RURAL ELECTRIFICATION AGENCY
ENERGY • EMPOWERMENT • EFFICIENCY

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

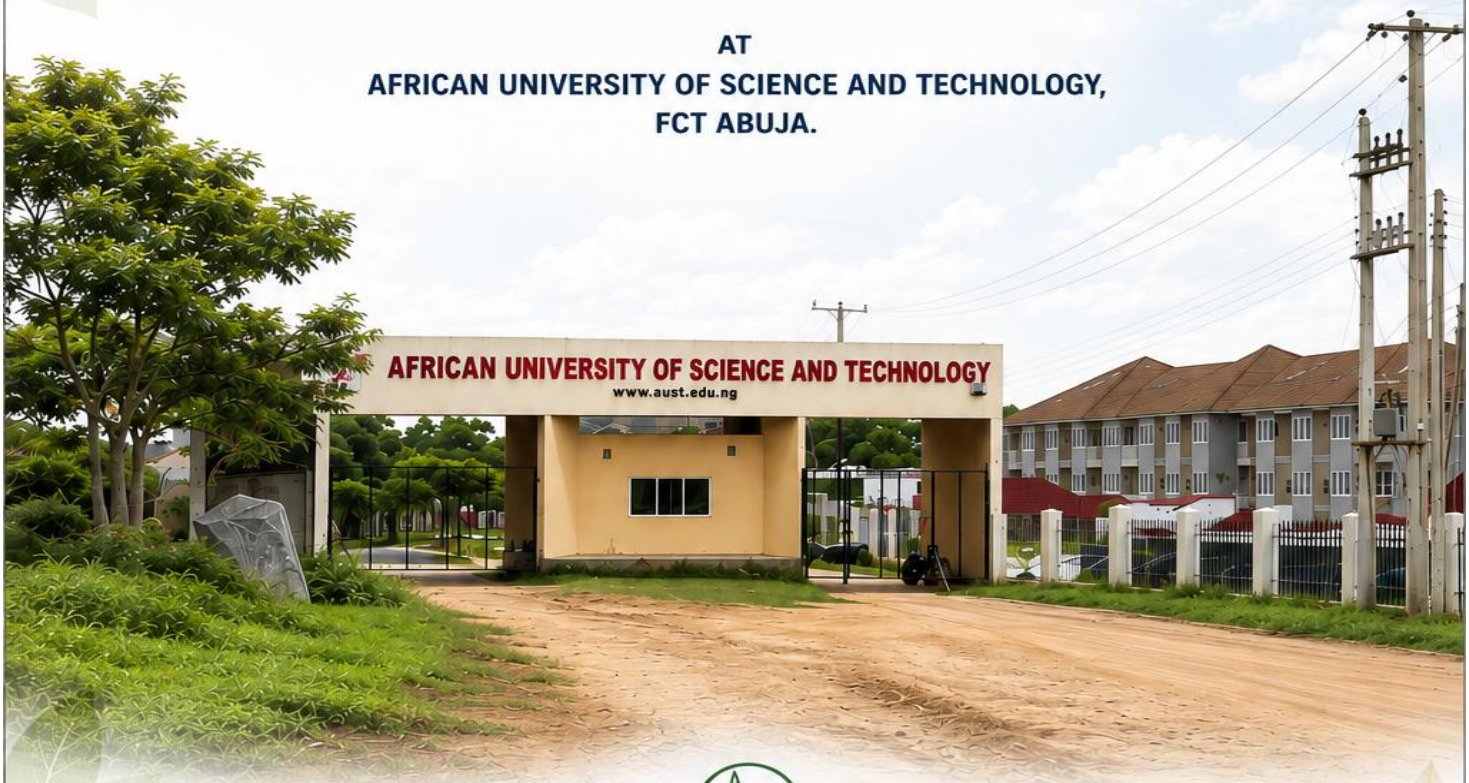
FOR THE PROPOSED

NIGERIA ELECTRIFICATION PROJECT

(DESERT TO POWER) PHASE II PROJECT.

AT

AFRICAN UNIVERSITY OF SCIENCE AND TECHNOLOGY,
FCT ABUJA.



PREPARED FOR:
RURAL ELECTRIFICATION AGENCY (REA)
(Nigeria Electrification Project – PMU)

DRAFT REPORT

AUGUST 2026

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ABBREVIATIONS

AUST	African University of Science and Technology
AfDB	African Development Bank
AOI	Area of Influence
ASTM	American Society for Testing and Materials
BOD	Biochemical Oxygen Demand
BOS	Balance of System
COPE	Care of the People
DRG	Debt Relief Gains
DtP	Desert to Power
ECN	Energy Commission of Nigeria
EEP	Energizing Education Programme
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EPC	Engineering, Procurement and Construction
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
GRM	Grievance Redress Mechanism
HSE	Health Safety and Environment
HT	High Tension
ICREEE	Inter-ministerial Committee on Renewable Energy and Energy Efficiency
kVA	kilovolt-ampere
KW	Kilowatt
kWac	kilowatts alternating current
kWdc	kilowatts direct current
LGA	Local Government Area
LT	Low Tension
MW	Megawatt
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
NSIFT	National Social Insurance Trust Fund
NUC	National University Commission
OHS	Occupational Health and Safety
PAPs	Project Affected Persons
RAP	Resettlement Action Plan
REA	Rural Electrification Agency
RoW	Right of Way
SE4All	Sustainable Energy for All
STEL	Short Term Exposure Limit
TCN	Transmission Company of Nigeria
TWA	Time Weighted Average

EXECUTIVE SUMMARY

ES 1: Introduction

The Federal Government of Nigeria (FGN), through the Rural Electrification Agency (REA), is implementing the Nigeria Electrification Project Phase II (Desert-to-Power) with financial support from the African Development Bank (AfDB). The project's primary objective is to accelerate Nigeria's electrification efforts by deploying sustainable, off-grid and grid-connected solar-powered renewable energy solutions. As part of the Energizing Education Programme (EEP), REA intends to electrify 24 Federal Universities and Teaching Hospitals across Nigeria, of which the African University of Science and Technology (AUST), located within the Galadimawa district off Ring Road 2 in the Federal Capital Territory (FCT), Abuja, is among the designated beneficiary institutions.

This Environmental and Social Impact Assessment (ESIA) has been prepared for the proposed Solar Hybrid Mini-Grid installation at the AUST campus in accordance with the African Development Bank's Integrated Safeguards System (ISS) 2023, the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, and other applicable Nigerian environmental and sectoral regulations and international good practice standards.

The relevant National and state environmental and social policies, laws, regulations, and the African Development Bank (AfDB) integrated safeguards as well as other international standards guided the preparation of this ESIA and will further guide the implementation of the project. A highlight of these policies / framework include;

a) Environmental Impact Assessment (EIA) Act CAP E12 LFN 2004
b) EIA Sectoral Guidelines for Power Sector (2013)
c) National Policy on the Environment (Revised 2016)
d) Climate Change Act 2021
e) Natural Resources Conservation Act CAP 349 LFN 1990
f) Nigeria's Nationally Determined Contribution (NDC) under the Paris Agreement of the UNFCCC COP26
g) Guidelines on Environmental Audit 2010
h) National Environmental Standards & Regulations Enforcement Agency (NESREA) Act, 2018
i) Public Health Act CAP 103 LFN 1995
j) Electric Power Sector Reform Act, 2005
k) Roadmap for Power Sector Reform, 2010
l) National Energy Policy 2013
m) Nigerian Electricity Regulatory Commission (NERC) 2005
n) Energy Commission of Nigeria Act No. 19 of 1989
o) Land Use Act CAP L5 LFN 2004
p) Penal Code Act CAP 53 LFN 2008
q) The Nigerian Urban and Regional Planning Act CAP N138 LFN 2014
r) Employees Compensation Act 2010
s) FMEnv Abandonment Guidelines 1995

The applicable International laws are: -

a) The African Development Bank (AfDB) Integrated Safeguards 2023

b) International Union for the Conservation of Nature and Natural Resources (IUCN) Guidelines, 1996
c) Convention on International Trade in Endangered Species of Wild Fauna and Flora, CITES 1975.
d) Convention on the Protection of the World Cultural and Natural Heritage Sites (World Heritage Convention) 1972
e) United Nations Framework Convention on Climate Change (UNFCCC) 1992

ES 2: Project Justification

The African University of Science and Technology (AUST) currently relies on a constrained mix of limited grid supply, diesel generation, and existing solar capacity, resulting in high operational costs, frequent power interruptions, and generator noise disrupting academic activities. The proposed intervention at AUST forms part of the Energizing Education Programme under the Desert-to-Power initiative, aimed at providing dedicated, clean and reliable electricity to federal universities. The project is intended to address these existing energy constraints, support academic and research activities, reduce dependence on grid and diesel-powered generation, and enhance overall institutional efficiency and sustainability.

Technical sustainability of the proposed solar hybrid mini-grid project will be ensured through implementation by qualified Engineering, Procurement and Construction contractors selected by REA through a competitive process in accordance with established technical standards. Project design, installation and commissioning activities will be supervised by competent technical personnel from REA in collaboration with AUST.

Environmental sustainability is supported by the adoption of solar photovoltaic technology as the primary renewable energy source, significantly reducing reliance on grid and diesel generation and associated greenhouse gas emissions, noise pollution and air quality impacts currently experienced on the AUST campus. The project is designed to promote clean energy utilization while minimizing adverse environmental impacts throughout its lifecycle through the implementation of robust mitigation measures and an Environmental and Social Management Plan.

Economic sustainability will be achieved through reduction in recurrent energy expenditure associated with diesel fuel procurement, generator maintenance, lubricants and emergency repairs, alongside reduced grid electricity costs. The solar hybrid system is expected to deliver significant long-term operational cost savings, improving overall institutional financial efficiency and freeing resources for academic and infrastructure investment.

Social sustainability is supported through inclusive stakeholder engagement conducted as part of the ESIA process, ensuring that University management, academic staff, students, and Galadimawa Roundabout stakeholder groups were informed and provided opportunities to contribute to project planning at an early stage. This process has facilitated transparency, addressed community concerns including employment expectations and long-term sustainability, and strengthened relationships between REA, AUST and surrounding stakeholders.

ES 3: Project Description

The Desert-to-Power (DtP) intervention at the African University of Science and Technology (AUST) in the Federal Capital Territory, Abuja, will involve the development of a solar hybrid mini-grid system with a generation capacity exceeding 1 MW, designed to provide reliable and sustainable electricity

supply to the University's permanent campus. The system will convert solar radiation into usable electrical power through ground-mounted photovoltaic arrays, supported by battery energy storage and diesel generator backup, and will be complemented by appropriate operation and maintenance arrangements to ensure long-term performance and sustainability. Generated electricity will be evacuated to the University's central powerhouse through underground armoured cables, from where it will be distributed across the campus through the existing distribution network.

The key project components will include:

- Ground-mounted and/or rooftop polycrystalline solar PV modules installed in regular arrays
- Battery energy storage systems for load balancing and energy reliability
- Inverters, step-up transformers, marshalling switchgear, and associated power conditioning and control systems
- Overhead and/or underground electrical conduits and cabling for internal power distribution
- Interconnection infrastructure linking the solar plant to the University's internal grid (and, where applicable, the national grid)
- A supervisory control and monitoring system
- Site office and maintenance building
- Limited backup generation facilities to enhance system reliability

The proposed project site

The proposed project is located within the campus of the African University of Science and Technology (AUST), situated within the Galadimawa district off Ring Road 2 in the Abuja Municipal Area Council (AMAC) of the Federal Capital Territory (FCT), Abuja. The specific project footprint falls within the coordinate range of approximately Latitudes 8.993750°N to 9.002248°N and Longitudes 7.412381°E to 7.422333°E. The allocated land for the proposed solar hybrid mini-grid installation covers approximately 3 hectares within the secured campus perimeter, approximately 500 metres from the University's load centre and transformer connection point.

The proposed project site currently contains no electrical or utility infrastructure within the designated project footprint. Field observations confirmed the absence of transmission lines, transformers, substations or internal power distribution facilities within the footprint boundary. The broader campus is fully established, with administrative blocks, classroom facilities, hostels and other academic and support structures already developed and in active use.

The proposed site is technically suitable for the development of the planned solar hybrid mini-grid system. The 3-hectare footprint is sufficient to accommodate the photovoltaic arrays, battery storage, control room and associated infrastructure without affecting existing campus buildings or ongoing institutional activities. The flat terrain minimizes the need for major earthworks and supports efficient panel installation and system layout.

ES 4: Description of the Environmental and Social Baseline Conditions

The baseline assessment describes the existing environmental and socioeconomic conditions within the project area at the African University of Science and Technology (AUST) and its Area of Influence, extending approximately 3km from the proposed project footprint. The purpose is to establish current conditions against which potential project impacts can be assessed and to ensure that project activities do not degrade existing environmental quality but maintain or improve prevailing conditions. Baseline data collection was conducted between 8th and 17th July 2026, covering reconnaissance surveys, field

observations, stakeholder consultations, environmental sampling and socioeconomic surveys during the wet season period.

Physical Environment

The project area is characterized by a tropical savannah climate with distinct wet and dry seasons, with the wet season extending from April to October and the dry harmattan season from November to March. The terrain across the proposed 3-hectare project footprint is generally flat, providing favourable conditions for solar infrastructure development and minimizing the need for major earthworks.

Soil Characteristics

Soil samples were collected from ten locations across the project footprint and surrounding Area of Influence, with samples taken separately from the topsoil horizon at 0 to 15cm and the subsoil horizon at 15 to 30cm.

The soil is predominantly loam in character, with loam content ranging from 36% to 73% and sandy content ranging from 11% to 47% across sampling locations.

Laboratory analysis confirmed there is no evidence of soil contamination, with mercury and lead not detected at any sampling location.

The disturbed, cultivated character of the footprint indicates moderate susceptibility to surface erosion, reinforcing the need for topsoil protection and erosion control during construction, particularly given the nearby stream.

Water Quality

Five water samples were collected, comprising one Ground Water sample and four surface water samples from Stream I, Stream II, and paired upstream and downstream points on Stream III within the Area of Influence.

Stream III, located just outside the University's perimeter fence beside an active dumpsite, showed significant exceedances across multiple parameters including Total Suspended Solids, Magnesium, Chromium, Nickel, Cobalt, Iron and Mercury, representing a pre-existing condition unrelated to the proposed project.

The campus Ground Water source showed generally acceptable physicochemical quality, though Lead and E. coli were detected, a finding unrelated to the Stream III dumpsite that warrants further investigation.

Total Suspended Solids exceeded the FMEnv limit at all five sampling points, most severely at Stream III.

Air Quality and Noise

Ambient air quality and noise measurements were conducted at ten monitoring locations across the project site and surrounding Area of Influence.

Chlorine gas exceedances were recorded at eight of ten monitoring locations and sulphur dioxide exceedances at seven of ten locations, representing pre-existing conditions warranting further investigation.

PM2.5 exceedances were recorded at five monitoring locations.

The Air Quality Index was classified as Excellent at seven locations and Good at three locations, confirming generally satisfactory overall ambient air quality across the site.

Biodiversity

Vegetation within the project footprint is characteristic of the Southern Guinea Savannah ecological zone of the FCT, consisting of scattered grasses, shrubs and a few trees along the footprint boundary. A total

of 20 plant species were documented within the project Area of Influence, all assessed against the IUCN Red List 2024, with the majority classified as Least Concern. Terminalia neotaliala was the only species recorded as Vulnerable. No endangered, protected or conservation-significant plant species were identified within the project footprint, and no critical habitat was identified within or adjacent to the site. Faunal presence is limited to common and adaptable species typical of a disturbed cultivated environment, including small mammals, reptiles, birds, insects and amphibians. Given the disturbed and cultivated character of the site, impacts on biodiversity are expected to be negligible and fully manageable through standard mitigation measures.

Socio-Economic Environment

The socioeconomic survey conducted during the baseline assessment, as presented in Section 4.5, covered University management, academic and non-academic staff, students, and the Galadimawa Roundabout stakeholder groups. Livelihoods within the surrounding area are based primarily on small-scale trading, transport services and informal economic activities. The University operates under a structured administrative system headed by a President, with governance provided by the Governing Council. The University is a fully established and operational campus, with academic, administrative and residential facilities already developed and functioning. The University is connected to the national grid through the Abuja Electricity Distribution Company (AEDC), though supply is limited, and this shortfall is supplemented by diesel generation and existing solar capacity.

ES 5: Potential and Associated Impacts

The assessment of potential environmental and social impacts associated with the proposed project was carried out across the pre-construction, construction, operation, and decommissioning phases. Most impacts are site-specific, short-term, and reversible. Moderate impacts are primarily associated with construction activities. Major impacts are limited to occupational health and community safety risks if unmanaged. No significant impacts on sensitive ecological receptors or protected areas were identified.

Key Potential Adverse Impacts

These impacts are expected to be temporary, localized, and manageable through proper coordination and mitigation measures.

Pre-Construction Phase

Impacts at this phase are expected to be minimal and short-term, arising mainly from site preparation and mobilization activities:

- Minor removal of maize and bambara nut crops and cultivated vegetation within the 3-hectare project footprint, with negligible impact given the disturbed and agricultural character of the site.
- Localized disturbance of the cultivated topsoil, with moderate susceptibility to surface erosion during wet season rainfall events given the flat, open character of the site and proximity to the nearby stream.
- Temporary dust emissions from initial site clearing and vehicle movement along the site access route and internal campus roads.
- Slight increase in traffic and vehicular movement within the campus environment during equipment mobilization.
- Minor safety risks to students, staff, and pedestrians associated with increased vehicle and equipment movement within the active campus.
- Potential supply chain risks related to the procurement of solar equipment from manufacturers associated with forced labour or child labour if due diligence is not undertaken.

- Potential for low-level stakeholder expectations and grievances if employment commitments and communication obligations are not properly managed.

Construction Phase

This phase presents the highest level of environmental and social interaction due to intensive civil and electrical works including excavation, cable trenching across the campus and panel installation activities:

Environmental Impacts

- Increased risk of soil erosion and land disturbance arising from excavation, cable trench works along the underground cable corridor, grading and foundation works within the project footprint, with potential sediment runoff toward the nearby stream, an already degraded receptor.
- Generation of dust and particulate matter affecting ambient air quality within the campus and along the site access route.
- Elevated noise levels from construction machinery and installation activities within the active academic campus environment, with potential disruption to lectures and academic sessions.
- Temporary disruption of drainage paths along the cable trench route, given the campus drainage system currently under construction.
- Generation of construction waste including excavated soil, scrap materials, packaging and debris requiring proper segregation and licensed disposal.
- Minor disturbance to cultivated vegetation and common fauna species within and around the project footprint.

Social Impacts

- Temporary disturbance to ongoing academic and administrative activities due to noise, dust and movement of personnel and equipment within the active campus.
- Increased traffic and access disruptions along campus internal roads and the express road corridor during delivery of equipment and materials.
- Potential for unmet employment expectations and minor grievances among Galadimawa Roundabout stakeholders if local labour engagement commitments are not fulfilled.
- Labour influx risks including gender-based violence, sexual exploitation and abuse, and social tensions arising from interaction between construction workers and students, staff and stakeholder groups if the Code of Conduct is not enforced.

Occupational Health and Safety Impacts

- Increased risk of workplace accidents including injuries from excavation, trench collapse, equipment handling and materials movement.
- Potential for electrical hazards including electric shock or electrocution during cable installation, equipment connection, testing and commissioning activities.
- Risk of falls and musculoskeletal injuries during installation of mounting structures and solar panels.
- Risk of injuries from falling tools, equipment or photovoltaic modules during installation activities.
- Traffic-related accident risks due to movement of construction vehicles within the campus.
- Safety risks to students and staff from open trenches and active construction zones within the campus environment.

Operation Phase

- Minimal environmental emissions as the solar PV system generates clean renewable energy, directly displacing grid and diesel dependence and associated greenhouse gas emissions, noise and air quality impacts currently experienced on campus.
- Potential risk of soil and groundwater contamination from improper handling or leakage of battery electrolyte materials from the battery energy storage system.
- Generation of hazardous electronic waste from damaged or end-of-life components including batteries, inverters and PV panels, requiring management in accordance with NESREA Electrical and Electronic Sector Regulations 2011.
- Low-level noise emissions from operational inverters and transformers, negligible relative to the site ambient noise baseline.
- Restricted access to operational areas for safety purposes, with potential risk of unauthorized access by students, staff or visitors to energized solar arrays and battery storage areas within the campus.
- Risk of electrical hazards including electric shock or electrocution during routine operation and maintenance activities.
- Risk of battery failure, fire incidents or chemical exposure from improper battery handling or management.

ES 6: Mitigation Measures

Mitigation measures have been developed to address the identified environmental and social impacts of the proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology (AUST). These measures follow the mitigation hierarchy of avoidance, minimization, restoration and offsetting, and are tailored to the specific conditions of the AUST campus environment.

