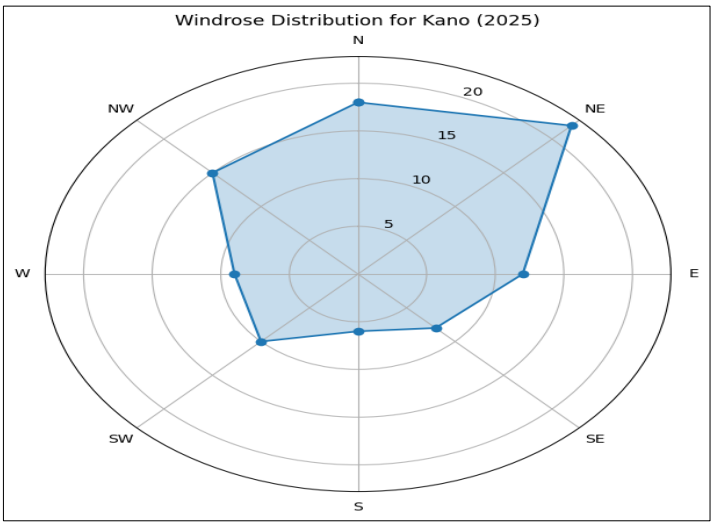

Figure 4. 6: Surface Windrose of the Proposed Project Area *(Source: NIMET, 2025)*

Sunshine

Sunshine period in the study area is 3.2 – 8.4 hours per day, with the minimum in August and maximum in January (Figure 4.8). The short sunshine period in August is associated with its greater cloudiness and rainfall characteristics. Conversely, the higher January period is due to the prevalent clear skies when the ITCZ has once more started its Northward migration. The sunshine duration reflects the double maxima feature of the rainfall pattern.

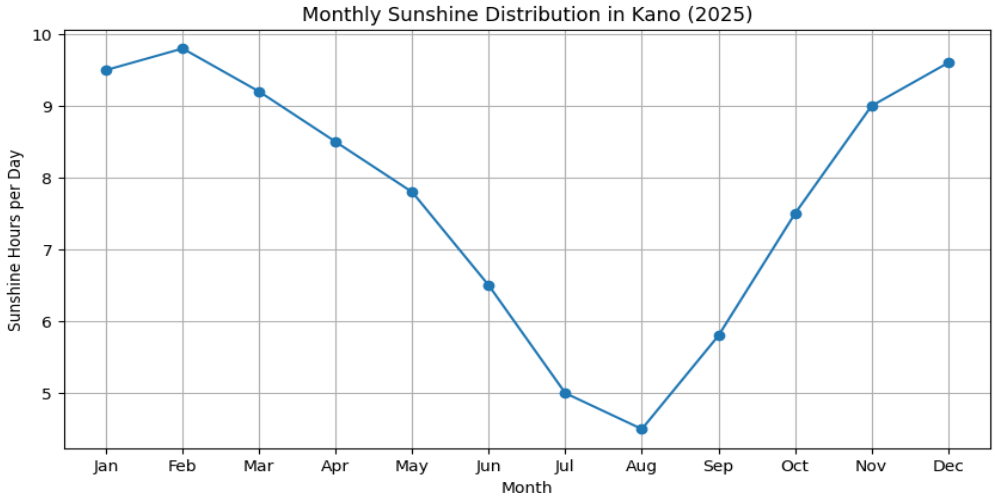

Figure 4. 7: Monthly Sunshine Daily Sunshine Period in the Proposed Area *(Source: NIMET, 2025)*

4.7 The Local Geology

The geology of Wudil in Kano State is part of the broader geological structure of northern Nigeria, which is dominated by sedimentary formations of the Chad Basin. This region represents a low-lying sedimentary environment that developed over millions of years through the accumulation of materials such as sand, silt, and clay. These materials were transported and deposited by ancient rivers, wind action, and other geological processes. As a result, the surface geology of Wudil is mainly composed of unconsolidated or weakly consolidated sediments, which give rise to the sandy and loamy soils commonly observed in the area.

Beneath these sedimentary deposits lies the Basement Complex, which consists of very old crystalline rocks such as granite, gneiss, and schist. These rocks are of Precambrian age and form the geological foundation of much of Nigeria. However, in Wudil, they are not usually exposed at the surface because they are buried under thick layers of sediment. The presence of these underlying rocks is important because they influence the structure and stability of the overlying sediments, as well as the occurrence of groundwater. The surface geology of Wudil is characterized by flat to gently undulating plains, which are typical of sedimentary basin environments. The soils derived from these sediments are generally sandy, porous, and low in organic matter. This explains why the area is prone to erosion and why vegetation cover is often sparse, especially during the dry season. In some areas, especially near seasonal rivers and drainage channels, alluvial deposits are present. These are more fertile and support limited irrigation farming.

A key aspect of the geology of Wudil is its hydrogeology, or groundwater system. The sandy layers within the sedimentary sequence act as aquifers, meaning they can store and transmit water. These aquifers are often separated by layers of clay, which are less permeable and act as barriers to water movement. This layered structure allows groundwater to accumulate and be accessed through wells and boreholes, making it an important resource for domestic use and agriculture in the area. Below is a simplified diagram illustrating the geological structure of Kano State:

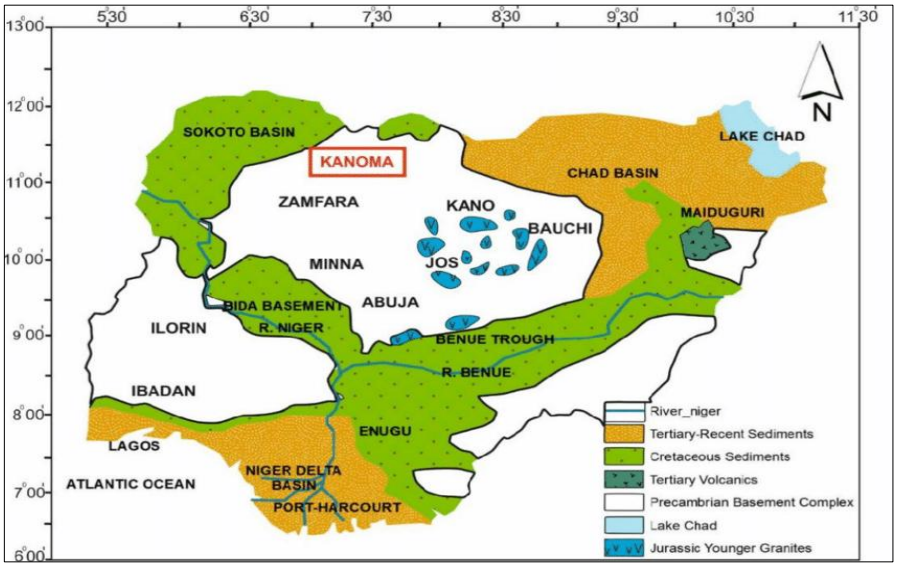

Figure 4.9: Geological Map of the Area

Geological processes such as weathering and erosion are very active in this region. High temperatures cause physical weathering of rocks, breaking them down into smaller particles that form sandy soils. Wind erosion, especially during the Harmattan season, removes fine particles from the soil surface, leading to land degradation. In addition, the loose nature of the sediments makes the area vulnerable to desertification if vegetation cover is not maintained.

4.7.1 The Topography

The topography of Wudil is characteristic of the Sudan savanna region in northern Nigeria. The area is generally low-lying and gently undulating, with broad plains that stretch across much of the landscape. Elevation in Wudil is relatively modest, and there are no major mountains; instead, the terrain is dominated by flat or slightly rolling land that supports agriculture and settlement. This gentle relief makes the area accessible and suitable for farming activities, which are central to the local economy.

The soil composition in Wudil is largely sandy to loamy, typical of savanna regions, with patches of clay in low-lying areas. This variation in soil types is influenced by both erosion and deposition processes over time. Vegetation is mainly grassland with scattered trees such as acacia, reflecting the semi-arid climate. The relatively open landscape allows for both farming and grazing, contributing to mixed land use patterns.

4.7.2 Project Location from Flood Level

The project location was selected in relation to flood levels to prioritize safety and long-term sustainability. The known floodplain level in Wudil is not defined by a single fixed number, because it varies depending on seasonal rainfall, river discharge, and local topography. However, Wudil lies within the floodplain of the Kano River system, and its low-lying areas are typically between about 5 to 15 meters above the normal river channel level. During the rainy season, especially between July and September, water levels can rise significantly and spread across these plains.

In practical terms, the “known floodplain level” refers to the highest-level water has historically reached in the area. In Wudil, local observations and regional hydrological studies suggest that seasonal flooding can extend across farmlands and settlements close to the riverbanks, particularly in years of heavy rainfall. These flood levels are influenced by upstream water flow and releases from irrigation systems such as those connected to the Kano River Project.

For planning and construction purposes, engineers and planners usually adopt a safe elevation margin above the highest recorded flood level**.** In Wudil, this often means siting projects at least 1–2 meters above the observed maximum flood height**.** The result of the spot height mapping suggests that the proposed site is not vulnerable to flooding.

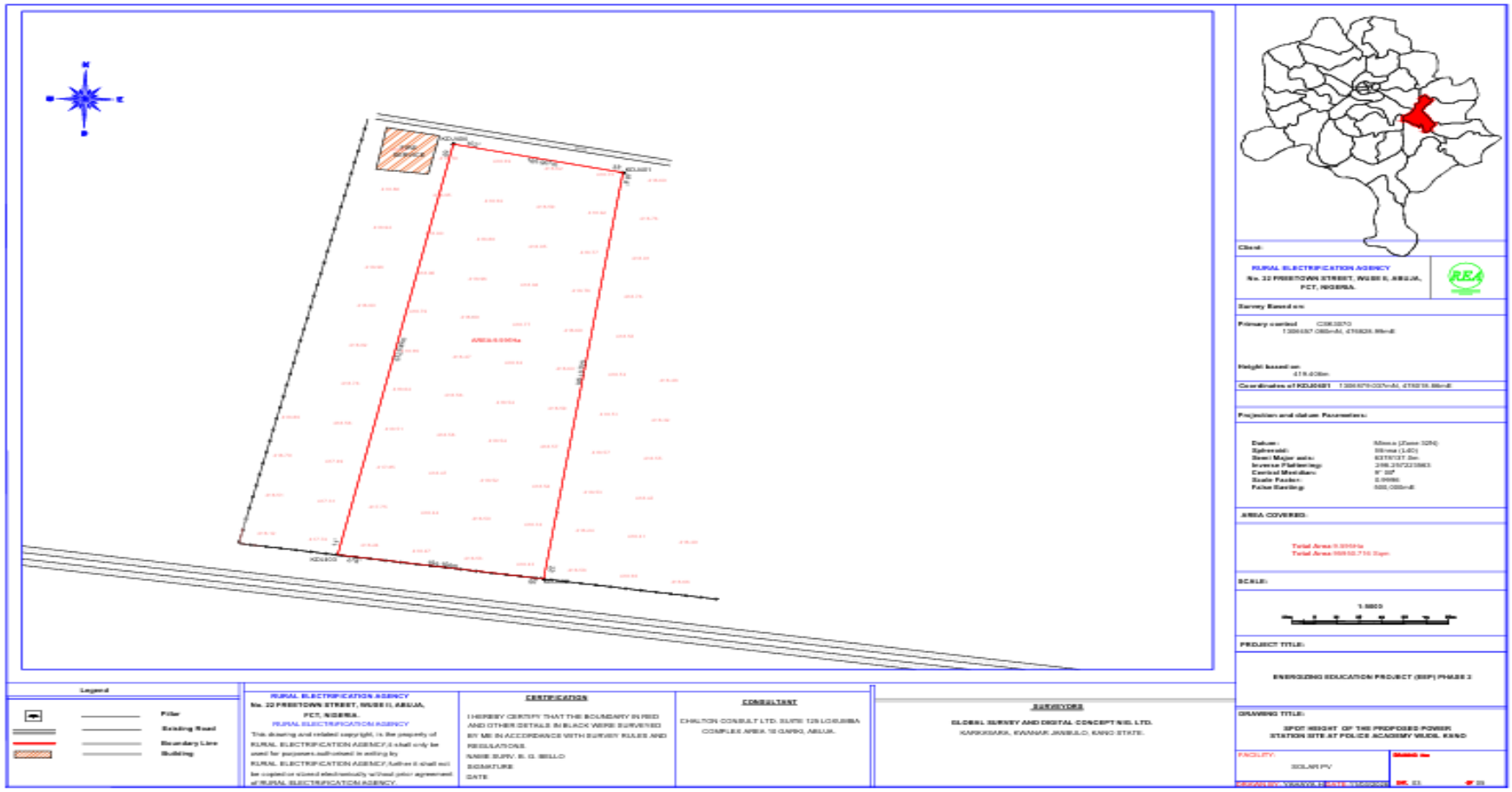

Figure 4.8: Spot Height Mapping of the Proposed Site

4.11 Air Quality and Noise Level

The environmental data for both dry and wet seasons indicate that most measured parameters remain within acceptable limits set by the Federal Ministry of Environment (FMEnv), with only minor variations between seasons. Noise levels during the dry season range from 56.5–58.3 dB(A), with a control value of 65.21 dB(A), while the wet season shows a wider range of 56.8–68.9 dB(A) and a slightly higher control value of 69.1 dB(A). All recorded values are well below the FMEnv limit of 90 dB(A), indicating no significant noise pollution concern.

For gaseous pollutants, SO_x, NO_x, VOCs, CO, and H_2S recorded values of zero in both seasons, remaining far below FMEnv limits (26 µg/m³ for SO_x, 75–113 µg/m³ for NO_x, 60 µg/m³ for VOCs, 11.4 µg/m³ for CO, and 0.01 µg/m³ for H_2S). This suggests an absence of detectable emissions from these pollutants at the monitoring site. Suspended Particulate Matter (SPM) levels ranged from 24–28 µg/m³ (control: 29 µg/m³) in the dry season and about 31–31.5 µg/m³ in the wet season, which are significantly below the FMEnv limit of 250 µg/m³, indicating good air quality with respect to particulates.

For other atmospheric parameters, ozone (O_3) levels ranged from 23–35 µg/m³ (control: 37.29 µg/m³) in the dry season and 34–40 µg/m³ (control: 10 µg/m³) in the wet season; however, no FMEnv limit is specified for comparison. Similarly, carbon dioxide (CO_2) concentrations ranged from 231–410 µg/m³ (control: 458.29 µg/m³) in the dry season and 437–500 µg/m³ (control: 455.5 µg/m³) in the wet season, with no regulatory limit provided. These values indicate slightly higher concentrations during the wet season but remain within typical environmental ranges.

Meteorological parameters show seasonal variation, with air temperature ranging from 34–36°C (control: 34.7°C) in the dry season and 34–37.1°C (control: 29.9°C) in the wet season. Wind speed is lower in the dry season (0.1–0.3 m/s; control: 0.83 m/s) compared to the wet season (1.0–1.1 m/s; control: 1.05 m/s), indicating more active atmospheric movement during the wet period. Relative humidity is slightly higher in the wet season (68.9–78.1%; control: 71.25%) compared to the dry season (65–70.1%; control: 71.79%), reflecting increased moisture content associated with rainfall.

Table 4.5: Air Quality around the Project Area (Dry and Wet Seasons)

Parameters/Unit	Units	Dry Season		EA Cobalt 2014 Wet Season		FMENV Limits 8 h Average
		Range	Ctrl	Range	Ctrl	
Noise level	d(B) A (day)	56.5-58.3	65.21	56.8-68.9	69.1	90
SO_X	µg/m³	0	0	0	0	26
NO_X	µg/m³	0	0	0	0	75-113
SPM	µg/m³	24-28	29	31	31.5	250
VOC	µg/m³	0	0	0	0	60
CO	µg/m³	0	0	0	0	11.4
O_3	µg/m³	23-35	37.29	34-40	10	NA
CO_2	µg/m³	231-410	458.29	437-500	455.5	NA
H_2S	µg/m³	0	0	0	0	0.01
Air Temperature	°C	34-36	34.7	34-37.1	29.9	NA
Wind Speed	m/s	0.1-0.3	0.83	1.0-1.1	1.05	NA
Humidity	%	65-70.1	71.79	68.9-78.1	71.25	NA

4.12 SOIL QUALITY

4.12.1 Physicochemical Parameters

The soil pH shows a clear seasonal variation across both depths. In the dry season, pH ranges from 5.4–5.67 (0–15 cm) and 4.5–5.65 (15–30 cm), indicating moderately acidic conditions. In the wet season, pH increases to 5.7–6.69 (0–15 cm) and 5.6–6.79 (15–30 cm), showing a shift toward near-neutral conditions. This suggests that soils are less acidic during the wet season compared to the dry season.

Electrical conductivity (EC) is lower in the dry season, ranging from 78–98 µS/cm (0–15 cm) and 113–125 µS/cm (15–30 cm), while in the wet season, it increases to 143–162.76 µS/cm (0–15 cm) and shows wider variability at depth (44.56–1220.4 µS/cm). This indicates higher dissolved ion concentration and greater variability during the wet season.

Temperature remains fairly consistent throughout seasons. In the dry season, it ranges from 32.5–33.4°C (0–15 cm) and 31–32.2°C (15–30 cm), while in the wet season, it is slightly higher at the surface (32.8–34.63°C) and 32.5–34.32°C at depth, indicating minimal seasonal variation.

For nutrients, nitrate in the dry season ranges from 0.1–0.38 mg/kg (0–15 cm) and 0.11–0.7 mg/kg (15–30 cm), while in the wet season it increases to 0.4–0.63 mg/kg and 0.3–0.46 mg/kg, showing higher availability during the wet season. Ammonia also increases significantly from 0.2–0.8 mg/kg (dry surface) and 0.5–0.97 mg/kg (dry depth) to 1.9–2.13 mg/kg (wet surface) and 1.3–2.57 mg/kg (wet depth), indicating enhanced nitrogen presence in the wet season.

Phosphate shows low surface values in the dry season (0.1–0.56 mg/kg) but much higher values at depth (5.9–7.23 mg/kg). In the wet season, it increases to 0.8–1.14 mg/kg (surface) and 7.9–12.5 mg/kg (depth), confirming greater accumulation and mobility during the wet period. Sulphate ranges from 9.1–12.11 mg/kg (surface) and 0.0–0.12 mg/kg (depth) in the dry season, increasing to 12.7–14.04 mg/kg (surface) and 0.5–1.95 mg/kg (depth) in the wet season. Chloride also rises from 0.7–0.87 mg/kg and 0.79–0.8 mg/kg (dry) to 0.9–1.7 mg/kg and 2.1–3.11 mg/kg (wet), particularly at deeper levels.

Total Organic Carbon (TOC) increases slightly from 0.5–0.63% (dry surface) and 0.6–0.69% (dry depth) to 0.7–0.87% (wet surface) and 0.4–0.85% (wet depth), indicating improved organic matter during the wet season. Moisture content is lower in the dry season (5.7–6.74% surface; 5.4–6.37% depth) compared to the wet season (0.8–7.73% surface; 5.4–7.64% depth), showing greater variability and generally higher moisture during the wet period.

For cations, magnesium ranges from 12.9–22.75 mg/kg (dry surface) and 17.9–19.09 mg/kg (dry depth), increasing in the wet season to 12.9–31.59 mg/kg and 24.9–29.63 mg/kg. Potassium rises from 1.4–2.43 mg/kg and 1.5–2.75 mg/kg (dry) to 2.2–5.33 mg/kg and 4.3–5.41 mg/kg (wet). Sodium also increases from 4.4–9.1 mg/kg and 6.7–8.81 mg/kg (dry) to 9.1–12.25 mg/kg and 9.8–11.98 mg/kg (wet), indicating higher ion mobility in the wet season.

Among heavy metals, copper increases from 1.9–3.44 mg/kg (dry surface) and 1.4–3.63 mg/kg (dry depth) to 3.7–4.19 mg/kg and 2.4–3.98 mg/kg in the wet season. Iron shows a significant rise from 56.0–97.18 mg/kg and 78.9–94.62 mg/kg (dry) to 121.0–170.59 mg/kg and 153–160.41 mg/kg (wet). Lead increases slightly from 0.1–0.84 mg/kg and 0.8–0.89 mg/kg to 0.7–1.35 mg/kg and 0.9–1.38 mg/kg. Zinc rises from 4.2–5.17 mg/kg and 4.7–5.13 mg/kg (dry) to 4.6–7.05 mg/kg and 6.5–7.2 mg/kg (wet). Manganese also shows an increase from 0.1–1.3 mg/kg and 0.5–1.21 mg/kg to 0.7–1.97 mg/kg and 0.5–1.99 mg/kg.

Table 4.6: Physicochemical Characteristics of Soil Quality Around the Project Area (Wet and Dry Season)

			Dry Season Ranges		EA Cobalt 2014		Control means		EA Cobalt 2014	
Sample ID					**Wet Season Ranges**				**Control means**	
Description (Depth)			**(0-15cm)**	**(15-30cm)**	**(0-15cm)**	**(15-30cm)**	**(0-15cm)**	**(15-30cm)**	**(0-15cm)**	**(15-30cm)**
pH		APHA 4500-H+	5.4-5.67	4.5-5.65	5.7-6.69	5.6- 6.79	6.4	6.6	6.325	6.015
EC	µS/cm	APHA 2510 B	78-98	125-113	143-162.76	1220.4- 44.56	107	147	131.5	167
Temperature	°C	ASTM E2877	32.5-33.4	31-32.2	32.8-34.63	32.5- 34.32	34.35	34.76	28.5	29.35
Nitrate	mg/kg	APHA 4500-NO_3-E	0.1-0.38	0.7-0.11	0.4-0.63	0.3-0.46	0.86	0.49	0.745	0.8
Ammonia	mg/kg	APHA 4500-NH_3C	0.2-0.8	0.5-0.97	1.9-2.13	1.3- 2.57	0.96	0.2	2.415	0.985
Phosphate	mg/kg	APHA 4500-PE	0.1-0.56	5.9-7.23	0.8-1.14	7.9-12.5	1.62	1.5	7.83	1.62
Sulphate	mg/kg	EPA375.4 (600/4-79-020)	09.1-12.11	0.0-0.12	12.7-14.04	0.5- 1.95	10.67	12.67	1.34	10.67
Chloride	mg/kg	APHA 4500-Cl-B	0.7-0.87	0.8-0.79	0.9-1.7	2.1-3.11	2.06	1.03	0.97	2.06
TOC	%	APHA 2340 A	0.5-0.63	0.6-0.69	0.7-0.87	0.4-0.85	1.16	1.4	1.23	1.145
Moisture Content	%	ASTM D2216-05	5.7-6.74	5.4-6.37	0.8-7.73	5.4-7.64	8.66	6.5	9.24	8.605
CATIONS										
Magnesium	mg/kg	APHA 3111B	12.9-22.75	17.9-19.09	12.9-31.59	24.9-29.63	27.16	6.16	25.26	27.165
Potassium	mg/kg	APHA 3111B	1.4-2.43	1.5-2.75	2.2-5.33	4.3-5.41	4.6	4.4	6.08	4.755
Sodium	mg/kg	APHA 3111B	4.4-9.1	6.7-8.81	9.1-12.25	9.8-11.98	6.365	12.6	12.52	12.365
HEAVY METALS										
Copper	mg/kg	APHA 3111B	1.9-3.44	1.4-3.63	3.7-4.19	2.4-3.98	2	2	1.825	2
Iron	mg/kg	APHA 3111B	56.0-97.18	78.9-94.62	121.0-170.59	153-160.41	153.62	123.7	184.8	183.62
Lead	mg/kg	APHA 3111B	0.1-0.84	0.8-0.89	0.7-1.35	0.9-1.38	1.6	1.4	0.955	1.09
Zinc	mg/kg	APHA 3111B	4.2-5.17	4.7-5.13	4.6-7.05	6.5-7.2	9.075	10.04	8.715	10.075
Manganese	mg/kg	APHA 3111B	0.1-1.3	0.5-1.21	0.7-1.97	0.5-1.99	1.88	1.83	1.975	1.83

4.13 Vegetation Studies

Wudil, located in Wudil in Kano State, lies within the Sudan Savanna ecological zone of northern Nigeria. This zone represents a transitional belt between the arid Sahel to the north and the more humid Guinea savanna to the south. The ecological setting is characterized by a tropical wet-and-dry climate, with a distinct seasonal pattern. The rainy season is relatively short, typically lasting from June to September, while the dry season extends from October to May and is often influenced by the dry, dusty Harmattan winds. Annual rainfall is moderate, generally ranging between 600 and 1000 mm, and temperatures are high throughout the year. The soil in this region is usually sandy to loamy, with relatively low organic content, which affects the type and density of vegetation that can grow.

Plate 4.4: Vegetation Type

The natural vegetation of Wudil is best described as Sudan savanna vegetation, which consists mainly of open grassland interspersed with scattered trees and shrubs. Grasses form the dominant ground cover, especially during the rainy season when they grow rapidly and turn the landscape green. These grasses are typically short to medium in height and include species such as *Andropogon* and *Hyparrhenia*. However, during the long dry season, the grasses dry out, becoming brown and sparse, and are often subject to bush burning and grazing by livestock. This seasonal variation gives the landscape a markedly different appearance at different times of the year.

The tree component of the vegetation is generally sparse and consists of drought-resistant species that are well adapted to harsh climatic conditions. Common trees found in this ecological zone include acacia species, which are usually thorny and have small leaves to reduce water loss; the baobab tree (*Adansonia digitata*), known for its thick trunk that stores water; and the locust bean tree (*Parkia biglobosa*), which is economically important to local communities. Many of these trees are deciduous, shedding their leaves during the dry season to conserve moisture. Shrubs are also present and are often scattered across the landscape, contributing to soil stability and providing additional vegetation cover.

Human activities have significantly modified the natural vegetation in Wudil. Much of the original savanna has been cleared for agricultural purposes, as the area supports the cultivation of crops such as millet, sorghum, maize, and groundnuts. In areas close to water sources, especially along seasonal rivers, irrigation farming is practiced, allowing for the cultivation of crops like rice and vegetables even during the dry season. Additionally, widespread grazing by livestock such as cattle, goats, and sheep has reduced grass cover in some areas, while the cutting of trees for fuelwood and construction has contributed to deforestation. As a result, the present-day vegetation is largely a mixture of natural savanna and human-modified landscapes.

Wildlife and Conservation Status

Table 4.7: Wildlife and Conservation Status (Sudan Savanna – Wudil Area)

Common Name	Scientific Name	Group	Conservation Status (IUCN)	Remarks
West African Lion	*Panthera leo senegalensis*	Mammal	Critically Endangered	Extremely rare in West Africa; locally extinct in many areas
African Wild Dog	*Lycaon pictus*	Mammal	Endangered	Declining due to habitat loss and human conflict
Caracal	*Caracal caracal*	Mammal	Least Concern (locally threatened)	Still present but under pressure from hunting
Patas Monkey	*Erythrocebus patas*	Mammal	Near Threatened	Population decreasing, habitat degradation
African Golden Wolf	*Canis lupaster*	Mammal	Least Concern	Adaptable but affected by habitat changes
Spotted Hyena	*Crocuta crocuta*	Mammal	Least Concern	Declining in populated regions
Denham's Bustard	*Neotis denhami*	Bird	Vulnerable	Threatened by hunting and habitat loss
Secretary Bird	*Sagittarius serpentarius*	Bird	Vulnerable	Declining due to agricultural expansion
Northern Ground Hornbill	*Bucorvus abyssinicus*	Bird	Vulnerable	Sensitive to habitat disturbance
Hooded Vulture	*Necrosyrtes monachus*	Bird	Critically Endangered	Rapid decline due to poisoning and human activity
African Grey Hornbill	*Lophoceros nasutus*	Bird	Least Concern	Common but affected by deforestation
Nile Monitor Lizard	*Varanus niloticus*	Reptile	Least Concern	Found near water bodies
African Rock Python	*Python sebae*	Reptile	Near Threatened	Threatened by hunting and habitat loss
Senegal Coucal	*Centropus senegalensis*	Bird	Least Concern	Common in savanna and farmland
Grasshopper (various spp.)	Various	Insect	Not Evaluated	Important for ecosystem food chain

Plants Conservation Status

Table 4.8: Plants and Conservation Status (Sudan Savanna – Wudil Area)

Common Name	Scientific Name	Plant Type	Conservation Status (IUCN)	Remarks / Uses
Baobab	*Adansonia digitata*	Tree	Least Concern (declining locally)	Stores water; food, medicine, cultural value
Gum Arabic Tree	*Acacia senegal*	Tree	Least Concern	Arabic source of gum; drought-resistant
Umbrella Thorn Acacia	*Acacia tortilis*	Tree	Least Concern	Common savanna tree; prevents desertification
Locust Bean Tree	*Parkia biglobosa*	Tree	Vulnerable (regional decline)	Produces food condiment ("dawadawa")
Neem Tree	*Azadirachta indica*	Tree (introduced)	Not Evaluated	Widely planted; medicinal and shade
Shea Tree	*Vitellaria paradoxa*	Tree	Vulnerable	Produces shea butter; threatened by land clearing
Desert Date	*Balanites aegyptiaca*	Tree	Least Concern	Highly drought-tolerant; food and medicine
African Birch	*Anogeissus leiocarpa*	Tree	Least Concern	Used for timber and fuelwood
Bush Willow	*Combretum spp.*	Shrub/Small tree	Not Evaluated	Common in degraded savanna
Spear Grass	*Imperata cylindrica*	Grass	Least Concern (invasive in some areas)	Dominant grass; colonizes disturbed land
Guinea Grass	*Panicum maximum*	Grass	Least Concern	Important for grazing livestock
Andropogon Grass	*Andropogon gayanus*	Grass	Least Concern	Typical savanna grass species
Hyparrhenia Grass	*Hyparrhenia spp.*	Grass	Not Evaluated	Seasonal grass; grows during rainy season

Plant Pathology

Plant pathology in the Sudan savanna environment of Wudil is largely influenced by the region's harsh climatic conditions and increasing human disturbance. The vegetation observed in the image characterized by dry grasses, scattered trees, and sparse shrubs shows clear signs of environmental stress. Many of the plants appear withered, with reduced foliage and stunted growth, which are typical indicators of plant health problems in semi-arid regions. These conditions are not only seasonal but are also linked to deeper pathological issues affecting plant survival and productivity.

A major factor influencing plant pathology in this area is abiotic stress**,** particularly drought and high temperature. The long dry season in Wudil leads to severe water deficiency, causing plants to lose moisture rapidly through transpiration. As a result, grass dries out completely, and many trees shed their leaves to conserve water. Prolonged exposure to high temperatures further intensifies this stress, often leading to leaf scorching and reduced photosynthetic activity. In addition, the soils in this region are typically sandy and low in organic matter, which limits nutrient availability. This results in weak plant growth, poor root development, and symptoms such as yellowing of leaves and reduced biomass.

In addition to environmental stress, biotic factors such as pathogens and pests also contribute to plant diseases. During the short rainy season, fungi become more active and may cause diseases like leaf spots and root rot, especially in crops and young plants. Bacterial infections can also occur, leading to wilting and tissue decay. Viral diseases, particularly in cultivated crops like maize and sorghum, can cause stunted growth and abnormal leaf coloration. Although these pathogens are not directly visible in the image, their effects are often reflected in the poor condition of vegetation in such environments.

Pests and herbivory play a significant role in plant pathology in Wudil. Termites are especially common in savanna ecosystems and can damage plant roots and stems, weakening or killing trees and shrubs. Grasshoppers and locusts feed on grasses and crops, leading to defoliation and reduced plant cover. Additionally, overgrazing by livestock such as cattle, goats, and sheep is a major problem. Continuous grazing prevents grass from regenerating and exposes the soil, contributing to land degradation and making plants more vulnerable to disease and environmental stress.

Human activities further exacerbate plant health problems in the area. The clearing of land for agriculture and construction reduces vegetation cover and disrupts natural ecosystems. Bush burning, which is often practiced to clear land, destroys young plants and beneficial soil organisms. Soil compaction from human movement and livestock reduces the ability of roots to penetrate the soil and access nutrients. These activities collectively weaken the resilience of vegetation and increase susceptibility to both abiotic and biotic stress factors.

Flora and Fauna

The bio-ecological environment of Wuldi, Kano reflects the broader characteristics of the Sudan savanna ecological zone in northern Nigeria. This region is defined by a semi-arid climate**,** marked by distinct wet and dry seasons, relatively high temperatures, and moderate to low rainfall. Such environmental conditions strongly influence the distribution, structure, and adaptation of both flora and fauna. Vegetation is generally less dense than in southern Nigeria, and biodiversity is shaped by water availability, soil type, and human land use such as farming and grazing.

Flora in Wuldi is typically composed of savanna vegetation**,** including scattered trees, shrubs, and grasses adapted to drought and seasonal changes. Common tree species include drought-resistant varieties such as Acacia species, Baobab, and Neem tree, many of which have deep root systems and small or waxy leaves to reduce water loss. Grasses dominate the ground layer during the rainy season, growing rapidly and providing forage for animals, but they often dry out in the dry season, contributing to a brown and sparse landscape. Human activities such as agriculture (e.g., millet, sorghum, and maize cultivation) and fuelwood collection have also influenced vegetation patterns, sometimes leading to reduced tree cover and land degradation.

Fauna in this environment is adapted to the open savanna and seasonal resource availability. Typical animal species include small to medium-sized mammals such as rodents, hares, and occasionally antelopes in less disturbed areas. Reptiles like lizards and snakes are common due to the warm climate, while birds such as weaver birds, doves, and ground-dwelling species are abundant and play important roles in seed dispersal and insect control. Insects, including grasshoppers, termites, and beetles, are particularly significant in this ecosystem, contributing to nutrient cycling and serving as a key food source for many animals. Domestic

animals such as cattle, goats, and sheep are also prominent and form an important part of the local agro-pastoral system.

Seasonality plays a critical role in shaping ecological dynamics in Wuldi. During the rainy season, increased moisture leads to rapid vegetation growth, higher food availability, and increased animal activity and reproduction**.** In contrast, the dry season brings water scarcity, reduced plant cover, and migration or behavioral adaptation among animals to cope with harsh conditions. Some species rely on burrowing, nocturnal activity, or drought resistance strategies to survive the extreme heat and limited water supply.

Terrestrial Ecosystem in Wuldi, Kano

The terrestrial ecosystem of Wuldi, Kano is characteristic of the Sudan savanna biome, which is dominated by open grasslands interspersed with scattered trees and shrubs. This ecosystem is shaped by a combination of low to moderate rainfall, high temperatures, and prolonged dry seasons**,** resulting in vegetation that is drought-resistant and widely spaced. The soil is generally sandy to loamy, supporting seasonal grasses and hardy plant species. Ecological processes such as nutrient cycling, grazing, and fire (both natural and human-induced) play significant roles in maintaining the structure and function of this ecosystem.

Primary producers in this terrestrial system include savanna grasses and woody plants like Acacia species and Baobab, which provide food and shelter for herbivores. These, in turn, support a food web consisting of primary consumers (e.g., rodents, grazing livestock), secondary consumers (e.g., reptiles and small carnivores), and decomposers such as fungi and termites that recycle nutrients back into the soil. The ecosystem is dynamic, with productivity peaking during the rainy season and declining sharply during the dry season.

Protected Areas

Although Wuldi does not host a formally designated conservation site, it lies within a region influenced by nearby protected areas such as Kano Zoological Garden and Challawa Gorge Dam and Forest Reserve. These areas play an important role in biodiversity conservation, environmental education, and habitat protection within Kano State.

The Kano Zoological Garden serves as a conservation and research center, housing various native and exotic animal species while promoting awareness about wildlife protection. On the other hand, Challawa Gorge Dam and Forest Reserve provides a semi-natural habitat that supports vegetation cover, protects watersheds, and offers refuge for local wildlife species. Such protected areas are essential in regions facing increasing pressure from urbanization, agriculture, and deforestation.

Red Book Species (Threatened Flora and Fauna)

In the Sudan savanna region, several species are considered threatened or vulnerable according to conservation assessments such as the IUCN Red List (often referred to as the “Red Book”). While specific records for Wuldi may be limited, species commonly associated with northern Nigeria include:

- African Elephant – Vulnerable due to habitat loss and poaching.
- West African Lion – Critically endangered in West Africa due to shrinking habitats and human-wildlife conflict.

- African Wild Dog – Endangered, largely due to habitat fragmentation and disease.
- Hooded Vulture – Critically endangered, affected by poisoning and habitat disturbance.

For flora, certain economically important trees such as Shea tree and African Mahogany are under pressure due to overexploitation for timber, fuelwood, and agricultural expansion.

4.14 Socio-economic and Health Study

This chapter presents the results and analysis of the survey questionnaire conducted as part of the Environmental and Social Impact Assessment (ESIA) for the proposed hybrid solar power plant at POLAC. A total of 40 respondents completed and submitted the questionnaire, providing comprehensive information on socioeconomic and demographic characteristics, health status, standard of living, gender-based violence concerns, environmental and cultural resources, project impact perceptions, and grievance redress mechanisms.

The data collected has been analyzed and presented using various visualization techniques including pie charts and bar charts to facilitate better understanding of the survey findings. The results are organized according to the survey sections: Household Data, Health Status, Standard of Living, Gender-Based Violence/Sexual Exploitation and Abuse, Resources/Cultural Property, Project Activities Impact Evaluation, Grievance Redress Mechanism, and World Bank Environmental and Social Standards (ESS).

Household Data

This section presents the demographic and socioeconomic characteristics of the respondents, including gender distribution, age groups, marital status, occupation, residential status, ethnic composition, religious affiliation, household relationships, duration of residence, and educational attainment.

Age Distribution

The age distribution shows that most respondents (65%) fall within the 18-45 years age bracket, representing 26 individuals. This is followed by 30% in the 46-65 years category (12 respondents), and 5% below 18 years (2 respondents). This distribution indicates a predominantly young to middle-aged population, which is typical for a university community.

Marital Status

The study population showed that 55% of the respondents were married, the single population represented 45% while no respondent indicated divorce or widowed as their marital status. A significant population of the students were single as expected of undergraduate, while the married population were predominantly staffs and business operators within the campus community.

Occupation Distribution

The occupation distribution in Wuldi, Kano reflects the broader socio-economic structure of rural and peri-urban communities in northern Nigeria, where livelihoods are largely shaped by environmental conditions, cultural practices, and access to resources. The economy is predominantly informal and agrarian, with most residents engaged in primary production and small-scale enterprises.

Agriculture is the dominant occupation in Wuldi, employing a large proportion of the population. Farmers cultivate staple crops such as millet, sorghum, maize, and groundnuts, which are well adapted to the semi-arid Sudan savanna climate. Farming is mostly rain-fed and seasonal, with increased activity during the rainy season and reduced productivity during the dry period. In addition to crop farming, many households' practice subsistence agriculture**,** producing mainly for local consumption with limited surplus for sale. Pastoral and agro-pastoral practices are widespread, with herders moving animals in search of pasture and water, especially during the dry season. This occupation plays a crucial role in supporting household livelihoods and food security.

Trade and commerce form another significant component of occupation distribution. Many inhabitants engage in petty trading**,** selling agricultural produce, grains, livestock products, and household goods in local markets. Small-scale businesses such as kiosks, food vending, and craft sales are common, particularly among women and youth. These activities provide daily income and support the circulation of goods within the community.

Artisan and vocational occupations are also present, though on a smaller scale. These include blacksmithing, tailoring, carpentry, leatherwork, and weaving**,** which are traditional skills passed down through generations. Such occupations contribute to local economic diversity and provide essential goods and services to the community.

A portion of the population is involved in public and private sector employment**,** including teaching, civil service, healthcare work, and security services. However, these formal jobs are relatively limited compared to agricultural and informal activities. Youth employment may also include casual labor, transportation services (such as motorcycle riding), and construction work.

Residential Status

The majority of respondents (55%) are permanent residents, indicating strong community ties and long-term investment in the area. Returnees constitute 35% of the population, while only 10% are non-residents. This residential pattern suggests a stable community with established roots in the area.

Relationship to Household Head

Relationship to household head defines a person's familial or functional connection to the primary decision-maker/breadwinner in a household. The relationship with the head of household is such that 45% of the respondents were the actual household head, 20% are spouses of the household head, 35% are children of the Head of household.

Household Size

The household size of a typical family is relative, depending on several factors such as income, level of education and religious belief. The household size of the respondents varies between 3 to 8 members, with a mean household size of 6 persons.

Duration of Living/Working in the Area

The analysis showed that 45% of respondents have lived or worked in the area for 6-9 years, 30% have been there for 10 years or more. 25% of respondents are living and working 3-5 years and below. This data

indicates a well-established community with significant institutional memory and long-term stakes in the area's development.

4.15 Health Status

This section examines the health management practices, healthcare access patterns, common ailments, and perceptions about potential health impacts of the proposed infrastructure project.

Health Management Practices

An overwhelming majority of respondents (90%) indicated that they attend hospitals or clinics when sick, demonstrating good health-seeking behavior. Only 10% reported buying drugs from nearby chemists without professional consultation. This pattern suggests adequate awareness of the importance of professional medical care and likely indicates reasonable access to healthcare facilities.

Hospital/Clinic Visit Frequency and Common Ailments and Sicknesses

The most commonly reported ailments are Malaria (45%) and Typhoid fever (30%), which are endemic diseases in Nigeria. High Blood pressure/ Hypertension (10%), Diarrhea affected 10% and 5% of respondents had Eye pain. These disease patterns are typical of tropical regions and do not indicate any unusual health burden that would be exacerbated by the proposed solar power project.

Perceived Health Impact of Proposed project

The perception of respondents on the perceived health implications of the proposed solar power plant project was positive. All the respondents indicated that they do not believe their health conditions will be affected by the proposed infrastructure intervention. This unanimous perception suggests strong confidence in the project's safety and minimal anticipated health risks from the solar power installation.

Standard of Living/Socioeconomic Activities

This section analyzes the living conditions, housing characteristics, utility services, income levels, and perceptions about changes in standard of living among respondents.

Housing Characteristics

The most common house types within Wuldi are bungalows (ranging from 2-bedroom to 4-bedroom), which are popular for being easier to build and maintain. Other prevalent residential building types include blocks of flats (apartments), duplexes (fully detached and semi-detached), and terraced houses. However, the predominant housing type in the study areas were constructed with cement, blocks and plastered walls, indicating good quality housing infrastructure. The interior compartments each household consist of an average of 3-4 rooms, which represent 55%, while 1-2 rooms households represent 35%. Majority of the students occupies single rooms hostel apartment on campus while others share 2-bedroom apartments usually off campus.

Sanitation Facilities

Sanitation facilities are systems and infrastructure designed to safely separate human excreta from human contact, preventing disease transmission and ensuring public health. Improved, safe options include flush/pour-flush toilets connected to sewers or septic tanks among others. Water closet toilet facilities are

available in 90% of households, demonstrating good sanitation infrastructure. However, 10% use toilet facilities (pit latrine) located outside their dwellings while others engage in open defecation.

Housing and Land Tenure

Housing tenure shows that 65% of respondents rented their accommodation while 25% own their homes while 10% did not indicate their housing tenure. The land tenure distribution mirrors this pattern exactly, with 65% renting and 25% owning land.

Table 4.9: Distribution of land tenure in the study area

S/No	Land Tenure	Percentage distribution
1	rented	75%
2	Owned	25%

Refuse Disposal Methods

The study area had a mixed household solid waste disposal method, they range from disposal at Community refuse pit/dumpsite, burning, depositing at the backyard of residence, collection by waste contractors among others. The predominant solid waste disposal method was by burning which represent 40 %, this was followed by deposition at the backyard which represent 25% and waste collection by registered waste contractors representing 25%. Dumping at community dumpsite represents 10%. However, within the community, Solid wastes are collected and disposed off by waste contractors, unfortunately, students engage in indiscriminate dumping of waste behind their hostels. Therefore, it is pertinent that waste segregation at source, reuse and recycling be prioritized in the stud areas.

Source of Lighting

All respondents (100%) indicated access to electricity from the nation grid, through the existing Distribution Company, although the duration and quality of supply vary due to the Band scheme which specify the number of hours of electricity available to users per day. Alternative lighting sources include torchlight/battery (10%), standalone Solar system (35%) candles (10%), and generators (45%). The reliance on multiple backup sources suggests unreliable electricity supply from the national grid, hence the proposed solar power project will mitigate the power gap within the community. Figure 4.10 shows electricity facility on site.

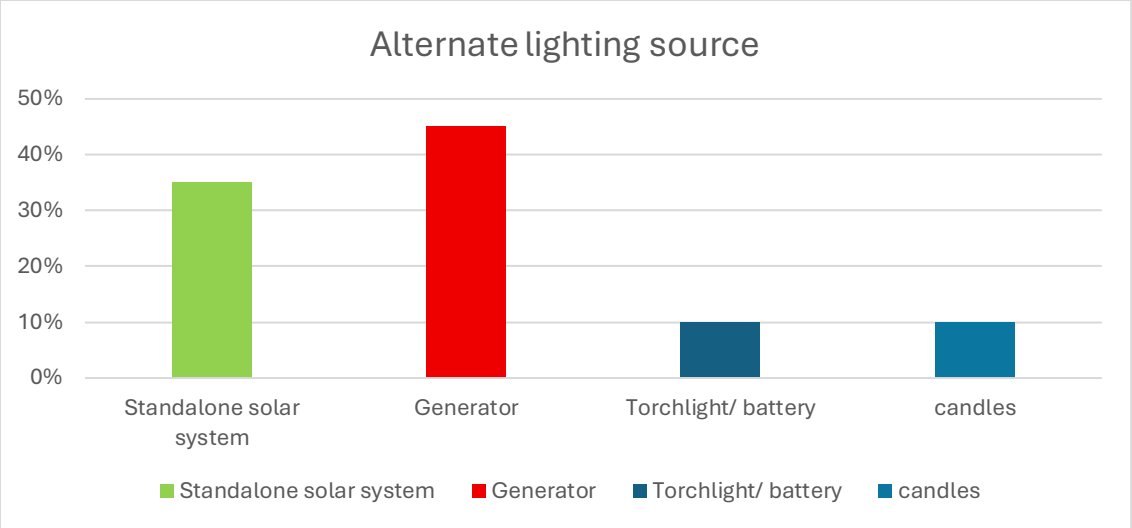

Figure 4.10: Alternative Source of Electricity

Energy Sources for Cooking

The predominant energy for cooking is gas, which represent 45%, kerosene stove represents 25% and firewood represent 10%, Coal represents 15% while electricity users constitute 5%. This heavy reliance on biomass fuels (coal and firewood) indicates significant potential for environmental impact and suggests that improved electricity access could lead to cleaner cooking practices. Figure 4.11 shows firewood for cooking in the study area.

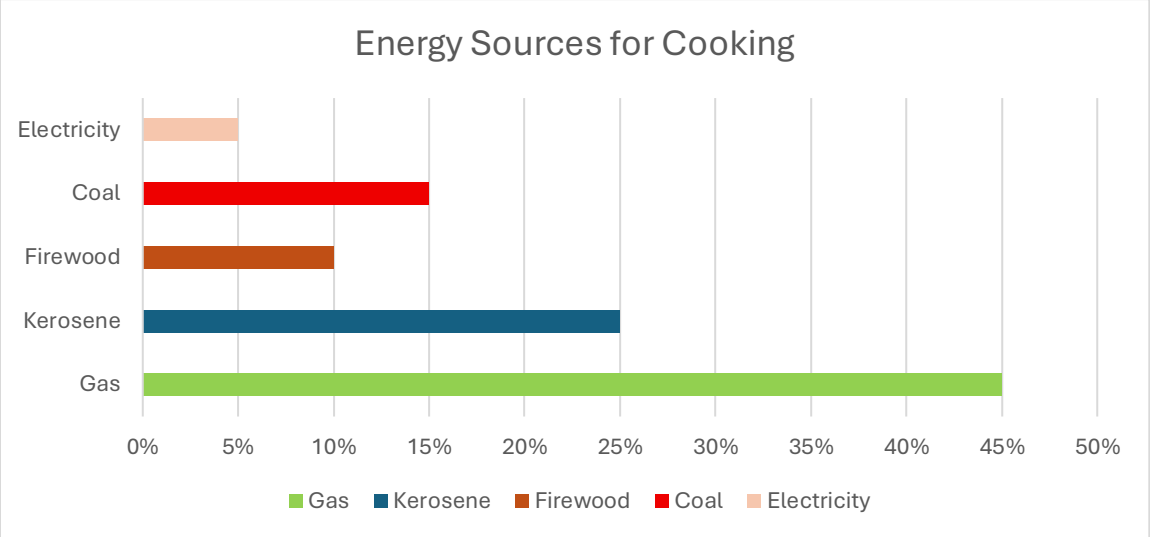

Figure 4.11: Energy Sources for Cooking

Income Distribution

Income distribution measures the spread of income across different groups (households, individuals, or income sources) within an economy, rather than just the average income. Unfortunately, 40% of the respondents refused to disclose their monthly income for personal reasons. However, 20% of the

respondents earn a monthly income of 200,000 only, 25% earns less than 150,000 monthly while 15% earn 100,000 and below. Table 4.12 shows the income distribution of the study area.

Table 4.10: Income Distribution of the study Area

S/No	Monthly income	Percentage distribution
1	100,000 and below	15%
2	101,000 – 150,000	25%
3	200,000 and above	20%
4	Non-disclosure	40%

Changes in Standard of Living

When asked about changes in standard of living over the previous three years, 50% indicated that it had nosedive tremendously impacting livelihood negatively. 35% of the respondent reported marginal improvement (better), while 15% indicated similar situation (same). This mixed response suggests varying economic experiences within the community, which could be attributable to the earning opportunities peculiar to the different respondents.

Electricity's Role in Living Standards

Access to reliable and affordable electricity has a multiplier effect in enhancing economic prosperity and improve the standard of living due to lower cost of generating power individually and spurring small and medium-scale businesses. However, 35% percent of respondents reported that their standard of living changed positively due to improved electricity supply, while 65% attribute changes to other factors. This indicates that while electricity is important, it is not the sole determinant of living standards in the community. Figure. 4.12 shows the contribution of electricity supply to the change in the standard of living of respondents in the study area.

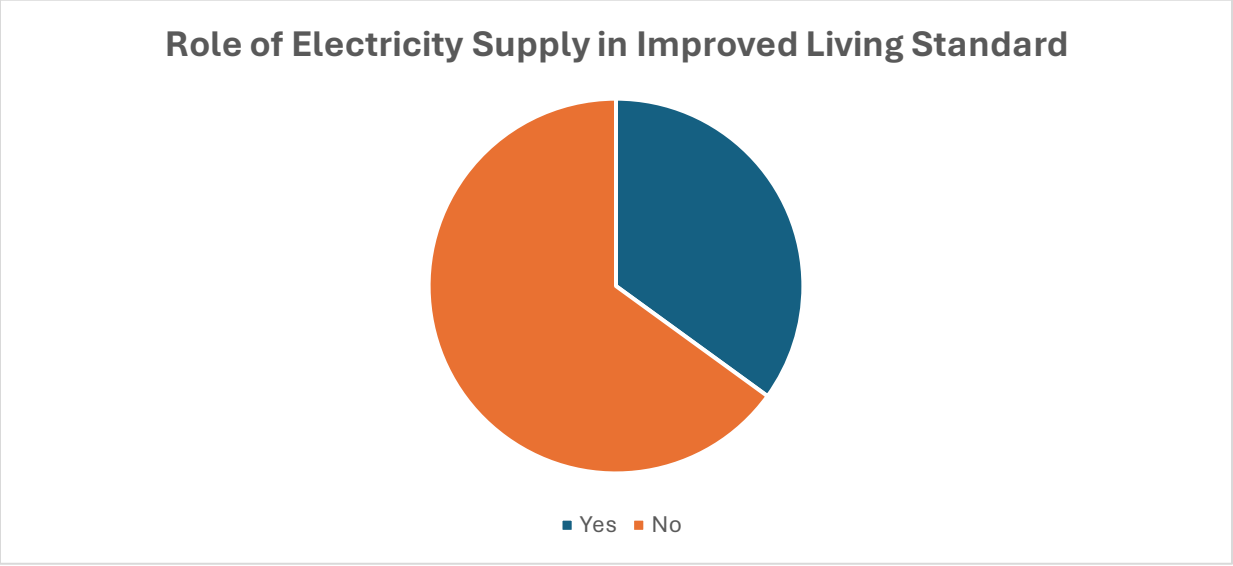

Figure 4.12: Role of Electricity Supply in Improved Living Standards

Gender-Based Violence/Sexual Exploitation and Abuse

Gender-Based Violence (GBV) and Sexual Exploitation and Abuse (SEA) remain critical concerns in many parts of northern Nigeria, including communities such as Wuldi in Kano State. These issues are often driven by deeply rooted gender inequalities, poverty, and social norms that limit the rights and voices of women and girls. In such settings, GBV manifests in various forms, including domestic violence, early and forced marriage, denial of education, and sexual abuse. Cultural silence and stigma frequently discourage survivors from speaking out, which allows cases to go unreported and unaddressed.