Pre-Construction Phase

- Restrict vegetation clearance strictly to the approved 3-hectare project footprint and avoid unnecessary disturbance of surrounding vegetation and economic trees outside the designated boundary.
- Strip and stockpile topsoil separately from subsoil during site clearing for reuse in reinstatement, and install silt fences and erosion control measures along the perimeter facing the nearby stream before clearing commences.
- Apply water-based dust suppression on all access routes and within the project site during dry and windy periods, and cover all vehicles transporting materials with tarpaulins to prevent dust dispersion.
- Restrict vehicle and equipment movement to designated access routes and implement site traffic management measures during mobilization, coordinating delivery schedules to avoid peak academic activity periods.
- Implement appropriate safety measures including warning signs, barriers and controlled access to safeguard students, staff, and authorized visitors during mobilization activities.
- Implement a supply chain due diligence policy requiring all equipment suppliers to provide written declarations confirming the absence of forced labour, modern slavery and child labour in their supply chains.
- Maintain effective stakeholder engagement and communication with AUST management and Galadimawa Roundabout stakeholder groups, supported by an accessible grievance redress mechanism to address stakeholder concerns.

Construction Phase

- Apply water-based dust suppression daily on all active earthworks areas, the underground cable trench corridor and haul routes, and cover all vehicles transporting excavated soil or fine materials with tarpaulins.
- Restrict vegetation clearance strictly to the approved project footprint, conducting clearing progressively to allow fauna to relocate naturally before disturbance.
- Promptly backfill and compact trenches after cable installation and reinstate surface cover immediately, installing silt fences and erosion control measures along the full length of the cable trench corridor.
- Install temporary drainage diversions and sediment traps to manage stormwater runoff and sediment transport during wet season construction activities, with particular attention to protecting the nearby stream.
- Schedule all high-noise construction activities to avoid core academic hours, concentrating noisy works in early morning before 8:00am and after 4:00pm when academic sessions have concluded, or during weekends and public holidays, in coordination with University management.
- Designate a bunded fuel and materials storage area with impermeable base and secondary containment, and maintain spill response kits on site at all times.
- Implement waste segregation at source into general, recyclable and hazardous categories, and contract a licensed waste collector for regular removal and disposal of all construction waste in compliance with AEPB requirements.
- Develop and implement a Traffic Management Plan covering all vehicle routes within the campus and along the express road access corridor to the Galadimawa Roundabout, designating flagpersons at all vehicle-pedestrian conflict points.
- Enforce a strict speed limit of 10 km/h for all vehicles within the campus and schedule heavy vehicle deliveries during off-peak academic activity periods.
- Prioritize employment of qualified local labour from Galadimawa Roundabout stakeholder groups and the AUST campus community for unskilled and semi-skilled roles in line with AfDB safeguard standards.
- Maintain continuous stakeholder engagement with AUST management and Galadimawa Roundabout stakeholder groups and operate an accessible Grievance Redress Mechanism throughout the construction phase
- Implement the Labour Management Plan and enforce the Workers Code of Conduct, with zero tolerance for gender-based violence, sexual exploitation and abuse, and sexual harassment.
- Implement dedicated GBV, SEAH and sexual harassment prevention measures including worker awareness training, a confidential reporting mechanism and immediate removal of any violating worker from the project.
- Provide appropriate PPE to all workers, conduct pre-mobilization safety induction and deliver regular toolbox talks and occupational health and safety training throughout the construction period.
- Implement safe trenching and excavation procedures including installation of shoring for trenches deeper than 1.2 metres, safety signage, physical barriers and controlled access around all open trenches, with daily inspection before works commence.
- Install temporary bridging over open trenches at all major pedestrian crossing points and erect barriers along the full length of open trench sections to protect students, staff within the active campus.
- Ensure all electrical installation, testing and commissioning works are carried out exclusively by certified and licensed electricians, with lockout/tagout procedures enforced for all electrical works.
- Coordinate construction scheduling with the AUST academic calendar to avoid examination periods, consistent with commitments made during stakeholder consultations.

- Maintain first aid facilities on site at all times and implement emergency preparedness and response procedures throughout the construction phase.

Operational Phase

- Conduct routine inspection and maintenance of solar panels, battery storage systems, inverters, transformers and all associated electrical infrastructure in accordance with the Operations and Maintenance plan developed by the dedicated O&M contractor.
- Schedule regular panel cleaning, particularly during the harmattan period when dust accumulation on panel surfaces reduces generation efficiency, using minimum water volumes from the campus borehole supply.
- Ensure proper housing, ventilation and thermal management of battery storage systems to prevent overheating, electrolyte leakage and fire risk, with monthly inspection of battery banks for signs of swelling, corrosion or damage.
- Manage all end-of-life components including spent batteries, degraded PV panels and failed inverters as hazardous e-waste through NESREA-licensed handlers in compliance with the National Environmental Electrical and Electronic Sector Regulations 2011 and the project e-waste management plan.
- Continue operation of the project Grievance Redress Mechanism, maintaining accessibility to AUST management, staff, students and Galadimawa Roundabout stakeholder groups throughout the operational phase (see Section 9.2).
- Install and maintain perimeter fencing, lockable gates and clearly visible warning signs around the solar array, battery storage room and control room to prevent unauthorized access by students, staff or visitors.
- Maintain ongoing engagement with AUST management on system performance, any operational issues and community safety matters arising during operation.
- Engage only certified and licensed electricians for all operation and maintenance electrical works, with lockout/tagout procedures and a Permit-to-Work system enforced for all high-risk activities including electrical maintenance, work at height, hot work and other hazardous tasks.
- Install, test and maintain appropriate lightning protection and surge protection systems to safeguard PV arrays, battery storage, inverters, transformers and associated electrical equipment, with routine inspection and testing of lightning protection and earthing arrangements.
- Conduct regular inspection and testing of fire protection equipment including smoke detectors and fire suppression systems within the battery storage room.
- Provide continuous safety training for all operational staff covering electrical safety, battery management, fire emergency response and evacuation procedures.

ES 7: Environmental and Social Management Plan (ESMP)

The Environmental and Social Management Plan (ESMP) outlines the measures required to avoid, minimize and manage the potential adverse impacts identified for the proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology (AUST). It also defines the roles, responsibilities and monitoring framework necessary to ensure effective implementation throughout the project lifecycle (Tables 22 and 23).

Implementation of mitigation measures will be primarily the responsibility of the Engineering, Procurement and Construction (EPC) Contractor during the pre-construction and construction phases, where most significant impacts are anticipated. The Contractor will be required to comply with all environmental and social requirements, including site-specific management plans, the Labour Management Plan, the Health Safety and Environment Plan, the Waste Management Plan, the Workers

Code of Conduct, and applicable good international industry practice. During the operational phase, implementation responsibility transfers to the dedicated Operations and Maintenance contractor under the oversight of AUST management.

The Nigeria Electrification Project Management Unit (NEP-PMU) will provide oversight and supervisory functions, ensuring that mitigation measures are properly implemented and that the project remains compliant with applicable environmental and social standards including the AfDB ISS 2023. This will include routine monitoring, reporting and auditing of contractor performance. The Abuja Environmental Protection Board (AEPB), FMEnv and NESREA will provide regulatory oversight in accordance with their respective mandates within the FCT.

The total costs of the ESMP implementation including costs for mitigation, monitoring and capacity building is estimated as: **₦30,910,000.00** (Thirty Million, Nine Hundred and Ten Thousand Naira, only.*)* which converts to **$22,694.56** (Twenty-Two Thousand, Six Hundred and Ninety-Four Dollars, Fifty-Six Cents), as detailed in Table 29 below:

ITEM	RESPONSIBILITY	COST ESTIMATE	
		NAIRA (₦)	USD ($)
Cost of Mitigation	Contractor	13,800,000.00	10,132.16
Cost of Monitoring	NEP-PMU, MDAs	4,300,000.00	3,157.12
Capacity Building	NEP- PMU/Contractor	10,000,000.00	7,342.14
Sub-total		28,100,000.00	20,631.42
Contingency (10% of sub-total)		2,810,000.00	2,063.14
TOTAL		**30,910,000.00**	**22,694.56**

Exchange Rate $1.00(USD) = ₦1,362 (NGN) – CBN rate as at August, 2026

ES 8: Remediation Plan After Decommissioning and Closure

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.
In the event of decommissioning, NEP, in conjunction with the leadership of African University of Science and Technology, FCT Abuja, 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.

The key personnel and institutions with major roles in the implementation and monitoring of environmental and social measures for the Project decommissioning/closure are as follows:

- Contractor(s) Engaged for Decommissioning Activities
- NEP-PMU
- AUST Site Manager
- Director of Works and Physical Planning Department in AUST
- FMEnv Ministry of Environment Representatives

ES 9: Stakeholder Engagement and Grievance Redress Mechanism

Stakeholder analysis was undertaken to identify relevant stakeholders, understand their roles and assess their level of influence and interest in relation to the proposed project. Stakeholder consultations were conducted at various levels between 8th and 17th July 2026 to ensure that the views, concerns and expectations of relevant stakeholders were incorporated into the ESIA process for the Solar Hybrid Mini-Grid Project at AUST

Key Stakeholders Consulted

- University management, including representatives of the Directorate of Works
- Academic staff and students through focused group discussions
- Union chairmen and representatives of traders, transporters and commercial motorcyclists at the Galadimawa Roundabout
- The Knowledge Court Estate Chairman and representatives
- Relevant Ministries, Departments and Agencies including the Federal Ministry of Environment (FMEnv) and the Abuja Environmental Protection Board (AEPB)

Key Concerns Raised

- Concern over the proposed solar site's proximity to the football pitch, raised by students
- Concerns about the frequency and duration of power outages during the transition to the hybrid system, raised by students
- Safety risks to tricyclists and traders from increased construction traffic around the Galadimawa Roundabout, raised by the Transporters Union
- Demand for transparent and fair employment opportunities, including long-term maintenance roles, raised by the Transporters Union
- Need for good traffic management along the express road, raised by the Knowledge Court Estate Chairman
- Concern about the long-term sustainability and maintenance of the solar installation
- Need for continuous communication and stakeholder engagement throughout project implementation

Expectations and Requests

- Priority consideration for local labour recruitment from Galadimawa Roundabout stakeholder groups and the AUST campus community for unskilled and semi-skilled roles
- Provision of skills acquisition and training opportunities for youth in renewable energy systems
- Inclusion of women in project-related economic opportunities
- Maintenance of open communication channels and an accessible grievance mechanism throughout all project phases
- Construction scheduling to avoid examination periods, as confirmed during university management consultations

- Effective traffic management along the express road and around the Galadimawa Roundabout during construction

Grievance redress mechanism (GRM) is presented in chapter 9. The GRM framework enables local communities and relevant stakeholders of a project to raise issues (including logging, tracking, and grievances resolution) about the project which are addressed efficiently and effectively while issues as regards implementation are resolved. The GRM will be communicated to all stakeholders in the course of project development and implementation and will make publicly available a log documenting the responses to all grievances received. The GRM shall be maintained throughout the project life cycle.

ES 10: Conclusion and Recommendation

The proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology (AUST) is designed to stabilise and strengthen electricity supply to a campus currently reliant on a constrained mix of limited grid supply and diesel generation. The project will enhance academic activities and significantly reduce dependence on grid and diesel power, in alignment with national energy objectives and Nigeria's international sustainable development commitments.

Potential adverse impacts are largely site-specific, temporary and manageable (see Chapter Five). Key construction phase impacts include dust, noise within the active campus environment, soil disturbance, vegetation removal, OHS risks and minor social disturbances from labour influx. Particular attention has been given to protecting the nearby stream, an already degraded receptor, from additional construction related pressure. Operational phase impacts are minimal, relating primarily to e-waste management and electrical safety. All impacts can be effectively managed through the mitigation measures in Chapter Six and the ESMP in Chapter Seven. Stakeholder consultations confirmed broad support across all groups, with all concerns addressed and incorporated into the ESMP.

Based on the findings of this ESIA, the project is considered environmentally and socially viable. The anticipated benefits significantly outweigh the potential adverse impacts, and it is recommended that the project proceed to implementation subject to full compliance with applicable regulatory requirements and the ESMP.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

The Federal Government of Nigeria (FGN), acting through the Rural Electrification Agency (REA), is executing the Nigeria Electrification Project Phase II (Desert to Power) with funding support from the African Development Bank (AfDB). The programme's core aim is to fast-track Nigeria's rural and institutional electrification drive by rolling out sustainable, off grid and grid connected solar powered renewable energy systems. Drawing on Nigeria's abundant solar energy potential, the initiative seeks to deliver clean, dependable, and durable power supply to Federal Universities and their affiliated teaching hospitals nationwide. The overarching intent is to strengthen academic outcomes, bolster research capacity, and enhance the quality of healthcare service delivery.

Under the Energizing Education Programme (EEP), REA plans to provide electricity access to 24 Federal Universities and Teaching Hospitals across Nigeria. Among the beneficiary institutions selected for this intervention is the African University of Science and Technology, situated in the Federal Capital Territory (FCT), Abuja, hereinafter referred to as AUST. The proposed intervention entails the installation of a solar hybrid power system with a generation capacity exceeding 1 MW, intended to guarantee stable and sustainable electricity supply to the University campus.

In fulfilment of applicable regulatory and safeguard obligations, this Environmental and Social Impact Assessment (ESIA) has been developed in line with the African Development Bank's Integrated Safeguards System (ISS) 2023, the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, and other pertinent Nigerian environmental and sectoral regulations, alongside relevant international best practice standards.

1.2 Rationale for the ESIA

The project is rated as Category 2 (Medium Risk) in line with the Bank's Integrated Safeguards System (ISS) and Nigeria's Environmental Impact Assessment (EIA) Act, CAP E.12 LFN 2004 and the Environmental Impact Assessment Procedures and Charges Regulations (2021). The justification for the E&S categorization has been based on the nature, scale, sensitivity, and location of the proposed projects, with the likelihood to generate limited, site-specific and reversible E&S impacts such as: limited changes in environmental baseline due to pre-construction and construction activities (e.g., excavation, waste generation, etc.,); unsustainable waste management practices including management of solar e-wastes (spent batteries, broken panels and faulty electrical components); exposure of workers to occupational hazards and risks to health during construction activities, etc.

1.3 Objectives of the Assignment

The objective of this consultancy is to conduct site specific ESIA for the proposed power systems and associated infrastructure in the African University of Science and Technology (AUST) to:

- Establish environmental and socio-economic baselines for each site;
- Identify, predict, and evaluate environmental, social, health, and safety impacts (positive and negative);
- Recommend mitigation and enhancement measures;
- Ensure compliance with AfDB and Nigerian E&S standards;
- Develop site-specific Environmental and Social Management Plans (ESMPs); and
- Facilitate environmental approvals, and stakeholder acceptance.
- Support REA in securing FMEnv ESIA certification and AfDB no-objection;

- Conduct inclusive stakeholder engagement (including women, youth, and persons with disabilities); and
- Build local institutional capacity for ESMP implementation.

This shall be in line with the requirements of the Federal Government of Nigeria and the African Development Bank's Integrated Safeguards System to ensure that any adverse effects on the environment and wellbeing of people are properly identified and mitigated.

1.4 Scope of Works

The scope of work for this assignment is to conduct an Environmental and Social Impact Assessment (ESIA) for the proposed Desert-to-Power (DtP) solar-hybrid power systems at the African University of Science and Technology, FCT Abuja. The assignment will include the preparation of a site-specific Environmental and Social Management Plan (ESMP) detailing mitigation measures, monitoring requirements, implementation responsibilities, and indicative costs, in line with applicable national regulations and the African Development Bank's Integrated Safeguards System.

To ensure a robust ESIA study, the following tasks were conducted:

Review of Project Information and Regulatory Requirements

- ❖ Review NEP documentation, feasibility studies, conceptual designs, layouts, and maps for each of the four universities.
- ❖ Identify applicable national regulations, FMEnv procedures, and AfDB safeguard requirements.
- ❖ Prepare ESIA registration documentation and liaise with FMEnv for project registration.

Scoping and Work Planning

- ❖ Conduct preliminary scoping and environmental and social risk screening.
- ❖ Identify key stakeholders and sensitive receptors within the project areas.
- ❖ Prepare detailed and site-specific ESIA work plans and schedules.

Baseline Data Collection (within defined area of influence)

- ❖ Undertake biophysical studies covering air quality, noise, water, soil, hydrology, flora, and fauna.
- ❖ Conduct socio-economic surveys addressing demography, livelihoods, gender issues, land use/tenure, cultural heritage, and traffic/transport conditions.
- ❖ Utilize GIS and remote sensing tools for spatial analysis and sensitivity mapping.
- ❖ Ensure laboratory analyses are performed by FMEnv-accredited laboratories.

Impact Identification and Evaluation

- ❖ Identify and assess direct, indirect, induced, and cumulative impacts.
- ❖ Evaluate pollution pathways, waste streams, and greenhouse gas emissions.
- ❖ Apply FMEnv and AfDB risk-rating methodologies (high, moderate, low).
- ❖ Develop mitigation hierarchy measures (avoid, minimize, mitigate, offset).

Stakeholder Engagement and Social Inclusion

- ❖ Conduct Free, Prior, and Informed Consultations (FPIC) with host communities, institutions, and relevant authorities around each university.
- ❖ Ensure inclusive participation of women, youth, and persons with disabilities.
- ❖ Maintain consultation records including attendance sheets, photographs, and feedback logs.
- ❖ Establish and operationalize a multi-tier Grievance Redress Mechanism (GRM).
- ❖ Prepare a costed Stakeholder Engagement Plan.

Development of Environmental and Social Management Plans (ESMPs)

- Define mitigation measures with clear performance indicators.
- Establish monitoring frameworks and reporting schedules.
- Specify roles, responsibilities, and institutional arrangements.
- Develop capacity-building plans for implementing entities.
- Provide cost estimates and financing considerations.
- Integrate ESMP provisions into EPC and operational contracts.

Reporting, Disclosure, and Approvals

- Prepare and submit inception, draft, and final ESIA reports in required formats.
- Facilitate statutory disclosure processes (public notices, hearings, gazette publications).
- Support disclosure through AfDB channels via the PMU.
- Facilitate issuance of ESIA approval letters and certificates.

1.5 Study Approach/ Methodology in Details

The ESIA of the proposed Project of the African University of Science and Technology has been carried out in line with the Federal Ministry of Environment (FMEnv) approved EIA process for mini-grid / off-grid projects being implemented under the Nigeria Electrification Project (NEP) Desert to Power (DtP) project. It also considers the requirements of relevant and applicable international standards and best practices such as the AfDB Integrated Safeguard system. The approach and methodology applied for undertaking the environmental and social impact assessment is as provided in the flowchart below.

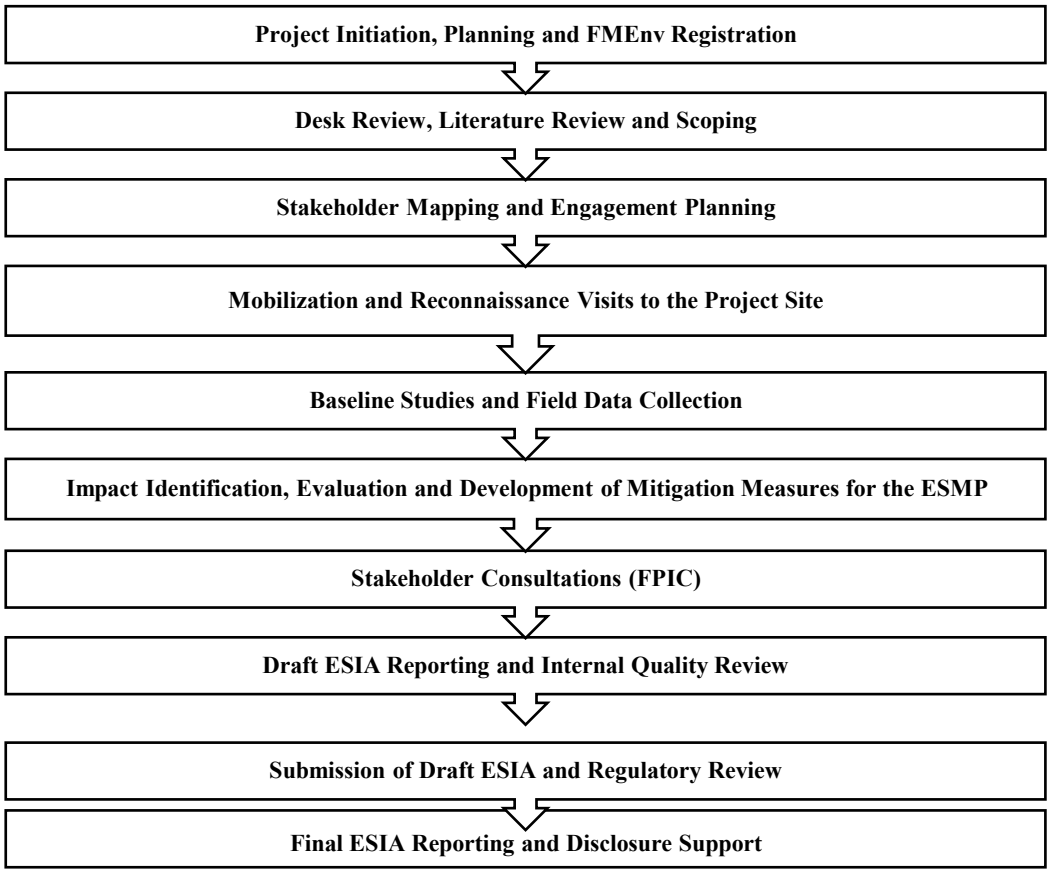

Figure 1: ESIA Methodology Flowchart

1.6 Policy, Legal and Administrative Framework

The proposed Project forms part of the Federal Government of Nigeria's Energizing Education Programme under the Nigeria Electrification Project, with the Desert-to-Power initiative representing the

current scale-up phase. Several national laws and sectoral regulations govern the power and environmental sectors in Nigeria, alongside policies and guidelines that direct environmental and social assessment processes.

This section therefore outlines the relevant statutory, regulatory, and policy framework applicable to the proposed Project, noting that the ESIA will be conducted in compliance with applicable national and international standards throughout the project lifecycle.

1.6.1 Policy Framework

1.6.1.1 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 ensure 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.

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

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.

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).

1.6.1.3 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 privatization 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.

1.6.1.4 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.

1.6.1.5 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.

1.6.1.6 National Occupational Health and Safety Policy 2020

The National Occupational Health and Safety Policy 2020 provides the overarching framework for the protection of workers and the working environment in Nigeria. The Policy establishes principles for the prevention of occupational accidents, diseases, and hazardous exposures, and places obligations on employers to maintain safe working conditions. Its provisions are directly relevant to this project during the construction phase, where workers will be exposed to excavation hazards, working at height, electrical installation risks, and heavy equipment operation.

1.6.1.7 National Gender Policy 2021 to 2026

The National Gender Policy 2021 to 2026 provides the strategic framework for mainstreaming gender equality and women's empowerment across all sectors of national development in Nigeria. The Policy promotes equal participation of women in economic, social, and political life and seeks to eliminate gender-based discrimination. Its provisions are relevant to this project in respect of gender-responsive stakeholder engagement, equitable local employment practices during construction, and the prevention of gender-based violence and sexual exploitation and abuse associated with labour influx.

1.6.1.8 National Policy on Solid Waste Management 2020

The National Policy on Solid Waste Management 2020 establishes the framework for environmentally sound management of solid waste generated from domestic, commercial, industrial, and construction activities in Nigeria. The Policy promotes waste minimization, segregation at source, recycling, and the polluter pays principle. Its provisions are relevant to this project in respect of construction waste, general operational waste streams, and the management of spent materials arising from the solar hybrid mini-grid system.

1.6.1.9 National Policy on Plastic Waste Management 2020

The National Policy on Plastic Waste Management 2020 addresses the growing challenge of plastic pollution in Nigeria and establishes principles for the reduction, reuse, recycling, and responsible disposal of plastic waste. The Policy is relevant to this project given the plastic components associated with solar PV module packaging, cable insulation, and ancillary construction materials, all of which must be managed in accordance with the Policy's waste minimization and responsible disposal requirements.

1.6.2 National Legal Framework

1.6.2.1 Environmental Impact Assessment Act Cap E12 LFN 2004 and EIA Procedures and Charges Regulations 2021

The EIA Act makes it mandatory for any person, authority, corporate body private or public, to conduct EIA prior to 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 considered to be a minor development, which is expected to have minimum impact on the environment. Hence, the programme is categorised 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.

The EIA Procedures and Charges Regulations 2021, made pursuant to the EIA Act Cap E12 LFN 2004, prescribe the procedural requirements and applicable fees governing the conduct and administration of environmental impact assessments in Nigeria. The Regulations establish the mandatory steps for EIA registration, scoping, review, public participation, and approval, and specify the access charges and Interim Management and Monitoring (IMM) fees payable at defined stages of the EIA clearance process. Compliance with these Regulations is required for the issuance of the EIA approval certificate and environmental compliance certificate for this project.

1.6.2.2 The Electricity Act 2023.

The Electricity Act 2023 is the principal legislation governing the Nigerian electricity sector, enacted to modernize the regulatory framework and consolidate all electricity sector laws in Nigeria. The Act devolves significant regulatory powers to states, establishes a liberalized electricity market, and provides for the licensing, regulation, and operation of electricity generation, transmission, distribution, and retail activities including off-grid and embedded generation systems such as solar hybrid mini-grids. The provisions of the Electricity Act 2023 are directly applicable to this project as the primary sector legislation governing its development, operation, and regulatory compliance

1.6.2.3 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 the 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.

1.6.2.4 Land Use Act Cap 5 LFN 2004

The Land Use Act, Cap L5, Laws of the Federation of Nigeria (LFN) 2004**, vests** all land within each State of the Federation in the Governor, who holds and administers such land in trust for the use and common benefit of all Nigerians. The Act empowers the Governor to grant statutory rights of occupancy in urban areas, while Local Governments administer customary rights of occupancy in rural areas for

agricultural and residential purposes. It also provides for the revocation of land rights for overriding public interest, including public infrastructure and development projects, subject to payment of compensation for unexhausted improvements such as buildings, crops, and economic trees. Furthermore, the Act requires the Governor's consent for land transfers or assignments and serves as the principal legal framework guiding land acquisition, compensation, and resettlement processes in Nigeria.

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

The Urban and Regional Planning Act is aimed at overseeing a 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.

1.6.2.6 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 persons who have suffered injury as a result of his offending act.

1.6.2.7 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 as a result of over exploitation. These sections are noteworthy:

- **Section 1** prohibits, except under a valid license, the 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.

The proposed project site is a cultivated farmland within the university campus, representing a disturbed environment with limited wildlife habitat value. Notwithstanding, project activities shall be carried out in compliance with the relevant provisions of this Act to ensure no species of conservation concern is adversely affected during site clearing and construction.

1.6.2.8 The Factories Act (Cap F1, Laws of the Federation of Nigeria, 2004)

The Factories Act (Cap F1, Laws of the Federation of Nigeria, 2004) provides the legal framework for safeguarding the health, safety, and welfare of workers in factories and other designated workplaces. The Act prescribes requirements relating to workplace safety, the use and maintenance of machinery, fire

prevention, welfare facilities, accident reporting, and the protection of workers from occupational hazards. The Act is relevant to the proposed project during the construction and operational phases, where contractors shall implement appropriate occupational health and safety measures to ensure a safe working environment and compliance with applicable statutory requirements.

This Act deals with working conditions at work sites, including construction sites, such as the type to be undertaken under this proposed project. Hence, the occupational requirements applicable to construction sites, as well as other work sites to be used by the programme shall be subjected to the provisions of this Act.

1.6.2.9 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 of the Act deal with the employment of young adults.

1.6.2.10 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 monitory 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.

1.6.2.11 Employee Compensation Act 2010

The Employee Compensation Act 2010 establishes a comprehensive framework for the payment of compensation to employees who suffer from occupational diseases, sustain injuries, or die in the course of employment in Nigeria. The Act replaces the Workmen's Compensation Act and provides for a contributory scheme administered by the Nigeria Social Insurance Trust Fund (NSITF). Its provisions are directly relevant to this project during the construction phase, where workers will be exposed to occupational hazards including excavation risks, working at height, electrical installation, and heavy equipment operation, and where the contractor bears statutory obligations to ensure compensation coverage for all site personnel.

1.6.2.12 Violence Against Persons (Prohibition) Act 2015

The Violence Against Persons (Prohibition) Act 2015 prohibits all forms of violence against persons in private and public life and provides for the protection of victims and punishment of offenders in Nigeria. The Act criminalizes physical, sexual, psychological, and socio-economic violence including sexual harassment, exploitation, and abuse. Its provisions are relevant to this project in the context of labour

influx during construction, which carries an inherent risk of gender-based violence and sexual exploitation and abuse affecting the host community, and imposes obligations on the project to implement preventive measures and reporting mechanisms.

1.6.2.13 Child Rights Act 2003

The Child Rights Act 2003 domesticates the provisions of the United Nations Convention on the Rights of the Child in Nigeria and establishes a comprehensive legal framework for the protection of children from all forms of exploitation, abuse, and hazardous labour. The Act prohibits the engagement of children in any form of work that is harmful to their health, education, or development. This legislation is directly applicable to the project given the risk of child labour associated with labour influx during project implementation. Compliance with the Act requires that the EPC Contractor implement a robust labour screening mechanism to verify the age of all workers prior to engagement and maintain records confirming that no person under the age of 18 is employed on the project site.

National Environmental Regulations:

Section 34 of the NESREA Act, 2007 empowers the Minister of Environment to make regulations for safe and sustainable environment. In exercise of this power, the minster 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 (Battery Control) Regulations, 2024.
- National Environmental (Permitting and Licensing System) Regulations, S. I. No. 29, 2009.
- National Environmental (Control of Vehicular Emissions from Petrol and Diesel Engines) Regulations, S. I. No. 20, 2011.
- National Environmental (Plastic Waste Control) Regulations, 2026
- National Environmental (Electrical/Electronic Sector) Regulations, 2011, S.I. No. 23
- National Environmental (Wetlands, River Banks 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 Catchments 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.

1.6.3 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, in order to ensure that the programme is implemented with maximum consideration of environmental factors. This ESIA study will be conducted in compliance with this guideline.

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 optimize the mini-grid projects EIA timeline and the cost of development.

1.6.4 Other Relevant Guidelines, Regulations and Policies

- Nigerian Electricity Supply and Installation Standards Regulations, 2015.
- The Renewable Energy Master Plan (REMP) - Policy
- National Renewable Energy and Energy Efficiency Policy, 2015
- National Renewable Energy Action Plans (NREAP), (2015-2030)
- Sustainable Energy for All Action Agenda (SE4ALL-AA)
- Nigerian Nationally Determined Contributions (Revised), 2021
- The Penal Code (Northern States) Federal Provisions Act (Cap. P3, Laws of the Federation of Nigeria, 2004)
- Public Health Law Cap 103 LFN 1990
- Fire and Rescue Service Act 2004;
- Abandonment Guidelines 1995;
- National Guidelines on Environmental Management System 1999 □
- REA's HSE Policy.

1.6.5 International Legislations

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 (2003):** This Convention is applicable as the project involves land clearing and vegetation removal within the Southern Guinea Savannah ecosystem of the Federal Capital Territory, requiring that natural resources are managed sustainably and in accordance with Africa-wide conservation commitments throughout all phases of project implementation.
- **Convention on Biological Diversity (1992):** This Convention is relevant given that project activities, including site clearing and soil disturbance, have the potential to affect local flora and fauna within the project footprint, necessitating measures to avoid biodiversity loss and protect ecosystem integrity.
- **Convention on International Trade in Endangered Species of Wild Fauna and Flora, CITES (1973:** Although no CITES-listed species were identified within the project area, this Convention remains applicable as a precautionary reference to ensure that no project activities inadvertently affect protected species or facilitate illegal wildlife trade during construction.
- **Conservation of Migratory Species of Wild Animals 1973:** This Convention is applicable as the project site lies within the Southern Guinea Savannah ecological zone of the Federal Capital Territory, which provides habitat for migratory bird and animal species. The movement patterns and habitats of such species shall be considered during project implementation to ensure that construction activities do not disrupt known migratory routes or breeding grounds within the Area of Influence.
- **UN Framework Convention on Climate Change 1992**: This Convention is directly relevant as the project involves the deployment of solar photovoltaic technology as a clean energy alternative to fossil fuel-based generation, contributing to Nigeria's nationally determined contributions and global greenhouse gas reduction commitments.
- **Convention to Combat Desertification 1994:** This Convention is applicable given that the project involves ground disturbing activities including site clearing, excavation and cable trenching within the Federal Capital Territory, where land degradation and soil erosion pressures can arise if construction activities are not properly managed. Appropriate land management, topsoil

conservation and erosion control measures shall be implemented during construction to ensure compliance with the spirit and provisions of this Convention.

- **Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) (1979):** This Convention is relevant as the project involves labour engagement and community interactions, requiring that gender equality principles are upheld throughout recruitment, occupational health and safety, and stakeholder engagement processes.
- **Human and Peoples' Rights on the Rights of Women in Africa 2005**: This instrument is applicable as it reinforces CEDAW obligations within an African context, requiring that the project avoids and mitigates risks of gender-based violence, sexual exploitation and abuse, and unequal access to project benefits by women in the host community.
- **Civil and Political Rights Covenant (1966):** This Covenant is relevant as it underpins the right of affected communities and workers to information, participation, and redress, which are operationalized through the project's stakeholder engagement and grievance redress mechanisms.
- **Economic, Social and Cultural Rights Covenant (1966):** This Covenant is applicable as the project has implications for the right to safe working conditions, adequate living standards, and access to energy as a socioeconomic enabler for the university community and surrounding population.
- **Convention on the Rights of the Child (1989):** This Convention is relevant as the project involves labour influx into a university environment that includes young persons, requiring that child labour is strictly prohibited in accordance with the Child Rights Act 2003 and that construction activities do not expose children within or near the university campus to safety risks. All contractors shall be required to verify the age of workers prior to engagement and maintain records confirming compliance with minimum age requirements.

1.6.6 Institutional Framework

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

1.6.6.1 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.

1.6.6.2 National Environment Standards and Regulations Enforcement Agency (NESREA)

ensures 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.

1.6.6.3 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

1.6.6.4 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 its supervision

1.6.6.5 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, 2005 was the legislation that led to the establishment of NERC.
The Commission is mandated 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.

1.6.6.6 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.

1.6.6.7 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 electrification of rural and unserved communities.

The mission is 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 reasonable return on investment through appropriate tariff that is economically responsive and supportive of the average rural customer.

1.6.6.8 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 among others:

- Eliminate cultural/ religions gender-based biases and harmful cultural and religious practices which rise to inequalities in gender-role relations in the Nigerian society. A culture which is amendable 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 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.

1.6.6.9 Nigerian Electricity Management Services Authority

The Nigerian Electricity Management Services Authority (NEMSA), established by the NEMSA Act 2015, is the technical regulatory agency responsible for the enforcement of technical standards, metering regulations, and safety requirements for electrical installations and equipment in Nigeria. NEMSA is mandated to inspect, test, and certify all categories of electrical equipment and installations, including renewable energy systems, prior to commissioning and operation. The Authority's technical oversight is directly applicable to this project, as all electrical components of the solar hybrid mini-grid including the PV array, inverters, battery energy storage system, transformers, switchgear, and the 11 kV campus distribution network will be subject to NEMSA inspection and certification before energization.

1.6.7 State Institutions

1.6.7.1 Abuja Environmental Protection Board

The Abuja Environmental Protection Board (AEPB) was established in 1997 by the Federal Government of Nigeria through the promulgation of Abuja Environment Protection Board Decree No. 10 of 1997. The Board's functions shall cover, but not limited to:

- The control of removal and disposal of liquid wastes
- The control and disposal of solid wastes
- The control of vector pests, rodents, and reptiles; water and waste water effluent discharges; noise which constitute a nuisance; the use of septic tanks and sewage maintenance; bush burning, poaching and indiscriminate felling of trees; stray and wandering animals; public conveniences and cemeteries; the
  use of residential areas for prohibited purposes; walking or driving on prohibited areas.

1.6.7.2 Abuja Municipal Area Council

The proposed Project falls within the jurisdiction of Abuja Municipal Area Council. The Council has an Environmental Health Department which ensures compliance with environmental sanitation law.

1.6.8 Funding Agency Requirements

This programme is funded by the African Development Bank (AfDB). Therefore, the AfDB safeguard systems will be integrated in the project cycle as well as other national and international environmental and social protection requirements, in order to comply with international best practices. Both main

environmental and social requirements that the project needs to comply with are described in the following sections.

1.6.8.1 The African Development Bank's Integrated Safeguards System

The proposed project has been classified as a Category 2 project under the African Development Bank's Integrated Safeguards System (ISS, effective May 2024). Category 2 projects are those with site-specific environmental and social risks and impacts that are generally reversible and can be effectively mitigated through appropriate management measures.

Under the ISS framework, the Operational Safeguards (OS1–OS10) have been considered during preliminary screening of the project. Given the nature of the proposed solar-hybrid mini-grid development, including civil works, electrical installations, labour engagement, community interface, climate considerations, and stakeholder interactions, all Operational Safeguards are considered applicable at this stage, with the exception of OS9 (Financial Institutions).

The Operational Safeguards considered include:

- OS 1 (OS1): Assessment and Management of Environmental and Social Risks and Impacts
- OS 2 (OS2): Labour and Working Conditions
- OS 3 (OS3): Resource Efficiency and Pollution Prevention and Management
- OS 4 (OS4): Community Health, Safety and Security
- OS 5 (OS5): Land Acquisition, Restrictions on Access to Land and Land use, and Involuntary Resettlement
- OS 6 (OS6): Habitat and Biodiversity Conservation and Sustainable Management of Living Natural Resources
- OS 7 (OS7): Vulnerable Groups
- OS 8 (OS8): Cultural Heritage
- OS 10 (OS10): Stakeholder Engagement and Information Disclosure.

In addition to the Operational Safeguards, the African Development Bank has published Borrowers' Guidance Notes corresponding to each Operational Safeguard. These Guidance Notes provide detailed technical and procedural guidance to borrowers on the practical implementation of the safeguard requirements and have been consulted in the preparation of this ESIA alongside the Operational Safeguards themselves. The Guidance Notes are publicly available on the AfDB website and constitute an integral reference within the AfDB Integrated Safeguards System[1]

The ESIA report provides comprehensive evaluation of the relevance and level of applicability of each Operational Safeguard and outlines corresponding mitigation and management measures in compliance with AfDB ISS requirements.

1.6.9 AfDB Integrated Safeguards System Compliance and Traceability

The project has been screened as Category 2 under the AfDB Integrated Safeguards System (ISS 2023), with OS1–OS8, and OS10 considered applicable in the draft. To strengthen traceability, the following compliance matrix links each applicable Operational Safeguard to the project-specific assessment, management response and evidence required for implementation. The matrix shall be updated during detailed design and prior to financial close/commencement where project information changes.

[1] African Development Bank Group (AfDB), Borrowers' Guidance Notes for the Integrated Safeguards System (ISS), available at:*https://www.afdb.org/en/documents/borrower-guidance-note*

Operational Safeguard	Status	Key project issue	Required management response	Evidence / implementation record
OS1 – Assessment and Management of Environmental and Social Risks and Impacts	Applicable	Site-specific ESIA, impact assessment, ESMP, monitoring and reporting	Maintain ESIA/ESMP as live instruments; contractor C-ESMPs; periodic audits; management of change	ESIA Chapters 4–7; contractor plans; monitoring reports
OS2 – Labour and Working Conditions	Applicable	Construction and O&M workforce; OHS; child labour; labour influx	Implement LMP, worker GRM, age verification, employment terms, OHS procedures and Code of Conduct	Annex 6 LMP; Annex 7 HSE Plan; worker records
OS3 – Resource Efficiency and Pollution Prevention and Management	Applicable	Water use, soil/water protection, air/noise, waste and e-waste	Waste hierarchy, spill prevention, water efficiency, licensed waste handlers, battery/PV end-of-life controls	Annex 4; ESMP; e-waste records
OS4 – Community Health, Safety and Security	Applicable	Active university campus, traffic, trenches, electrical hazards, fire and emergency risks	Traffic Management Plan, barriers, access control, emergency response, public information and incident reporting	ESMP; HSE Plan; emergency response procedures
OS5 – Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement	Screening required	3-ha campus footprint require documentary confirmation	Confirm land ownership/use rights and affected users before clearing; where economic loss or access restriction is confirmed, prepare and implement an appropriate compensation/livelihood instrument before impact	Land-use confirmation; crop/user inventory; compensation records if triggered
OS6 – Habitat and Biodiversity Conservation and Sustainable Management of Living Natural Resources	Applicable	Cultivated/disturbed habitat; vegetation and fauna; Vulnerable plant species recorded in AOI	Avoid unnecessary clearing; tree inventory; native replanting; fauna escape measures; monitor vegetation restoration and species survival	Chapter 4 biodiversity baseline; biodiversity/tree management measures
OS7 – Vulnerable Groups	Applicable	Women, youth, persons with disabilities and other potentially vulnerable stakeholders	Disaggregated engagement, accessible consultation, non-discrimination, targeted grievance access and monitoring	SEP/GRM; consultation records; gender/vulnerability indicators

OS8 – Cultural Heritage	Applicable	Potential chance finds during excavation/trenching	Implement chance-find procedure; stop-work and notification protocol; specialist/regulatory clearance before resumption	Chance Finds Procedure; contractor method statements
OS9 – Financial Intermediaries	Not applicable on current project structure	Direct project financing rather than FI intermediation	No OS9 management instrument required unless financing structure changes	Financing documentation
OS10 – Stakeholder Engagement and Information Disclosure	Applicable	University, nearby stakeholders, regulators, workers and potentially vulnerable groups	Lifecycle SEP, accessible disclosure, feedback tracking, site/community GRM and confidential GBV/SEA/SH channels	Chapter 9; attendance sheets; grievance register

Compliance statement: The project shall not be considered fully safeguard-ready solely because the Operational Safeguards are listed. Compliance will be demonstrated through implementation records, updated baseline information where necessary, approved management plans, contractual E&S clauses, monitoring results, grievance records and evidence that mitigation measures have been incorporated into project design and procurement.