In Wuldi-Kano, vulnerability to Sexual Exploitation and Abuse is heightened by economic hardship and unequal power dynamics. Individuals in positions of authority such as employers, community leaders, or service providers may take advantage of vulnerable women, girls, or even boys by demanding sexual favors in exchange for assistance, employment, or protection. This form of exploitation is particularly harmful because it abuses trust and deepens the cycle of poverty and dependency. Limited awareness of rights and weak reporting mechanisms further compound the problem, making it difficult for survivors to seek justice. The impact of GBV and SEA on individuals and the community is severe and long-lasting. Survivors may suffer physical injuries, psychological trauma, social exclusion, and loss of educational or economic opportunities. In Wuldi-Kano, as in many similar communities, survivors often face blame or rejection, which discourages others from reporting abuse. This not only affects individual well-being but also hinders community development, as fear and inequality prevent full participation in social and economic life.

Efforts to address GBV and SEA in Wuldi-Kano require a multi-sectoral approach. Community sensitization programs are essential to challenge harmful norms and promote gender equality. Strengthening local institutions such as healthcare centers, law enforcement, and social services is necessary to provide safe, confidential, and survivor-centered support. Additionally, enforcing existing laws and ensuring accountability for perpetrators can help deter abuse. Collaboration between government agencies, non-governmental organizations, religious leaders, and community members is crucial to creating a safer environment where human rights are respected and protected.

Provisions Restricting Women's Access to Health Services

The survey showed that there is no restriction on women's access to health and social services requiring male consent for medical treatment, 70% responded yes, 5% no, and 10% did not respond. Regarding parental consent for adolescents' access to contraceptives, 60% responded yes, 10% no, and 30% no response. For medical practitioners refusing services based on conscientious objection, 60% said yes, 10% no, and 25% did not respond. These responses indicate significant awareness of restrictive practices that may affect women's health access.

Gender Equity in the Community

The Nigeria Constitutional Provisions (Section 42): Nigeria's Constitution guarantees freedom from discrimination on the basis of sex, gender, or religion, providing a legal foundation for equality. Nigeria’s primary framework for gender equality is the National Gender Policy (2021–2026), which aims to bridge gender gaps, promote women's empowerment, and achieve 35% affirmative action in political and decision-making roles. When asked how gender equity is ensured, 30% of respondents indicated that Women are elected to public office, 25% indicated that quotas on genders are ensured in leadership of community-

based organizations, while 45% of the respondent indicated that females are given equal opportunity and access to education and employment.

Vulnerable Group

Vulnerable groups are individuals or populations who, due to certain conditions or circumstances, are at a higher risk of harm, discrimination, or exclusion from social, economic, educational, or health opportunities. They often need special protection, support, or attention in policies, institutions, and community programs to ensure fairness and inclusion. At a university level, vulnerable groups may include Students with disabilities, Students from extremely poor backgrounds, Female students facing gender-related challenges, international students or minorities, Students with mental health difficulties. The Command's does not have any cadet with disabilities.

Resources/Cultural Property

This section assesses environmental challenges in the community and potential impacts of the proposed project on natural and cultural resources.

Expected Environmental Problems from Project Construction

Remarkably, 100% of respondents indicated that they do not expect any of the listed environmental problems (soil infertility, poor drainage, bad roads, low visibility, erosion, flooding, environmental degradation, infrastructure destruction, land encroachment, or pollution) to result from the proposed solar power project during construction. This unanimous perception reflects strong confidence in the project's environmental safety and proper management.

Impact on Valued Cultural/Archaeological Property

All respondents (100%) indicated that the proposed Solar power plant infrastructure project will not affect any valued resource, cultural, or archaeological property in their area. Rather, it will enhance the appeal of the community and its valued resources. This is consistent with the project being located on a virgin land belonging to the university that is not currently in use and has no known cultural or archaeological significance.

Intervention Project Activities Impact Evaluation

This section evaluates awareness of the proposed solar power project, information sources, potential for community restiveness, expected impacts, and community expectations from the project.

Proposed Project Awareness

Project awareness involves educating stakeholders or the public about a project's goals, impact, or existence, crucial for fostering community support, compliance, and successful implementation. Unfortunately, the level of awareness of the proposed intervention was abysmally low, only a handful of persons are aware among the management team of the Command. 10% of respondents indicated awareness of the proposed solar power project, while 90% were not aware. This low awareness level highlights the importance of enhanced stakeholder engagement and communication about the project to ensure community understanding and participation.

Positive Impacts of the Proposed Project

Respondents identified multiple positive impacts expected from the project, including constant power supply, increased productivity and efficiency, enhanced research and academic output for lecturers and students, promotion of economic development and prosperity, and reduction of noise and global warming. No negative impacts were identified by respondents, further demonstrating strong community support.

Community Expectations from the Project

The survey revealed several key expectations from the community. Employment of locals and contracting opportunities during construction was expected by 80% of respondents, capacity building for maintenance during implementation by 90%, and community input into final engineering design by 20%. Additionally, respondents emphasized the importance of durability, proper maintenance, and adequate security to protect against theft and robbery.

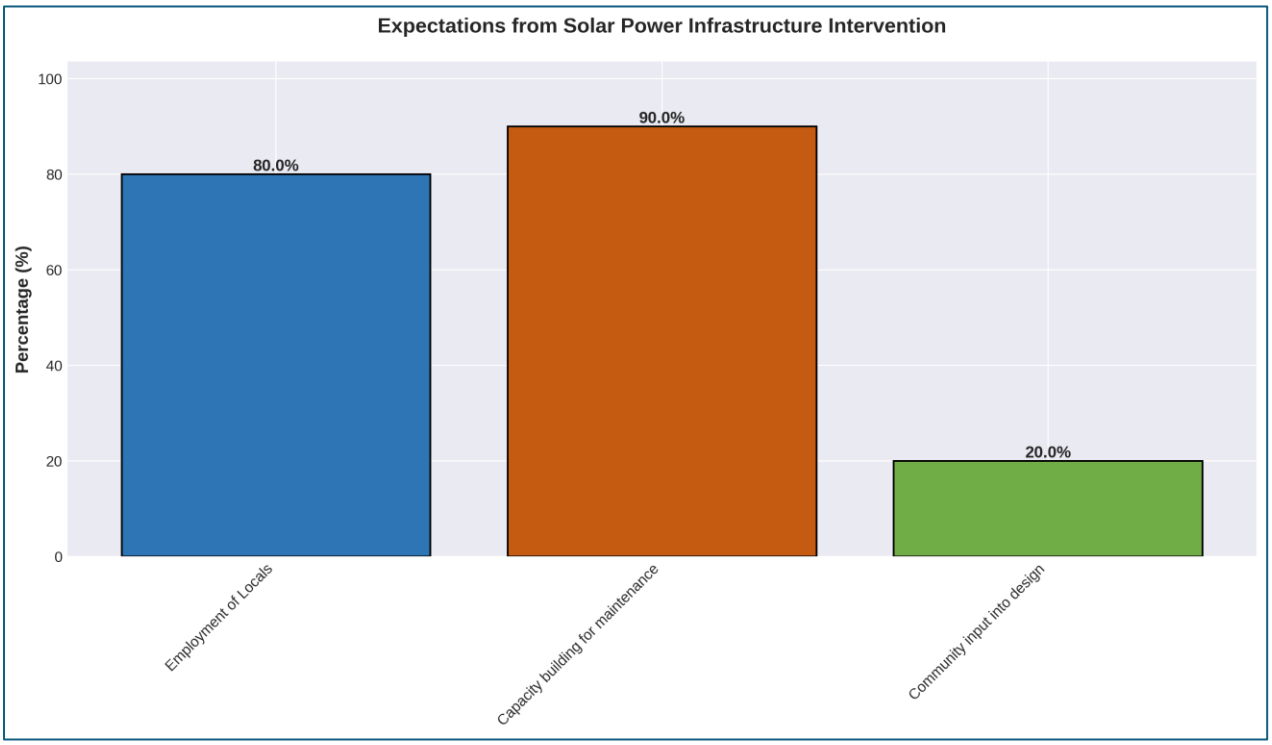

Figure 4:13: Expectations from Solar Power Infrastructure

Grievance Redress Mechanism

A grievance refers to any complaint, dissatisfaction, or concern an individual (staff or student) has regarding: Academic issues (e.g., grading, supervision, examination results), Administrative matters (e.g., delays, misconduct). Workplace conditions (for staff): Harassment, discrimination, or unfair treatment. The Grievance Redress Mechanism (GRM) at POLAC provides a structured process for students and staff to seek resolution when they encounter unfair treatment, academic issues, or administrative problems. The Command ensures that the GRM is guided by: Fairness and impartiality, Confidentiality, Timeliness, Non-retaliation (no punishment for filing a genuine complaint), and documentation of every step for accountability.

Step-by-Step Process of Grievance Redress

Informal Resolution

The complainant (cadets or staff) is encouraged to first discuss the issue informally with the person directly involved, such as a lecturer, supervisor, or department officer. Many issues can be resolved at this level through communication and clarification.

Departmental / Faculty Level

If the issue is not resolved informally, the complainant submits a written complaint to the Head of Department (HOD) or Dean of Faculty. The commandant investigates the matter, possibly holding a meeting with all parties involved. A decision or recommendation is then communicated to the complainant.

Grievance Committee

If the complainant is unsatisfied with the departmental resolution, the case is escalated to the Cadets Grievance Redress Committee. This committee reviews the complaint, conducts hearings if necessary, and ensures due process is followed. Both parties may be invited for clarification or presentation of evidence.

Appeal to the Commandant

If the complainant still feels dissatisfied with the outcome, they can appeal to the Command. The Command reviews the entire process and may make a final decision or direct further investigation.

External Resolution

Statistically, 75% of grievances were reported to the university authority for resolution, 15% were reported to the law enforcement agency (Police) while 10% were reported to the landlords/ CDA. Overall, 80% satisfactory grievance resolution rate were reported. This section examines the community's experience with grievances, reporting mechanisms, and satisfaction with resolution processes.

Grievances in the Last Three Years

40% of respondents indicated that they have had grievance issues in the community in the last three years, while 50% reported not to have had any major grievance issues within the community. However, 10% of the respondent did not indicate because they could not remember and did not want to give a misleading view on the question.

Grievance Reporting Channels

When asked where they would report grievances, 75% indicated they would approach the school authority/management, 10% would go to the landlord/ CDA, and 15% would approach the law enforcement agency. This distribution shows that the university administration is seen as the primary authority for addressing concerns, which is appropriate given the institutional context.

Satisfaction with Grievance Resolution

The level of satisfaction derived from the grievance resolution mechanism varied in the study area, 80% of respondents indicated that grievances are satisfactorily addressed or resolved by the chosen reporting channels while 20% objected and were dissatisfied with the outcome of the grievance resolution. However, there are opportunities for improvement in the existing redress mechanism.

Specific Concerns about the Project

Concerns and fears about developmental projects are part of every developmental process. Concerns and fear stem from little knowledge about the project design, its impacts, and scope, among others. However, the beneficiaries of the proposed projects and respondents expressed specific concerns regarding the proposed intervention project, primarily focusing on the durability and proper maintenance of the solar power plant. They emphasized the need for adequate security measures to protect against theft and vandalism.

CHAPTER FIVE
ASSOCIATED AND POTENTIAL IMPACTS

5.1 Introduction

The project has overall positive impacts by providing a competitive, cost-effective, pollution-free, and reliable mode of solar power. It will certainly meet the ever-increasing demand for power and bridge the gap between demand and supply of power. However, the proposed project may have some negative impact on the environment during site preparation, construction & operation phases. During the construction phase, the impacts may be regarded as temporary or short-term; while long-term impacts may be observed during the operation stage.

5.2 Impact Assessment Overview

The potential for an Environmental and Social impact exists where an environmental and social aspect has been identified i.e. where a project activity has been determined to have the potential to interact with the biophysical and socio-economic environment.

The assessment process was as follows:

- Identification of the various potential impacts using an interaction matrix to show the relationship/ interaction between the project environmental components and planned project activities.
- A screening of potential impacts associated with each phase of the project is performed using a Risk Assessment Matrix, and
- A detailed evaluation of the individual impact-producing factors that comprise each aspect of the project phases is then performed. The significance of the potential impacts is quantified using the same rationale as for the screening.

The assessment of impact significance is both in qualitative and quantitative terms. Qualitatively, the impact significance is ranked on four (4) widely accepted levels: Major, Moderate, Minor and Negligible. The impact assessment covers the entire life cycle of the Project. i.e.: preconstruction, Construction, operation, and decommissioning.

5.3 Identification of Environmental and Socio-economic Aspects and Impacts

A number of project activities would be carried out in phases. These planned activities are what would impact on the environmental components positively or negatively. The PV-based power plant project activities are grouped into five phases as follows:

Pre-Construction phase: Involves activities such as award of contract, project design and planning, consultation, recruitment, site preparation and transportation of the utility scale PV based power plant components to site.
Construction phase: It involves activities such as mobilization of workforce and equipment to site, digging, trenching, bulldozing, grading, soil compaction; and installation of temporary camp and power plant components. This phase is usually a short term one. Commissioning phase: It involves the integrated application of a set of engineering techniques and procedures to check, inspect and test every operational component of the project, from individual functions, such as instruments and equipment, up to complex amalgamations such as modules, subsystems and systems. Operational phase: This is usually ‘long term’, involving activities from post construction to pre-decommissioning. It commences once the power plant has been commissioned for use.

Activities include use of natural resources (water for domestic uses and cleaning of solar modules), plant and equipment operations, and routine maintenance of equipment and plant. Decommissioning phase: It begins once the power plant use is discontinued or the project life span has come to an end. It should be noted that impacts can occur at any time; during these phases mentioned above i.e. pre-construction, construction and operational phases of the project. Some impacts may however occur in some or all phases of the project. To identify environmental and social aspects of the Project, the proposed Project activities were considered in terms of their direct or indirect potential to:

- Interact with the existing natural environment including its physical and biological elements;
- Interact with the existing socio-economic environment; and
- Breach relevant policy, legal and administrative frameworks including national legislation, relevant international legislation/conventions, standards and guidelines, and corporate environmental policy and management systems.

The FMEnv EIA Procedural Guidelines and the World Bank Safeguard Systems and ISO 14001 approach among other references were used in the identification process.

The assessment approach generally involved matching the various activities of the different stages of the proposed project (as described in Chapter 3 of this report) with the components of the existing environment. Consequently, the possible changes (and extent of changes) in the environment as a result of the interactions have been identified/ evaluated, hence mitigation measures are proffered in order to reduce, offset or ameliorate such changes. The potential/ associated adverse and beneficial impacts of the proposed power plant project on the existing environment were identified at this stage of the ESIA.

The Risk Assessment Matrix (RAM) has been employed in determining risks posed by the identified potential/associated impacts of the project in order to proffer appropriate mitigation measures. In predicting impacts, the experiential/practical 'worst case scenario' approach has been applied to determine the extreme effects of project activities on environmental components, while 'consensus of opinions' has been used to determine the importance of affected environmental components. The impact evaluation results make up the pedestal for developing the ESMP of the proposed project.

5.3.1 Potential Impact Characterization

The following characteristics were also used to define potential impacts that may be associated with the proposed Project:

- Negative: An impact that is considered to represent an adverse change from the baseline or to introduce a new undesirable factor.
- Positive: An impact that is considered to represent an improvement to the baseline or to introduce a new desirable factor.
- Direct: Impacts that result from the direct interaction between a planned project activity and the receiving bio-physical and socio-cultural environment.
- Indirect: Impacts that result from other activities that are encouraged to happen as a consequence of the project.
- Temporary: Temporary impacts are predicted to be of short duration, reversible and intermittent/occasional in nature

- Short-term: Short term impacts are predicted to last only for a limited period but will cease on completion of the activity, or as a result of mitigation measures and natural recovery
- Long-term: Impacts that will continue for the life of the project, but cease when the project stops operating.
- Permanent: Potential impacts that may occur during the development of the project and cause a permanent change in the affected receptor or resource that endures substantially beyond the project lifetime
- On-site: Impact that is limited to the project site.
- Local: Impacts that affect locally important environmental resources or are restricted to a single (local) administrative area or a single community.
- Regional: Impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries.
- National: Impacts that affect nationally important environmental resources; affect an area that is nationally protected; or have macroeconomic consequences
- Reversible: An impact that the environment can return to its natural state.
- Irreversible: An impact that the environment cannot return to its original state, e.g. the extinction of an animal or plant species
- Cumulative: Potential impacts that may result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project. This also includes synergy with other projects/infrastructure in the project area
- Residual: Both environmental and social impacts that will remain after the application of mitigation measures to project impacts during each of the project phases.

5.3.2 Screening and Scoping for Potential Impacts

The first step in identifying impacts associated with the project is the development of an interaction matrix which shows the relationship/ interaction between the project's environmental and social components and planned project activities. A modified version of the Leopold Interaction-matrix technique was employed to screen and scope for the potential impacts of the proposed Project on the environment. The basis for the screening was derived from the following:

- Knowledge of Project activities.
- Detailed information on the environmental and socio-economic setting of the Project’s area of influence.
- Consultation with relevant stakeholders.
- Review of other ESIA reports on similar projects/environments.

Table 5.1: Project Activities – Leopold's Environmental and Social Interaction Matrix (Impact Significance Matrix)

Project Phase	Activity	Air Quality	Ambient Noise	Soil	Landscape / Topography	Terrestrial Flora	Terrestrial Fauna	Land Use	Population	Utilities Infrastructure	Employment / Income	Gender Issues	Construction Workers (H&S)	Workplace Health & Safety	General Public
Pre-construction Phase	Site selection	X													
	Site clearing and preparation	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Mobilization of equipment & materials	X	X	X	X										
Construction Phase	Civil works (excavation, trenching, cable laying, foundation, buildings)	X	X	X	X	X	X	X	X	X					
	Installation of power plant & infrastructure	X	X	X	X	X									
	Waste generation and disposal	X	X	X	X	X			X	X	X	X	X		
Commissioning Phase	Testing of power plant & infrastructure	X	X	X											
Operational Phase	Power generation, distribution & training	X	X	X	X			X	X	X	X	X			
	Routine maintenance; waste generation & disposal	X	X	X	X	X	X	X	X	X					
Decommissioning	Loss of employment														

Project Phase	Activity	Air Quality	Ambient Noise	Soil	Landscape / Topography	Terrestrial Flora	Terrestrial Fauna	Land Use	Population	Utilities Infrastructure	Employment / Income	Gender Issues	Construction Workers (H&S)	Workplace Health & Safety	General Public
	and business opportunities														
	Reduced power supply to the University		X	X	X	X	X	X	X	X	X	X	X		X
	Risk of injuries from collision with abandoned structures	X	X	X	X	X	X	X	X	X	X	X	X		X
	Risk of accidents during demolition activities		X	X	X	X	X	X	X	X	X	X	X		X
	Increased dust and vehicular emissions	X	X	X	X	X	X	X	X	X	X	X	X		X
	Traffic obstruction from movement of vehicles		X	X	X	X	X	X	X	X	X	X	X		X
	Availability of land for	X	X	X	X	X	X	X	X	X	X	X	X		X

Project Phase	Activity	Air Quality	Ambient Noise	Soil	Landscape / Topography	Terrestrial Flora	Terrestrial Fauna	Land Use	Population	Utilities Infrastructure	Employment / Income	Gender Issues	Construction Workers (H&S)	Workplace Health & Safety	General Public
	alternative uses														
	Loss of site aesthetic quality (abandoned/dilapidated structures)	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 5.2: EEP III Solar Power Plant Impacts Categorization -Project Activities and Associated Potential Impacts Matrix

Project Phase / Activity	Associated & Potential Impacts	Direct	Indirect	Adverse	Beneficial	Reversible	Irreversible	Cumulative	Short Term	Long Term
Pre-construction Phase	Employment opportunities from recruitment	X			X	X			X	
	Business opportunities for local contractors	X			X	X		X	X	
	Skill acquisition and workforce enhancement	X			X	X		X		X
	Improvement in quality of life (compensation)	X			X	X				X
	Conflicts over employment (quotas, methods)		X	X		X		X	X	
	Disputes over MoU with project proponents		X	X		X		X	X	
	Influx of migrant workers & pressure on infrastructure		X	X		X		X	X	X
	Increase in social vices (theft, prostitution)		X	X		X		X	X	X
	Agitations over land disputes & leadership tussles		X	X			X	X	X	X
	Loss of vegetation & forest resources	X		X			X	X		X

	Increased risk of accidents during mobilization	X		X		X			X	
	Risk of armed robbery / hostage situations		X	X			X	X	X	X
	Noise and vibration from heavy equipment	X		X		X		X	X	
	Dust and vehicular emissions	X		X		X		X	X	
	Waste generation (scrap, domestic waste, etc.)	X		X		X		X	X	X

Table 5.3: Commissioning and Operational Phases – Potential Impact Matrix

Project Phase / Activity	Associated & Potential Impacts	Direct	Indirect	Adverse	Beneficial	Reversible	Irreversible	Cumulative	Short Term	Long Term
Commissioning Phase	Testing and commissioning of power supply	X			X	X			X	
Operational Phase	Improved quality of life due to enhanced power supply	X			X	X		X		X
	Improvement in air quality (reduced generator emissions)		X		X	X		X		X
	Reduced demand for petrol and diesel for power generation		X		X	X		X		X

	Injuries/fatalities from operational accidents	X		X			X	X	X	X
	Soil/groundwater contamination from oil/fuel spills	X		X		X		X	X	X
	Workplace accidents (cuts, trips, falls)	X		X		X		X	X	
	Skill acquisition for plant operation personnel	X			X	X		X		X

Table 5.4: Decommissioning Phase – Potential Impact Matrix

Project Phase / Activity	Associated & Potential Impacts	Direct	Indirect	Adverse	Beneficial	Reversible	Irreversible	Cumulative	Short Term	Long Term
Decommissioning Phase	Loss of employment and business opportunities	X		X		X		X		X
	Reduced power supply to the University	X		X		X			X	X
	Risk of injuries from collision with abandoned structures	X		X		X			X	
	Risk of accidents during demolition activities	X		X		X		X	X	
	Increased dust and vehicular emissions	X		X		X		X	X	
	Traffic obstruction from movement of vehicles		X	X		X		X	X	
	Availability of land for alternative uses	X			X	X				X
	Loss of site aesthetic quality (abandoned/dilapidated structures)	X		X			X	X		X

5.4 Determination of Impact Significance

The significance of impacts that could occur due to the implementation of the project's activities was established based on three steps, which are:

- Impact Magnitude, which combines the extent, duration, scale, and frequency of an impact
- Value/ Sensitivity/ Fragility and importance of the relevant Receptor.
- Identification of the impact significance, which is the cumulative indicator of both of the above two key variables.

The magnitude of an effect requires quantifying the sources of potential environmental and socio-economic effects from routine and non-routine project activities, such as the extent of land take or predicted change in noise levels. On the other hand, the receptor sensitivity is derived from factors such as:

- Legislative controls.
- Designated status within the land use planning system;
- Number of affected individual receptors;
- Ability of the resource or receptor to absorb change; and
- Public perception about the criticality or sensitivity of the receptors.

The determination of impact significance also entails considering compliance with environmental policies, quality standards and set pollution limits.

5.4.1 Method for Determining Impact Magnitude

Potential negative impacts were assigned Negligible, Low, Medium, and High labels based on their magnitude while for positive impacts, it sufficed to indicate that the project is expected to result in a particular positive impact without assigning a magnitude to it.

5.4.1.1 Defining Magnitude Levels for Biophysical Impacts

A High Magnitude Impact is considered to affect an entire area, physical system or species at sufficient magnitude to cause a significant measurable numerical increase in measured concentrations or levels (when compared with national or international limits and standards specific to the receptors) or a decline in species abundance beyond which natural process would not return that population or species, to its former level within several generations.

A Medium Magnitude Impact occurs at a sufficient magnitude to cause a measurable numerical increase in measured concentrations or levels and may bring about a change in species abundance but does not threaten the integrity of that population or any population dependent on it.

A Low Magnitude Impact affects a specific area, system, aspect (physical), group of localized individuals within a population (biological), and at sufficient magnitude to result in a small increase in measured concentrations or levels over a short time period but does not affect other trophic levels or the population itself, and a localized area.

A Negligible Magnitude Impact results in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation.

5.4.1.2 Defining Magnitude Levels for Socio-economic Impacts

For socio-economic impacts, the magnitude is based on the perspective of those who would be affected by the impact; this considers the likely perceived importance of the impact, the ability of people to manage and adapt to change caused by the impact and the extent to which a human receptor gains or loses access to, or control over socio-economic resources resulting in a positive or negative effect on their well-being. The event magnitude rankings are shown in Table 5.5.