1.7 Report Structure

In line with the FMEnv guidelines and requirements of the Terms of Reference, this report is structured as follows:

- Preliminary Sections
- 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 Justification containing a rationale for the proposed Project as well as the Technical, Environmental, Social and Economical sustainability of the project
- 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 three also discusses Project Alternatives.
- 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: Associated and Potential Impacts. It provides details of environmental and social impacts associated with the project area.
- Chapter Six: Mitigation Measures. This chapter provides detailed measures to mitigate potential impacts on environment and the people with the project area of influence.
- Chapter Seven: Environmental and Social Management Plan. It details relevant procedures on the management of potential environmental and social impacts, list responsible parties to manage impacts, and the cost implication.
- Chapter Eight: Remediation Plan After Decommissioning/ Closure. This chapter provides details of steps to be taken after project closure to ensure the environment retains its native state.
- Chapter Nine: Stakeholder Engagement and Grievance Redress Mechanism. This chapter provides details on consultation with stakeholders and management of grievance related issues.
- Chapter Ten: Conclusion and Recommendations.

CHAPTER TWO: PROJECT JUSTIFICATION

2.1 Need for the Project

Nigeria's public tertiary institutions continue to experience unreliable grid electricity supply, a situation that significantly undermines effective teaching delivery, research output, and day to day institutional functioning. Federal universities, in particular, rely heavily on diesel powered generators to supplement their electricity needs, a dependence that translates into high operational costs, recurrent power interruptions, and associated environmental burdens including air pollution, noise nuisance, and greenhouse gas emissions.

To address these challenges, the Federal Government of Nigeria launched the Nigeria Electrification Project (NEP) with the aim of expanding electricity access through the deployment of sustainable and renewable energy solutions. Drawing on lessons from NEP Phase I, the Desert to Power (DtP) initiative is now being implemented by the Rural Electrification Agency (REA), with financial backing from the African Development Bank (AfDB), to extend reliable electricity supply to public institutions and underserved communities through solar based hybrid systems.

The proposed intervention at the African University of Science and Technology (AUST) forms part of the Energizing Education Programme (EEP) under the DtP initiative, which seeks to provide dedicated, clean, and reliable electricity to federal universities across Nigeria. Specifically, the project is intended to resolve existing power supply limitations at AUST, support academic and research activities, reduce the institution's dependence on fossil fuel based generation, and enhance overall institutional efficiency and sustainability. The intervention further contributes to Nigeria's commitments to climate change mitigation and sustainable energy transition, in line with national development objectives and applicable international obligations.

2.2 Project Benefits

The proposed solar hybrid mini grid project at the African University of Science and Technology is expected to deliver significant environmental, institutional, and socioeconomic benefits. Key anticipated benefits include:

- Provision of reliable and sustainable electricity supply to support academic, research, administrative, and residential activities within the University.
- Enhancement of teaching, laboratory operations, ICT services, and research productivity through improved power reliability.
- Reduction in dependence on diesel powered generators, resulting in lower operational costs, decreased fuel consumption, and reduced greenhouse gas emissions.
- Improvement in campus safety and security through enhanced outdoor lighting and increased nighttime visibility.
- Promotion of renewable energy knowledge and technical capacity development through exposure to solar power technology and associated training opportunities.
- Creation of direct and indirect employment opportunities during construction and operational phases, with associated skills transfer and local economic stimulation.
- Support for institutional expansion and improved living and learning conditions for students and staff within the permanent campus.
- Contribution to national renewable energy deployment and climate change mitigation objectives consistent with Nigeria’s Nationally Determined Contributions under the Paris Agreement.

Overall, the project is expected to strengthen energy reliability, improve institutional efficiency, and promote environmentally sustainable development within the University and its surrounding community.

2.3 Envisaged Sustainability

2.3.1 Technical Sustainability

Technical sustainability of the proposed solar hybrid mini grid project will be ensured through implementation by qualified Engineering, Procurement and Construction contractors selected by the Rural Electrification Agency through a competitive process in accordance with established technical standards and procedures. Project design, installation, and commissioning activities will be supervised by competent technical personnel from the Rural Electrification Agency in collaboration with the African University of Science and Technology (AUST).

Standard operating procedures and operation and maintenance manuals will be developed to guide system management throughout the project lifecycle. Prior to commissioning, relevant University personnel will receive technical training to support effective system operation and routine maintenance.

Following completion of construction, an Operations and Maintenance contractor will be engaged to manage system performance and ensure continued functionality of the installation. Capacity building and knowledge transfer programmes will be implemented to enable designated University staff to progressively support day-to-day system operations. In addition, practical training opportunities will be provided for selected students in relevant science and engineering disciplines to enhance technical skills in renewable energy systems.

2.3.2 Environmental Sustainability

Environmental sustainability of the proposed project is supported by the adoption of solar energy as a renewable power source, thereby reducing reliance on fossil fuel-based electricity generation and associated greenhouse gas emissions. The project is designed to promote clean energy utilization while minimizing adverse environmental impacts throughout its lifecycle.

Oversight of environmental and social performance will be undertaken by the Rural Electrification Agency through its Project Management Unit, which includes qualified Environmental and Social Safeguards Specialists responsible for monitoring compliance with applicable standards and safeguards requirements. Furthermore, the conduct of this Environmental and Social Impact Assessment at the early stage of project development enables identification of potential impacts and incorporation of appropriate mitigation measures through the Environmental and Social Management Plan to ensure environmentally responsible project implementation.

2.3.3 Economic Sustainability

Economic sustainability of the proposed solar hybrid mini grid project will be realized through reduced dependence on grid electricity and diesel-powered generation, both of which currently constitute AUST's primary sources of power alongside existing solar capacity. The University's electricity supply arrangement is characterized by grid supply averaging only 8 to 12 hours a day from AEDC, compelling the institution to rely on eight generating sets with a combined capacity of 1,705 KVA to bridge the shortfall. The project will lower recurring expenditure on diesel procurement, generator servicing, lubricants, spare parts, emergency repairs, and productivity losses associated with power outages and generator downtime. Although the initial capital cost of solar hybrid infrastructure exceeds the short-term cost of running existing generators and drawing from the grid, the operational cost profile of renewable

energy systems is generally more favourable over the project lifecycle, given that solar generation carries no fuel cost, lower routine maintenance requirements, and reduced exposure to fuel price volatility.

At present, AUST's diesel fuel consumption stands at approximately 9,500 litres monthly, at an estimated monthly cost of ₦17,575,000, while the University also incurs an annual grid electricity bill of approximately ₦54,272,400 and annual generator maintenance expenditure of approximately ₦10,136,000. These figures represent AUST's actual current baseline energy costs and illustrate the scale of recurrent expenditure that the proposed solar hybrid intervention is designed to reduce.

For AUST, the project is expected to reduce diesel generator runtime, diesel fuel consumption, generator maintenance frequency, expenditure on lubricants and spare parts, emergency generator repairs, and indirect economic losses associated with power interruptions including disruption of academic activities, ICT services, laboratory operations, administrative work, and security lighting across the campus.

The economic sustainability of the project shall be tracked using measurable indicators including reduction in litres of diesel consumed per month, reduction in monthly diesel expenditure, reduction in generator maintenance cost, reduction in generator runtime, improvement in daily hours of reliable electricity supply, and reduction in electricity related operational disruptions. The results of this monitoring shall inform long term operation and maintenance planning including budgeting for battery replacement, inverter replacement, preventive maintenance, and lifecycle asset management.

The project is therefore expected to improve AUST's energy reliability, reduce long term operating costs, enhance institutional financial efficiency, and reduce dependence on recurrent government funding for electricity supply.

2.3.4 Social Sustainability

Social sustainability of the proposed project is supported through inclusive stakeholder engagement conducted as part of the ESIA process, ensuring that relevant stakeholders are informed and provided opportunities to contribute to project planning at an early stage. This process has facilitated transparency and strengthened relationships between the project implementing agency, the University, and surrounding communities.

A Stakeholder Engagement Plan has been developed to guide continuous consultation and information disclosure throughout the project lifecycle. In addition, a Grievance Redress Mechanism established by the Rural Electrification Agency will provide accessible channels for stakeholders, affected persons, and community members to submit concerns or complaints related to project activities. The mechanism ensures timely review, documentation, and resolution of grievances, thereby promoting accountability and minimizing potential social conflicts during project implementation and operation.

CHAPTER THREE: PROJECT DESCRIPTION

3.1 Project Overview

As part of the Energizing Education Programme (EEP) under the Nigeria Electrification Project Phase II (Desert-to-Power), the Rural Electrification Agency (REA) is facilitating the deployment of a solar hybrid mini-grid system at the African University of Science and Technology (AUST), located in the Federal Capital Territory (FCT), Abuja. The proposed installation is designed to provide reliable, clean and sustainable electricity to the University's permanent campus, which currently has no national grid connection and depends entirely on diesel powered generators for its electricity needs.

The proposed system will have a generation capacity exceeding 1 MW and will integrate solar photovoltaic generation as the primary energy source, battery energy storage for load balancing and overnight supply, and diesel generator backup for periods of low solar irradiance or peak demand conditions. Generated electricity will be evacuated to the University's central powerhouse through underground 11KV armoured cables, from where it will be distributed across the campus through the existing distribution network.

The key project components will include:

- Ground-mounted and/or rooftop polycrystalline solar PV modules installed in regular arrays
- Battery energy storage systems for load balancing and energy reliability
- Inverters, step-up transformers, marshalling switchgear, and associated power conditioning and control systems
- Overhead and/or underground electrical conduits and cabling for internal power distribution
- Interconnection infrastructure linking the solar plant to the University's internal grid (and, where applicable, the national grid)
- A supervisory control and monitoring system
- Site office and maintenance building
- Limited backup generation facilities to enhance system reliability

Power produced by the plant would be converted to AC through inverters. Transformers would be installed to step up voltage so that it is compatible with the national grid.

3.2 Proposed Project Site and Location

3.2.1 Overview of the African University of Science and Technology

The African University of Science and Technology (AUST) is a tertiary institution located within the Galadimawa district of the Federal Capital Territory (FCT), Abuja, in the North Central geopolitical zone of Nigeria. The campus falls within the Southern Guinea Savannah ecological zone characteristic of the FCT, marked by a mix of savannah vegetation, open grassland, and scattered tree cover.

AUST is a fully established and operational campus, with academic, administrative, and residential facilities already developed and functioning. The University currently serves a sizeable student and staff population, sustaining active academic and institutional operations across its built campus environment. The University is connected to the national grid through the Abuja Electricity Distribution Company (AEDC), though supply is limited. To bridge this shortfall, the University supplements grid power with diesel generating sets and an existing solar installation, though this combined supply arrangement remains constrained and costly to sustain

The proposed solar hybrid mini grid intervention under the Desert to Power initiative is intended to strengthen and stabilize this existing but inadequate power supply arrangement, providing more reliable and sustainable electricity to support the University's continued academic operations and institutional efficiency.

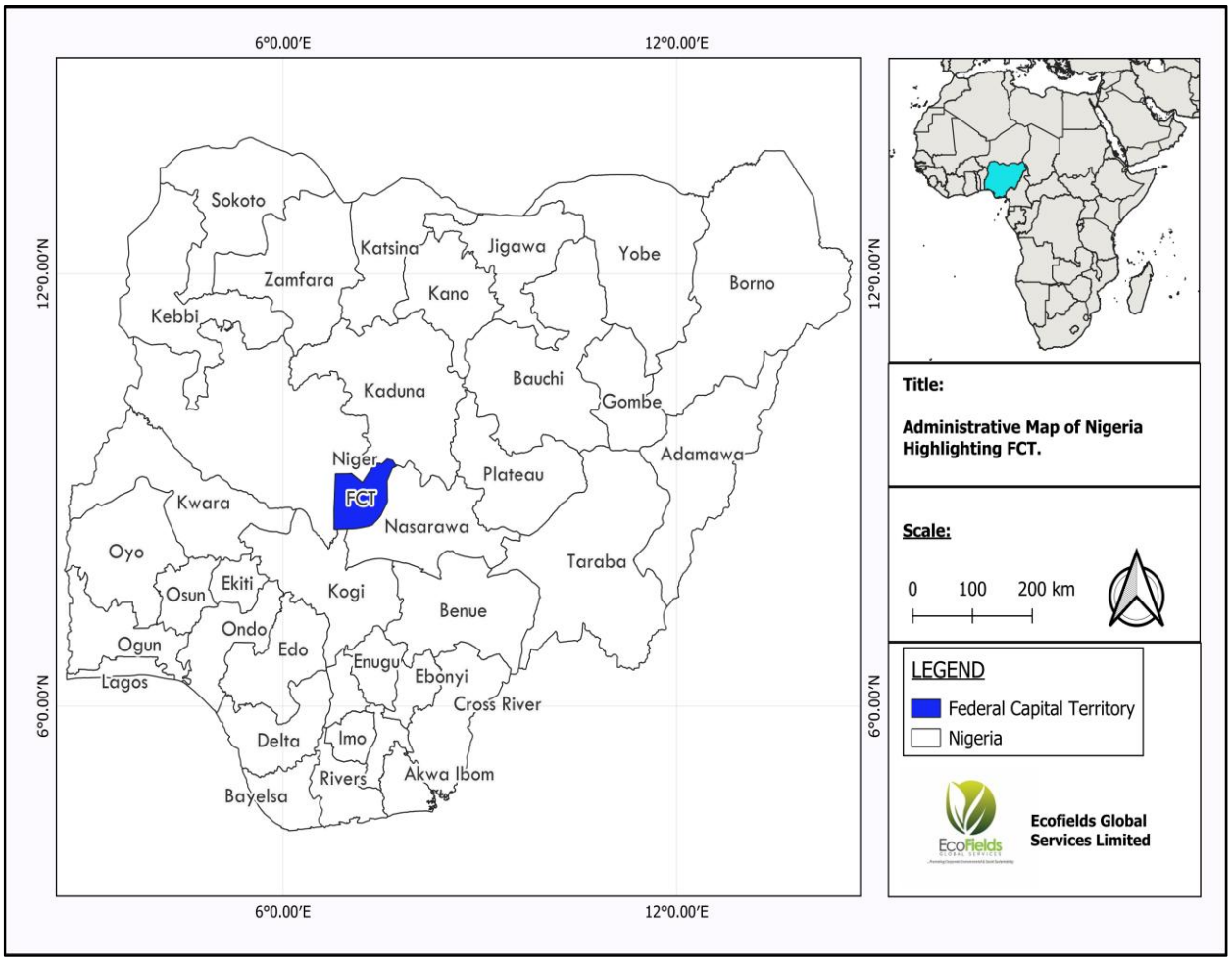

Figure 2: Map of Nigeria Showing the Project Site, FCT Abuja

3.2.2 Survey Assessment of the Proposed Site

The proposed project is to be sited within the campus of the African University of Science and Technology (AUST), located within the Galadimawa district of the Abuja Municipal Area Council (AMAC), Federal Capital Territory (FCT), Abuja. The specific project footprint falls within the coordinate range of approximately Latitudes 8.993750°N to 9.002248°N and Longitudes 7.412381°E to 7.422333°E.

The proposed project footprint covers approximately 3 hectares of relatively flat land, situated centrally within the campus and positioned approximately 500 metres from the University's load centre and existing transformer connection point.

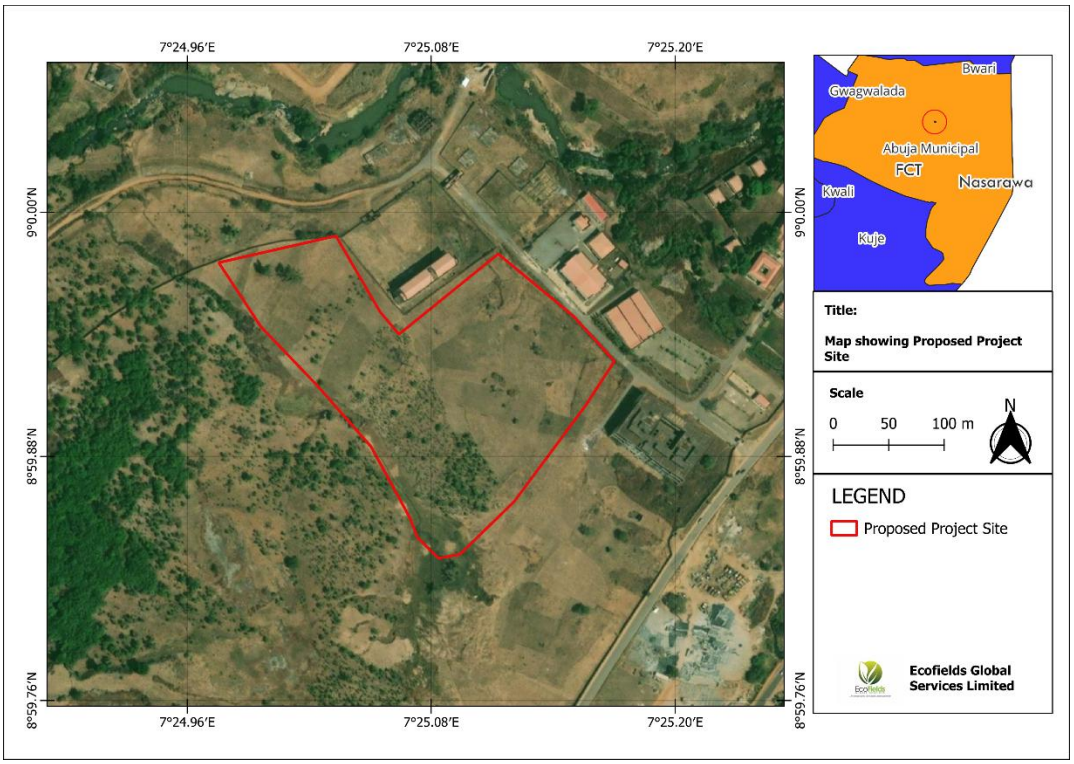

Figure 3: Map showing the Project footprint

Existing Infrastructure

The proposed project site does not contain any electrical or utility infrastructure within the designated project footprint. Field observations confirmed the absence of transmission lines, transformers, substations, or internal power distribution facilities within the footprint boundary. No underground utilities were identified crossing the site, although electric poles connected to an existing transformer were observed within the broader campus area, forming part of the campus's active grid supply network.

The broader campus is fully developed, with administrative blocks, classroom facilities, hostels, and other academic and support structures already established and in active use. The campus is fully secured within a perimeter fence, with an established security post at the main entrance gate. Water supply is provided through functional borehole points distributed across the campus, with two distribution transformers serving the campus's electrical network. Existing power supply to the campus is drawn from a combination of national grid supply through the Abuja Electricity Distribution Company (AEDC), diesel powered generating sets, and an existing solar installation, reflecting the campus's reliance on a mixed and currently inadequate power supply arrangement.

3.2.3 Site Suitability for the Proposed Project

The proposed site is technically suitable for the development of the planned solar hybrid mini grid system. The allocated 3-hectare footprint is sufficient to accommodate the photovoltaic arrays, battery storage, control room, and associated infrastructure without affecting existing campus buildings or ongoing institutional activities. The flat terrain minimizes the need for major earthworks and supports efficient panel installation and system layout.

The footprint is an open area, containing shrubs with limited ecological value, situated at a reasonable buffer from sensitive receptors, the nearest uncompleted clinic building lies approximately 100 metres away, the nearest engineering laboratory building approximately 300 metres away, and the student hostel approximately 1.5 kilometres away, providing an adequate separation from construction activities relative to the more sensitive of these receptors.

The site is accessible via the main campus entrance, reached from the tarred express road running past the University frontage. The University's first gate has been identified as the preferred construction access route, as it minimizes disruption to students, who predominantly use the second gate for daily campus movement. The campus is fully secured within a perimeter fence with an operational security post, facilitating effective access control during the construction phase.

Given AUST's current reliance on a constrained and costly mix of limited grid supply, diesel generation, and existing solar capacity, the proposed solar hybrid mini grid is well suited to this location, as it will strengthen and stabilize the University's electricity supply, reduce dependence on diesel backup, and directly address the institution's prevailing energy gap in support of its long term operational and academic objectives.

3.3 Project Requirements

Land:
The allocated land is under full ownership and control of the University and is situated within the secured campus perimeter. The footprint provides adequate space for full implementation of the proposed project without encroaching on existing campus buildings or affecting ongoing institutional activities.

Water Use and Supply
Water demand for the proposed solar hybrid mini grid project is expected to be minimal. During construction, limited quantities of water may be required for minor civil works, equipment installation activities, and domestic use by construction personnel, as cement intensive construction activities are anticipated to be limited. Based on standard construction water consumption rates, total construction phase water demand is estimated at approximately 8,250 litres per day.

During operation, water will primarily be required for periodic cleaning of photovoltaic panels to remove dust accumulation, particularly during the dry season when airborne particles may reduce panel efficiency. Cleaning activities will be undertaken manually and regulated to minimize water consumption. Based on experience from similar solar power installations, each photovoltaic panel may require approximately 5 litres of water per cleaning cycle. giving a total estimated water consumption of approximately 12,500 litres per cleaning cycle for the full panel array. Where practicable, washing water will be collected and reused to minimize freshwater abstraction.

Water for construction and operational activities will be sourced from existing groundwater facilities within the University or other approved local supply sources. Considering the relatively low and intermittent water demand associated with panel cleaning, abstraction for the project is not expected to adversely affect local groundwater resources. Wastewater generated from panel cleaning may carry trace metallic particles from panel frames and support structures as well as micro-plastic residues from aged panel components. Uncontrolled infiltration of such wastewater into the surrounding soil over the operational lifecycle presents a potential contamination risk. Mitigation measures addressing the management of panel cleaning wastewater, including collection, controlled disposal arrangements, and soil quality monitoring provisions, are detailed in the Environmental and Social Management Plan.

Health and Safety

Occupational health and safety (OHS) is an issue that needs to be properly managed during all project phases in order to minimize the risk of preventable accidents leading to injuries and/or fatalities. Proper OHS risk identification and management measures should be incorporated in every project’s management plan and standard EPC contractual clauses.

The contractor shall engage dedicated personnel competent on the basis of 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 particularly in the following aspects:

Occupational Health and Safety:

- General Facility design and operation.
- Communication and Training.
- Physical Hazards.
- Chemical Hazards.
- Biological Hazards.
- Personal Protective Equipment (PPE).
- Special Hazard Environments.
- Monitoring.

Community Health and Safety:

- Water Quality and Availability.
- Structural Safety of Project Infrastructure.
- Life and Fire Safety (L&FS).
- Traffic Safety.
- Transport of Hazardous Materials.
- Disease Prevention.

Waste Management

Waste generation associated with the proposed solar hybrid mini grid project is expected to be limited and will occur mainly during construction, operation, and eventual decommissioning phases. Construction activities may generate typical solid waste such as packaging materials, scrap metals, cable offcuts, and minor construction debris, while operational waste streams are expected to be minimal and largely associated with routine maintenance activities. Based on the proposed project scale, waste generation during the construction phase is expected to be estimated at approximately 1–3 tonnes over the construction period

Although solar photovoltaic systems generate negligible emissions during operation, some project components may require periodic replacement over their service life. These materials will be handled, stored, recycled, or disposed of in accordance with applicable environmental regulations, manufacturer recommendations, and approved waste management procedures.

During the operation and maintenance phase, waste generation is expected to be minimal, consisting primarily of packaging materials, spent consumables, and occasional electrical or electronic components, with quantities estimated at less than 0.2 tonnes per year. At the decommissioning stage, higher waste volumes are anticipated from the dismantling of solar panels, mounting structures, electrical systems, energy storage units, and associated infrastructure. Total waste generation is estimated at approximately 15–25 tonnes, a substantial proportion of which is expected to be reusable or recyclable through licensed recovery and waste management facilities.

The University maintains an existing waste management system which will support collection and management of non-hazardous wastes generated during project implementation. Specialized wastes

arising from electrical or electronic components will be managed through approved vendors and licensed waste handlers in the state, to ensure environmentally sound disposal practices. A summary of anticipated waste streams across project phases is presented in Table 1.

Table 1: Typical waste Streams across Project Phases

Waste Stream	Sources	Waste Generation Phase		
		Construction	Operation	Decommissioning
General rubbish, refuse, and putrescible wastes (Food wastes)	Wood splinter, domestic waste, food packs, used bottles	X	X	X
Cleared vegetation	During site clearing and preparation	X	X	X
Scrap metals	Used tubular and casings, used iron rods	X	X	X
Excavated materials	Foundation works	X		X
Damaged/expired PV panels	PV modules	X	X	X
Expired inverters	Electrical installation		X	X
Damaged/expired Batteries	Power generation		X	X
Sanitary waste	Training centre	X	X	X

Solar Photovoltaic Installation Standards

Design, installation, and operation of the proposed solar photovoltaic hybrid system will comply with applicable national and international standards governing electrical safety, construction practices, and renewable energy installations. The project will adhere to relevant International Electro-Technical Commission standards for photovoltaic systems and mini grid development, including IEC 62257 guidelines covering system design, installation, operation, and maintenance.

Implementation will also conform to recognized engineering and construction codes relating to building safety, fire prevention, and electrical system protection. Compliance with these standards will ensure safe installation, reliable system performance, and long-term operational integrity of the solar power infrastructure throughout the project lifecycle.

3.4 Project Components

The proposed project consists of integrated infrastructure designed for electricity generation, storage, control, and distribution within the permanent campus of AUST. This section provides a description of the major system components and their functions within the overall project configuration.

Solar Power Generation System

The solar power generation system constitutes the primary energy producing component of the proposed project. Electricity will be generated through ground mounted photovoltaic (PV) arrays installed in organized rows within the designated project footprint. The PV modules will be mounted on engineered support structures designed to ensure structural stability, optimal panel orientation, and resistance to prevailing environmental conditions such as wind and rainfall.

The photovoltaic modules will be configured in interconnected strings and arrays to maximize solar energy capture and overall system efficiency. Through the photovoltaic effect, solar radiation incident on the modules will be converted directly into direct current electricity, which will subsequently be transmitted to inverters for conversion into usable alternating current for distribution within the University's electrical network.

The system will utilize polycrystalline silicon photovoltaic technology with an expected operational lifespan of approximately 25 to 30 years under normal operating conditions, providing a reliable and renewable source of energy throughout the project lifecycle.

Figure 4: Example of a Monofacial Si-poly photovoltaic module

Table 2: Photovoltaic module characteristics

Main characteristics	
Technology	Si-poly
Type of module	Monofacial
Maximum voltage	1500 V
Standard test conditions (STC)	
Peak power	415.0 W
Efficiency	18.79 %
MPP voltage	39.3 V
MPP current	10.55 A
Open circuit voltage	47.8 V
Short circuit current	11.14 A
Temperature coefficients	
Power coefficient	-0.370 %/°C
Voltage coefficient	-0.291 %/°C
Current coefficient	0.050 %/°C
Mechanical characteristics	
Length	2108.0 mm
Width	1048.0 mm
Thickness	0.04 mm
Weight	24.9 kg

Energy Storage System

The project will incorporate a Battery Energy Storage System to enhance reliability and stability of electricity supply within the campus. The storage system will retain excess energy generated by the photovoltaic arrays during periods of peak solar production for use when solar generation is reduced or unavailable.

The Battery Energy Storage System will support load balancing and energy stabilization by regulating fluctuations in power output and maintaining consistent voltage supply. Stored energy will primarily be utilized during nighttime operations, low solar irradiation periods, or temporary demand surges, thereby ensuring continuous electricity availability to critical university facilities.

Power Conversion and Control System

The power conversion and control system will regulate and manage electricity generated from the solar photovoltaic arrays to ensure safe, efficient, and reliable utilization within the University's electrical network. Direct current electricity produced by the PV modules will be converted into alternating current through grid compliant inverters designed for institutional power applications. The inverters will incorporate Maximum Power Point Tracking technology to optimize energy extraction from photovoltaic strings under varying solar irradiation conditions.

Table 3: Inverter characteristics

Inverter characteristics	
Main characteristics	
Inverter type	STRING
Maximum DC to AC conversion efficiency	98.79 %
Input side (DC)	
MPPT search range	880- 1300 V
Maximum input voltage	1500 V
Output side (AC)	
Rated power	110.0 kVA
Power at 30 C (datasheet)	110.0 kVA
Power at 50 C (datasheet)	100.0 kVA
Output voltage	800 V
Output frequency	50 Hz

Converted power will be transmitted through step up transformers to increase voltage levels suitable for integration into the campus medium voltage distribution system. Power evacuation and system integration will be supported through dedicated transformer or power stations configured as enclosed or containerized units housing transformers and associated medium voltage equipment.

Medium voltage switchgear assemblies and protection systems will be installed to provide system isolation, fault detection, operational safety, and controlled power flow. Power conditioning equipment will further stabilize voltage and frequency to maintain consistent power quality and safeguard connected electrical installations. Collectively, these components ensure efficient energy conversion, secure transmission, and stable operation of the solar hybrid system under varying load and generation conditions.

Figure 5: Example of string photovoltaic inverter

Figure 6: A transformer

Figure 7: Example of a Power Station

Electrical Distribution and Interconnection Infrastructure

The electrical distribution and interconnection infrastructure will facilitate transmission of electricity from the solar hybrid generation facility to designated load centres within the University's campus. Power evacuation will be achieved primarily through medium voltage distribution lines operating at approximately 11 kV, with underground cabling installed along designated utility corridors and campus road alignments to minimize surface disturbance and ensure maintenance accessibility.

The distribution network will integrate with the University's internal electrical system to enable efficient and controlled supply to academic buildings, residential facilities, research centres, and essential service infrastructure. Provision will also be incorporated for coordinated operation with existing or future grid infrastructure where applicable, allowing system flexibility and reliable interface between the solar hybrid installation and external electricity supply sources.

Monitoring and Supervisory Control System

The project will incorporate an integrated monitoring and supervisory control system to ensure efficient operation and management of solar hybrid power installation. The system will utilize Supervisory Control and Data Acquisition technology to enable real time monitoring of energy generation, battery storage performance, and electricity distribution across the facility.

The platform will support remote supervision, system diagnostics, performance analysis, and early fault detection, enabling timely corrective actions and optimized power flow regulation. These functions will enhance operational reliability, system safety, and overall efficiency of the installation.

As part of the monitoring framework, a solar weather station will be installed to capture real time meteorological and performance data. The station will include sensors for solar irradiation, ambient

temperature, relative humidity, wind speed, wind direction, and photovoltaic module temperature. Data collected will inform system performance evaluation, preventive maintenance planning, and operational optimization.

Supporting Infrastructure

Supporting infrastructure will be provided to facilitate effective operation, maintenance, and security of the proposed solar hybrid power facility. This will include construction of a site office and maintenance building to accommodate operational personnel, equipment storage, and routine system management activities.

Internal access tracks will be developed within the project area to enable movement of personnel and maintenance equipment during installation and operational phases. Security installations, including perimeter fencing and controlled access points, will be provided to safeguard project infrastructure against unauthorized access, vandalism, and theft, thereby ensuring safe and sustained operation of the facility.

Internal access tracks will be developed within the solar facility to provide connectivity between major project components and facilitate movement of personnel, equipment, and maintenance vehicles during construction and operational phases. These access routes will support routine inspection, operation, and maintenance activities within the project area and will connect the various installation units to existing campus circulation routes.

The access tracks will be designed with appropriate surface finishing and basic drainage provisions to manage stormwater runoff and minimize localized erosion within the facility. These internal roads are distinct from the external access routes to the University previously described under the site accessibility section.

To ensure operational safety and infrastructure protection, the project area will be secured through installation of perimeter fencing with controlled access points. Additional security measures, including perimeter lighting and surveillance systems, will be provided to prevent unauthorized access and safeguard installed equipment.

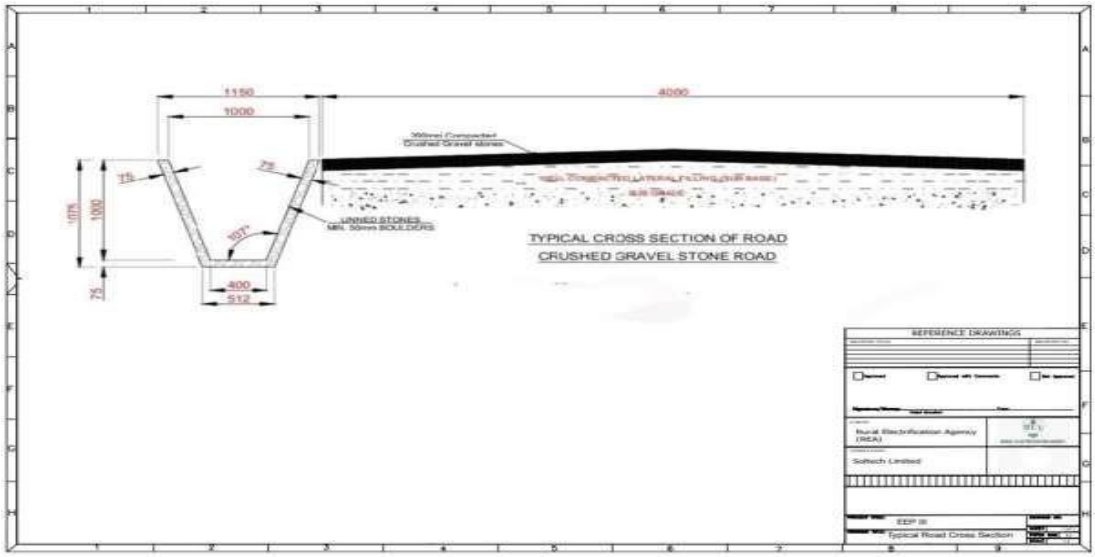

Figure 8: Typical Road Cross Section

Backup Power System

The proposed solar hybrid mini grid will incorporate limited backup generation facilities to enhance reliability and continuity of electricity supply within the University campus. The backup system, typically comprising diesel powered generators, will operate as a supplementary power source during periods of prolonged low solar generation, battery depletion, system maintenance, or emergency conditions.

The backup generators will be integrated into the hybrid control system to enable automatic synchronization and controlled operation alongside the solar photovoltaic and battery storage systems. This arrangement ensures uninterrupted power supply to critical facilities while maintaining overall system stability and operational flexibility.

3.5 Operation and Maintenance

Operation and maintenance of the system would be expected to occur on a limited basis at certain points during the system's estimated 25-year life cycle. To enhance the performance and reliability of the plant, the following types of maintenance will be carried out:

Preventive Maintenance: which involves routine inspection and servicing of plant equipment to prevent breakdowns. This includes panel cleaning, vegetation management, wildlife prevention, water drainage, monitoring of electrical components. It also involves retro- commissioning to improve the efficiency of the PV plant by detecting and solving problems in the system.

Corrective Maintenance: which involves repair of broken-down equipment. This includes on-site monitoring and mitigation, and critical and non-critical repairs of plant components.

Condition-based maintenance: which involves monitoring equipment and plant operations real- time and addressing potential problems early on in order to prevent plant downtime. This includes continuous monitoring via remote and on-site methods, warranty enforcement, and planned and unplanned equipment replacement.
Maintenance activities will be carried out by skilled manpower with backgrounds in electrical/electronic engineering and unskilled local labour where applicable. Specific maintenance activities include the following:

PV Modules

PV modules need to be cleaned weekly in the dry season manually using water and monthly in the wet season to prevent accumulation of dust. Also, the cabling around the modules needs to be checked regularly for damages. Panels need to be checked regularly for cracks and breaks. Panel testing needs to be conducted annually to ensure they live up to the manufacturer’s warranty.

Electrical System

- Inverter components need to be checked to prevent breakdowns which can occur during very hot weather conditions.
- Electrical wiring and earthing protection need to be checked for wear and tear. Also, the underground cabling needs to be monitored regularly for damages from pests.
- Infrared technology may be employed to identify spots where there are electricity leaks.

Civil Structures

- Mounting structures need to be checked regularly for bending damage which can affect the PV modules

- Access roads, drainage works, plant foundation and array structures need to be checked by visual inspection for water damage during the rainy season

Vegetation

- Growth of shrubs and other vegetation needs to be curtailed to prevent shadowing effect on the solar panels leading to a decrease in the output from the plant. Weeds also need to be eliminated as they present a fire hazard.
- Vegetation around the transmission line RoW needs to be cleared quarterly to maintain a vegetation height at less than 2 ft (0.61 m).

A stockpile of spare parts will be kept on-site to facilitate replacement of broken-down or out- dated solar panels and inverters. On-site security and inventory management will be implemented to prevent theft of spare parts and installed plant components.

Monitoring of the PV system components needs to be conducted to ensure increased system output and to reduce down-time. Traditional monitoring methods that compare actual energy generation against predicted energy generation will help to track the system's relative health.

3.6 Project Implementation Phase Activities

3.6.1 Preconstruction

Preconstruction work is proposed to last for 1-2 months. The work at this stage will entail activities such as site selection and preparation, completion of engineering design for the Project and receipt of relevant approvals, mobilization of personnel, equipment and materials to site, site preparation and installation of temporary structures for material storage.

3.6.2 Construction

Construction activities would last about 12-18 months. The major facilities to be constructed will include:

- ❖ Towers;
- ❖ Transformers;
- ❖ Control building;
- ❖ Weather station; and
- ❖ Transmission lines;

The proposed construction programme would be as follows:

- ❖ Construct the site access roads with gates and temporary fencing;
- ❖ Erect weather station;
- ❖ Excavate the foundations
- ❖ Construct the panel foundations;
- ❖ Erect and connect the panels;
- ❖ Lay power and instrumentation cables;
- ❖ Construct the control station;
- ❖ Construct the transformer and install the grid connection;
- ❖ Commission the panels and transmission lines; and
- ❖ Carry out land reinstatement, remove temporary compounds and clear the site

The construction will normally be completed during daytime hours; however, there will be requirements for extended hours during major concrete pours or other installations that cannot be interrupted.

3.6.3 Commissioning and Operation

Following the completion of all works at the construction phase, the power plant will be commissioned for operations. The commission phase will involve 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. Standard operating procedures (SOPs) shall be developed by the EPS Contractor for the operation and maintenance of the solar panels, inverters, batteries, and other associated components of the Project.

Upon completion of the commissioning of the power plant and other ancillary infrastructures, the EPC contractor will hand over the power plant to the Operation and Maintenance (O&M) Consultant who will be charged with the responsibility of operating and maintaining the plant for a period of 1 year. At this period, the O&M Consultant will also train the technical unit staff of university for ease of handover at the end of the O&M period. Activities under this phase will include:

- Power generation and distribution to various sections of the University
- The preventative, corrective and predictive maintenance of the power plant and associated facilities.

Also, the training centre will be utilized in enhancing learning in renewable energy.

3.6.4 Decommissioning

Upon completion of the power plant, the project site area will be cleared up for proper housekeeping. This is different from the decommission of the site which will be undertaken at the end of life of the power plant. The plant has a life cycle of at least 25years, which is expected to be extended with proper and timely maintenance of the plant. Upon the end-of-life of the power plant, the decommissioning activities will include:

- 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).
- Removal of PV panels and equipment, demolition of structures and evacuation as well as site remediation.
- Waste management – recycling, disposal of unusable parts etc.
- Restoring the environment to allowable baseline conditions and monitoring of the process.
- Assessing the residual impacts, if any, that the project has on the environment.

Table 4: Project Implementation Phase Activities and Staff Requirement.

Project Phases	Activities	Staff Requirement	Employment Type
Pre-construction Phase Activities	• Land identification and confirmation of project site • Completion of detailed engineering design • Obtaining regulatory approvals and permits • Mobilization of personnel, equipment and materials to site • Site preparation and demarcation • Installation of temporary facilities for material storage and site operations	15–25 persons: project engineer's / design specialists, E&S officers, surveyors, security personnel, and limited support workers	Temporary / short-term professional assignment
Construction Phase Activities	• Construction of internal access roads, gates and temporary fencing. • Excavation and preparation of foundations • Installation of panel mounting structures and PV arrays • Installation of transformers and grid connection	50–70 persons at peak construction: skilled technicians, electricians, civil workers, equipment operators, HSE/ safeguard	Temporary, mainly construction-period employment

	• Infrastructure. • Laying of power and instrumentation cables • Construction of control station and supporting facilities • Installation of weather monitoring station • Erection and electrical connection of solar panels • Testing and commissioning of solar panels and transmission lines • Site reinstatement and removal of temporary structures after construction	personnel, supervisors, security personnel, and unskilled local labour	
Commissioning and Operation Phase Activities	• Testing and verification of installed equipment and systems • Commissioning of solar power plant and associated infrastructure • Development and implementation of standard operating procedures (SOPs) • Electricity generation and distribution across the university campus • Preventive, corrective and predictive maintenance of plant components • System monitoring and performance management • Training of university technical personnel for system operation and maintenance	10–15 persons: commissioning engineers, electrical specialists, HSE officer, REA/ AUST representatives, EPC technical personnel O&M manager/ engineer, electrical technicians, BESS technician, HSE/support officer, security personnel, cleaner/ site attendants,	Temporary / short-term technical assignment for commissioning phase & Long-term O&M contract / permanent operational support for operation and maintenance phase
Decommissioning	• Dismantling and removal of photovoltaic panels and mounting structures • Removal of electrical components including inverters, transformers, batteries and cables • Removal of underground installations • Demolition of supporting structures and evacuation of materials • Waste management including recycling and disposal of unusable components • Site remediation and restoration to baseline conditions • Post-decommissioning environmental monitoring and impact assessment	25–35 persons: decommissioning contractor, electricians, waste handlers, HSE officer, environmental officer, security and manual workers	Temporary / end-of-life decommissioning employment

3.7 Analysis of Project Alternatives

The proposed solar hybrid mini grid system for the African University of Science and Technology, Abuja has been designed to provide a reliable and sustainable electricity supply to support the University's continued academic and institutional operations. In line with good environmental and social assessment practice, consideration was given to feasible alternatives during project planning in order to identify an option that meets the project objectives while minimizing potential environmental and social impacts.

The alternatives analysis focused primarily on the suitability of the selected project site within the University premises, the availability of land, proximity to electricity demand centers, accessibility, environmental sensitivity of the surrounding area, and compatibility with the campus master plan. Technology options were also considered, particularly the suitability of renewable energy-based electricity generation compared to continued reliance on the University's existing grid, diesel, and solar supply mix.