Table 5.5: Event Magnitude Rankings

Importance Level	Description / Attributes
High	• Highly undesirable outcome (e.g., impairment of endangered or protected habitat/species) • Detrimental and prolonged changes to flora and fauna behavior (breeding, spawning, moulting) • Major reduction or disruption in value, function, or service of impacted resource • Occurs during environmentally sensitive periods • Continuous non-compliance with international best practices • Significant negative impact on livelihoods, income, or living conditions affecting a large population, leading to economic loss and possible protests • Reputational damage and/or revenue loss threatening business viability • Increased public health risk leading to injury or fatality • Damage to public infrastructure (e.g., sewer, water pipeline), causing wider environmental or socio-economic impacts
Medium	• Noticeable negative outcome • Measurable reduction or disruption in value, function, or service of impacted resource • Potential non-compliance with international best practices • Moderate negative impact on livelihoods, income, or living conditions • Temporary business disruption causing minor revenue loss • Increased public health risk is manageable with mitigation measures • Disruption to public infrastructure (e.g., road closures) causing inconvenience
Low	• Imperceptible or minimal outcome • Insignificant change in value, function, or service of impacted resource • Fully compliant; no controls required • Minor, localized, temporary, and reversible nuisance to livelihoods or living conditions • Temporary business disruption without revenue loss or reputational impact • No change in community health status • Minor inconvenience from temporary infrastructure disruption

5.4.2 Determining Receptor Sensitivity

Receptor sensitivity refers to the socio-economic and environmental importance of the receptor, including human dependence on the receptor for food and income. It basically considers the type of receptor (namely, biological/ecological, human, and physical receptors) and the impacts that directly affect people. Vital natural resources are considered more important than indirect impacts.

Where the receptor is physical (for example, soil environment) its current quality, sensitivity to change, and importance (on a local, national and international scale) are considered. Where the receptor is biological (for example, the aquatic environment), its local, regional, national or international importance and its sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered. The receptors' sensitivity is categorized as Low, Medium and High and the criteria for ranking the receptor sensitivity are defined in Table 5.6.

Table 5. 6: Receptor Sensitivity Ranking

Sensitivity Level	Description / Attributes
Low	• Receptors have a moderate to high capacity to adapt to change and maintain or improve quality of life • Individuals who can quickly adapt to temporary disruptions in living conditions, livelihoods, or public infrastructure (e.g., road closures) • Businesses with robust economic models that can easily adjust to restrictions or even benefit from changes
Medium	• Receptors have limited capacity to adapt to change and maintain or improve quality of life • Individuals who depend heavily on their livelihood and have limited ability to adapt to changes • Businesses with limited flexibility that are sensitive to reductions in revenue or reputational impacts
High	• Receptors are vulnerable with little or no capacity to adapt to change or maintain quality of life • Includes vulnerable groups such as homeless individuals, internally displaced people, people without land titles, migrants, or seasonal herders • Individuals with marginal livelihoods, low income, or poor living conditions • Individuals vulnerable due to age, disability, or other factors requiring special assistance • Businesses with marginal economic viability that cannot easily adapt to change

5.4.3 Significance

Risk Assessment Matrix

Magnitude ↓ / Sensitivity →	Low Sensitivity	Medium Sensitivity	High Sensitivity
High Magnitude	Minor	Moderate	Major
Medium Magnitude	Minor	Moderate	Major
Low Magnitude	Negligible	Minor	Moderate

Negligible Significant impacts are where a resource or receptor will not be affected in any way by a particular activity, or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations. An impact of minor significance is one where an effect will be experienced. Still, the impact severity is sufficiently low (with or without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value. An impact of moderate significance is one within accepted limits and standards. Moderate impacts range from a threshold below which the impact is minor, up to a level that might be just short of breaching a permissible limit. Thus, impacts of Negligible, Minor, or Moderate significance are considered as being mitigated as far as practicable and necessary, and therefore, do not require further mitigation.

An impact of major significance is one in which acceptable limits or standards may be exceeded, or a high-magnitude impact occurs to highly valued/sensitive receptors/resources, and for such negative impacts, additional mitigation is required.

Table 5.7: Impact Magnitude Ranking												
Phase	**Activity**	**Air Quality**	**Noise**	**Soil**	**Groundwater / Aquifer**	**Flora**	**Fauna**	**Land Use**	**Infrastructure / Utilities**	**Employment / Income**	**Public Health & Safety**	**Workers Health & Safety**
Pre-construction	Site selection	2(2)	–	–	–	–	–	–	–	–	–	–
	Site clearing & preparation	2(2)	2(2)	2(2)	–	2(1)	–	3(1)	3(1)	+	2(2)	–
	Mobilization of equipment & materials	2(2)	2(2)	–	–	–	–	2(2)	+	–	–	–
Construction	Civil works (excavation, trenching, cable laying, buildings)	2(2)	2(2)	3(1)	2(2)	–	–	3(2)	++	–	2(2)	2(3)
	Installation of plant, batteries, infrastructure	2(2)	2(2)	3(1)	–	–	–	2(2)	–	–	–	–
	Waste generation & disposal	2(2)	–	2(2)	2(1)	–	–	+	–	–	2(2)	2(2)
Commissioning	Testing of plant & infrastructure	2(1)	–	–	–	1(1)	–	1(1)	–	–	–	–
Operational	Power generation & distribution	2(1)	–	–	–	–	–	++	–	–	–	–
	Routine maintenance & waste disposal	2(2)	–	2(2)	2(2)	–	–	2(2)	2(2)	–	2(1)	1(2)
Decommissioning	Land recovery	-	-	-	-	–	–	-	++	–	-	-
	Waste management	2(2)	2(2)	3(1)	2(2)	–	–	2(2)	–	–	–	–

Receptor sensitivity ranking: 1 = Low; 2 = Medium; 3 = High. Impact Magnitude Ranking: 1 = Negligible; 2 = Low; 3 = Medium; 4 = High

5.5 Impacts Discussion

5.5.1 Potential Positive Impacts

The proposed Project seeks to provide an independent and reliable power supply to the Academy through solar energy source and thus, improve the quality of education and other services within the institution as there will be longer hours available with better illumination for studying. Ultimately, the activities of the project will contribute to the achievement of Nigeria's carbon emission reduction targets (20% reduction by the year 2030) in fulfilment of the nation's Nationally Determined Contributions (NDC) to climate change. The positive impacts' significance is thus considered **high.**

Within the project area, there will be reduced noise and pollutants from generator sets, and natural habitats and human health will be protected from pollution arising from the use of fossil fuels. The renewable energy training centre constructed during the project implementation will provide capacity development through learning renewable energy technologies and practices in the University and consequently, the certification of trained individuals. The positive impacts' significance is thus considered **moderate.**

The installation of streetlights as part of the proposed Project will improve safety by reducing hazards associated with flammable fuels and candles and enhance security within the school. The positive impacts' significance is thus considered **moderate.**

In addition, the project will improve social cohesion and community development and generate new income as it would stimulate economic activities and offer new opportunities for small businesses in the University premises. The employment opportunities for skilled, semi-skilled, and unskilled labour associated with the project will multiply job creation, especially during construction to facilitate overall socioeconomic development. The positive impacts' significance is thus considered **moderate.**

5.5.2 Potential Negative Impacts

The potential adverse impacts from project activities are grouped into the following subjects and discussed further according to the different applicable phases – Preconstruction, Construction, Operation and Decommissioning phase:

- Land use
- Impacts from equipment, personnel and plant material movement;
- Impact on traffic;
- Impact on air;
- Impacts from noise and vibration;
- Impacts on terrestrial flora and fauna;
- Impact on water resources
- Impacts on waste generation;
- Impact on soil quality;
- Visual/ aesthetic impact;
- Social economic impacts;
- Health impacts; and
- Impacts from workplace hazards.

5.5.2. Preconstruction/ Mobilization Phase

The pre-construction phase of the proposed Project includes the following activities:

- Site selection
- Site clearing and preparation
- Mobilization of equipment, materials and personnel to site

Site selection

The Project site is characterized by farmlands (covering approximately 20% of the land) and vegetation which includes grass, shrubs, and a few trees. There are no physical structures on the site. The farmlands are cultivated by staff of school. It was gathered from the University management that the farms plots are usually allocated to staff for short periods or seasonal farming.

Though the management specifies that land is always available for farming for staff, and the land uptake will not pose a risk to the secondary income or food source for the staff, the land take for the project will however result in loss of access to land for the staff pending reallocation to other land areas. Thus, the impact significance of site selection for the proposed Project on the existing land use is rated moderate.

Site Clearing and Preparation

The project site will be cleared of vegetation before construction activities. The site clearing activities would involve the use of earth-moving equipment such as tractor. The potential impacts associated with the site clearing activities are discussed as follows:

Potential Impact on Terrestrial Flora and Fauna

Site clearing activities associated with the proposed Project will lead to loss of terrestrial flora on the Project site. The potential impact on the terrestrial flora is considered to be negative, direct, site specific and largely irreversible. The impact magnitude is considered to be medium considering that not all the land area (12.8ha) will be cleared for the Project. However, the sensitivity /importance of the receptor is regarded as low since the Project site is a modified habitat, and none of the plant species identified within the Project site during the baseline survey was found to be endangered or threatened based on the International Union for Conservation of Nature (IUCN)-2018 classification scheme. Also, the local community has no direct or indirect ecosystem services that they benefit from the site. Furthermore, there are no protected/conservation areas within the site. The significance of the potential impact of site clearing on the existing terrestrial flora species of the Project site is therefore regarded as minor. While the plant species are unable to avoid the point of impact, most fauna species may be able to migrate away from unfavourable areas. Animals are generally mobile and, in most cases, can move away from a potential threat. The tolerance levels of some animal species are of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from areas of impact.

About the clearing of the Project site prior to the construction phase, the potential impact on terrestrial fauna species may include loss of individual or localized population of fauna species or disturbance to avifauna species. This is unlikely to lead to a change in conservation status of the species since none of the fauna species (including avi-fauna) encountered or reported in the project site belongs to the IUCN

classification of threatened animal species which include those classified as critically endangered, endangered or vulnerable. The sensitivity of the fauna species recorded on the Project site is thus regarded as **low**. The impact magnitude is considered to be **low** given that the site clearing activities would cover approximately 12.8 ha of land allocated for the Project. The potential impact is direct, irreversible, short term and localized. The impact significance is thus considered **minor**.

Potential Impact on Soil

The proposed site clearing and preparation activities could potentially impact on the soil environment of the Project site. The potential effects on soil include degradation due to site preparation e.g. compaction of soil as a result of the movement of earth-moving equipment. Soil degradation is the removal, alteration, or damage to soil and associated soil-forming processes, usually related to human activities. The stripping of vegetation or disturbance to the natural ground level over disturbance areas will negatively affect soil formation, moisture levels, soil density, soil chemistry, and biological activity. Uncontrolled site clearance of vegetation could lead to direct surface soil exposure and hence erosion of soil, which could be significant.

The impact magnitude is considered as **medium** as the extent of soil erosion could be high, especially if the site clearing activities are carried out in the wet season. However, based on the results of laboratory analysis conducted on soil samples from the Project area, the Project site is not considered to be significantly prone to land-based erosion. Thus, the impact and significance of site clearing on soil environment of the study area is considered **minor**.

Potential Impact on Air Quality and Ambient Noise

The pollutants which could impair air quality during site clearing activities are particulate matter in form of dust, and NOx, CO, Total Suspended Particulates (TSP), SOx from combustion engines of the earth-moving equipment that will be used for clearing. Intermittent noise emissions could also occur from the operation of the machinery. The impact magnitude is considered to be low since the activities will be short-term, intermittent, localized and reversible. The site clearing activities will take less than 1 week. The sensitivity of the airshed of the Project area is also regarded as low based on the results of air quality measurements conducted in the area during the field data gathering. The impact significance of site clearing on the ambient air environment of the Project site is considered to be **minor**.

Potential Impact on Workers Safety

Site clearing and preparation are potentially hazardous activities. Accidents may occur, especially when those involved are unskilled. Such accidents may result in loss of man-hours, which may ultimately affect the scheduled date of completion of the Project development, especially if the man-hour losses are high. The site clearing activities will take about 1 week, and the number of workers required will be less than 10. The impact significance is considered to be **minor**.

Mobilization of equipment, materials, and personnel to the site

In executing the proposed project, a great deal of haulage/ movement would be undertaken throughout the phases of the project. Movements would include transportation of equipment and personnel for construction and operational phases; and movement of plant components to the project site for construction and installation. Anticipated impacts during the mobilization of equipment and personnel to the site will include:

Potential Impact on Air Quality and Ambient Noise

Construction equipment and materials will be moved to the Project site prior to commencement of main construction activities. The potential biophysical impacts associated with the mobilization activities include decrease in ambient air quality of the Project area as a result of emissions from vehicles that will convey materials and equipment to site.

It is anticipated that the potential impacts will be similar to those experienced during site clearing activities. The capacity for assimilation of vehicular emissions and dust associated with the mobilization activities in the Project's AoI is considered to be high. The overall impact significance of mobilization activities on the ambient air quality and noise of the Project area is rated **minor**.

Potential Impact on Infrastructure (Road) Regarding safety along the project route, the mobilization activities during the preconstruction phase of the Project could increase the traffic volume in the Project area (and potential for road accident) as a result of movement of vehicles in and out of the Project site. The social aspects of these activities could lead to accidents, traffic congestion and annoyance from other road users in the area. The magnitude of the impact is considered low since the mobilization activities would be within 1 week. The sensitivity of the receptors is judged as medium given that the existing vehicular movement in the University environment is high. The prominent means of transportation are cars, motorcycles/tricycles, and buses/trucks. The impact significance is considered to be **minor**.

Potential Impact on Workers Safety

Mobilization of construction materials will involve offloading of heavy consumables such as cement, gravel, etc. Injuries and accidents may occur especially when those involved are unskilled. It is expected that the potential impacts will be similar to those experienced during site clearing and preparation activities. The impact significance is **minor**. Table 5.8 summarizes the potential impacts associated with the pre-construction phase of the proposed Project.

Table 5. 8: Summary of Potential Negative Impacts Associated with the Pre- Construction Phase of the proposed Project

Activity	Receptor	Associated Impact	Significance
Site Selection/ land	Existing crop farming on site	• Loss of land for farming activities due to land Take for the Project	Moderate
Site clearing and preparation	Terrestrial flora and fauna	• Vegetation loss • Direct impacts on vegetation and soil-dwelling organisms; indirect impacts on fauna species in the immediate surroundings of the Project site	Minor
	Soil	• Loss of topsoil • Soil compaction and degradation • Increased erosion potential • Reduction in structural stability and percolative ability of soil	Minor
	Air Quality and Noise	• Air quality impacts due to emissions from site clearing equipment • Increase in ambient noise levels	Minor

	Workers Safety	• Injuries and accidents to workers during site clearing and preparation.	Minor
Mobilization of construction equipment and materials to site	Air Quality and Noise	• Air quality impacts from vehicular emissions (TSP, NOx, CO, SOx) • Increase in noise levels	Minor
	Infrastructure (road)	• Increase in vehicular movement and traffic including potential for road accident	Minor
	Workers Safety	• Injuries and accidents to workers during loading and offloading of construction materials.	Minor

5.5.2.2 Construction Phase

The construction phase of the proposed Project will include activities such as civil and electrical works (excavation, trenching, concrete mixing, etc.), installation of PV panels and associated components; construction of training centre; installation of streetlights, upgrade of existing electricity distribution infrastructure; and waste generation and disposal. The potential environmental and social impacts associated with the construction phase of the proposed Project are assessed and discussed as follows:

Equipment, Personnel and Plant Material Movement

As part of the construction phase, personnel and materials would be transported to site on need basis. Transportation could be from workers or visitors to the site. Vehicles to be deployed for construction purposes would include saloon, SUVs and heavy-duty vehicles (such as trucks, excavators, etc).

Movement of vehicles during this phase is important and cannot be avoided as such would impact significantly on the environment as well as on people living within the area in the following ways:

- Vehicular emission of pollutant gases (such as CO, SO2 and NO2) from vehicle exhaust;
- Contribution to global gas warming and ozone layer depletion from pollutant gases emitted from vehicles;
- Increased traffic movement of heavy-duty truck en-route project site;
- Potential accident to personnel and asset from vehicle movement during construction; and
- Dust emission arising from construction activities at the project site.

The impact from equipment, personnel and plant material movement on surrounding receptors is therefore considered to be of moderate significance before mitigation and steps will be taken to minimize the effects.

Civil and Electrical Works, and Installation of Plant Facilities

Potential Impact on Air Quality

At the installation and construction phases of the project, the potential sources of emissions would include dust, particulate matter (PM), emissions from heavy trucks and earthmoving equipment that will be operated on the project site. Exhaust emissions during material transportation, stockpiling and equipment transfer during construction activities. It is proposed that the construction phase of the Project would take

up to 12 months. These emissions will be localized to the construction site area and will be short-term, the extent of impact would therefore be **medium** and its significance is rated **minor**

Potential Impact on Noise Levels

The primary short-term noise and vibration impacts are associated with construction and decommissioning activities. During construction activities, work equipment will result in increased noise level and vibration in the area, although noise would not cause a major disturbance to its surroundings. The potential source of noise during the construction phase of the Project includes civil work and installation activities, vehicular movement and operation of construction equipment may lead to elevated noise levels beyond the baseline concentration. Noise may cause a major disturbance to fauna species such as birds and mammals in the area.

These would move further into the forest to avoid the disturbance.

The noise levels from construction activities would be intermittent and localized and are not envisaged to result in a maximum increase in background levels of 3 dB(A) at the nearest receptor location. The potential impact magnitude is regarded as low due to the envisaged low extent of its effect. The overall impact significance is considered minor.

Potential Impact on Soil

The proposed construction activities will include excavation, loosening of soil, stockpiling, mixing, filling, etc. These activities can directly impact soil environment negatively contributing to soil degradation and possibly accelerated erosion. Soil environment of the Project site could be impacted in terms of removal of topsoil and soil compaction, reduction in structural stability and percolative ability of soil, loss of soil dwelling organisms resulting from compaction during excavation activities, installation of PV panels, mounting structures, and 11kv underground cable. These activities also have the potential to increase siltation as a result of accelerated erosion. The impact magnitude is considered to be **medium** considering the number of PV panels to be installed and the distance for burial of the proposed underground cable from the Power Plant to the switchyard. The sensitivity of the soil environment in the Project area is regarded **medium** as the soil in the area is prone to erosion especially during the rainy season. Therefore, the impact significance is considered to be **moderate**.

Potential Impact on Terrestrial Flora and Fauna

The project would require the removal of clearing of vegetation to accommodate the power plant and ancillary structures. Increase in human activity, noise level, creation of areas of bare soil would create a resulting effect which would be the altering of the composition and diversity of flora species in the site as well as migration of fauna species that make use of the plants for food and shelter further away into the forest. Also, the disturbance associated with noise and movement of construction equipment and personnel at the Project site may deter bird species from the area and disrupt the breeding of avifauna. It may also lead to increased risk to species such as snakes, rodents and mammals. The sensitivity of the receptor is judged to be **low**. Based on desktop reviews and field observation, the project area is not known as a migratory route for avifauna species. The impact significance is regarded as **minor**.

Potential impact on Gender

During construction activities, women may experience discrimination as most employment and training opportunities may be provided to men, while women will be left with menial jobs. This may result in marginalization thereby reinforcing gender stereotypes and gender pay gaps. In attempts to reduce the gender knowledge gaps, select female students will undergo end-to-end onthe-job training and capacity building participating in the full construction activity.

Furthermore, there is the possibility that the proposed Project may increase the risk of GBV, as a result of shifting existing power dynamics and financial relationships. This is considered a minor risk as many women in the community are engaged in economic activities.

Potential Impact on Socio-economic and Health

Impacts associated with the construction phase of a project are usually of a short to medium term in nature, but could have long term effects on the surrounding environment. During construction, the proposed Project has the potential to affect the University community and the nearby community.

With regard to the presence of construction workers on site, the manner in which the workers conduct themselves can affect the University environment and local community in terms of disruption of existing structures due to influx of people. The potential behaviour of workers, most especially male construction workers, may lead to an increase in levels of crime and drug and alcohol abuse, and an increase in incidence of casual sexual relations, which may result in increase in sexually transmitted disease (such as HIV/AIDS infections) and unwanted pregnancies.

Additional pressure may also be placed on existing social infrastructure. Considering that the proposed number of workers for the construction phase of the Project may be relatively high, the potential risk to social structures is regarded as high. However, given that the majority of the construction workers, especially unskilled labour force would be drawn from the local community, the impact significance is considered to be **moderate**.

Potential Impact on Infrastructure (Road)

It is envisaged that movement of personnel and equipment along the road leading to the University would increase once the project commences. The road is slightly busy during the day and as such may lead to intermittent traffic build up which may not last long with proper coordination. During the installation of street lights around the University campus, traffic flow might be obstructed along the road paths where the street lights will be installed if activities are improperly managed. Construction activities may result in a significant increase in movement of vehicles for the transport of construction materials and equipment increasing the risk of traffic-related accidents. The impact magnitude is considered as **low** due to the minimal number of Project vehicles and trucks to be used during the construction phase. Therefore, the impact significance is considered **minor**.

Potential Impact on Construction Workers Safety

Construction sites are potentially hazardous place. Occupational accidents may occur especially when those involved are unskilled. Such occupational accidents may result in loss of man-hours which may ultimately affect the schedule date of completion of the Project development especially if the man-hour losses are

high. Potential impacts to construction workers include increase in noise level and air emissions from construction activities, injuries, electrical shocks, accident, and denial of rights. The impact significance is considered **moderate**.

Waste Generation and Disposal

Wastes from the project are grouped into solid wastes, liquid (wastewater) and air emissions. Solid wastes would include; wood, metals, food remains, glass, and refuse etc. Liquid wastes include sewage, while gaseous air pollutants (NO_x, SO_x and CO) would be from exhausts of vehicles. It should be noted however that during their normal operation PV systems emit no gaseous or liquid pollutants, and no radioactive substances.

Potential Impact on Soil

The proposed construction activities will lead to the generation of wastes. Improper handling of these wastes or their discharge into the surrounding environment without proper treatment would increase the level of micro-organisms (bacteria, viruses and fungi) that could be pathogenic to staff working in the area. The potential construction wastes to be generated include scrap metals, electrical cables, spent oils, wood/planks, paper waste, leftover sand and gravel, etc. The impact magnitude of the wastes on the soil is considered to be **low**. Thus, the impact significance is considered to be **minor**.

Table 5.9: Potential Negative Impacts Associated with the Construction Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance
Movement of Equipment, Personnel and Plant Materials	Air Quality	• Vehicular emissions (CO, SO_2, NO_2) from exhaust • Contribution to global warming and ozone layer depletion • Dust emissions from construction activities	Minor
	Social System (Road)	• Increased traffic from heavy-duty trucks en route to the project site	Minor
	Health & Safety	• Risk of accidents involving personnel and assets due to vehicle movement	Minor
Civil and Electrical Works / Installation Activities	Air Quality	• Emissions from construction equipment (SPM, NOx, CO, SOx) • Dust from land clearing and stockpiles	Minor
	Ambient Noise	• Increased noise levels from construction activities	Minor
	Soil	• Increased erosion from excavation • Reduced soil stability and permeability due to compaction	Moderate
	Terrestrial Flora and Fauna	• Loss of plant species due to invasive species • Loss of fauna due to human activity and noise	Minor

Activity	Receptor	Associated Impact	Significance
	Gender	• Potential discrimination against women and GBV risks	Moderate
	Socio-economic & Health	• Influx of people leading to increased risk of sexually transmitted diseases	Moderate
	Infrastructure (Road)	• Road damage, traffic congestion, and safety concerns	Minor
	Construction Workers Safety	• Risk of injury during construction activities	Moderate
	Soil	• Soil contamination from construction waste (solid and liquid)	Minor
Waste Generation and Disposal	Groundwater	• Contamination from liquid construction waste streams	Minor
	Infrastructure (Waste Management Facility)	• Disposal of waste at existing facilities in the project area	Negligible

5.5.2.3 Commissioning Phase

Once the construction phase of the Solar Power Plant is completed, the Plant will be tested to ensure that it has been installed according to the pre-design and operational requirements.

Potential Impact on Noise

During the Plant commissioning, there could be increase in noise level due to humming noise emission from the Plant components (inverters and batteries), vehicular movement (transportation of commissioning officials), public address system, crowd noise, and other ceremonial activities. The impact significance is however rated **minor**.

Potential Impact on Safety

Also, there is potential for occupational hazards during the Plant testing as a result of any wrong electrical connection. The impact significance is considered to be **moderate** on the workers' health and safety. However, the potential hazard of to the public during the commissioning activities could be electrical shocks from exposure to wrong electrical connections. This is considered to have a **minor** impact on the general public.

Potential Impact on infrastructure (road)

The commissioning phase will lead to an influx of guest and officials which will have an impact on the population and infrastructure (road). Due to the short duration of the commissioning phase (1 day), the impacts are considered to be **negligible**. Table 5.10 summarizes the potential negative impacts associated with the commissioning phase of the proposed Project.

Table 5. 10: Summary of Potential Impact Associated with the Commissioning Phase of the proposed Project

Activity	Receptor	Associated Impact	Significance
Plant Testing	Ambient Noise	• Increase in ambient noise levels during testing activities	Minor

	Workers	• Occupational health and safety hazards (e.g., injuries, electrocution) due to incorrect electrical connections	Moderate
	Campus Occupants' Safety	• Risk of electrocution from wrong electrical connections	Minor
	Population Influx	• Temporary increase in population during commissioning phase	Negligible
	Infrastructure (Road)	• Increased traffic and risk of road accidents	Negligible

5.5.2.4 Operational Phase

Power Generation and Distribution

Potential Impact on Noise

The potential sources of noise during the Power Plant operations are inverters and batteries. Typically, the designed noise level from an inverter is approximately 30- 35 dB(A) while that of a battery is 15-20 dB(A). The associated noise levels from the inverters and batteries are not envisaged to result in a maximum increase in background levels of 3 dB(A) at the nearest receptor location offsite. The impact significance is considered to be **negligible**.

Potential Impact on Gender

Women have conventionally been under-represented in the energy sector; they are often marginalized from many power sector employment and training opportunities. There is a potential that this situation may come to play during the operations phase of the Project, as women who experience discrimination may be denied training and employment opportunities. Male and female staff will be trained on the management and maintenance of the facility. Although the number of personnel working at the Project site would be reduced, the likelihood of impacts predicted during the construction phase may exist. Therefore, the impact significance is regarded as **minor.**

Potential Impact on Socio-economic and Health

The potential negative impacts on the socio-economic environment (community health and safety) during the operational phase of the Project are related to visual impact and the generation of electromagnetic field (EMF) radiation.