Thus, this sub-section specifically focuses on the alternatives considered within the proposed solar-hybrid power plant.

3.7.1 Site Alternatives

Two potential locations within the campus of the African University of Science and Technology (AUST) were reviewed and assessed during the field survey conducted on 10th of July 2026. The evaluation considered key criteria including land availability, proximity to the electricity load centre and transformer connection point, environmental sensitivity, social impacts, topography, flood risk, accessibility, and security.

Selected Site

Field verification was undertaken through site walkthrough surveys, GPS mapping, and review of the campus master plan. The assessment confirmed that the selected site within the campus perimeter is the most technically and environmentally suitable option, based on the following factors:

- The site is located approximately 500 metres from the University's main load centre and approximately 500 metres from the existing transformer connection point, minimizing transmission losses and reducing the need for extensive distribution infrastructure.
- The terrain is flat, providing optimal conditions for ground mounted photovoltaic array installation and minimizing the need for major earthworks or ground preparation.
- The site is situated within the secured campus perimeter, fully fenced with an operational security post, facilitating effective access control during construction and operation.
- The footprint is accessible via the University's first gate, identified as the preferred construction access route from the tarred express road fronting the campus, minimizing disruption to students who predominantly use the second gate for daily movement.
- No permanent structures, underground utilities, or ecologically sensitive features were identified within the footprint.
- The site is an open field with minimal shading, save for distant vegetation, ensuring good solar irradiance potential for the photovoltaic arrays.
- The footprint is located within the Southern Guinea Savannah ecological zone of the FCT, with cultivated vegetation of low ecological sensitivity and no evidence of protected plant species, critical habitats, or cultural heritage resources within or adjacent to the site.

Alternative Site

An alternative site was identified during the field assessment, located within University land but at a greater distance from existing infrastructure than the selected site. This alternative site was assessed against the same criteria and rejected on the following grounds:

- The alternative site lies closer to an active water course and was assessed as prone to flooding, presenting a higher flood and waterlogging risk compared to the selected site, where flood risk is minimal notwithstanding a minor erosion feature approximately 100 metres away.
- The terrain at the alternative site is undulating and rocky rather than flat, requiring more extensive earthworks and increasing installation complexity and cost.
- The soil at the alternative site is sandy with several rock outcrops, compared to the more workable farmland soil at the selected site, increasing foundation costs and complicating construction.
- The alternative site is less accessible for construction equipment and heavy vehicles compared to the selected site.

On the basis of this comparative assessment, the selection is confirmed as the preferred option, offering superior technical suitability, lower flood risk, more favourable terrain and soil conditions, and better access relative to the alternative considered.

3.7.2 Solar Power Technology Alternatives

The solar technologies available for the proposed power plant in the University are:

- Concentrated Solar Power (CSP) Systems
- Photovoltaic (PV) Solar Panels

Concentrated Solar Power (CSP) Systems

Concentrated solar power (CSP) technologies harness thermal energy from the sun to drive a thermodynamic cycle. Thermal energy storage (TES) is realized through the addition of tanks, which allows CSP systems to generate electricity at times of little or no solar irradiance. This includes operating 24 hours a day (baseline generation) or adjusting electricity generation during times of increased demand and high prices.

There are four different types of solar collector designs indicated in figure 10 parabolic troughs, heliostats (for power towers), linear Fresnel lenses, and dish receivers.

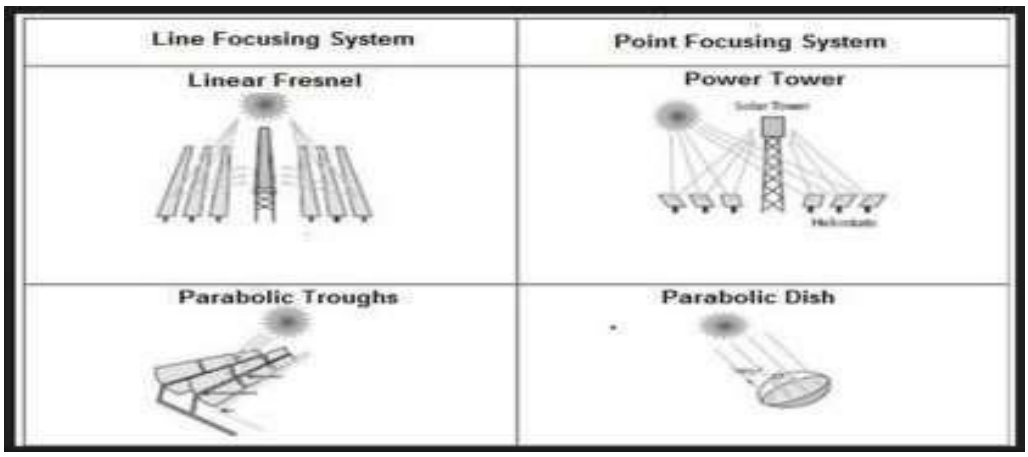

Figure 9: Four different types of solar collector designs

Solar Photovoltaic Power Systems

SPV systems utilize semiconductor-based materials (solar cells) which directly convert solar energy into electricity. SPV systems have many attractive features, including modularity, no fuel requirements, zero emissions, no noise and no need for grid connection. SPV systems can be classified according to three principal applications.

- Stand-alone solar devices purpose-built for a particular end use, such as solar HF radios, solar home lighting systems, or solar coolers. These dedicated SPV systems can either be configured to include some energy storage capacity or directly power electrical or mechanical loads, such as pumping or refrigeration;
- Stand-alone solar power plants, basically small power plants designed to provide electricity from a centralized SPV power plant to a small locality like village or a building; and
- Grid-connected SPV power plants, which are equivalent to any other generator supplying power to the electricity grid.

Comparison of solar power technologies

Parameter	Concentrated Solar Power (CSP)	Solar Photovoltaic (SPV)
Energy Conversion	Thermal (Heat to Steam to Electricity)	Direct (Semiconductor/Light to Electricity)
Mechanical Parts	High (Requires turbines, tracking mirrors)	Minimal (Solid-state, no moving parts)
Scalability	Best for large-scale utility projects	Highly scalable (from small devices to utility)
Operational Flexibility	Good (Thermal storage allows baseload)	Modular (Easy to expand/configure)
Maintenance	High (Complexity of thermal/mechanical systems)	Low (No fuel, no moving parts, simple upkeep)
Noise/Emissions	Low (Steam cycle may have some noise)	Zero (Silent, no emissions during operation)
Infrastructure Needs	Grid connection usually required	Can operate standalone or grid-tied

The final design preference is for Solar Photovoltaic Power Systems.

3.7.3 Solar Batteries Alternatives

Solar batteries are mainly categorized by manufacturing material. There are four main types of solar batteries available on the market:

Lead Acid Batteries

Lead-acid batteries are the oldest form of battery with technology dating back more than a century. As a result, lead-acid batteries are tried-and-true when it comes to storage. Lead acid batteries are categorized into two types: flooded lead acid and sealed lead acid batteries. The lead-acid variety is considerably more inexpensive than other solar batteries. These batteries come with some challenges: shorter lifespan and lower depth of discharge. Lead-acid battery capacity is also comparatively lower than other batteries. These limitations can complicate the installation process.

Figure 10: Illustrative Photo of a Lead Acid Battery

Lithium-Ion Batteries

Lithium-ion batteries are relatively new. Their advanced technology has updated features. Many portable devices, such as mobile phones and laptops, use lithium-ion batteries. They are efficient, compact and lightweight. If not properly installed, lithium-ion batteries could experience thermal runaway and catch fire.

Figure 11: Illustrative Photo of a Lithium-Ion Battery

Nickel Cadmium Batteries

Nickle Cadmium (Ni-Cd) batteries are not as common as lead-acid or lithium-ion batteries. These batteries are also a century old. They were popular in the aircraft industry. Because of their sturdiness, Ni-Cd batteries are useful for large-scale applications, such as utility solar energy storage.

Known for durability, Ni-Cd batteries can operate at higher temperatures. They also don't need complicated battery management systems and are almost maintenance-free. Ni-Cd batteries' biggest drawback is that they are toxic. Even when recycled, they can become a major environmental concern.

Figure 12: Illustrative Photo of a Nickel Cadmium Battery

Flow Batteries

Flow batteries are still in the development phase, and it may take some time before they are widely available in the market. Knowing about them now is worthwhile because this variety is expected to be a game changer in future solar panel storage methods. Within these batteries, water-based electrolyte liquid circulates between two different chambers. The chemical reaction of the charging process allows the battery to store and release electrical energy.

The biggest advantage of flow batteries is that they offer 100% depth-of-discharge capability. This means you can utilize all the energy stored in the battery without damaging it.

Table 5: Comparison of the Battery Technologies

Parameter	**Lead-Acid (VRLA/AGM)**	**Nickel-Cadmium (Ni-Cd)**	**Lithium Iron Phosphate (LiFePO4)**
Energy Density	Low	Low to Moderate	High
Cycle Life	Short (300–800 cycles)	Long (1,500–3,000+ cycles)	Very Long (3,000–6,000+ cycles)
Depth of Discharge	Shallow (50% recommended)	High (up to 80%)	Very High (up to 95%+)
Thermal Stability	Moderate	Very High	Excellent
Maintenance	Regular (depending on type)	Moderate	Low (Maintenance-free)
Environmental Risk	High (Lead/Acid)	Very High (Cadmium)	Low (No heavy metals)

N.B. The final design option is in preference of lithium battery. As illustrated in table 5 above, the Lithium-Ion Batteries technology is the preferred option. Its superior cycle life, high depth-of-discharge capability, and significantly lower environmental risk profile align with international best practices for modern, sustainable energy storage systems.

3.7.4 Climate Change Considerations

Climate change considerations formed an explicit criterion in the evaluation of project alternatives, reflecting the requirements of the AfDB ISS 2023 and the need to ensure long-term project resilience and sustainability within the FCT Abuja environment.

Climate Risk: The proposed site experiences a tropical savannah climate characterized by a distinct wet season from April to October and a dry season from November to March. Climate related risks relevant to the project include high ambient temperatures during the dry season, intense rainfall events and associated stormwater runoff during the wet season, harmattan dust conditions from November to February, seasonal wind loading, and lightning associated with convective thunderstorms during the early wet season. Among the site options assessed, the selected location presents the lowest climate vulnerability due to its flat terrain, open aspect maximizing solar irradiance, and position within the secured campus perimeter away from waterlogged areas. Appropriate climate resilience measures including lightning protection systems, surge protection, adequate earthing of all electrical installations, and panel orientation optimized for the FCT solar irradiance profile will be incorporated into the detailed project design.

Climate Impact on Project: The selected solar PV technology and battery energy storage system were evaluated against their susceptibility to climate related impacts including heat stress on panels and batteries, dust accumulation on PV surfaces during harmattan conditions, and wind and rain exposure during the wet season. Lithium-ion battery storage was preferred over lead-acid alternatives in part due to superior thermal performance under the high ambient temperatures characteristic of the FCT environment, as well as longer cycle life and lower maintenance requirements. Panel cleaning and maintenance provisions will be incorporated into the Operations and Maintenance plan to address dust related efficiency losses during the harmattan period.

Project GHG Contribution: Among the alternatives considered, solar photovoltaic generation produces negligible operational greenhouse gas emissions compared to continued reliance on diesel powered generation, which currently constitutes the sole source of electricity at AUST. Based on standard IPCC emission factors for diesel combustion, continued diesel generation at a university campus of this scale is estimated to contribute significantly to annual carbon dioxide equivalent emissions. The preferred solar hybrid alternative directly displaces this fossil fuel dependency and supports Nigeria's mitigation commitments under the National Climate Change Policy 2021 to 2030, the Nationally Determined Contributions under the Paris Agreement, and the Federal Government's Sustainable Energy for All Action Plan.

3.7.5 Project Options

No Project Option

The "No Project Option" refers to the scenario in which the proposed solar hybrid mini grid is not implemented at the African University of Science and Technology (AUST). Under this scenario, the University would continue to rely on its existing constrained supply arrangement, comprising limited

national grid supply through AEDC, diesel powered generating sets, and existing solar capacity, to meet its electricity needs.

The current electricity situation at AUST is characterized by an inadequate and costly mixed supply arrangement, with grid power available for only a limited number of hours daily and diesel generation required to bridge the resulting shortfall. This arrangement results in high and recurring operational costs covering diesel procurement, lubricants, spare parts, generator maintenance and emergency repairs, alongside continuous greenhouse gas emissions, noise pollution and air quality impacts from generator exhaust within the campus environment. It also exposes the institution to the risk of fuel supply disruptions and price volatility.

Continued reliance on this constrained supply arrangement would limit the University's ability to expand its academic programmes, research activities, ICT services and laboratory operations. Power interruptions and generator downtime would continue to disrupt teaching schedules, examination activities and administrative operations, undermining the University's academic performance and institutional efficiency.

Failure to implement the project would also prevent the realization of the expected benefits of the Energizing Education Programme under the Desert to Power initiative, including the provision of clean and reliable electricity, reduction in fossil fuel dependence, improved learning and research conditions, creation of local employment opportunities, and enhanced institutional sustainability.

For these reasons, the no project option is considered neither technically nor environmentally desirable and was not selected as a viable alternative for meeting AUST's long term electricity demand.

Delayed Option

The delayed project option refers to a scenario in which implementation of the proposed solar hybrid mini grid at the African University of Science and Technology (AUST) is postponed to a later date. Under this option, the University would continue to experience its existing constrained and costly mixed supply arrangement, comprising limited grid supply, diesel generation, and existing solar capacity, with no near term improvement in electricity reliability.

Delaying the project would prolong the University's reliance on diesel generators to bridge its power shortfall, resulting in continued high operational costs, energy insecurity, recurring generator maintenance burdens, and ongoing environmental impacts from fossil fuel combustion including greenhouse gas emissions, noise pollution and air quality degradation within the campus environment. The persistence of unreliable electricity supply would continue to constrain academic activities, laboratory operations, ICT services, research productivity and administrative efficiency.

A delay would equally slow the realization of the expected benefits of the Energizing Education Programme under the Desert to Power initiative, including improved electricity reliability for academic and research activities, reduction in fossil fuel dependence, creation of local employment opportunities during construction, and enhanced institutional sustainability.

For these reasons, the delayed project option is considered undesirable and was not retained as a practical alternative for meeting AUST's immediate and long term energy needs.

Go Ahead Option

The go-ahead option refers to the implementation of the proposed solar hybrid mini grid project at the African University of Science and Technology (AUST) as planned under the Energizing Education Programme of the Desert to Power initiative. This option represents the most technically feasible, environmentally compatible, and socioeconomically beneficial alternative assessed, and is therefore the recommended and selected course of action.

Implementation of the project will provide reliable, sustainable, and clean electricity supply to the University's campus, directly addressing the current constrained mixed supply arrangement and the associated operational, environmental and financial burdens arising from continued diesel dependence.

The project will enhance teaching, research and innovation activities by providing stable electricity for academic buildings, laboratories, ICT facilities and administrative operations across the campus. Improved power availability and outdoor lighting will contribute to better campus security, operational efficiency and a more conducive learning environment for students and staff.

The use of solar photovoltaic technology will significantly reduce reliance on diesel powered generators, lower greenhouse gas emissions, reduce noise and air pollution from generator exhaust on campus, and contribute to Nigeria's renewable energy commitments under the Nationally Determined Contributions and the National Climate Change Policy 2021 to 2030.

Considering the technical feasibility, environmental compatibility, economic sustainability, and broad socioeconomic benefits associated with the project, the go ahead option represents the most appropriate and sustainable alternative when compared with the no project and delayed project options, and is therefore selected as the preferred course of action for meeting AUST's long term electricity needs.

CHAPTER FOUR: DESCRIPTION OF THE ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

4.1 Introduction

This chapter presents the baseline environmental and social conditions of the project area prior to the implementation of the proposed Project. The assessment provides an understanding of the existing physical, biological, and socio-economic characteristics of the project environment, which serves as a reference point for identifying and evaluating potential environmental and social impacts associated with the project.

4.2 Methodology for Baseline Data Collection

The baseline environmental and social conditions of the proposed Project at the AUST site were established through a combination of primary field investigations and secondary data review. The approach adopted ensured that sufficient information was gathered on the physical, biological, and socio-economic characteristics of the project site and its surrounding environment.

Baseline data collection activities were carried out between 8th and 17th July 2026, and involved reconnaissance surveys, field observations, stakeholder consultations, environmental sampling, and socioeconomic surveys. Fieldwork coincided with the wet season period of July 2026, during which the Federal Capital Territory typically experiences moderate to heavy rainfall, elevated humidity, suppressed dust levels, and active surface water flow. Secondary data sourced from the Nigerian Meteorological Agency and other published references were used to complement field measurements and provide a fuller characterization of environmental conditions across both seasons.

These methods formed the basis for describing the existing environmental and social conditions within the project area prior to project implementation.

4.2.1 Study Area and Project Area of Influence

The assessment covered the proposed project site and its surrounding environment, defined as the Project Area of Influence (AoI). For this study, the AoI encompasses the immediate project footprint and the surrounding environment within an approximate 3km radius from the centre of the proposed solar hybrid mini-grid installation site, located within the campus of the African University of Science and Technology (AUST), along the Galadimawa Roundabout express corridor in the Federal Capital Territory, Abuja. This spatial boundary was considered appropriate for capturing the environmental and social conditions that may potentially interact with the proposed project through construction activities, movement of personnel and equipment, drainage patterns, underground cable routing, and community interactions.

In delineating the AoI, consideration was given to the proximity of nearby receptors and facilities, including established academic and administrative structures within the AUST campus, the nearest of which (an uncompleted clinic building and an engineering laboratory block) lie approximately 100 metres and 300 metres respectively from the project footprint, with student hostel accommodation located approximately 1.5 kilometres away. The Knowledge Court residential estate, situated near the University's main entrance, was identified as the closest formal residential receptor within the AoI. The Galadimawa Roundabout, also located approximately 1.5 kilometre from the project site, was also considered a key receptor given the concentration of informal economic activity there, comprising traders, transporters, and commercial motorcyclists organized under recognized trade unions and union chairmen. The surrounding area beyond these receptors is predominantly characterized by express roads rather than

residential settlements. Access routes, water sources, drainage infrastructure under construction, and the general campus environment were also taken into account in defining the spatial scope of the assessment.

Baseline environmental sampling, field observations, and socioeconomic surveys were conducted within the defined AoI to ensure that the existing environmental and social conditions of the project environment were adequately characterized prior to project implementation.

4.2.2 Field Observations

Detailed field observations were carried out across the project site and its immediate surroundings during the baseline study period. The purpose of these observations was to document the prevailing physical, biological and social conditions of the project environment prior to implementation.

Field observations focused on the following key environmental and social parameters:

- Topography and drainage characteristics including slope, terrain condition, drainage patterns and the status of drainage channels under construction within the campus.
- Soil conditions and surface stability including soil colour, texture, compaction and evidence of erosion or disturbance within and around the project footprint.
- Existing vegetation cover and habitat conditions including the type, density and ecological sensitivity of vegetation within the footprint and the broader Area of Influence.
- Presence or absence of wildlife and indicators of ecological sensitivity including fauna species observed or detected within the footprint and surrounding area.
- Current land use and human activities within the project vicinity including the ongoing campus construction activities, and community activities within the Area of Influence.
- Existing infrastructure conditions including the status of roads, drainage channels, security arrangements, water supply and power generation facilities within the campus.
- Sensitive receptors including the location and distance of campus buildings.

Information obtained from field observations was recorded through field notes, geo-referenced photographs, GPS coordinate logging, and direct visual inspection by the ESIA team.

4.2.3 Secondary Data Review

Secondary environmental and socioeconomic data relevant to the project area were obtained through a review of existing literature and institutional sources. This review provided contextual information on the broader environmental and socioeconomic conditions of the Federal Capital Territory and the immediate project environment. The reviewed materials included:

- Project documentation provided by the Rural Electrification Agency, including the Terms of Reference for the ESIA.
- Technical planning documents and infrastructure information provided by the African University of Science and Technology, including campus development information and electrical planning data for the permanent campus.
- Environmental and Social Impact Assessment for the Proposed 3.0 MW Solar-Hybrid Power Plant and Associated Infrastructure in University of Abuja (UNIABUJA), Federal Capital Territory. Final Report, December 2020.
- National and regional environmental datasets including climatic and meteorological information for the Federal Capital Territory obtained from the Nigerian Meteorological Agency (NiMet).

- ❖ Relevant national environmental policies, legislation and guidelines including the Environmental Impact Assessment Act Cap E12 LFN 2004 and the Federal Ministry of Environment Environmental Impact Assessment Procedural Guidelines 2017.
- ❖ Applicable international environmental and social safeguard frameworks including the African Development Bank Integrated Safeguards System 2023 and other international good practice guidance relevant to environmental and social assessment.

4.2.4 Environmental Sampling and Laboratory Analysis

Environmental sampling was conducted as part of the baseline study to establish the existing quality of key environmental media within the project area. Sampling focused on soil, air quality, and water resources within and around the project site. Sampling activities were conducted on 11th July 2026 at representative locations within the project footprint and along the surrounding environment.

Soil Sampling

Soil sampling was undertaken at representative locations within the proposed project footprint and surrounding Area of Influence to establish the general baseline quality of the soil environment prior to project implementation. Samples were collected within the soil horizons likely to be affected by project activities, particularly site clearing, grading, excavation of the underground cable trench route, foundation works, vehicle movement and temporary stockpiling of construction materials.

At each sampling location, soil samples were collected separately from two depth intervals, being the topsoil horizon at 0 to 15 cm and the subsoil horizon at 15 to 30 cm, in accordance with standard soil sampling practice for environmental baseline assessments. Samples from each depth interval were composited to obtain representative samples for laboratory analysis. The laboratory results (Table 6) therefore represent composite samples for each depth interval independently, providing a differentiated baseline of soil quality between the topsoil and subsoil horizons at each sampling location.

The samples were collected randomly using grab and composite techniques to achieve an even spread from the project site, and the sampling points were adequately captured by the use of a GPS and photo recognizable geographies on satellite imagery of the location. Laboratory analyses were conducted by the Pollution Control Laboratory, Ministry of Environment, Kano State, an FMEnv-accredited environmental laboratory, to determine parameters including soil pH, organic matter content, particle size distribution, and selected heavy metals. The laboratory applied established analytical procedures and quality assurance/quality control (QA/QC) protocols to ensure the reliability of the analytical results. Supporting laboratory documentation is provided in the Annex Eight.

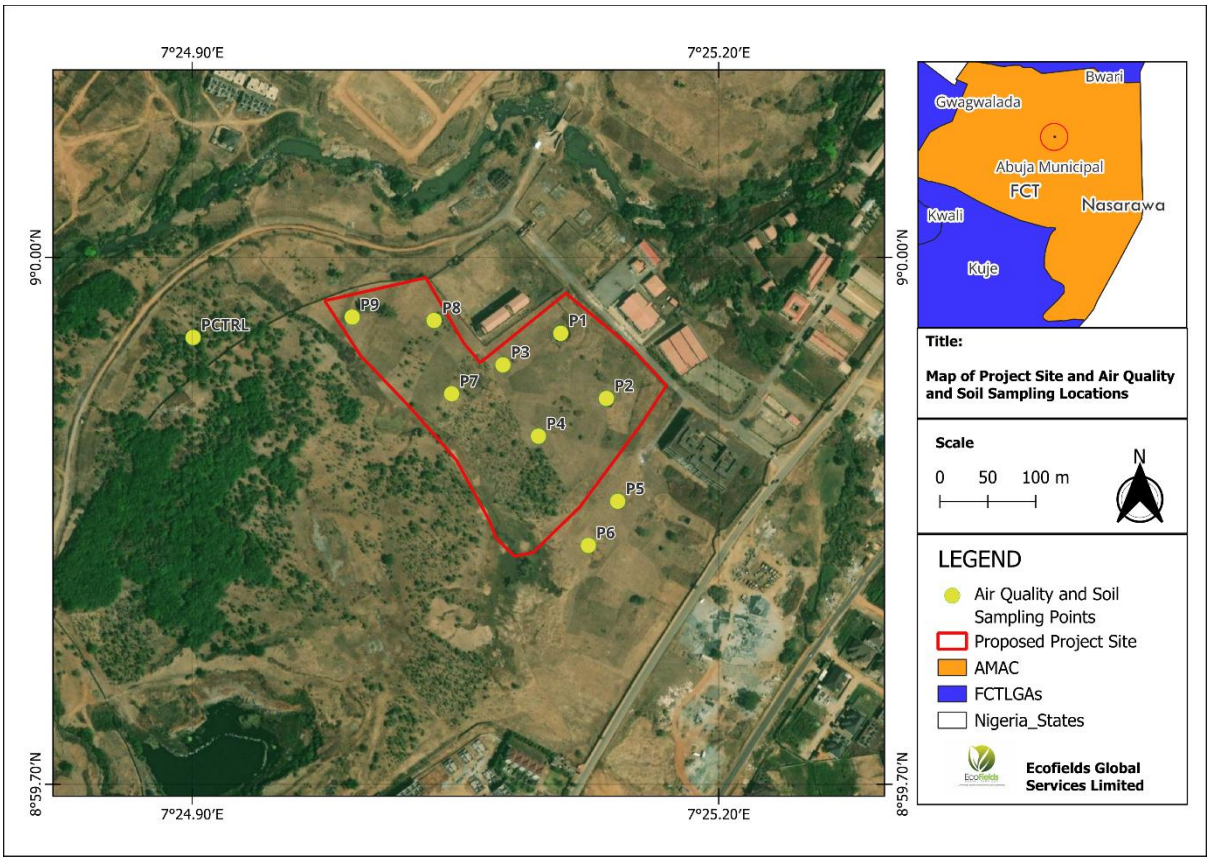

Figure 13: Map showing the soil sampling points in, and around the project footprint

Air Quality Monitoring and Noise measurement

Ambient air quality measurements were carried out at selected locations within the project area using pre-calibrated digital handheld Air Quality Monitoring Equipment such as pre-calibrated Crowcon [TETRA3] Pro Environmental Test Meter. Measurements focused on key parameters such as particulate matter (PM), carbon monoxide (CO), and other relevant indicators of air quality, carried out at Twelve (12) different points including control within and around the proposed project site. Air quality monitoring points were established within the project site and at nearby receptor locations to capture representative baseline conditions prior to project implementation.

Noise measurements were taken with a digital, battery-powered, sound pressure level meter (EXTEC Instruments, US Model 407735). The meter has both A and C weighting and 0.1 dB resolution with fast/slow responses. Its high- and low-metering ranges were 35 – 100 dB and 65 – 130 dB, respectively. The meter is also equipped with a building calibration check (94 dB), tripod mount, and analogue DC/AC conditioned outputs of 10mV/dB and utilized a 0.49 "(12.3 mm) condenser microphone.

Water Sampling

Water samples were collected from representative water sources within the project Area of Influence to establish baseline water quality conditions prior to project implementation. A total of four water samples were obtained, comprising two groundwater samples from campus boreholes designated Borehole I and Borehole II, and two surface water samples from the stream within the Area of Influence designated Stream I Upstream and Stream I Midstream. Sampling locations were selected to capture conditions representative of the campus water supply infrastructure and the nearest surface water body to the proposed project footprint.

Samples were collected using pre-cleaned and sterilized sampling bottles and preserved in accordance with standard sampling and preservation protocols prior to transportation for laboratory analysis. The

collected samples were analyzed for selected physicochemical and microbiological parameters, including indicators of water quality such as pH, turbidity, total dissolved solids (TDS), electrical conductivity (EC), and other relevant parameters as discussed in subsection 4.3.3.

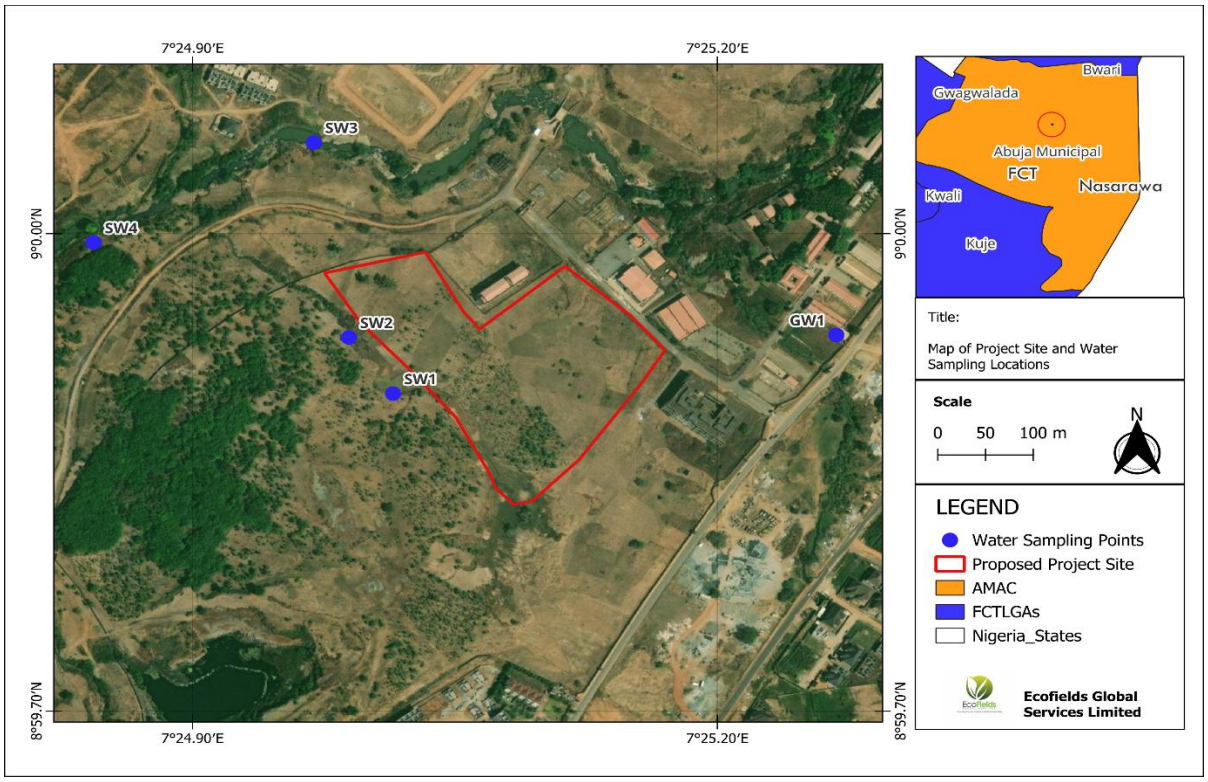

Figure 14: Water sampling points

Quality Assurance and Control

Quality Assurance/ Quality Control (QA/QC) procedures covered all aspects of the study, including sample collection, handling, laboratory analyses, data coding and manipulation, statistical analyses, presentation and communication of results. The methods of analyses used in this study were those specified in Federal Ministry of Environment Guidelines, EGASPIN 2002 and other internationally accepted analytical procedures, in order to ensure the reliability and integrity of the data obtained.

Sample Collection and Handling

Sample collection and handling procedures to maintain the integrity of samples and enhance the quality of the results, were in accordance with Federal Ministry of Environment. Following procurement, all samples were immediately labelled indelibly, giving details of sampling point, location of sampling, date and time of sampling, name of personnel sampling, etc. To reduce sampling error, measurements were replicated and a number of spatially distributed samples were composited before sub sampling for analysis. The sample collection and handling procedures are summarized as follow:

- Standard field procedures and methods approved FMEnv were adopted.
- All sampling equipment was maintained in excellent condition, calibrated against international standards and adequate steps were taken to ensure that they function normally.
- Only new and thoroughly washed, rinsed and sterilized sampling containers were used.
- For heavy metal determination, sampling bottles were used and were rinsed with a solution of one-part nitric acid to four parts water, followed by copious amounts of distilled water.
- Water samples for BOD_5 determination were collected in black oxygen bottles and kept away from light source.

- ❖ All parameters without holding time were measured *in situ* on the field.
- ❖ Samples for other parameters were preserved as soon as they were collected.
- ❖ All samples were safely packed and transported to the laboratory base

Sample contamination and deterioration were avoided by pre-sterilizing sampling tools and containers, pre-treating and preserving samples in transit in ice-cooled chest (<4^{o}C) to the laboratory and storing samples at that temperature in refrigerators pending subsequent analysis especially for attributes having short-holding time such as total hydrocarbon, heavy metals and microbiology.

Sample Preservation

Sample contamination and deterioration were avoided by pre-sterilizing sampling tools and containers, pre-treating and preserving samples in transit in ice-cooled chests to the laboratory and stored at that temperature in refrigerators pending subsequent analysis. All parameters with short holding time such as pH and temperature were measured *in situ* on the field, while samples for delayed analyses were preserved by refrigeration (for general water chemistry), pH adjustment or chemical pre-treatment (for heavy metals, Total Hydrocarbon, Dissolved oxygen). Dissolved oxygen samples were acidified to a pH 2 with concentrated H_2SO_4 and NHO_3 respectively and samples for microbiology were stored immediately in ice cooled chest (at 4^{o}C) in transit to the laboratory base where they were stored in refrigerators.

4.2.5 Socio-Economic Survey Methods

Socioeconomic baseline information was obtained through a combination of stakeholder consultations, key informant interviews, focus group discussions, field observations and structured questionnaire surveys conducted within the project area and its surrounding environment. The study employed a sequential mixed methods research design, integrating both quantitative and qualitative approaches for data collection, analysis and reporting.

The socioeconomic survey was conducted within the fieldwork period of 8th to 17th July 2026, covering the AUST campus and its surrounding Area of Influence, including the Galadimawa Roundabout and the Knowledge Court residential estate. Quantitative and qualitative data were collected using structured questionnaires and through Key Informant Interviews (KII) administered to selected respondents drawn from the university student population, academic and non-academic staff, within the campus premises, and traders, transporters, and commercial motorcyclists operating at the Galadimawa Roundabout. The assessment focused on gathering information on key socioeconomic indicators including population characteristics and livelihood patterns, livelihood activities and sources of income, access to education, healthcare and other basic services, existing infrastructure and facilities, energy access and expenditure, awareness of and attitude toward the proposed project, and community perceptions regarding potential project impacts and benefits.

Information obtained from the various survey methods was triangulated to ensure reliability and to distinguish community and stakeholder perceptions from verifiable conditions within the project environment. The results of the socioeconomic assessment provided the basis for understanding existing social conditions and for evaluating potential project related impacts on the project environment.

4.3 Physical Environment

4.3.1 Climate and Meteorology

The study area proposed which is located within the Federal Capital Territory (FCT), Abuja, experiences a tropical wet-and-dry savannah climate classified as Aw under the Köppen–Geiger climate classification. The climate is characterized by a distinct wet season and dry season, associated with the

seasonal movement of the Inter-Tropical Convergence Zone (ITCZ) and the corresponding alternation between moisture-bearing south-westerly winds and dry north-easterly continental air masses. The wet season generally extends from about April to October, while the dry season occurs predominantly from November to March.

The monthly climate profile is presented in Figure 15 The figure demonstrates the strong seasonal relationship between temperature and rainfall, with temperatures increasing toward the late dry season and rainfall increasing markedly from April, reaching a maximum during August–September, before declining rapidly toward November and December.

Air Temperature

Abuja has a warm tropical climate throughout the year. The late dry season, particularly February–April, is associated with the highest temperatures, while temperatures decrease during the peak wet season as cloud cover and rainfall increase. The long-term warming trend of approximately 0.19°C per decade indicates that climate variability and increasing heat exposure should be considered in project design and occupational health and safety planning. For the proposed project, this supports the need for adequate worker hydration, heat-stress management, appropriate work scheduling and protection of electrical and battery systems against elevated ambient temperatures.

The monthly climate normals show mean minimum temperatures ranging from approximately 18.6°C in December to 24.3°C in April, while mean maximum temperatures range from approximately 28.5°C in August to 36.0°C in March. These values represent climatological averages and should not be interpreted as absolute historical temperature extremes.

Rainfall

Annual rainfall averages approximately 1,365 mm, with pronounced seasonal variability. Rainfall increases from April and becomes substantial between May and October, with peak monthly totals of approximately 280.3 mm in August and 279.5 mm in September. December and January are comparatively dry, with approximately 1.1 mm and 2.1 mm of average rainfall, respectively.

The seasonal rainfall pattern has direct implications for the project. Construction activities involving excavation, trenching and access roads may be affected by intense rainfall, runoff, temporary waterlogging and erosion. Accordingly, the ESMP shall provide for appropriate stormwater diversion, erosion and sediment control, protection of excavated areas, safe management of open trenches and timely reinstatement of disturbed surfaces.

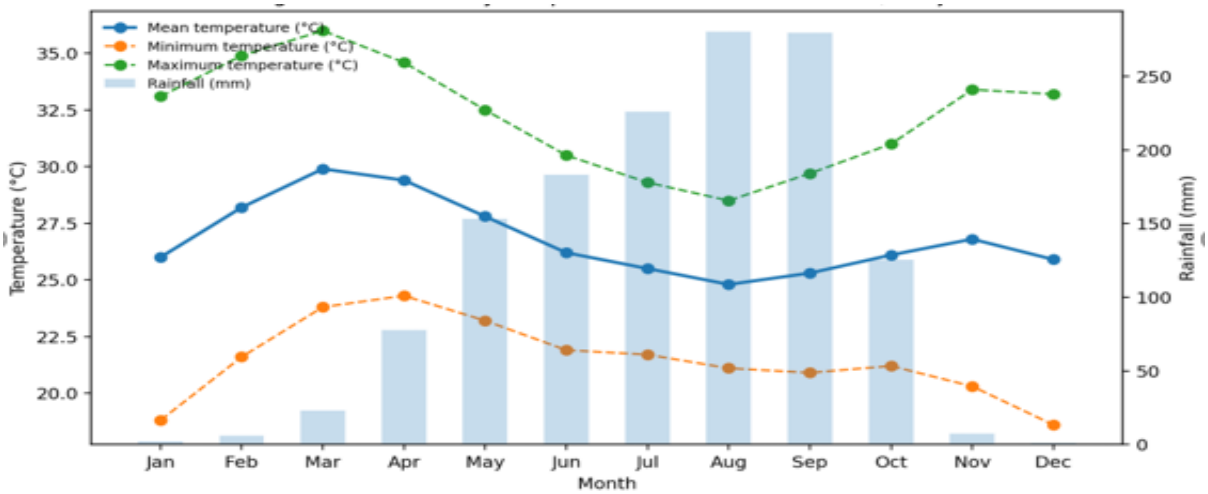

Figure 15:Climatic profile of the project area

Sunshine Hours and Solar Resource

Abuja has a favourable solar resource for photovoltaic electricity generation, with substantial sunshine during the dry season and reduced sunshine during the peak wet season due mainly to increased cloud cover. Available climate data indicate an average annual sunshine duration of approximately 2,694 hours, equivalent to about 224.5 hours per month. Average daily sunshine duration is highest during the dry-season months, reaching approximately 10.3 hours per day in January, February and December, and declines to about 3.9 hours per day in August.

The monthly sunshine pattern is presented in Figure 16. The seasonal profile supports the technical suitability of the FCT for solar PV generation. For environmental and operational management, the project shall also consider dust deposition during the dry season because accumulated dust on module surfaces can reduce solar conversion efficiency. Routine module cleaning shall therefore be incorporated into the Operations and Maintenance Plan, using methods that minimize water consumption and prevent uncontrolled wastewater discharge.

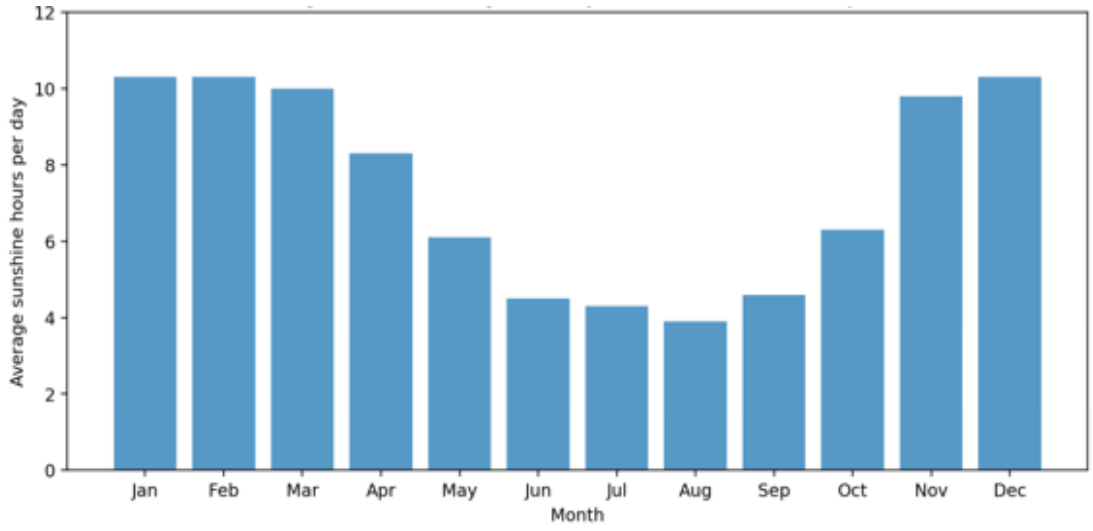

Figure 16: Monthly sunshine pattern

Geology of the Project Area

The study area is located within the Central Nigeria Precambrian Basement Complex. The geology of the area has been studied and discussed by previous publications like Oyawoye (1972), McCurry (1976) etc. They described the rocks as comprising mostly granite, gneisses, mica schists, hornblende and feldspathic schists and migmatites. The rocks are highly fractured and jointed showing essentially two fracture patterns, NE – SW and NW – SE. These fractures control the drainage and flow patterns of rivers in the area. However, minor Cretaceous deposits of Nupe sandstones occur in the southern part of FCT between Kwali and Abaji, extending to Rubochi and the border with Nassarawa State. Similarly, meta-sediments have also been mapped along a general NNE-SSW direction through the west of Kusaki (in the south) and east of Takushara (in the north) (USGS 1977). Mica schists and amphibolite schists occur around Kusaki and Buze villages outside the study area.