For visual impact, the Project site is not known to be a tourist route or to have any special scenic characteristics; hence, it has a limited potential for visual impacts on the receiving environment. However, the facility (primarily the PV panels) will be visible during operation.
The impact significance is considered **negligible.**

Regarding EMF radiation, Solar PV panels, inverters, batteries, and other components that make up solar PV arrays produce extremely low-frequency EMF when generating and transmitting electricity. Thus, the potential impact of EMF radiation from the proposed Solar The power plant on community health and safety is considered to be **negligible**.

Potential Impact on Occupational Health, Safety, and Welfare of Workers

During the Plant operation, workers may be exposed to occupational health and safety issues (e.g. electrical and field exposure, shock hazards and mechanical injuries), including work-related issues such as discrimination, denial of rights, unfair treatment, poor working conditions etc. The impact significance is considered to be **moderate** primarily due to the low number of staff (approximately 10) required for operation.

Routine Maintenance, Waste Generation and Disposal

Potential Impact on Soil

Routine maintenance of the Plant will lead to the generation of wastes which can contaminate the soil within the Project site and AoI. The major waste stream will be e-waste generated from spent/damaged components of the Project such as batteries, inverters and PV panels. These wastes will be stored within the Project site according to the manufacturer's instructions. All components to be used for the Project will have buy back agreements with the manufacturers as specified in the Extended Producer Responsibility Program (EPRP). The impact significance is considered to be **minor**.

Potential Impact on Groundwater

Potential impacts may include decrease in amount of groundwater reservoir as a result of water abstraction for cleaning of the PV panels. Cleaning of the PV panels is envisaged to be carried more during the dry season than in the rainy season.

Based on previous experience, each MW of panels would require approximately 5 litres of water per cleaning cycle. The water required for the cleaning purpose would be obtained from the boreholes proposed to be dug at the project site. Based on observations noted during the field survey and the estimated quantity of water required for occasional cleaning of the PV panels, water abstraction for the Project is not envisaged to have serious effect on the existing groundwater aquifer of the Project area as well as the local water use. Thus, the impact significance is considered **minor**.

Potential Impact on Occupational Health, and Safety of Workers

During routine maintenance, workers may be exposed to occupational health and safety issues (e.g. electrical and field exposure, shock hazards and mechanical injuries). The impact significance is considered to be **minor** primarily due to the low number of staff (approximately) required for maintenance activities and low frequency of maintenance. Table 5.11 summarizes the potential negative impacts associated with the operational phase of the proposed Project.

Table 5. 11: Summary of Potential Negative Impacts Associated with the Operational Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance
Power Generation and Distribution	Noise	• Noise from batteries and inverters during power generation and evacuation	Negligible

Activity	Receptor	Associated Impact	Significance
	Gender	• Discrimination against women during employment • GBV (sexual harassment, assault, poor working conditions)	Minor
	Socio-economic (Visual)	• Landscape alterations causing unpleasant visual changes in the area	Negligible
	Socio-economic (Health Issues)	• Community health and safety concerns due to electromagnetic field (EMF) radiation	Negligible
	Health, Safety and Welfare of Staff (Plant Operation)	• Electric shock and injuries during plant operation • Work-related issues (discrimination, denial of rights, unfair treatment, poor working conditions)	Moderate
Routine Maintenance	Soil	• Soil contamination from spent batteries and inverters	Minor
	Groundwater	• Groundwater abstraction from the cleaning of PV panels	Minor
Waste Generation and Disposal	Soil & Groundwater	• Soil and groundwater contamination from waste streams	Negligible
	Health, Safety and Welfare of Staff (Maintenance)	• Electric shock and injuries during maintenance activities	Minor

5.5.2.5 Potential Cumulative Impacts

Cumulative impacts are those impacts resulting from the combined effects of past, present or reasonably foreseeable actions owing to the project aspects and activities outside the project (GSI, 2003). The concept of cumulative effects is an important one. It holds that, while impacts may be small individually, the overall impact of all environmental changes affecting the receptors taken together can be significant. When a resource is nearing its tolerance threshold, a small change can push it over.

The major existing activities around the Project area are seasonal farmlands. The nature of the activities associated with the proposed Project and the existing activities around the project area, the potential cumulative impacts of the Project on road traffic, ambient noise levels, and groundwater availability is considered **low**.

5.6 Risk and Hazard Assessment

Risk assessment refers to the determination of the quantitative or qualitative estimate of risk(s) associated with recognized threats/hazards posed by the project's activities. The assessment of the risks and hazards associated with the proposed project involves:

- Identification of hazards/risks
- Assessing their likelihood of occurrence
- Estimating the consequence/severity of the hazards

5.6. Risk Assessment Methodology

Risk assessment refers to the determination of quantitative and/or qualitative estimates of risks associated with identified hazards arising from project activities. The objective is to systematically identify potential hazards, evaluate their likelihood of occurrence, assess the severity of their potential consequences, and determine appropriate mitigation measures to reduce risks to acceptable levels.

The assessment of risks and hazards associated with the proposed project involves the following key steps:

- Identification of hazards and potential risk sources associated with project activities.
- Assessment of the likelihood or probability of occurrence of each identified hazard.
- Evaluation of the potential consequences or severity of impacts should the hazard occur.
- Determination of the overall risk level through a structured Risk Assessment Matrix (RAM).
- Developmzent of mitigation and control measures to eliminate or reduce identified risks.

Risk Assessment Matrix (RAM) Methodology

The Risk Assessment Matrix (RAM) methodology was adopted to evaluate and rank identified project risks. The methodology combines the likelihood of occurrence of a hazard with the severity of its potential consequences to determine the overall risk rating. This approach enables prioritization of risks and supports the development of appropriate mitigation measures.

The risk rating is determined using the following relationship:

Risk Rating = Likelihood × Consequence (Severity)

Likelihood is assessed based on the probability of a hazard occurring during project implementation, while consequence reflects the potential impact on personnel, equipment, the environment, project schedule, and operational continuity. The resulting risk scores are categorized into Low, Medium, High, or Extreme risk levels, allowing management attention and resources to be directed toward the most significant risks.

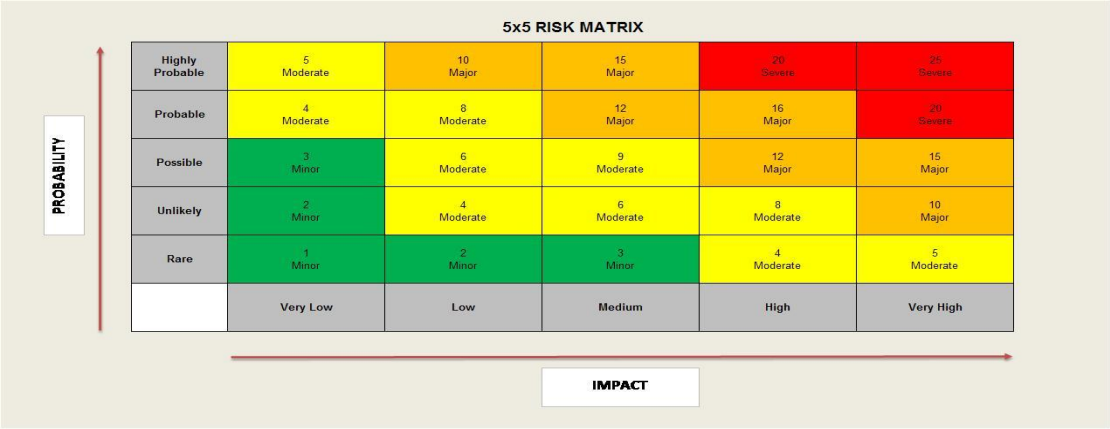

Figure 5.1: Risk Assessment Matrix

Project Specific Risks and Hazards

The potential risks and hazards associated with the proposed project are:

5.6.1.1 Fire and Explosion

The major risk associated with the operation of the plant is fire and explosion because PV systems are subject to electrical faults like other electrical installations such as short circuits, ground faults and reverse currents. Failures within the plant system could cause hotspots that can ignite nearby combustible materials. Faulty installations or failure with DC/AC inverters can also cause photovoltaic fires. Overcharging, high temperatures and physical stress to Lithium-ion battery cells can cause thermal escape, which commonly leads to the destruction of the battery, fire and even explosions. In addition, deep discharge can also cause battery fires. Any outbreak of uncontrolled fire in the area can escalate to dangerous dimensions, which could be critical. Thus, this hazard is classified as high risk.

5.6.1.2 Electrocution

Electrocution from direct contact with high-voltage electricity or tools, vehicles, ladders, and other devices that are in contact with high-voltage electricity could occur during the plant operation. This hazard is hardly likely to occur, and it is of minimal severe consequence and is thus classified as moderate risk.

5.6.1. Occupational Hazards

During construction, workers carrying out activities at heights could be exposed to occupational hazards. Electrical accidents may also result in shocks and/or burns, muscle contractions, and traumatic injuries associated with falls after the shock. This hazard is fairly probable although its severity is considered minimal thus it is classified as moderate risk.

5.7. Summary of Anticipated Impacts

These include significant risks such as electric shock and injuries of workers during the construction phase as well as GBV risks and soil degradation. The execution of suitable mitigation measures presented in the next chapter will abate the effect of identified negative impacts/risks to the most minimal level possible and heighten the effects of the identified positive impacts. Table 5.12 is a summary of the general potential site specific environmental and social impacts on the project.

Table 5. 12: Summarized Environmental and Social Impacts of Solar Power Plant			
Category	**Direct Impacts**	**Indirect Impacts**	**Cumulative Impacts**
Environmental Impacts	- Reduction in noise and odours from generator sets - Protection of natural habitats (reduced deforestation) - Reduced fuel consumption and carbon emissions - Lower greenhouse gas (GHG) emissions - Land use and land-use change - Waste production (including battery waste) - Material production impacts - Localized air, water, and soil pollution - Flood and erosion hazards - Occupational health and safety risks	- Improved safety (reduced exposure to flammable fuels) - Reduced indoor air pollution and improved health - Reduced impacts from fuel production chain - Effects on end-user industries - Improved equity of access to clean energy	- Improved quality of education and healthcare services - Long-term GHG emission reduction - Population pressure on biodiversity - Broader ecosystem and climate benefits
Social Impacts	- Longer hours of lighting for studying and productivity - Improved social cohesion and development - Enhanced safety and equitable opportunities for women - Improved access to ICT (radio, TV, mobile, internet) - Access to information and distance education - Temporary land-use or access restrictions	- Reduced household expenditure on fuels (10–15% savings) - Increased savings and investment opportunities - Growth in income-generating activities - Support for small businesses (longer operating hours) - Increased trade and job creation - Improved socioeconomic development	- Risk of land-use conflicts if not properly managed - Need for community engagement and inclusion - Long-term livelihood improvement and economic stability

CHAPTER SIX
MITIGATION MEASURES

6.1 Introduction

This chapter presents the mitigation measures proffered for the associated and potential impacts of the proposed solar-based power plant project in the Nigeria Police Academy, Wuldi Local Government of Kano State. A comprehensive risk assessment matrix, as indicated in Figure 6.1, was used to determine the mitigation requirements for each of the impacts identified. The frequency, severity, sensitivity, scale, longevity, political, economic, legal, reputation/ image, and communication/complaints were factors taken into consideration during these assessments.

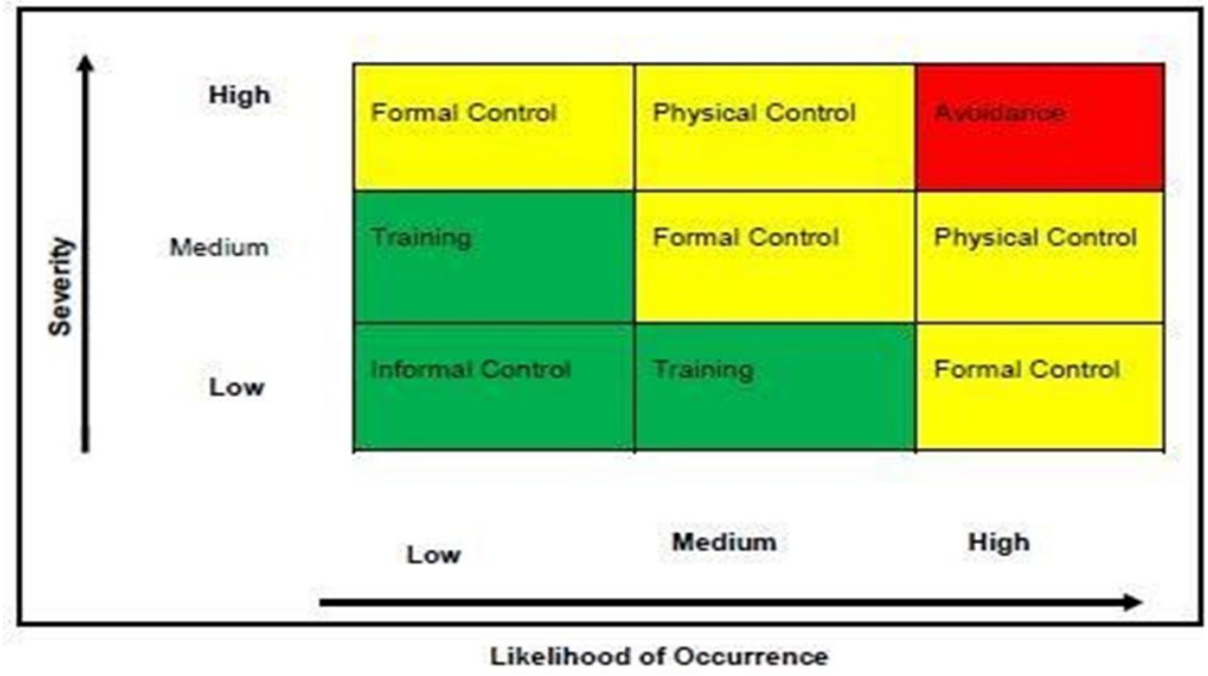

Figure 6. 1: Matrix for Determination of Mitigation Measures
(Source: www.researchgate.net/risk assessment matrix)

Mitigation measures designed to prevent, reduce or control the adverse impacts of the environmental and social aspects of the proposed project to as low as reasonably practicable were considered and documented in this chapter of the report.

Subsequently, the specific mitigation measures satisfying the mitigation requirement were established, putting the following into consideration:

- Available resources and competencies.
- On-site conditions; and
- Public concerns and technology.

6.2 Mitigation Measures and Approach

Mitigation refers to measures or interventions necessary to avoid, minimize, reduce, or offset adverse impacts. The approach, as indicated in Table 6.1 for selecting appropriate mitigation measures, includes:

- Anticipate and avoid risks and impacts.
- Where avoidance is not possible, minimize or reduce risks and impacts to acceptable levels.
- Once risks and impacts have been minimized or reduced, mitigate.
- Where significant residual impacts remain, compensate or offset them, where technically and financially feasible.

The mitigation measures proposed for the identified environmental and social impacts were developed following the mitigation hierarchy, with priority given to avoiding or preventing adverse impacts wherever possible. Where avoidance was not feasible, practical and cost-effective measures based on best available technology and good industry practice were recommended to minimize or control potential impacts. Rehabilitation, restoration, or compensation measures were considered only as a last resort where residual impacts could not be completely avoided. The recommended mitigation measures address impacts that may arise during the pre-construction, construction, operation, and decommissioning phases of the Project. These measures include effective environmental management practices, pollution prevention controls, waste management procedures, occupational health and safety measures, and stakeholder engagement initiatives. The implementation of these measures is expected to significantly reduce the magnitude and significance of identified impacts.

Based on the impact assessment, the residual impacts remaining after the application of the proposed mitigation measures are expected to be of negligible to minor significance. Furthermore, no significant long-term environmental or social impacts have been identified that cannot be mitigated to acceptable levels. This demonstrates that the Project can be implemented in an environmentally and socially responsible manner, provided that the recommended mitigation and monitoring measures are effectively applied throughout the Project lifecycle.

Table 6. 1: Summary of Mitigation Approaches for the University Solar Hybrid Power Projects

Project Phase	Mitigation Hierarchy	Approach
Project Design Phase	Avoidance & Minimization	• Micro-siting: changing the layout of project infrastructure to avoid sensitive areas • Re-routing, marking, or burying powerlines to reduce collision risks and barrier effects

Table 6. 1: Summary of Mitigation Approaches for the University Solar Hybrid Power Projects		
Project Phase	Mitigation Hierarchy	Approach
Construction Phase	Avoidance	• Scheduling: adjusting the timing of construction to avoid disturbing biodiversity during sensitive periods
	Minimization	• Abatement controls to reduce emissions and pollutants (noise, erosion, waste) • Operational controls: exclusion fencing, designated machinery and lay-down areas, minimizing vegetation loss and soil disturbance
	Restoration & Rehabilitation	• Repairing biodiversity damage and ecosystem services • Revegetation of temporary-use and lay-down areas as soon as practicable after construction
Operational Phase	Minimization	• Physical controls: modifying infrastructure (e.g., solar technology, foundations, fencing, transmission lines) • Abatement controls: wastewater management and water conservation • Operational controls: managing the timing of vegetation control activities
End-of-Life Phase	Avoidance	• Scheduling: timing decommissioning to avoid biodiversity disturbance (e.g., breeding seasons)
	Minimization	• Abatement controls to reduce emissions and pollutants during decommissioning • Operational controls: exclusion fencing, designated machinery, and lay-down areas
	Restoration & Rehabilitation	• Repairing biodiversity damage and ecosystem services

Table 6. 1: Summary of Mitigation Approaches for the University Solar Hybrid Power Projects		
Project Phase	Mitigation Hierarchy	Approach
		• Revegetation of temporary-use and lay-down areas after decommissioning

Table 6. 2: Mitigation Measures for the Pre-construction Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Site Selection / Land Take	Existing Crop Farming	• Loss of land for farming activities	Moderate	REA shall; • Avoid high-value agricultural land where possible (site optimization) • Provide fair and prompt compensation in line with World Bank ESS5 standards • Implement Livelihood Restoration Plan (LRP)	Minor
Site Clearing & Preparation	Terrestrial Flora & Fauna	• Vegetation loss • Direct and indirect impacts on fauna	Minor	REA shall: • Minimize clearing footprint to only required areas • Pre-clearance ecological surveys and species relocation where necessary • Avoid clearing during breeding seasons • Implement biodiversity management plan	Negligible
	Soil	• Loss of topsoil • Soil compaction and erosion • Reduced soil stability and permeability	Minor	REA shall: • Strip and store topsoil for later reuse (rehabilitation). Restrict movement of heavy machinery to designated routes • Implement erosion control measures (mulching, silt fences) • Progressive site restoration	Negligible
	Air Quality & Noise	• Emissions from equipment • Increased noise levels	Minor	REA shall: • Regular maintenance of machinery to reduce emissions • Use dust suppression methods (water spraying) • Limit work to daytime hours • Provide noise control measures and PPE (ear protection)	Negligible
	Workers Safety	• Injuries and accidents during site clearing	Minor	REA shall: • Implement Occupational Health & Safety procedures aligned with International Labour Organization standards • Provide PPE (helmets, gloves, boots) • Conduct safety training and toolbox talks • Supervision and enforcement of safety protocols	Negligible
Mobilization of Construction Equipment & Materials	Air Quality & Noise	• Vehicular emissions (TSP, NOx, CO, SOx) • Increased noise levels	Minor	REA shall: • Maintain vehicles regularly to meet emission standards • Optimize logistics to reduce trips • Enforce speed limits and idle-time reduction • Use low-sulfur fuels where possible	Negligible

Table 6.3: Impacts Mitigation Measures for the Construction Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Movement of Equipment, Personnel & Materials	Air Quality	• Vehicular emissions (CO, SO_2, NO_2) • Dust emissions	Minor	REA shall: • Regular vehicle maintenance and emission checks • Use of low-sulfur fuels and efficient engines • Dust suppression (water spraying, covering trucks) • Limit vehicle idling and enforce speed limits	Negligible
	Social System (Road)	• Increased traffic from heavy-duty trucks	Minor	REA shall: • Implement Traffic Management Plan • Schedule deliveries during off-peak hours • Use designated haulage routes • Community awareness and signage	Negligible
	Health & Safety	• Risk of accidents due to vehicle movement	Minor	REA shall: • Driver training and certification • Speed control and enforcement • Vehicle inspection and maintenance • Use of warning signs and traffic marshals	Negligible
Civil & Electrical Works / Installation	Air Quality	• Emissions from equipment • Dust from land clearing and stockpiles	Minor	REA shall: • Maintain construction equipment regularly • Dust suppression measures (watering, covering materials) • Limit activities during high winds • Provide PPE (respirators where necessary)	Negligible
	Ambient Noise	• Increased noise levels	Minor	REA shall: • Restrict noisy activities to daytime hours • Use well-maintained equipment with silencers • Provide hearing protection to workers • Establish buffer zones near sensitive receptors	Negligible

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
	Soil	• Erosion from excavation • Soil compaction and reduced permeability	Moderate	REA shall: • Implement erosion and sediment control measures (silt fences, drainage control) • Limit heavy machinery movement to designated areas • Progressive rehabilitation and re-vegetation • Proper site grading and drainage design	Minor
	Terrestrial Flora & Fauna	• Loss of plant species (invasive species risk) • Disturbance to fauna	Minor	REA shall: • Control and monitor invasive species • Minimize vegetation clearing • Restrict worker movement to designated areas • Implement biodiversity management plan	Negligible
	Groundwater	• Depletion from abstraction • Increased sediment load and runoff	Minor	REA shall: • Use water-efficient construction practices • Obtain abstraction permits and monitor usage • Install sediment traps and proper drainage systems • Avoid contamination of water sources	Negligible
	Gender	• Discrimination and GBV risks	Moderate	REA shall: • Develop and implement Gender Action Plan and GBV Action Plan aligned with World Bank guidelines • Code of conduct for workers • Awareness training and strict sanctions • Confidential grievance redress mechanism	Minor
	Socio-economic & Health	• Spread of STDs due to influx of workers	Moderate	REA shall: • Community health awareness programs • Provide access to healthcare services and testing • Enforce worker codes of conduct	Minor

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
				• Collaborate with local health authorities and NGOs	
	Infrastructure (Road)	• Road damage, congestion, safety issues	Minor	REA shall: • Traffic and logistics management plan • Routine road maintenance and repairs • Use appropriate vehicle sizes and loads • Coordination with local authorities	Negligible
	Construction Workers Safety	• Risk of injury during construction	Moderate	REA shall: • Implement Occupational Health & Safety system (aligned with International Labour Organization standards) • PPE provision and enforcement • Safety training, supervision, and emergency preparedness • Regular audits and incident reporting	Minor
	Soil	• Soil contamination from construction waste	Minor	REA shall: • Proper waste segregation and storage • Use lined containment areas for hazardous waste • Spill prevention and response plan • Disposal through licensed contractors	Negligible
Waste Generation & Disposal	Groundwater	• Contamination from liquid waste streams	Minor	REA shall: • Treat wastewater before discharge • Use impermeable liners for storage areas • Regular inspection of waste systems • Compliance with environmental standards	Negligible

Table 6.4: Mitigation Measures for the Commissioning Phase of the proposed Project

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Plant Testing	Ambient Noise	• Increase in ambient noise levels during testing activities	Minor	REA shall: • Restrict testing to daytime hours	Negligible

				• Use well-maintained equipment with noise suppression features • Notify nearby occupants in advance • Provide hearing protection (PPE) to workers	
	Workers	• Occupational health and safety hazards (injuries, electrocution due to incorrect connections)	Moderate	REA shall: • Implement strict electrical safety procedures (lockout/tagout systems) • Ensure only certified personnel handle electrical connections • Provide appropriate PPE (insulated gloves, boots) • Conduct pre-commissioning safety checks and supervision • Emergency response and first aid readiness	Minor
	Campus Occupants' Safety	• Risk of electrocution from wrong electrical connections	Minor	REA shall: • Secure and restrict access to testing areas • Install warning signage and physical barriers • Ensure proper grounding and insulation of systems • Supervise all testing activities closely	Negligible

Table 6.5: Mitigation measure for the Operational Phase of the proposed Project

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Power Generation & Distribution	Gender	• Discrimination of women during employment • GBV (sexual harassment, assault, poor working conditions)	Minor	REA shall: • Implement Gender Action Plan and GBV prevention measures aligned with World Bank guidelines • Enforce equal opportunity employment policy • Worker code of conduct and regular training	Negligible

				• Establish confidential grievance redress mechanism	
	Health, Safety & Welfare of Staff (Plant Operation)	• Electric shock and injuries • Workplace discrimination and unfair treatment	Moderate	REA shall: • Implement Occupational Health & Safety (OHS) system in line with International Labour Organization standards • Install lockout/tagout (LOTO) systems and safety signage • Provide appropriate PPE (insulated gloves, boots, etc.) • Conduct routine safety training and audits • Enforce fair labor practices and worker rights policies	Minor
Routine Maintenance	Soil	• Soil contamination from spent batteries and inverters	Minor	REA shall: • Store hazardous materials in sealed, labeled containers • Implement hazardous waste management plan • Use certified waste handlers for disposal/recycling • Install secondary containment and spill response systems	Negligible
	Groundwater	• Groundwater abstraction from cleaning PV panels	Minor	REA shall: • Use water-efficient or dry-cleaning technologies • Harvest and reuse rainwater where feasible • Monitor abstraction rates and comply with permits • Adopt water conservation measures	Negligible

Waste Generation & Disposal	Health, Safety & Welfare of Staff (Maintenance)	• Electric shock and injuries during maintenance	Minor	REA shall: • Enforce electrical isolation procedures (LOTO) • Provide PPE and insulated tools • Conduct competency-based training • Routine inspection and supervision of maintenance work	Negligible

Table 6.6: Mitigation Measures for the Decommissioning Phase of the Proposed Project

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Dismantling of Plant & Equipment	Air Quality	• Dust emissions from dismantling activities • Emissions from machinery and vehicles	Minor	REA shall: • Apply dust suppression measures (water spraying) • Use well-maintained, low-emission equipment • Cover trucks transporting materials • Limit unnecessary idling of machinery	Negligible
	Ambient Noise	• Increased noise from dismantling activities	Minor	REA shall: • Restrict activities to daytime hours • Use equipment fitted with silencers • Provide hearing protection (PPE) to workers • Notify nearby communities in advance	Negligible
	Workers Safety	• Injuries from equipment dismantling • Risk of electrocution	Moderate	REA shall: • Implement Occupational Health & Safety procedures aligned with International Labour Organization standards • Apply lockout/tagout (LOTO) systems before dismantling • Provide appropriate PPE (helmets, gloves, insulated gear)	Minor

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
				• Ensure only trained personnel handle electrical components • Emergency preparedness and supervision	
Removal of Foundations & Civil Works	Soil	• Soil disturbance, erosion, and compaction	Minor	REA shall: • Minimize excavation footprint • Implement erosion and sediment control measures • Reuse and reinstate topsoil • Progressive rehabilitation of disturbed areas	Negligible
	Groundwater	• Potential contamination from spills and exposed materials	Minor	REA shall: • Proper storage and handling of fuels and chemicals REA shall: • Spill prevention and response plans • Avoid discharge of contaminants into soil and water • Regular inspection of work areas	Negligible
Waste Generation & Disposal	Soil & Groundwater	• Contamination from hazardous and non-hazardous waste	Moderate	REA shall: • Implement comprehensive waste management plan (segregation, recycling, disposal) • Use licensed waste contractors • Store hazardous waste in secure, labeled containers with secondary containment • Comply with national and international waste regulations	Minor
	Infrastructure (Waste Facilities)	• Increased burden on existing waste management systems	Minor	REA shall: • Coordinate with approved waste facilities • Schedule waste transport efficiently • Promote recycling and material recovery (e.g., metals, panels)	Negligible

Activity	Receptor	Associated Impact	Significance	Mitigation Measures	Residual Impact
Transportation of Decommissioned Materials	Air Quality & Noise	• Emissions and noise from haulage vehicles	Minor	REA shall: • Maintain vehicles to reduce emissions • Optimize transport logistics • Enforce speed limits and reduce idling • Use designated transport routes	Negligible
	Infrastructure (Road)	• Traffic congestion and road safety risks	Minor	REA shall: • Implement Traffic Management Plan • Use trained drivers and road signage • Schedule transport during off-peak hours • Repair any road damage caused	Negligible
	Community Health & Safety	• Risk of accidents involving local communities	Minor	REA shall: • Community awareness programs • Install warning signs and barriers • Escort oversized loads where necessary • Enforce strict safety protocols	Negligible
Site Restoration & Rehabilitation	Terrestrial Flora & Fauna	• Loss of habitat prior to restoration	Minor	REA shall: • Re-vegetate using native species • Restore natural habitat conditions • Monitor ecological recovery • Prevent introduction of invasive species	Negligible
	Socio-economic	• Temporary loss of employment after project closure	Moderate	REA shall: • Develop worker transition and livelihood restoration programs • Provide skills training and job placement support • Engage stakeholders early on closure plans	Minor

CHAPTER SEVEN

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Introduction

This section deals with the set of mitigation management measures to be taken to avoid, reduce, mitigate or compensate for adverse environmental, occupational and social impacts with the institutional arrangement, monitoring schedule, parameters to be monitored and soon including tentative monitoring budget. It includes the following aspects:

- Types of Impacts and their Mitigations
- Mitigation Measures
- Environmental Code of Conduct/ Practices (to be attached to bidding documents and/ or contracts)
- Monitoring Plan
- Communication and Documentation
- Cost of ESMP
- Integration with Project (contract clauses, others)
- Grievance Resolution Process
- Plan for stakeholder/ community engagement during pre-construction, construction, and operation phases; the plan should include community mobilization approach from both social and commercial perspectives.

Further to the impacts assessed in the previous chapter, this section presents more detailed mitigation measures and monitoring requirements that correspond to the impacts examined in the previous section, thus exploring them in more detail. Mitigation measures aim to offset any negative impacts that may result from the project, and monitoring is the process of measuring the success of mitigation measures to assess their effectiveness.

7.2 Objectives of the ESMP

The purpose of the Environmental and Social Management Plan (ESMP) is to ensure that Environmental and Social impacts identified during the ESIA process are effectively addressed during the construction, operation and closure of the project. The ESMP specifies the mitigation and management measures to which the Proponent is committed and shows how the Project will mobilize organizational capacity and resources to implement these measures. The ESMP will be a living document and will continue to develop during the design and construction phases to enable continuous improvement of the Project's environmental performance.

The specific objectives of the ESMP are to:

- Promote effective environmental and social management and communicate the objectives and requirements of the ESMP.
- Ensure compliance with applicable environmental and social laws, regulations, permit conditions, and Project commitments.
- Define clear roles, responsibilities, and accountability for implementing environmental and social measures.
- Integrate environmental and social considerations into Project planning, design, construction, and operation.
- Apply the mitigation hierarchy by avoiding, minimizing, restoring, and, where necessary, compensating for adverse impacts.
- Enhance positive environmental, social, and economic benefits generated by the Project.
- Serve as an action plan for implementing environmental and social management measures.
- Provide a framework for implementing and monitoring mitigation and enhancement measures identified in the ESIA.
- Support continual improvement through monitoring, reporting, and corrective actions.

7.3 Environmental and Social Management Measures

The recommended environmental and social management measures required to mitigate the identified impacts of the proposed project activities during pre-construction, construction, commissioning, and operation phases are presented in Tables 7.1 to 7.8.

Table 7. 1: Environmental Management Plan for Pre-Construction Phase of the proposed Project

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
Site Selection / Land Take	• Loss of land for farming activities	REA shall: • Engage affected communities through consultation and participation	Minor	Inspection	Before Mobilization	Evidence of consultations; grievances resolved	EPC Contractor	PMU	1,400
Site Clearing & Preparation	• Vegetation loss • Direct and indirect impacts on fauna	REA shall: • Minimize clearing footprint • Conduct pre-clearance ecological surveys • Avoid clearing during breeding seasons • Implement biodiversity management plan	Negligible	Inspection	Monthly	Compliance with clearing limits; no unnecessary vegetation loss	EPC Contractor	PMU / POE	2,000
	• Loss of topsoil • Soil compaction and erosion • Reduced soil stability	REA shall: • Strip and store topsoil • Restrict heavy machinery movement • Implement erosion control (mulching, silt fences) • Progressive restoration	Negligible	Inspection	Quarterly	Evidence of topsoil stockpiling; reduced erosion signs	EPC Contractor	PMU	1,800
	• Air emissions from equipment • Increased noise levels	REA shall: • Maintain machinery regularly • Apply dust suppression (water spraying) • Limit work to daytime	Negligible	Inspection	Quarterly	Reduced dust levels; acceptable noise levels	EPC Contractor	PMU	1,500

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
		• Provide PPE for noise protection							
	• Injuries and accidents	REA shall: • Implement OHS procedures (ILO standards) • Provide PPE • Conduct safety training/toolbox talks • Enforce supervision	Nelgiigble	Inspection	Daily	Number of incidents recorded; PPE compliance rate	EPC Contractor	PMU / HSE Officer	2,200
Mobilization of Construction Equipment & Materials	• Vehicular emissions (TSP, NOx, CO, SOx) • Increased noise levels	REA shall: • Maintain vehicles to emission standards • Optimize logistics • Enforce speed limits and reduce idling • Use low-sulfur fuels	Negligible	Inspection	Weekly	Reduced emissions; compliance with transport procedures	EPC Contractor	PMU	1,600

Table 7.2: Environmental Management Plan for Construction Phase of the proposed Project

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
Movement of Equipment, Personnel & Materials	• Vehicular emissions (CO, SO_2, NO_2) • Dust emissions	REA shall: • Maintain vehicles regularly • Use low-sulfur fuels • Apply dust suppression (water spraying, covering trucks) • Limit idling and enforce speed limits	Negligible	Inspection	Daily	Reduced dust levels; emission compliance	EPC Contractor	PMU	1,500

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
	• Increased traffic and congestion	REA shall: • Implement Traffic Management Plan • Schedule deliveries off-peak • Use designated routes • Community awareness and signage	Negligible	Inspection	Daily	Traffic incidents minimized; complaints resolved	EPC Contractor	PMU	1,200
	• Risk of accidents	REA shall: • Train drivers • Enforce speed limits • Conduct vehicle inspections • Use traffic marshals and signage	Negligible	Inspection	Daily	Number of accidents/incidents recorded	EPC Contractor	HSE Officer / PMU	1,300
Civil & Electrical Works / Installation	• Air emissions and dust generation	REA shall: • Maintain equipment • Apply dust suppression • Limit work during high winds • Provide PPE	Negligible	Inspection	Daily	Visible dust reduction; PPE compliance	EPC Contractor	PMU	1,600
	• Increased noise levels	REA shall: • Restrict work to daytime • Use silencers • Provide hearing protection • Establish buffer zones	Negligible	Inspection	Daily	Noise complaints minimized	EPC Contractor	PMU	1,200
	• Soil erosion and compaction	REA shall: • Install silt fences and drainage • Restrict machinery movement • Rehabilitate progressively • Proper grading	Minor	Inspection	Weekly	Evidence of erosion control measures	EPC Contractor	PMU	1,800
	• Loss of flora and fauna	REA shall: • Minimize clearing • Control invasive species • Restrict worker movement • Implement biodiversity plan	Negligible	Inspection	Weekly	Vegetation condition maintained	EPC Contractor	PMU	1,500

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
	• Groundwater depletion and contamination	REA shall: • Use water efficiently • Monitor abstraction • Install sediment traps • Prevent contamination	Negligible	Inspection	Monthly	Water usage records; no contamination	EPC Contractor	PMU	1,400
	• GBV and discrimination risks	REA shall: • Implement Gender & GBV Action Plans • Enforce code of conduct • Awareness training • Grievance mechanism	Minor	Monitoring	Monthly	Number of GBV cases resolved	EPC Contractor	PMU	2,000
	• Spread of STDs	REA shall:• Health awareness programs• Provide testing access• Enforce worker conduct• Collaborate with health agencies	Minor	Monitoring	Monthly	Participation rates; reported cases	EPC Contractor	PMU	1,800
	• Road damage and congestion	REA shall: • Traffic management plan • Maintain roads • Control vehicle loads • Coordinate with authorities	Negligible	Inspection	Weekly	Road condition maintained	EPC Contractor	PMU	1,500
	• Worker injuries and accidents	REA shall: • Implement OHS system (ILO aligned) • Provide PPE • Conduct training • Emergency preparedness	Minor	Inspection	Daily	Incident rate; PPE compliance	EPC Contr		

Table 7.3: Environmental Management Plan for with the Commissioning Phase

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)

Plant Testing	• Increase in ambient noise levels during testing activities	REA shall: • Restrict testing to daytime hours • Use well-maintained equipment with noise suppression features • Notify nearby occupants in advance • Provide hearing protection (PPE) to workers	Negligible	Inspection	Daily (during testing)	Noise complaints minimized; PPE usage compliance	EPC Contractor	PMU	1,200
	• Occupational health and safety hazards (injuries, electrocution due to incorrect connections)	REA shall: • Implement electrical safety procedures (lockout/tagout) • Use certified personnel only • Provide PPE (insulated gloves, boots) • Conduct safety checks and supervision • Ensure emergency response readiness	Minor	Inspection	Daily (during testing)	Zero fatal incidents; reduced injury rates	EPC Contractor	HSE Officer / PMU	2,000
	• Risk of electrocution to campus occupants	REA shall: • Restrict access to testing areas • Install warning signage and barriers • Ensure proper grounding and insulation • Supervise all testing activities	Negligible	Inspection	Daily (during testing)	No unauthorized access; zero electrocution incidents	EPC Contractor	PMU	1,000

Table 7.4: Environmental Management Plan for Operational Phase of the proposed Project

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)

Power Generation & Distribution	• Discrimination of women in employment• GBV (sexual harassment, assault, poor working conditions)	REA shall: • Implement Gender Action Plan & GBV prevention (World Bank aligned) • Enforce equal opportunity employment • Worker code of conduct & training • Confidential grievance mechanism	Negligible	Monitoring	Monthly	Number of grievances reported/resolved; gender balance in workforce	Plant Operator / EPC	PMU	2,000
	• Electric shock and injuries • Workplace discrimination	REA shall: • Implement OHS system (ILO aligned) • Install LOTO systems & signage • Provide PPE (insulated gloves, boots) • Conduct training & audits • Enforce fair labor practices	Minor	Inspection	Daily	Incident/accident rate; PPE compliance	Plant Operator	HSE Officer / PMU	2,500
Routine Maintenance	• Soil contamination from batteries and inverters	REA shall: • Store hazardous materials in sealed/labeled containers • Implement hazardous waste plan • Use certified waste handlers • Install secondary containment & spill response	Negligible	Inspection	Weekly	No contamination incidents; proper storage observed	Plant Operator	PMU	1,800
	• Groundwater use for panel cleaning	REA shall: • Use water-efficient/dry-cleaning methods • Harvest/reuse rainwater • Monitor abstraction & comply with permits • Apply water conservation measures	Negligible	Monitoring	Monthly	Water usage records; compliance with limits	Plant Operator	PMU	1,500

Waste Generation & Disposal	• Electric shock and injuries during maintenance	REA shall:• Enforce LOTO procedures• Provide PPE & insulated tools• Conduct competency-based training• Routine inspection & supervision	Negligible	Inspection	Weekly	Zero fatal incidents; reduced injury rates	Plant Operator	HSE Officer / PMU	1,600

Table 7.5: Environmental Management Plan for Decommissioning Phase

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
Dismantling of Plant & Equipment	• Dust emissions • Emissions from machinery and vehicles	REA shall: • Apply dust suppression (water spraying) • Use low-emission equipment • Cover haulage trucks • Limit idling	Negligible	Inspection	Daily	Reduced dust levels; emission compliance	EPC Contractor	PMU	1,800
	• Increased noise levels	REA shall: Restrict daytime hours • Use silencers • Provide hearing PPE • Notify nearby communities	Negligible	Inspection	Daily	Noise complaints minimized	EPC Contractor	PMU	1,400
	• Injuries and electrocution risks	REA shall: • Implement OHS procedures (ILO aligned) • Apply LOTO systems • Provide PPE • Use trained personnel • Emergency preparedness	Minor	Inspection	Daily	Incident rates; PPE compliance	EPC Contractor	HSE Officer / PMU	2,500

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
Removal of Foundations & Civil Works	• Soil disturbance, erosion, compaction	REA shall: • Minimize excavation footprint • Implement erosion controls • Reinstate topsoil • Progressive rehabilitation	Negligible	Inspection	Weekly	Evidence of rehabilitation; no erosion	EPC Contractor	PMU	1,700
	• Groundwater contamination risks	REA shall: • Proper storage of fuels/chemicals • Spill prevention & response plan • Prevent contaminant discharge • Regular inspections	Negligible	Inspection	Weekly	No contamination incidents	EPC Contractor	PMU	1,600
Waste Generation & Disposal	• Soil & groundwater contamination from waste	REA shall: • Implement waste management plan • Use licensed contractors • Secure hazardous waste storage • Comply with regulations	Minor	Inspection	Weekly	Proper waste handling; no contamination	EPC Contractor	PMU	2,000
	• Pressure on waste infrastructure	REA shall: • Coordinate with approved facilities • Schedule transport efficiently • Promote recycling and recovery	Negligible	Monitoring	Monthly	Volume of waste recycled; facility compliance	EPC Contractor	PMU	1,300

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
Transportation of Decommissioned Materials	• Emissions and noise from vehicles	REA shall: • Maintain vehicles • Optimize logistics • Enforce speed limits • Use designated routes	Negligible	Inspection	Weekly	Reduced emissions; compliance with routes	EPC Contractor	PMU	1,500
	• Traffic congestion and road safety risks	REA shall: • Traffic Management Plan • Trained drivers & signage • Off-peak scheduling • Repair road damage	Negligible	Inspection	Weekly	Traffic incidents minimized	EPC Contractor	PMU	1,400
	• Community accident risks	REA shall: • Community awareness programs • Warning signs and barriers • Escort oversized loads • Enforce safety protocols	Negligible	Inspection	Weekly	Zero community incidents	EPC Contractor	PMU	1,600
Site Restoration & Rehabilitation	• Habitat loss prior to restoration	REA shall: • Re-vegetate with native species • Restore habitat conditions • Monitor ecological recovery • Prevent invasive species	Negligible	Inspection	Monthly	Vegetation regrowth; biodiversity recovery	EPC Contractor	PMU	2,200
	• Loss of employment post-closure	REA shall: • Worker transition programs • Skills training • Job placement support	Minor	Monitoring	Monthly	Number of workers transitioned	EPC Contractor	PMU	2,000

Activity	Associated Impact	Mitigation Measures	Residual Impact	Monitoring Requirement	Frequency	Performance Indicators	Implementation	Monitoring	Cost (USD)
		• Stakeholder engagement							

7.5 Roles, Responsibilities and Accountabilities

The Rural Electrification Agency Project Management Unit (REA-PMU) supervises the implementation of the ESMP throughout the project life span while conformance with the mitigation measures will be ensured by the Engineering, Procurement and Construction (EPC) contractor during the construction phase and by the operations and maintenance (O&M) contractor during the operational phase of the project. Table 7.8 indicates the Roles and Responsibilities of the Stakeholders in the Implementation, Monitoring and Review of the ESMP.

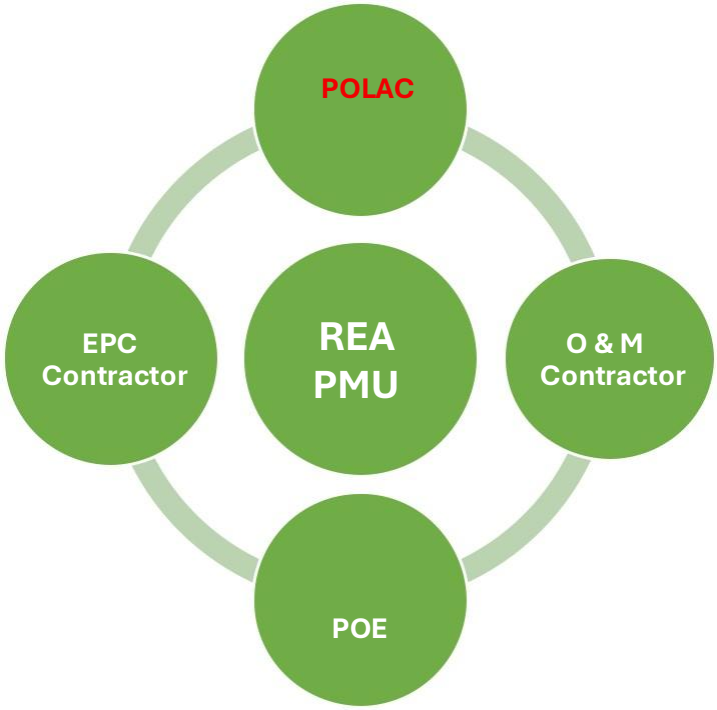

Figure 7. 1: Roles and Responsibilities: Pre-Construction, Construction & Operational Phases

Table 7. 6: The Roles and Responsibilities of the Stakeholders in the Implementation, Monitoring and Review of the ESMP					
Stakeholder	**Pre-Construction Phase**	**Construction Phase**	**Commissioning Phase**	**Operational Phase**	**Decommissioning Phase**
Director of Works / Physical Planning	• Approve site and land use • Review ESMP and ensure institutional commitment • Appoint & train Site Engineer • Ensure livelihood restoration before mobilization	• Supervise ESMP implementation• Ensure contractor compliance • Address grievances and enforce corrective actions	• Oversee safe plant testing • Ensure stakeholder communication • Confirm readiness for operation	• Review ESMP reports • Recommend improvements to PMU/O&M • Ensure safeguards (OHS, GBV, environment)	• Oversee decommissioning activities • Ensure site restoration • Support livelihood transition
REA – PMU	• Approve ESMP and integrate into contracts • Coordinate stakeholders and regulators • Allocate ESMP budget	• Monitor compliance and conduct audits• Report to regulators • Enforce corrective actions	• Ensure compliance during testing • Approve transition to operation	• Oversee ESMP implementation• Ensure monitoring, audits, reporting• Address non-compliance	• Supervise dismantling compliance • Ensure waste management • Prepare closure reports
Site Engineer	• Support ESMP planning • Participate in training	• Implement ESMP daily on-site• Monitor EHS compliance• Maintain records and reports	• Supervise testing • Ensure safety procedures (LOTO, PPE) • Report incidents	• Monitor operations & maintenance • Ensure ESMP compliance• Report environmental & safety issues	• Supervise dismantling • Monitor waste handling • Support site rehabilitation
NESREA / FMEnv Representatives	• Review and approve ESIA/ESMP•	• Monitor ESMP implementation	• Monitor compliance during commissioning	• Monitor ESMP implementation	• Monitor decommissioning activities

	Issue environmental permits	(environmental compliance) • Conduct inspections and enforce regulations • Engage stakeholders on compliance issues	• Verify environmental and safety readiness	(environmental compliance) • Conduct periodic audits and inspections • Discuss ESMP improvements with PMU, Director, and O&M Contractor to address non-compliance and emerging risks	• Verify environmental restoration • Approve closure compliance • Recommend corrective actions where necessary
State Ministry of Women's Affairs & Social Development (GBV/SEA Service Provider)	• Review Gender/GBV Action Plans• Support stakeholder engagement on GBV risks	• Monitor implementation of gender and GBV mitigation measures• Provide GBV/SEA support services• Conduct awareness programs	• Monitor GBV risk during commissioning activities• Ensure reporting and response mechanisms are active	• Monitor Gender Action Plan implementation • Handle GBV/SEA cases confidentially • Provide survivor support services • Engage with PMU, Director, and Gender Officer on improvements	• Monitor GBV risks during workforce demobilization • Support vulnerable groups and affected persons • Ensure proper closure of GBV cases and services

7.6 Additional Management Plans

During the progression of the project, management plans will be expanded to include specific procedures to guide implementation by the relevant project personnel and institutions, including contractors and subcontractors. Such documents will be prepared strictly in line with the requirements set out in the relevant international standards and guidelines and other applicable national and local regulations and guidelines. These additional management plans include the following:

- Stakeholder Engagement Plan
- Emergency Preparedness and Response Plan
- Traffic Management Plan
- Waste Management Plan (Annex 3)
- Occupational Health and Safety Plank,
- Local and Employment Management Plan
- Erosion and Sediment Control Management Plan
- Water Conservation Plan
- Livelihood Restoration Plan

7.7 Environmental Monitoring Program

Monitoring shall be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts. The key components of the environmental monitoring program that will be developed for this project include:

- Comprehensive identification of high-level issues, risks, opportunities, and gaps in system and operating practices that can impact the ability to achieve the required level of performance.
- Establishment of clear metrics to measure statistically significant performance improvement areas towards goals and targets;
- Establishment of processes to ensure documents and records that are critical to operational excellence are current, controlled, and accessible.
- Establishment and maintenance of appropriate processes for regular monitoring of HSE performance as well as conducting regular environmental audits and evaluations to ensure that the system is implemented and maintained and remains effective.

7.8 Training, Awareness and Capacity Building for Zonal Offices

REA shall identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact on the environmental or social conditions. Employees at each relevant phase of the project must be aware of the potential environmental impacts of their activities and the occupational hazards associated with the work; as well as their roles and responsibilities in achieving conformance with the management documented in this report. Thus, a formal training process will be organized for employees on environmental management programs, plans and procedures associated with the project.

All staff employed will be trained in the following:

- General operation of the plant.
- Environmental management.
- Specific job roles and procedures.
- Occupational health and safety; and
- Contingency plans and emergency procedures. Training will include:
- Induction training on appointments.
- Specialist training (as required for specific job roles); and
- Refresher training as required.

Training for the local community on general environmental awareness and ESMP mitigation measures on community health, safety, and security should also be provided.

7.8.1 ESMP Capacity Building Plan

The various actors involved in the ESMP implementation will need capacity enhancement to ensure adequate understanding of ESMP/ OHS/ Waste Management/ Code of Conduct requirements amongst other areas identified. Proposed topics and target audience is outlined in Table 7.11.

Table 7.7: ESMP Capacity Building Plan

/N	Training Content	Participants	Delivery Responsibility	Revised Cost (USD)
1	Specialized Training on Environmental & Social Management (ESM) (ESIA, safeguards, monitoring, reporting)	PMU, Environmental & Social Safeguard Officers	Consultant / PMU	4,500
2	ESMP Implementation Training (mitigation measures, roles & responsibilities, monitoring procedures)	Project Team (PMU, Site Engineer, Supervisors)	Consultant / PMU	1,500
3	Contractor Training on ESMP Compliance (mitigation measures, Code of Conduct, OHS requirements)	Contractor's management, workers, HSE Officers	Consultant / PMU	1,500
4	Driver & Traffic Management Training (fleet management, road safety, traffic control within project area)	Drivers, Transport Officers, HSE Officers, Security Personnel	Transport/Traffic Specialist / PMU	1,200
5	GBV/SEA/SH Prevention & Response Training (Code of Conduct, reporting channels, survivor-centered approach)	Project Team, Safeguard Officers, Contractors	GBV Specialist / Consultant / PMU	2,500
6	Grievance Redress Mechanism (GRM) Training (complaint handling, documentation, resolution process)	GRC Members (project & management levels), PMU	Consultant / PMU	2,000

Total Estimated Cost: $13,200

7.9 Record Keeping

The contractor should keep records providing evidence of ongoing mitigation activities. These documents should be made available upon request. The Safeguard Unit should keep records to provide evidence of monitoring activities and the effectiveness of the monitoring plan, including the monitoring Plan, identified problems/corrective actions, and monitoring Reports.

7.11 ESMP Costing

Table 7.10 provides a summary of the cost estimate required to effectively and efficiently implement the recommended mitigation measures and management plans required to address the potential and associated impacts of the proposed project. The total cost of implementing the ESMP is estimated at US$ **57,300** with the current Naira value of 135,00.32 to 1 dollar.

Table 7. 8: Cost of ESMP

S/N	ESMP Activity	Cost (USD)	Key Cost Components	Justification
1	Pre-Construction Phase	8,000	Stakeholder engagement, ESMP disclosure, livelihood restoration planning, training of safeguards staff	Required to address social risks early, prevent conflicts, and ensure readiness before project mobilization
2	Construction Phase	13,000	Daily monitoring, mitigation measures (dust, erosion, OHS), PPE, inspections, reporting	Most impact-intensive phase requiring continuous supervision and high resource allocation
3	Commissioning Phase	800	Testing supervision, safety monitoring, stakeholder notification	Short-term phase with limited activities but critical safety requirements
4	Operational Phase	13,500	Routine monitoring, OHS audits, waste management, GBV/SEA implementation, reporting	Long-term phase requiring sustained compliance, monitoring, and system maintenance
5	Decommissioning Phase	4,000	Dismantling supervision, waste disposal, site restoration, livelihood transition	Ensures safe closure, environmental restoration, and social safeguards at project end
6	Mitigation & Monitoring	7,000	Environmental sampling, inspections, compliance audits, documentation	Dedicated funding ensures effective tracking of impacts and regulatory compliance
7	Capacity Building	11,000	ESMP training, OHS training, GBV/SEA awareness, GRM training	Builds stakeholder capacity for effective ESMP implementation and sustainability
	TOTAL	**57,300**		**Cost reflects full lifecycle ESMP implementation aligned with international standards**

7.12 Remediation Plan After Decommissioning/ Closure

Upon the completion of useful life cycle of a project, there is a need to abandon and/or decommission such project if it no longer becomes economically viable either as a result of depleted feed stock or competing technology. The proposed solar project is expected to have a life span of 25 years. It is envisaged that technology and environmental policies could have changed so drastically by then, hence a definite decommissioning plan cannot be put in place for now. However, it is of importance that abandonment activities be planned in advance in accordance with the Nigerian regulatory requirements.

7.12.1 Decommissioning Activities

Decommissioning refers to the process of removing all the operating assets of a project after completion of its life cycle. The average life span of the solar Photovoltaic (PV) power plant to be provided as part of the proposed Project is 25years (which can be extended through regular maintenance), while the training center can last for 40 years or more. Even after 25 years, the PV panels can still generate up to 90% of the design capacity.

During decommissioning, REA shall ensure that the project sites are returned to a safe and environmentally acceptable condition. The decommissioning activities will typically include the following:
Dismantling and removal of PV panels and associated infrastructure (mounting structure, power evacuation cable, inverters, transformers, batteries, etc.);

- Removal of any sub-surface installations (e.g. underground cables);
- Waste generation and management;
- Restore the environment to allowable baseline conditions and monitor the process in line with legislative and regulatory requirements and best industry standards; and
- Assess the residual impacts, if any, that the project has on the environment; and specifically, if there are any future restrictions for other activities.

7.12.2 Management of Decommissioning Activities

In the event of decommissioning, REA, in conjunction with the leadership of the Academy, shall ensure that the Project site is left in a safe and environmentally acceptable condition. A standard decommissioning, abandonment, and closure programme shall be invoked. The tasks will include, amongst others:

- Evacuation of the dismantled PV panels and other related items (such as inverters and control devices) to the manufacturers for recycling.
- Transportation of spent batteries to recycling facilities;
- Monitoring the abandoned project environment as necessary.

Decommissioning activities will only begin after due consultation with the relevant stakeholders, including the regulatory authorities. The decommissioning activities shall be carried out in line with the relevant provisions of the National Guidelines for Decommissioning of Facilities in Nigeria (2017) issued by the FMEnv.

Typically, the following actions shall be undertaken for decommissioning:
An updated plan which takes into account the most cost-effective and best practicable methods, legal requirements and industry practices at that time for the facility decommissioning shall be developed and submitted to the FMEnv and other relevant regulatory authorities for approval. The plan shall include, but not limited to the following: Description of the site and components to be decommissioned.

Description of the decommissioning scope, objectives, end state and strategy;

- Activities to be performed during the decommissioning;
- Schedule of decommissioning activities; o Estimate of the decommissioning cost;
- Estimated inventory of waste streams to be generated during the decommissioning and handling techniques;
- Decommissioning team (qualifications, roles and responsibilities)

- To ensure that due consideration is given to all options a detailed evaluation of facility decommissioning options shall be carried out.
- The options will include facility mothballing, partial facility decommissioning or complete site decommissioning. The evaluation will consider environmental issues in conjunction with technical, safety and cost implications to establish the best practicable environment friendly options for the Project decommissioning.

- A risk assessment shall be conducted to ensure that nothing, which could be constituted as a hazard for other users of the site or for the environment in general, will be left at the site.
- The Project site shall be left in a safe and environmentally acceptable condition.

- Hazard identification and analysis shall be conducted to determine special safety concerns to be addressed.
- An appropriate Health, Safety and Environment (HSE) plan shall be implemented to ensure that the decommissioning activities are carried out in an environmentally sound manner and in conformity with relevant laws and regulations guiding such operations

- Third-party notifications should be carried out before any demolition and should be conducted in a phased sequence.

- Socio-economic considerations of facility decommissioning shall be carried out. These will include assessment of potential effects associated with termination of employment (at the end of the operational phase) and measures to minimize the effects by:

- Ensuring that employees are fully informed about the decommissioning and how it will affect them before the project finally closes.

- Building community capacity to manage opportunities and impacts arising from the decommissioning and post-decommissioning phase of the Project.

- Providing training to build local skills tailored to project decommissioning and post-decommissioning activities (e.g. equipment dismantling, rehabilitation activities, monitoring, etc.).

- Providing training to transfer project-learned skills to alternative and secondary industries tailored to respond to market economy.

- An effective waste management plan shall be developed for the decommissioning activities. The decommissioning options for redundant structures and equipment will include: the complete dismantling of structures and equipment and the return of all components to the equipment manufacturer for recycling. A detailed record of all suitable recycling materials shall be maintained.

7.12.3 Abandonment Plan

Before site abandonment, REA shall establish a standard procedure for incorporating the following practices:

- Identification of the components of the power plant that will be abandoned and/or removed;
- The proposed methods for abandonment or re-use of the plant equipment/material are applicable;
- Processes put in place to mitigate potential environmental impacts associated with the abandonment process; and
- Appropriate site rehabilitation programs (including re-vegetation of the site with native plant species) to return the Project site to its original status (as much as possible).

In the event of the project being abandoned, this shall be done in accordance with strict compliance with legislative requirements and international best practices. The decommissioning, abandonment and/or closure programme shall generally be managed by a team of competent personnel from the REA-Project Management Unit, the Department of Works and Physical Planning Department of the Academy. The abandonment process shall be carried out as follows:

- Relevant stakeholders shall be duly informed;
- Physical Asset Verification (PAV) of the facilities shall be carried out;
- National Sectoral Regulations, as they affect the abandonment of the project, shall be strictly complied with to ensure:
- Restoration and rehabilitation of the environment.
- Management of residual impacts of the project in strict compliance with extant
- National/ FMEnv sectoral regulations.
- In addition, a site close-out permit shall be obtained as appropriate and a close-out report shall be prepared and archived for future reference.

CHAPTER EIGHT
STAKEHOLDER ENGAGEMENT AND GRIEVANCE REDRESS MECHANISM

8.1 Preamble

Consultations play a crucial role in identifying the key environmental and social issues that are central to the preparation of this ESIA. A Stakeholder Engagement Plan (SEP) was developed to support the effective and sustainable implementation of all phases of the Project lifecycle, including pre-construction, construction, operation, and decommissioning.

The SEP outlines the methods used to identify stakeholders, the approaches adopted for engaging them, and the outcomes of consultations conducted to date. It also details the measures taken by the Project to ensure that relevant information was appropriately disclosed to stakeholders.

8.2 Stakeholder Engagement

A Stakeholder Engagement Plan (SEP) is the process of managing stakeholder expectations which influences project decisions throughout the life cycle of the project. This process provides a plan to interact effectively with stakeholders and support the project interest. It is very important to plan these activities well so that they appraise the contribution of stakeholders on projects, manage their expectations also achieve project objectives. The stakeholder engagement process emphasized free, prior, and informed consultation (FPIC) with affected communities and other relevant stakeholders, while considering appropriate approaches for involving vulnerable and marginalized groups. Consultations included early disclosure of information in formats that are accessible and easily understood, as well as key informant interviews, focus group discussions (segmented by men, women, and youth), and broader public meetings.

Table 8.1: Stakeholders Engagement Plan (SEP)

Groups and individuals	Date	Type of Engagement	Discussion
The Commandant of the Police Academy	12/02/2026	Consultation /homage	Overview of the ESIA, benefits of the proposed REA Solar project
Representatives of the Wuldi LGA, Kano State	13/02/2026	Focal Group Discussion,	An overview of the ESIA and the benefits of the proposed REA solar project.
Representatives of the various departments of POLAC	13/02/2026	General Group Discussions; Focus Group Discussions; Interviews.	ESIA overview, benefits, energy requirement, safeguard requirements, Land ownership and use, livelihoods, income levels and expenditure pattern. Housing and infrastructural development, housing conditions and availability of utilities etc

All consultation activities were properly documented, including relevant data, supporting evidence, participant lists with contact information, and photographic records. Information disclosure was in compliance with the provisions of national regulations, including the EIA Act No. 86 of 1992 (as amended under Cap E12 LFN 2004), as well as the World Bank's Environmental and Social Safeguards Standards (ESSS).

8.3 Objectives of Stakeholder Engagement

The purpose of public participation in an ESIA is to ensure that potentially affected and interested stakeholders are provided with adequate, clear, and accessible information in an objective manner. This enables them to identify key concerns, contribute meaningful input, and propose options for improving project benefits and considering alternatives.

The stakeholder engagement process has been structured in line with the requirements of the Nigerian EIA Act as well as applicable international standards. For this Project, the main objectives of stakeholder engagement are as follows:

- Identify key stakeholders that can influence the Project and its activities;
- Inform and educate stakeholders about the proposed Project;
- Gather local knowledge to improve the understanding of the environmental and social context;
- Better understand the locally-important issues;
- Identify the most effective methods and structures through which to disseminate project information, and to ensure regular, accessible, transparent and appropriate consultation;
- Provide a means for stakeholders to have input into the Project planning Process;
- Take into account the views of stakeholders in the development of effective mitigation measures and management plans; and
- Lay the foundation for future stakeholder engagement.

8.4 Disclosure and Participation Plan

Information disclosure is a critical activity, not only as a means of engagement but also as a foundation for enabling other engagement processes to be carried out in an informed and participatory manner. This section outlines the procedures to be followed for information disclosure and stakeholder participation as part of the implementation of the EEP.
In accordance with the World Bank Safeguards requirements, the REA is expected to disclose the environmental and social assessment, along with a documented record of stakeholder engagement. This record should include details of the stakeholders consulted, a summary of the feedback received, and a clear explanation of how the feedback was incorporated into the Project, or the reasons why it was not adopted.

8.4.1 Disclosure Mechanism

The process of information disclosure can be undertaken in two ways: either voluntary disclosure or disclosure as part of the regulatory requirements (EIA requirements, public hearing). While regulatory disclosure involves the provisioning of information as required by the authorities and agencies involved in the project, voluntary disclosure refers to the process of disclosing information to the various stakeholders in a voluntary manner. This disclosure not only allows for trust to be built amongst the stakeholders through the sharing of information, but it also allows for more constructive participation in the other processes of consultation and resolution of grievances due to availability of accurate and timely information.

8.4.2 Process for Disclosure of Information

As a standard practice, this ESIA will be released for public review according to the World Bank disclosure procedures, and for a period of 21 days in accordance with Nigerian Regulatory Frameworks. Distribution of the disclosure material will be done by making them available at venues and locations convenient for the stakeholders and places to which the public have unhindered access. The language of the ESIA is in English. The report will be made accessible for the general public at the following locations:

- The EA Department of the Federal Ministry of Environment;
- The Kano State Ministry of Environment,
- The Nigeria Police Academy
- Other designated public locations to ensure wide dissemination of the materials.

Electronic copies of the ESIA report will be made available on the websites of the World Bank and FMEnv, enabling stakeholders with internet access to review information on the proposed development and participate in the public consultation process. Stakeholder input will be facilitated through various mechanisms, including press releases and media announcements, as well as notifications to local, regional, and national NGOs, relevant professional bodies, and other interested parties regarding the disclosed materials.

8.5 Stakeholder Identification/Mapping and Analysis

The stakeholders were identified based on the direct project beneficiaries, adversely impacted groups, project supporters /proponents, regulatory/ planning, However, the stakeholders covered are;

- Rural Electricity Agency (REA)
- Federal Ministry of Environment (FMEnv)
- Kano State Ministry of Environment
- Wuldi Local Government Area
- Nigeria Police Academy /community

Major Points of the Initial Consultation Key agenda points included:

1. Introduction of Stakeholders
2. Opening Remarks
3. Description of the Proposed Project by REA/Consultant
4. Overview of The ESIA and Public Consultation by Consultant
5. Questions, Comments and Remarks by other stakeholders
6. Closing Remark

Key feedback received during Stakeholder Consultations are presented below

Table 8.2: Engagement with Staff of Nigeria Police Academy

S/N	Comments	Response
1	What is the objective of the REA solar project?	The objective of the REA solar project is to improve access to reliable, clean, and sustainable electricity in underserved and off-grid communities, thereby supporting economic growth and improving quality of life.
2	Who is funding and implementing the project?	The project is funded by development partners (World Bank) and implemented by the Rural Electrification Agency (REA)
3	What is the expected timeline for construction and operation?	Construction is expected to commence following all necessary approvals and will typically last a few months. The operational phase will begin immediately after commissioning and is expected to last for 20–25 years.
4	How will noise, dust, and waste be managed during construction?	Mitigation measures will include controlled working hours, regular water sprinkling to reduce dust, proper maintenance of equipment to minimize noise, and implementation of a waste management plan in line with environmental regulations.
5	Are there any risks to nearby communities?	Potential risks are minimal and largely limited to the construction phase. These will be managed through strict adherence to health, safety, and environmental management plans to ensure community safety.
6	Will land acquisition be required?	Yes, land may be required for the installation of solar panels and associated infrastructure. The process will follow legal guidelines and ensure fair and transparent acquisition.
7	Will anyone be displaced due to the project?	The project is designed to avoid physical displacement where possible. If any economic displacement occurs, affected persons will be compensated in accordance with applicable laws and standards.
8	How will the project improve electricity access in the area?	The project will provide stable and renewable power supply to homes, businesses, and public institutions, reducing reliance on diesel generators and improving energy reliability.
9	Will the project operate 24 hours a day? If yes, will there be any generating set and who will provide the diesel?	The project is designed to operate continuously using solar power supported by battery storage systems. Backup generators may be used only in rare cases, and fuel supply (if required) will be managed by the project operator.
10	What is the capacity of the proposed project?	The exact capacity will depend on site-specific design but is typically in the range of mini-grid or utility-scale solar installations designed to meet local demand.
11	What is the total land take required?	Land requirements depend on the project capacity, but solar projects generally require several hectares. The exact size will be determined during detailed design and site planning.

Table 8.3: Local Government Representatives

S/N	Comments	Response
1	How does the project align with local government development plans?	The project is aligned with local and national electrification strategies and supports economic development goals by improving access to reliable power.
2	What role will the local government play in project implementation?	The local government will support community engagement, facilitate coordination
3	Will the project generate revenue or economic benefits for the local government?	Yes, the project is expected to stimulate local economic activities, increase business productivity, and indirectly enhance local revenue generation.
4	How will environmental compliance be ensured?	The project will comply with all applicable environmental regulations and implement the Environmental and Social Management Plan (ESMP) throughout its lifecycle.
5	What measures are in place to manage community grievances?	A structured Grievance Redress Mechanism (GRM) will be implemented, ensuring timely and transparent resolution of complaints.
6	Will local contractors or suppliers be engaged?	Where feasible, local contractors and suppliers will be prioritized to promote local economic participation.
7	How will security of the project site be managed?	Security arrangements will be coordinated with local authorities and community leaders to ensure safety without disrupting community relations.
8	What is the sustainability plan for the project?	The project includes long-term operation and maintenance plans, including capacity building and possible private sector involvement.
9	Will there be training or capacity building for local personnel?	Yes, the project will include training programs aimed at building local technical and operational capacity.
10	How will the project be monitored and evaluated?	Regular monitoring and reporting mechanisms will be established in collaboration with relevant authorities to track performance and compliance.

Table 8.3: Host Community

S/N	Comments	Response
1	Will the project provide electricity directly to our homes?	Yes, the project is designed to improve electricity access for households, businesses, and public facilities within the community.
2	Will community members get employment opportunities?	Priority will be given to qualified local residents for available jobs during construction and operation phases.
3	Will our land be taken, and how will compensation be handled?	Any land acquisition will follow due process, and affected persons will be fairly compensated in line with applicable laws and standards.
4	Will the project affect our farming activities?	Efforts will be made to minimize impacts on livelihoods, and any affected farmers will be supported through compensation or livelihood restoration measures.
5	Is the project safe for our health?	Yes, solar projects have minimal health risks, and safety measures will be implemented to protect both workers and the community.
6	Will there be noise or disturbance during construction?	Some temporary disturbance may occur, but mitigation measures will be implemented to minimize noise, dust, and disruptions.
7	How can we report complaints or concerns?	A grievance redress mechanism will be established, allowing community members to easily report concerns and receive timely feedback.
8	Will electricity be affordable?	Tariffs will be designed to be fair and affordable while ensuring sustainability of the system.
9	What happens if the system breaks down?	Maintenance plans will be in place, and technical teams will respond promptly to ensure minimal downtime.
10	Will the project benefit our schools and health centers?	Yes, improved electricity supply will support better services in schools, clinics, and other public institutions.

Plate 8.1: Consultation at different Level

8.5 Summary of the socioeconomic study and stakeholder consultation

The socioeconomic study undertaken for the project area provided a comprehensive understanding of the demographic characteristics, livelihoods, and living conditions of the host communities. The findings indicate that the majority of residents rely on small-scale trading, agriculture, and informal sector activities as their primary sources of income. Access to essential infrastructure particularly reliable electricity, healthcare, potable water, and quality education remains limited, thereby constraining economic growth and overall well-being. The study also identified vulnerable groups, including women, youth, and low-income households, whose inclusion is critical to ensuring equitable distribution of project benefits.

Further analysis of the social environment revealed that land tenure systems in the area are predominantly customary, with traditional institutions and community leaders playing a central role in land administration and conflict resolution. Social cohesion within the communities is generally strong, although economic challenges persist. No significant cultural heritage resources were identified within the proposed project footprint; however, precautionary measures such as a chance-find procedure have been recommended. The study concludes that the project site is suitable for development, subject to the effective implementation of environmental and social mitigation measures.

The stakeholder consultation process was designed to be inclusive, participatory, and transparent, engaging a broad spectrum of stakeholders. These included community members, traditional rulers, women's groups, youth associations, local government authorities, and relevant state and federal agencies. Consultations were conducted through community meetings, focus group discussions, and key informant interviews to capture diverse perspectives. Stakeholders demonstrated a high level of awareness and interest in the project, recognizing its potential to address longstanding energy deficits in the area.

Generally, stakeholders expressed strong support for the project, citing anticipated benefits such as improved electricity access, enhanced business opportunities, better service delivery in health and education, and reduced dependence on diesel generators. Nevertheless, key concerns were raised, particularly regarding land acquisition processes, compensation arrangements, environmental management during construction, and the need for prioritizing local employment and capacity building. These concerns have informed the development of appropriate mitigation measures and management plans.

In response to stakeholder feedback, the project design has incorporated measures to minimize adverse impacts while maximizing benefits. These include fair and transparent land acquisition and compensation processes, implementation of environmental and social management plans, and targeted initiatives to promote local employment and skills development. Special attention will also be given to vulnerable groups to ensure they are not excluded from project opportunities.

A structured grievance redress mechanism has been established to provide stakeholders with accessible channels to raise concerns and seek timely resolution. This mechanism is designed to be transparent, culturally appropriate, and responsive, thereby strengthening trust between the project proponents and the communities. In addition, continuous stakeholder engagement will be maintained throughout the project lifecycle to monitor impacts, provide updates, and address emerging issues.

Finally, the socioeconomic study and consultation outcomes underscore the importance of sustained collaboration between the project implementers, government agencies, and host communities. With proper implementation of the recommended mitigation and engagement strategies, the project is expected to deliver significant socioeconomic benefits while minimizing potential adverse impacts, contributing to sustainable development in the project area.

8.6 Grievance Redress Mechanism

This section outlines the grievance redress mechanism (GRM) established to address both general project-related grievances and sensitive issues such as gender-based violence (GBV) and sexual exploitation and abuse (SEA), including the implementation of a dedicated GBV Action Plan. The GRM is designed to provide a safe, accessible, and transparent process through which affected communities and stakeholders can raise concerns related to project activities. While the standard GRM of the Rural Electrification Agency (REA) provides overarching guidance, it is intended to complement not replace the site-specific mechanisms that are developed and implemented at the subproject level to reflect local contexts and needs.

The GRM serves as a structured framework that enables stakeholders to lodge complaints, track their progress, and receive timely feedback on resolutions. It ensures that grievances are handled in a fair, consistent, and efficient manner, thereby strengthening accountability and trust between project

implementers and host communities. The mechanism covers a wide range of issues, including environmental impacts, social concerns, land-related matters, and labor issues. Clear procedures are established for receiving, recording, assessing, and resolving grievances, with defined timelines and responsibilities at each stage.

To ensure effectiveness, the GRM will be widely communicated to all stakeholders throughout the project lifecycle. This includes raising awareness during consultations, community meetings, and through information disclosure channels. Stakeholders will be informed about how to access the mechanism, the types of grievances that can be reported, and the expected timelines for resolution. In addition, a grievance register will be maintained to document all complaints received, actions taken, and outcomes achieved, ensuring transparency and enabling continuous improvement of the system.

Special provisions are included within the GRM to address GBV/SEA-related grievances in a confidential, survivor-centered, and ethically appropriate manner. These cases will be handled with strict confidentiality, and referral pathways to appropriate support services will be established. The GRM will remain operational throughout the entire project lifecycle, ensuring that stakeholders have continuous access to a reliable platform for raising concerns and seeking redress, thereby contributing to the overall sustainability and social acceptability of the project.

8.6.2 Publicizing and Disclosure of the GRM

The GRM will be disclosed to the stakeholders through written and verbal communication. The mediums to be used for this purpose are public meetings, group discussions The GRM disclosure will be done along with the disclosure of other management plans.

8.6.3 Receiving and Recording Grievances

As part of the GRM, the grievances from the stakeholder or their representatives may be communicated verbally (in person or over a telephonic conversation) or in written form to the project representatives or to the designated Grievance Officer (GO) directly. If the grievance is received directly by the GO or other project representatives, it will be recorded directly into the Grievance Form as soon as the personnel return to site. A sample grievance form is as follows:

Table 8. 5: Grievance Recording Form

GRIEVANCE REGISTRATION	
Case No.:	Date:
Name:	
Office Location:	Unit:
Phone no:	
Details of grievance:	
Name of person recording grievances:	

Designation of recording person:	
Proposed date of response to grievance:	
Signature of recording person	Signature of complainant
GRIEVANCE REDRESSAL RESPONSE	
Decision of GO (give full details):	
Claimant accepts the outcome:	
Accepted	Not accepted
Signature of claimant:	
Signature of GO:	

All project staff will be made aware of their responsibility to promptly forward any grievances or related communications they receive to the designated Grievance Officer at the project site. This ensures that no concern raised by stakeholders is overlooked or delayed. Staff are required to document key details, including the identity and contact information of the complainant (where provided), as well as the nature of the grievance, and submit this information as soon as possible. This approach promotes accountability and ensures that grievances enter the formal system without unnecessary delay.

Once the grievance is received, the Grievance Officer will serve as the central point for recording and coordinating responses. The officer will review the information provided and ensure that all grievances are properly documented and tracked. Subsequently, the Grievance Officer will forward the complaint to the Social Safeguard Officer, who is responsible for assessing the issue and facilitating an appropriate resolution in collaboration with relevant project teams and stakeholders. To make the grievance process accessible and inclusive, a grievance register will be established and maintained at both the project office and the site camp. This register will serve as a formal log where individuals or groups can submit their complaints in person. The availability of this register at easily accessible locations ensures that all stakeholders, including those without access to digital communication channels, have an opportunity to raise concerns directly.

The use of a grievance register also enhances transparency and consistency in handling complaints. Each entry will capture essential details such as the date of submission, nature of the grievance, actions taken, and status of resolution. This systematic documentation supports effective monitoring and follow-up, helps identify recurring issues, and contributes to improving overall project management and stakeholder relations.

8.6.4 Maintaining a Grievance Register

Each grievance thus received shall be recorded in a grievance register. This grievance register shall be updated at each stage of the grievance redressal. Once the grievance is recorded in the register, a preliminary analysis shall be undertaken by the social standard officer/ manager to ensure that the grievance is within the scope of the GRM.

8.6.5 Acknowledgment of Grievance

Once the grievance has been recorded, the stakeholder will receive an acknowledgment of receipt along with a summary of the complaint.

8.6.6 Site Inspection and Resolution

Site inspections may not be necessary for all grievances during the verification and resolution process. The need for a site visit will be determined based on the nature and sensitivity of the issue.

8.6.7 Resolution, Escalation, and Closure

Based on the understanding developed, the Social Safeguard Officer, in consultation with relevant departments, shall determine an appropriate resolution to the issue. This may include providing information to clarify the situation, implementing corrective actions to address identified problems, offering compensation; either financial or in kind for any damage caused, and introducing mitigation measures to prevent recurrence. The agreed resolution shall be communicated to the complainant within 10 working days after completion of the site investigation. Where the issue falls outside the mandate of the Social Safeguard Officer, it shall be escalated to the Head of the PMU under the NEP, and the complainant shall be duly informed of the escalation. The Head of the PMU shall make efforts to resolve the grievance within 10 working days of receiving it.

If the grievance remains unresolved and no adequate solution can be identified by the Head of the PMU, a formal response shall be provided to the complainant, along with guidance on alternative avenues for redress. This may include referral to a citizens' rights mediation centre for resolution prior to pursuing legal action.

At any stage, if the complainant is dissatisfied with the proposed resolution, they may request that the grievance be escalated to the next level. In cases where a grievance is determined to be unfounded, a clear and reasoned explanation shall be provided to the complainant.

8.6.8. Update of Records

The grievance register shall be updated on a weekly basis to reflect the current status of each complaint. Once a grievance has been resolved and the outcome communicated to the complainant, it shall be formally closed in the register. The register should also document how each grievance was addressed, providing a clear record of the resolution process. These records will serve as useful references for handling similar grievances in the future.

Where there is evidence of recurring issues or repeated grievances, such matters should be escalated to the Head of the PMU under the NEP for assessment, to determine whether modifications to the project design are necessary.

CHAPTER NINE

CONCLUSION AND RECOMMENDATIONS

9.1. Conclusion

The Environmental and Social Impact Assessment (ESIA) for the proposed solar power plant at the Nigeria Police Academy, Wudil, Kano, was conducted to comply with applicable government policies, regulatory requirements, financiers' standards, and stakeholder expectations. The objective is to ensure that proactive environmental and social considerations are integrated into the project design and implementation.

This study was carried out in accordance with Nigeria's regulatory framework for environmental and social management, particularly the Nigerian EIA Act Cap E12 LFN 2004, which mandates EIAs for projects with the potential to cause significant environmental impacts. Additionally, the ESIA aligns with the World Bank's Environmental and Social Standards.

The ESIA process is intended to provide comprehensive information to support informed decision-making and promote environmentally sound and socially sustainable development. Stakeholder consultations have been conducted and will continue throughout the project lifecycle. These engagements ensured that concerns and questions regarding the proposed project were adequately addressed to the satisfaction of stakeholders.

Baseline environmental and social conditions covering both biophysical and socio-economic aspects were established through field surveys and sampling, supported by literature reviews, maps, and other secondary data sources. This baseline information will serve as a reference point for future monitoring and evaluation.

The assessment examined interactions between the project activities and existing environmental and socio-economic conditions to identify, characterize, and evaluate potential impacts. Appropriate mitigation measures and recommendations were subsequently developed based on the mitigation hierarchy of avoiding impacts where possible, minimizing unavoidable impacts, restoring affected resources, and compensating for residual impacts where necessary. These measures were informed by industry best practices, available technologies, and health, safety, and environmental (HSE) considerations.

An Environmental and Social Management Plan (ESMP) was also developed to guide the management of potential adverse impacts during project implementation and operation. The ESMP outlines procedures for implementing environmental and social commitments and includes a monitoring framework to track changes in environmental conditions over time. In this regard, the Rural Electrification Agency (REA) will ensure that parameters such as air quality, noise levels, and groundwater conditions are monitored in compliance with the Federal Ministry of Environment (FMEnv) and World Bank standards. Mitigation measures implemented under the ESMP followed the hierarchy of avoid, minimize, restore, and compensate.

9.2. Recommendation

The ESIA study recommends the following:

The ESIA study recommends the following:

- Ensure full implementation of the Environmental and Social Management Plan (ESMP) throughout the project lifecycle.
- Conduct regular environmental monitoring for air quality, noise, groundwater, and waste management.
- Maintain continuous stakeholder engagement and effective community communication.
- Prioritize local employment, capacity building, and renewable energy training opportunities.
- Implement strong occupational health and safety measures, including emergency response systems.
- Establish and maintain an efficient Grievance Redress Mechanism (GRM) for timely resolution of complaints.
- Promote proper waste management, including safe disposal of hazardous and electronic waste.
- Ensure compliance with regulatory requirements through continuous oversight by the Rural Electrification Agency and relevant authorities.

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Appendix – Laboratory Report -Soil

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15th April 2026

Client: CHALTON
Sample Type: SOIL
Sample Analysis: E&S Compliance Audit Kano

Soil Physicochemical Properties

Parameter	Unit	SS1 (0–15 cm)	SS1 (15–30 cm)	SS2 (0–15 cm)	SS2 (15–30 cm)	SS3 (0–15 cm)	SS3 (15–30 cm)	Control (0–15 cm)	Control (15–30 cm)
pH	–	5.67	5.65	6.34	6.23	6.69	6.79	6.33	6.02
EC	µS/cm	98.00	162.76	105.40	101.40	162.76	144.56	167.00	131.50
Temperature	°C	28.40	30.63	30.60	27.90	30.63	29.99	29.35	28.50
Nitrate	mg/kg	0.38	0.63	0.45	0.39	0.63	0.46	0.90	0.75
Ammonia	mg/kg	0.80	1.13	0.76	0.67	1.13	2.57	0.99	2.42
Phosphate	mg/kg	0.56	1.14	1.16	1.10	1.14	12.50	1.62	7.83
Sulphate	mg/kg	12.11	14.04	13.09	12.09	14.04	1.95	10.67	1.34
Chloride	mg/kg	0.87	1.70	1.40	1.50	1.70	3.11	2.06	0.97
TOC	%	0.63	0.87	0.78	0.75	0.87	0.85	1.15	1.23
Oil & Grease	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND
THC	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND
TPH	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND
PAHs	mg/kg	ND	0.02	ND	ND	0.02	0.01	ND	ND
BTEX	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND

Soil Physical Properties (PSD)

Parameter	Unit	SS1 (0–15 cm)	SS1 (15–30 cm)	SS2 (0–15 cm)	SS2 (15–30 cm)	SS3 (0–15 cm)	SS3 (15–30 cm)	Control (0–15 cm)	Control (15–30 cm)
Moisture Content	%	6.74	6.37	7.72	7.61	7.73	7.64	8.61	9.24
Porosity	%	27.36	26.42	32.34	33.31	32.92	33.84	32.42	29.38
Sand	%	6.81	5.71	19.35	23.20	19.47	23.21	27.00	24.72
Silt	%	1.57	0.66	18.04	21.50	18.07	21.70	10.81	18.46
Clay	%	24.94	28.93	62.43	55.02	62.46	55.09	62.20	56.81

Cations

Parameter	Unit	SS1 (0–15 cm)	SS1 (15–30 cm)	SS2 (0–15 cm)	SS2 (15–30 cm)	SS3 (0–15 cm)	SS3 (15–30 cm)	Control (0–15 cm)	Control (15–30 cm)
Magnesium	mg/kg	22.75	19.09	31.32	29.16	31.59	29.63	27.17	25.26
Potassium	mg/kg	2.43	2.75	5.06	5.12	5.33	5.41	4.76	6.08
Sodium	mg/kg	9.10	8.81	12.14	11.12	12.25	11.98	12.37	12.52

Heavy Metals

Parameter	Unit	SS1 (0–15 cm)	SS1 (15–30 cm)	SS2 (0–15 cm)	SS2 (15–30 cm)	SS3 (0–15 cm)	SS3 (15–30 cm)	Control (0–15 cm)	Control (15–30 cm)
Copper	mg/kg	3.44	3.63	4.14	3.22	4.19	3.98	2.00	1.83
Chromium	mg/kg	1.32	1.23	1.33	1.23	1.53	1.52	1.01	1.21
Cadmium	mg/kg	0.68	0.62	1.01	0.21	1.03	0.95	0.83	0.85
Nickel	mg/kg	0.69	0.67	1.42	1.14	1.45	1.31	0.77	0.72
Arsenic	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND
Iron	mg/kg	97.18	94.62	170.59	160.43	170.59	160.41	183.62	184.80
Mercury	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND
Lead	mg/kg	0.84	0.89	1.12	1.14	1.35	1.38	1.09	0.96
Zinc	mg/kg	5.17	5.13	5.12	5.32	7.05	7.20	10.08	8.72
Manganese	mg/kg	1.30	1.23	1.32	1.32	1.97	1.99	1.83	1.98

Thank you for your patronage.

Bayo Lawal
Managing Director

TUDAKA Analytical Nig. Ltd.

QUESTIONNAIRES

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PLAN (ESIA) PHASE III: ENERGIZING EDUCATION PROGRAM (EEP) PROJECT

NOTE:

Please read each question carefully. Your answers are completely confidential and will be included only in summaries where individual answers cannot be identified. Unless otherwise instructed, please tick appropriate answer category that best describes your opinion. It will take approximately 20 minutes to complete this questionnaire.

SECTION A: Household data

Location/Name of School……

1. Gender of Respondent: (a) Male (b) Female
2. Age: (a) Below 18 yrs (b) 18-45 yrs (c) 46-65 yrs (d) Above 66 yrs
3. Marital Status: (a) Single (b) Married (d) Divorced/Separated (e) Widowed
4. Occupation: (a) Civil Servant (b) Daily Labourer (c) Trading & Shop Keeping (d) Artisans (e) Employed (salary)(f) Retired (g) Famer (h) Unemployed (i) Others specify……
5. Residential Status: (a) Permanent Resident (b) Back Home (Returnee) (c) Nonresidents, Visiting
6. Ethnic Group: (a) Ebira (b) Igala (c) Hausa-Fulani (d) Igbo (e) Hausa Yoruba (f) others……
7. Religion: (a) Islam (b) Christianity (c) Traditional
8. Relationship to Household Head (HH): (a) Self (b) Spouse (c) Child (d) Parent (e) Other, specify……
9. Size of the HH ……
10. How long have you been living/working in this area? (a) 0-2 yrs (b) 3-5 yrs (c) 6-9 yrs (d) 10 yrs and Above
11. Education: (a) NO formal education (b) Primary School (c) Secondary School (d) Tertiary (Excluding University) (e) University Graduate (f) University Postgraduate

SECTION B: Health Status

1. How do you manage your health conditions when sick? (a) Attend hospital/clinic (b) Buys drugs from nearby chemist (c) Traditional medicine (d) None (e) Others Specify……
2. If you do attend hospital/clinic, when last did you visit one? (a) last six months (b) last one year (c) last five years (d) more than five years ago (e) Never visited one.
3. Please tick one or more of the under-mentioned ailment/sicknesses, you suffer from most accordingly?
4.

Ailment	**√**	**Ailment**	**√**
Whooping Cough		Rheumatism	
Tuberculosis		Rashes	

Asthma		Eczema	
Dysentery		Ringworm	
Diarrhoea		Eye pains	
Cholera		Cataract	
Pile		Glaucoma	
Hypertension		Typhoid fever	
Congestive health problem		Malaria	
Pneumonia		Sickle cell anaemia	
Sexually transmitted diseases		Epilepsy	

7. Do you think your health condition will be affected by the proposed Infrastructure intervention? (a) Yes (b) No

8. If yes, how? .....

9. Please suggest how this can be averted during construction and implementation.....

SECTION C. Standard of Living /Socioeconomic Activities

1.0 Assets

1.1 What sort of housing does your household live in?					
a. Construction material - Walls		Plastered mud	c. Number of rooms		1-2
		Cement blocks			3-4
		Other (specify)			Other (specify)
b. Construction material - roofing		Corrugated roofing	d. Other structures on plot		Animal Pen
		Aluminium			Granary
		Asbestos			Shops
		Tile			Kiosks
		Other (specify)			Other (specify)
e. Construction material - floor		Earthen			
		Concretes			
		Tiles			
		Other (specify)			
f. Toilet Facility		Pit latrine			
		Water closet			
		Toilet facility outside dwelling			
		Pier latrine			

		Other (specify)
		None
g. Tenure of housing		Owned
		Rented
		Occupied rent free
		Other
h. Tenure of land		Owned
		Rented
		Occupied rent free
		Lease hold
		Others specify

1.2 Indicate household refuse disposal for solid waste? (Multiple options) (a) Depositing refuse at backyard of the house (b) Dumping in water body (c) Dumping in community refuse/garbage pit/dumpsite (d) Burning after gathering together (e) Waste collector (f) Other specify……

2.0 Household Services

2.1 Rank in order of availability and usability the source(s) of lighting for the household? (Please use 1, 2,in hierarchical order with 1 indicating the most available and used source)

(a) PHCN	(b) Generator	(c) Lantern	(d) Candle	(e) Palm Oil Lamp	(f) Torchlight Battery	(g) Wood	(h) Kerosene	(i) Gas

2.2 Using the method in 2.1, indicate major source of energy for cooking?

(a) Fire Wood	(b) Coal	(c) Kerosene	(d) Electricity	(e) Animal dropping	(f) Gas	(g) Crop Residue/saw dust	Others

3.0 Sources of Water

Sources	for drinking	for cooking	for bathing and washing
a.Well			
b. Borehole/Water pump			
c. Community tap			
d. Piped water outside dwelling			
e. River			
f. Rain harvesting			

g. Water vendor			
h. Tanked water			
i. Other (specify)			

4.0 Income and source livelihood

Please, state your main income per month and source livelihood	₦

4.1 Remittances

1. Does anyone in the family who lives elsewhere send money to you?	1	YES	2	NO
2. If yes, how much (per month)	₦			

5. In your opinion, how has the standard of living of your household changed over the previous three years? (a) Same (b) Better (c) Worse
6. Is the option in 5 propelled by the state of the electricity provision/availability? (a) Yes (b) No
7. If 6 is YES, do you think the proposed infrastructure intervention will improve the situation? (a) Yes (b) No
8. If 7 is YES specify how the project will improve the situation .....

SECTION D: Gender-Based Violence/Sexual Exploitation and Abuse

1. Are there any provisions which restrict women's access to health and other social services? In particular which:

(Please specify in the space provided for this purpose "yes" or "no")

( ) require the consent of a male relative/husband for a married woman's medical examination or treatment or access to contraceptives or abortion,

( ) require parental consent in case of adolescents' access to contraceptives abortion;

( ) allow medical practitioners to refuse provision of a legal medical service on grounds of conscientious objection

( ) prohibit certain medical services, or require that they be authorized by a physician, even where no medical procedure is required; in particular:

( ) IUDs (intrauterine devices) or hormonal contraceptives

( ) Emergency contraceptives, including the morning-after pill, ( ) Sterilization on request;

( ) Early abortion (in first trimester of pregnancy) at the pregnant woman's request

( ) Medically assisted reproduction (e.g., in vitro fertilization) 2. Are the following acts criminalized?

(Please specify in the space provided for this purpose "yes" or "no")

( ) adultery

( ) prostitution

(If yes, who is criminally responsible? (a) the sex worker (b) the procurer and/or the customer) (c) both

3. Are there any measures and programs put in place in order to increase women's participation safety e.g. in public urban spaces, in public transportation, etc.? (a) Yes (b) No (c) No idea
4. Are there specific training programs for medical and legal professionals on the issue of gender-based discrimination in the area of health and safety? (a) Yes (b) No (c) No idea

5. How do you ensure gender equity in the community? (a) Women are elected in public office (b) Females are given equal opportunity and access to education and employment (c) Quotas on genders are ensures in leadership of community-based organizations (d) Others specify……..

SECTION E: Resources/ Cultural Property

1. Please indicate the environmental problems which your community experiences? (a) Soil infertility (b) Poor drainage system (c) Bad road (d) Bad lands (e) environmental degradation (f) Degraded land (i) Destruction of infrastructures (j) Others

(specify) ……..

2. Please indicate the environmental problems which your community would likely experience and whose cause can be linked to the proposed Infrastructure intervention project during construction?

(a) Soil infertility (b) Poor drainage system (c) Bad road (d) Low visibility

(e) Erosion Problems (f) Flooding (g) Environmental degradation

(h) Destruction of infrastructures (i) encroachment of land properties (j) Pollution (air, surface water, ground water, noise) (k) others (specify)

……..

3. Do you think the proposed Infrastructure intervention project will affect any valued resource/cultural/archaeological property in your area? (a) YES (b) NO
4. If yes mention the name(s) of the valued resource/cultural/archaeological property

……..

5. How will valued resource/cultural/archaeological property be affected? (a) Displacement of such valued cultural properties (b) Vandalization of sacred items/locations (c) Possible theft of sacred/archaeological items (d) Others,

specify:……..

SECTION F: Intervention Project Activities Impact Evaluation

1. Are you aware of the proposed Solar Power Project? (a) Yes (b) No
2. If yes, from which source (a) Community meetings (b) Media (TV, Radio, Newspaper, Internet) (c) Others specify……..
3. Do you think the proposed Infrastructure intervention project can cause restiveness in your community? (a) YES (b) NO
4. If 3 is yes how will the proposed Infrastructure intervention result in restiveness? (a) Disrespect of norms and culture by contractors (b) loss of farmland / Property (c) Possible theft of sacred/archaeological items (d) local people not employed during

construction (e) Others, specify: ……

5. How will the proposed Infrastructure intervention project impact on your livelihood and environment?

Positive impacts	Negative impacts
(a)	
(b)	
(c)	

6. Can you name some of the animals and other habitat that may be affected by the proposed Infrastructure intervention project? ……

7. What do you expect from the activities of solar power Infrastructure intervention? (a) employment of Locals during construction (b) compensation for those whose properties will be affected (c) capacity building for maintenance during implementation (d) community input into final engineering design (e) Others please specify……

Section G: Grievance Redress Mechanism

1. Have you had grievances issue in this community in the last three years? (a) Yes (b) No

2. If 1 is yes, what was the cause of the grievance? (a) Land issue (b) theft of valuables (c) vandalization of property (d) Others, please specify……

3. Who do you report your grievances in this community to? (a) School authority/management (b) Law enforcement (c) My landlord/CDA (d) traditional/community leader (e) Others, please specify……

4. Are grievances satisfactorily addressed or resolved by option(s) chosen in question 3 above? (a) Yes (b) No

5. Are there any other issue(s) of concerned as regards the proposed intervention project in your area, please state clearly?……

Section H: World bank ESS

	World Bank ESS	Question	Yes	No
1	ESS1: Assessment and Management of Environmental and Social Risks and Impacts	Will the project activities impact or lead to disruption of the ecosystem?		
2	ESS2: Labour and Working Conditions	Are labour rights and safe working conditions ensured?		
	ESS3: Resource Efficiency and Pollution Prevention	Will waste be generated from this project		

	ESS4: Community Health and Safety	are community health and safety near by be affected by this project?		
	ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Will farmer within the university by displaced		
	ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	How is biodiversity protected?		

STAKEHOLDER ENGAGEMENT AND THE GRIEVANCE REDRESS MECHANISM

Stakeholder engagement and the grievance redress mechanism as key elements of the ESIA process. It explains that stakeholder consultations are essential for identifying environmental and social concerns and ensuring that the project is implemented in an inclusive and transparent manner. A Stakeholder Engagement Plan (SEP) guides how stakeholders are identified, informed, and engaged throughout the project lifecycle. This process includes consultations such as meetings, interviews, and focus group discussions, with special attention given to vulnerable groups to ensure their voices are heard.

The engagement process aims to inform stakeholders about the project, gather their input, and incorporate their views into project planning and decision-making. Information disclosure is a major part of this process, with ESIA documents made publicly available both physically and online in line with regulatory requirements. This ensures stakeholders can review the project details, provide feedback, and contribute meaningfully, thereby promoting transparency and trust between the project team and the community.

Consultations revealed that stakeholders generally support the project because of its potential to improve electricity access, enhance economic opportunities, and strengthen public services. However, concerns were raised about land acquisition, compensation, environmental impacts during construction, and the need for local employment. These concerns have been incorporated into mitigation strategies and project design improvements.

Stakeholders Engagement Plan (SEP)

Groups and individuals	Date	Type of Engagement	Discussion
The Commandant of the Police Academy		Consultation /homage	Overview of the ESIA, benefits of the proposed REA Solar project
Representatives of the Wuldi LGA, Kano State		Focal Group Discussion,	An overview of the ESIA and the benefits of the proposed REA solar project.
Representatives of the Various department of POLAC		General Group Discussions; Focus Group Discussions; Interviews.	ESIA overview, benefits, energy requirement, safeguard requirements, Land ownership and use, livelihoods, income levels and expenditure pattern. Housing and infrastructural development, housing conditions and availability of utilities etc

Stakeholder Feedback Summary

Nigeria Police Academy Staff

Key Concern	Response
Objective of project	Improve access to clean, reliable electricity
Funding & implementation	Funded by World Bank, implemented by REA
Timeline	Construction: few months; Operation: 20–25 years
Environmental impacts (noise, dust)	Managed through mitigation measures
Community risks	Minimal and controlled with safety plans
Land acquisition	Required with fair compensation
Displacement	Avoided where possible; compensation if needed
Electricity improvement	Reliable power for homes and institutions
Operation (24 hrs)	Solar + battery; backup generators rarely used
Capacity & land size	Depends on design; several hectares required

Local Government Representatives

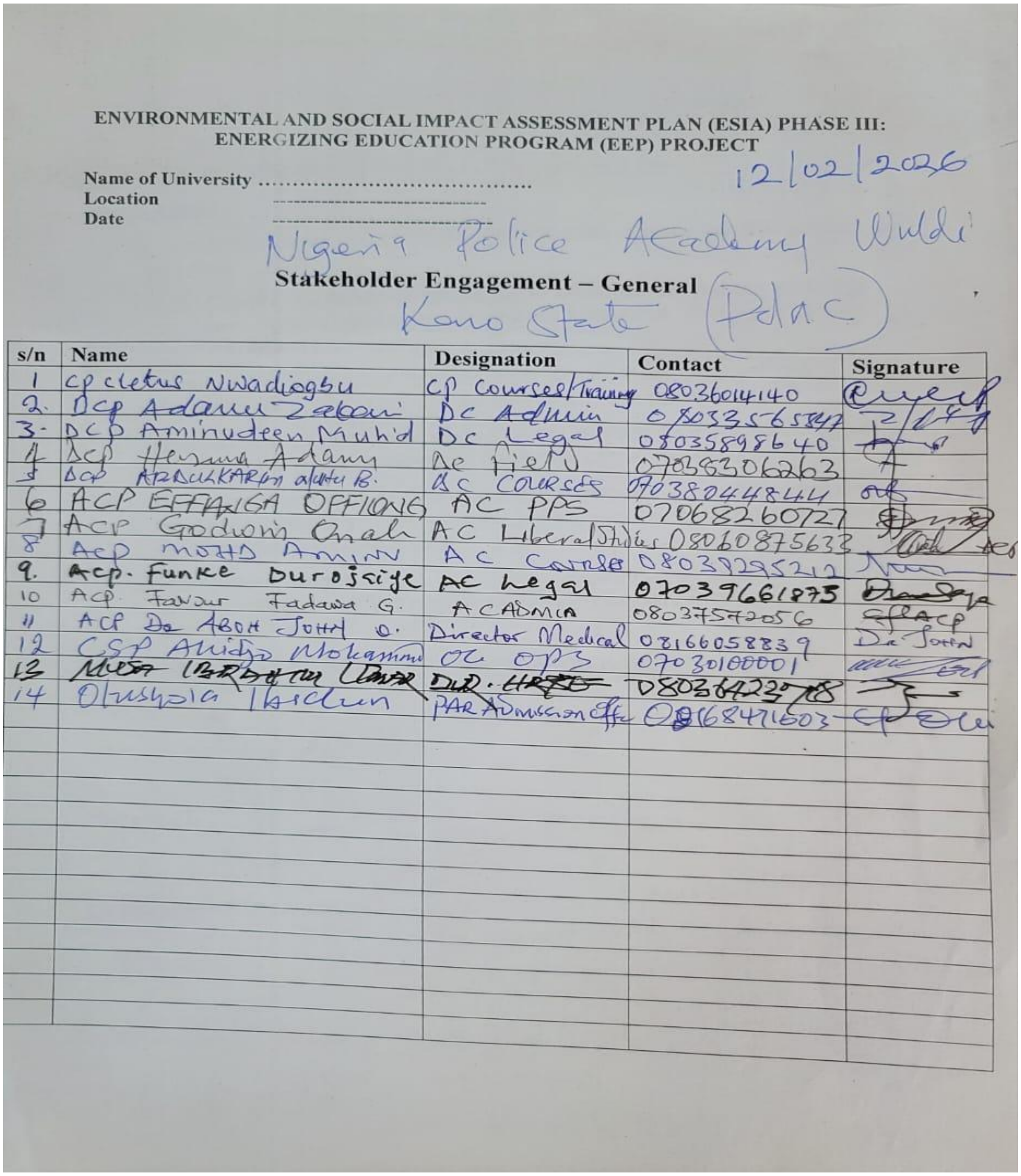
Key Concern	Response
Alignment with development plans	Supports local and national goals
Role of local government	Facilitate engagement and coordination
Economic benefits	Boosts business and revenue indirectly
Environmental compliance	ESMP and regulations will be followed
Grievance handling	Structured GRM will be implemented
Local participation	Preference for local contractors/suppliers
Security	Coordinated with authorities
Sustainability	Long-term operation and maintenance plans
Capacity building	Training programs included
Monitoring	Regular reporting and evaluation systems

Host Community

Key Concern	Response
Electricity access	Yes, for homes and businesses
Employment	Priority for local residents
Land & compensation	Fair and lawful compensation
Impact on farming	Minimized; support if affected
Health & safety	Minimal risk with safeguards
Construction disturbance	Temporary; mitigation measures applied
Reporting complaints	Through GRM system
Affordability	Tariffs designed to be fair
System failure	Maintenance teams will respond quickly
Community benefits	Improved schools, clinics, and services

The socioeconomic assessment further shows that the host communities largely depend on agriculture and small-scale trading, with limited access to basic infrastructure such as electricity, healthcare, and clean water. Vulnerable groups, including women and low-income households, were identified, and the project aims to ensure equitable access to its benefits.

ATTENDANCE



ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PLAN (ESIA) PHASE III:
ENERGIZING EDUCATION PROGRAM (EEP) PROJECT

Name of University .... Nigeria Police Academy Wudil
Location ------------------------------ Kano State (Polac)
Date ------------------------------ 12/02/2026

Stakeholder Engagement – General

s/n	Name	Designation	Contact	Signature
1	CP Cletus Nwadiogbu	CP Courses/Training	08036014140	
2.	DCP Adamu Zakari	DC Admin	08033565847	
3.	DCP Aminudeen Muh'd	DC Legal	08035898640	
4	DCP Hauwa Adamu	DC Field	07038306263	
5	DCP Abdulkarim Abubakar B.	AC Courses	07038044844	
6	ACP Effanga Offiong	AC PPS	07068260727	
7	ACP Godwin Onah	AC Liberal Studies	08060875633	
8	ACP Mohd Aminu	AC Courses	08039295212	
9.	ACP. Funke Durojaiye	AC Legal	07039661875	
10	ACP Fawour Fadawa G.	ACADMICA	08037572056	ACP
11	ACP Dr Aboh John O.	Director Medical	08166058839	Dr John
12	CSP Aliyu Mohammed	OC OPS	07030100001	
13	Musa Ibrahim Umar	DIR. HRD	08036423078	
14	Olushola Ibikunle	PAR Admission Offr	08168471603	