Topography and Land Use

The terrain across the proposed project site is generally flat with minimal natural undulations, providing highly favourable conditions for the installation of ground mounted solar photovoltaic infrastructure. No rock outcrops or hardpan layers were identified at the surface within the footprint, and no permanent or temporary structures were identified within the project footprint. Economic trees were observed scattered within the wider site surroundings, though none were identified within the project footprint itself. Drainage infrastructure is present within the wider campus but remains under active construction.

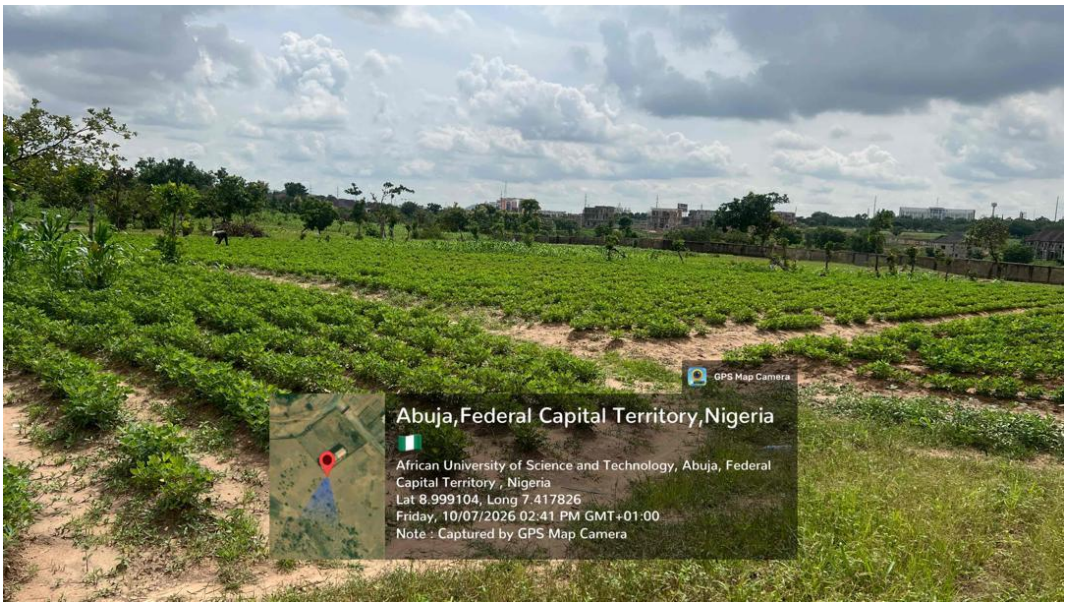

Figure 17: View of the proposed project footprint at AUST

4.3.2 Soil Physico-Chemical Characteristics

Soil samples were collected from ten locations designated SS1 to SS10 across the proposed project footprint and surrounding Area of Influence at the AUST campus. Samples were collected separately from the topsoil horizon at 0 to 15cm and the subsoil horizon at 15 to 30cm at each location and composited by depth interval for laboratory analysis. The results are presented below.

Analysis of Soil Sample Results

Physical Parameters

Soil colour across the ten sampling locations is predominantly dark brown, with SS7 recording a very dark brown colour, reflecting comparatively higher organic matter content at that location, while SS2, SS6, SS9 and SS10 recorded a lighter brown colouration. Soil pH ranges from 6.09 at SS3 to 6.99 at SS10, indicating consistently acidic to near neutral conditions across the site. These pH values are within acceptable ranges for infrastructure development and do not indicate chemical constraints for civil works associated with the proposed solar installation.

Electrical conductivity values range from 994 µS/cm at SS7 to 1,895 µS/cm at SS1. Salinity values are consistently very low across all sampling locations, ranging from 0.01% to 0.04%. These results confirm that the soil environment is non-saline and does not present corrosion risks to underground cable infrastructure, foundations or mounting structures. Oxidation-reduction potential (ORP) values range from 244mV at SS8 to 399mV at SS1, reflecting mildly to moderately oxidising conditions typical of surface soils in the FCT environment. Overall, the physical parameters indicate a chemically stable soil environment suitable for the proposed solar hybrid mini grid infrastructure.

Exchangeable Cations

Calcium concentrations range from 1.86 mg/kg at SS10 to 8.01 mg/kg at SS7. Magnesium ranges from 0.13 mg/kg at SS3 to 1.49 mg/kg at SS5. Sodium concentrations range from 11 mg/kg at SS4 to 38 mg/kg at SS1. These sodium levels are not excessively high and do not indicate sodic soil conditions that could lead to soil dispersion or structural instability during construction. Potassium levels range from 0.1 mg/kg at SS3, SS4, SS5 and SS9 to 2.2 mg/kg at SS8. Ammonium concentrations range from 0.009 mg/kg at SS6 to 0.043 mg/kg at SS4 across all ten sampling locations, consistently low and in line with natural background levels, with no anomalous readings observed. Overall, the exchangeable cation profile indicates low base cation presence with no evidence of chemical contamination or imbalance.

Exchangeable Anions

Sulphate concentrations range from 18 mg/kg at SS2 to 53 mg/kg at SS4. Nitrate concentrations range from 24.3 mg/kg at SS2 to 103.1 mg/kg at SS9. Phosphate concentrations range from 0.08 mg/kg at SS9 to 1.05 mg/kg at SS5. Chloride concentrations range from 0.3 mg/kg at SS1 to 2.8 mg/kg at SS3. All anion concentrations are within levels consistent with natural soil background conditions and do not indicate pollution or chemical accumulation within the project footprint.

Heavy Metals

Heavy metal concentrations across all sampling locations are generally very low. Iron ranges from 0.33 mg/kg at SS10 to 1.09 mg/kg at SS1. Copper ranges from 0.00 mg/kg at SS10 (not detected) to 0.42 mg/kg at SS2. Zinc ranges from 0.027 mg/kg at SS8 to 1.550 mg/kg at SS2. Manganese ranges from 0.009 mg/kg at SS10 to 0.316 mg/kg at SS1. Chromium concentrations are very low, ranging from 0.01 mg/kg at SS9 to 0.61 mg/kg at SS6. Cobalt concentrations are similarly low, with most locations recording no detectable cobalt and a maximum of 0.01 mg/kg at SS1. Mercury was not detected in any of the ten sampling locations, recording 0.000 µg/kg across all samples. Lead was likewise not detected in any sampling location, recording 0.000 µg/kg across all samples. The absence of mercury and lead and the very low concentrations of all other heavy metals confirm that the soil environment within and around the project footprint is free from heavy metal contamination and presents no elevated risk to workers, the environment or the proposed infrastructure during construction or operation.

Soil Characteristics

Loam content across the sampling locations ranges from 36% at SS6 to 73% at SS4, confirming loam as the dominant soil fraction across the site. Sandy content ranges from 11% at SS4 to 47% at SS6. Clay content ranges from 2% at SS10 to 16% at SS8, with generally low clay fractions across most locations. [I need clarification on this one, bestie, see note below.]

One clarification needed, bestie, your lab sheet has a fourth soil characteristic row simply labelled "Soil" (row 27, values ranging 2% to 14%), sitting alongside Loam, Sandy, and Clay. This is likely meant to be "Silt" given standard soil texture classification (loam, sand, clay, silt), but I don't want to relabel a lab parameter without your confirmation. Can you confirm if that fourth row should read as Silt content, or something else?

Microbiological Parameters

E. coli counts range from 4 cfu/100/kg at SS4 to 23 cfu/100/kg at SS5. Fungal counts range from 59 cfu/100/kg at SS4 to 248 cfu/100/kg at SS5. These values reflect natural background microbial activity typical of cultivated surface soils and do not indicate any abnormal biological contamination within the project footprint. No public health or environmental risk is associated with these microbiological findings in the context of the proposed project.

4.3.3 Water Quality Assessment

Water quality assessment was conducted to establish the baseline condition of water resources within the project area prior to project implementation. Five sampling points were assessed, comprising one Ground Water sample from within the AUST campus, two surface water samples designated Stream I and Stream II, and paired Upstream and Downstream samples from a third surface water body designated Stream III, all located within the Area of Influence. Samples were analyzed for physicochemical, chemical, heavy metal and microbiological parameters to determine existing water quality conditions relative to applicable Federal Ministry of Environment (FMEnv) limits. GPS coordinates for the sampling locations are presented in the results table.

Analysis of Water Sample Results

Physicochemical Characteristics

The Ground Water, Stream I and Stream II samples present as clear and odourless with tasteless water, consistent with acceptable aesthetic quality. Stream III presents differently at both sampling points, recording a dark brownish colouration upstream and cloudy appearance downstream, consistent with the presence of an active dumpsite situated immediately beside the stream just outside the University's perimeter fence.

pH values range from 7.13 at Stream III Upstream to 7.56 at Stream II, all within the FMEnv recommended range of 6.5 to 8.5. Total Dissolved Solids (TDS) range from 45 mg/l at the Ground Water point to 145 mg/l at Stream III Upstream, all well below the FMEnv limit of 500 mg/l. Electrical conductivity ranges from 90 µS/cm at the Ground Water point to 293 µS/cm at Stream III, all below the FMEnv limit of 1,000 µS/cm.

Total Suspended Solids (TSS) exceed the FMEnv limit of 20 mg/l at every sampling point, ranging from 26 mg/l at Stream I to 136 mg/l at Stream III Upstream. The exceedance is most pronounced at Stream III, attributable to the adjacent dumpsite and associated surface runoff, while the marginal exceedance recorded at the Ground Water point and Stream I and II warrants continued monitoring, though it does not indicate a project related impact given that baseline sampling preceded any project activity.

Dissolved oxygen ranges from 4.5 mg/l at Stream I to 5.1 mg/l at Stream III Downstream, all within the FMEnv range of 2 to 8 mg/l, indicating adequate oxygenation across all sampling points. BOD values range from 2.1 mg/l to 3.4 mg/l across all locations, with no FMEnv standard specified for this parameter. Salinity is negligible, recording 0.00% at the Ground Water point, Stream I and Stream II, and 0.01% at Stream III.

Overall, the physicochemical parameters indicate generally acceptable baseline water quality across most measured indicators, with the exception of Total Suspended Solids, which exceeds the regulatory limit at all sampling points and is most severe at Stream III due to its proximity to an existing dumpsite outside the campus boundary.

Chemical Characteristics

Calcium concentrations range from 3.1 mg/l at the Ground Water point to 37.1 mg/l at Stream III Downstream, well below the FMEnv limit of 200 mg/l. Magnesium ranges from 1.8 mg/l at the Ground Water point to 29.0 mg/l at Stream III Upstream, exceeding the FMEnv limit of 20 mg/l at both Stream III sampling points, again consistent with the influence of the adjacent dumpsite. Sodium concentrations range from 6 mg/l at Stream II to 18 mg/l at Stream III Upstream, all within the FMEnv limit of 20 mg/l.

Sulphate concentrations range from 2.6 mg/l at the Ground Water point to 12.3 mg/l at Stream III Upstream, all below the FMEnv limit of 100 mg/l. Nitrate concentrations range from 3.4 mg/l at Stream I to 11.3 mg/l at Stream III Upstream, well within the FMEnv limit of 50 mg/l. Chloride concentrations are very low, ranging from 0.05 mg/l to 1.55 mg/l, well within the FMEnv limit of 150 mg/l. Phosphate concentrations range from 3.6 mg/l at the Ground Water point to 8.2 mg/l at Stream III Downstream, with no FMEnv limit specified for this parameter. Ammonium data was not recorded for any sampling location and is flagged for follow up with the laboratory.

Overall, chemical concentrations across most sampling locations are within acceptable limits, with the exception of Magnesium, which exceeds the regulatory limit at Stream III, reinforcing the earlier finding

that this receptor is already under environmental pressure from the adjacent dumpsite rather than from any project related source.

Heavy Metals

Zinc concentrations range from 0.11 mg/l at Stream II to 0.48 mg/l at Stream III Upstream, all within the FMEnv limit of 3.0 mg/l. Copper concentrations range from 0.14 mg/l at Stream I to 0.56 mg/l at Stream III Upstream, all within the FMEnv limit of 1.5 mg/l. Lead was detected at every sampling point, ranging from 0.003 µg/l at Stream I to 0.076 µg/l at Stream III Upstream, exceeding the FMEnv limit of 0.001 µg/l across all five sampling locations, including the Ground Water source. This finding warrants attention independent of the Stream III dumpsite influence, as it affects the campus groundwater source as well. Mercury was not detected at the Ground Water and Stream I sampling points, was recorded at the FMEnv limit of 0.001 µg/l at Stream II, and significantly exceeded the limit at Stream III, recording 0.074 µg/l upstream and 0.072 µg/l downstream. Iron concentrations range from 0.22 mg/l at the Ground Water point to 0.99 mg/l at Stream III Upstream. The FMEnv limit of 0.3 mg/l is exceeded only at Stream III, while the Ground Water, Stream I and Stream II sources remain within limit.

Chromium was not detected at the Ground Water and Stream II points and recorded only a trace 0.01 mg/l at Stream I, but exceeded the FMEnv limit of 0.05 mg/l at Stream III, recording 0.13 mg/l upstream and 0.10 mg/l downstream. Nickel concentrations at the Ground Water, Stream I and Stream II points remain within the FMEnv limit of 0.07 mg/l, ranging from 0.027 to 0.031 mg/l, but Stream III significantly exceeds this limit, recording 0.288 mg/l upstream and 0.268 mg/l downstream. Cobalt concentrations follow the same pattern, remaining within the FMEnv limit of 0.2 mg/l at the Ground Water, Stream I and Stream II points, but exceeding it at Stream III, recording 0.398 mg/l upstream and 0.364 mg/l downstream.

Taken together, these results confirm that Stream III is significantly impacted across nearly every heavy metal parameter tested, consistent with its proximity to the adjacent dumpsite, and should be treated as an already degraded receptor requiring protection from any additional project related pressure during construction. Separately, the lead exceedance recorded across all sampling points, including the campus Ground Water source, is a finding that stands apart from the Stream III dumpsite narrative and should be flagged for further investigation and, if confirmed, appropriate water treatment guidance for campus use.

Microbiological Characteristics

E. coli was detected at every sampling point, ranging from 2 cfu/ml at the Ground Water point to 16 cfu/ml at Stream III Upstream, exceeding the FMEnv limit of nil for potable water across all five locations. This includes the campus Ground Water source, indicating that even this source carries some level of microbial contamination at baseline, in addition to the more pronounced detection at the stream sampling points, consistent with their open exposure to environmental contamination pathways and, for Stream III, the adjacent dumpsite. Total coliform counts range from 7 cfu/ml at the Ground Water point to 301 cfu/ml at Stream III Upstream. Against the FMEnv limit of 10 cfu/ml, the Ground Water source falls within an acceptable range, while Stream I (53 cfu/ml), Stream II (56 cfu/ml), and Stream III (301 cfu/ml upstream, 296 cfu/ml downstream) all exceed the limit substantially, with Stream III recording the most severe contamination by a wide margin.

Overall, the microbiological results reinforce the picture established by the physicochemical and heavy metal findings, Stream III is heavily impacted by the adjacent dumpsite and should not be considered a safe water source in its current state, while the Ground Water source, though within acceptable range for total coliform, shows a low level baseline E. coli detection.

Environmental Safeguard Considerations

The water quality results establish the existing baseline condition of water resources within the project Area of Influence. The identified exceedances, including Total Suspended Solids across all sampling points, Magnesium, Chromium, Nickel, Cobalt, Iron, Mercury and elevated microbiological counts at Stream III, along with Lead and E. coli detection across all sampling locations including the campus Ground Water source, represent pre-existing conditions unrelated to the proposed project. The Stream III exceedances are attributed to an active dumpsite situated immediately beside the stream, just outside the University's perimeter fence, while the Ground Water findings on Lead and E. coli warrant separate investigation and are not linked to the dumpsite. These baseline conditions shall be maintained and not worsened during construction and operational phases.

Project activities including site clearing, earthworks, cable trenching, material storage and equipment maintenance shall be managed to prevent contamination of the campus Ground Water supply and the surface water bodies within the Area of Influence, particularly Stream III given its already degraded condition. Specific measures including erosion and sediment controls along the cable trench route, spill prevention for fuels and lubricants, and prohibition of waste disposal near water sources shall be implemented and detailed in the ESMP. Periodic water quality monitoring of all sampling locations during construction is recommended to detect any project related changes against this established baseline, alongside recommended follow up testing to confirm the Lead and Ammonium findings noted earlier.

4.3.4 Air Quality and Noise Measurement

Ambient air quality and noise measurements were conducted at ten monitoring locations designated AQ1 to AQ10 across the proposed project site and surrounding Area of Influence. Parameters assessed include gaseous pollutants, particulate matter, total volatile organic compounds, formaldehyde and ambient noise levels.

Gaseous Parameters

Nitrogen dioxide (NO_2) concentrations range from 0.0 ppm to 0.8 ppm across the ten monitoring locations, with a single exceedance recorded at AQ4 (0.8 ppm) against the FMEnv limit of 0.4 ppm, while all other locations remain within limit. Carbon monoxide (CO) was detected at low levels across all monitoring points, ranging from 1 to 2 ppm, well within the FMEnv limit of 10 ppm. Chlorine gas concentrations range from 0.0 ppm to 1.3 ppm at AQ8, exceeding the FMEnv limit of 0.02 ppm at eight of the ten monitoring locations, with only AQ1 and AQ4 recording no detectable chlorine. Sulphur dioxide concentrations similarly range from 0.0 ppm to 1.1 ppm at AQ4, exceeding the FMEnv limit of 0.02 ppm at seven of the ten monitoring locations. These exceedances warrant further investigation and should inform air quality monitoring protocols during project construction.

Nitrous oxides (NOx) concentrations range from 0.000 ppm at several locations to 0.006 ppm at AQ6, all well within the FMEnv limit of 0.4 ppm. Hydrogen cyanide was detected only marginally at AQ4 (0.01 ppm), with all other locations recording 0.00 ppm, within the FMEnv limit of 0.05 ppm. Ammonia, phosphine and methane were not detected at any monitoring location.

Particulate Matter

PM2.5 concentrations range from 20 µg/m³ at AQ8 to 30 µg/m³ at AQ5. Five monitoring locations recorded values exceeding the FMEnv limit of 25 µg/m³, specifically AQ1 (27 µg/m³), AQ2 (29 µg/m³), AQ5 (30 µg/m³), AQ9 (29 µg/m³) and AQ10 (29 µg/m³). Given that measurements were taken during the

wet season, when dust levels are generally suppressed, these exceedances are more likely attributable to localised activity or nearby vehicular traffic along the express corridor connecting to the Galadimawa Roundabout, rather than fugitive dust from dry season conditions.

PM10 concentrations range from 26 µg/m³ at AQ8 to 39 µg/m³ at AQ4. No FMEnv limit is specified for this parameter within the dataset.

Other Organic Parameters

Total Volatile Organic Compounds (TVOC) range from 0.003 mg/m³ at AQ7 to 0.05 mg/m³ at AQ1, reflecting generally low organic compound concentrations consistent with a non-industrial environment. Formaldehyde (HCHO) concentrations range from 0.008 mg/m³ at AQ6 to 0.046 mg/m³ at AQ8, within levels generally consistent with background conditions.

Ambient Noise Levels

Ambient noise levels recorded across the ten monitoring locations range from 59.8 dB at AQ4 to 69.2 dB at AQ2, all well within the FMEnv occupational exposure limit of 85 dB. Noise levels are fairly consistent across the site, reflecting an institutional campus environment without significant localised noise anomalies.

Table 6: Results of Soil Sampling

S/N	PARAMETERS	UNIT	AUST SS1	AUST SS2	AUST SS3	AUST SS4	AUST SS5	AUST SS6	AUST SS7	AUST SS8	AUST SS9	AUST SS10
(A) PHYSICAL TES												
1.	Colour	Tcu	Dark Brown	Brown	Dark Brown	Dark Brown	Dark Brown	Brown	Very Dark Brown	Dark Brown	Brown	Brown
2.	PH	-	6.62	6.17	6.09	6.24	6.53	6.88	6.47	6.59	6.83	6.99
3.	Electrical conductivity	us/cm	1895	1291	1626	1338	1496	1039	994	1840	1039	1152
4.	ORP	mV	399	346	284	322	296	359	301	244	247	255
5.	Salinity	%	0.02	0.02	0.04	0.04	0.04	0.03	0.03	0.02	0.01	0.02
(B)	**EXCHANGEABLE CATION**											
6.	Calcium	mg/kg	2.61	4.68	5.58	5.64	4.60	3.52	8.01	7.09	2.55	1.86
7.	Magnesium	mg/kg	0.17	0.29	0.13	1.47	1.49	1.03	0.46	0.52	1.32	0.59
8.	Sodium	mg/kg	38	27	31	11	15	23	30	22	14	19
9.	Potassium	mg/kg	0.3	0.2	0.2	0.1	0.1	0.2	0.3	2.2	0.1	0.6
10.	Ammonium	mg/kg	0.031	0.022	0.020	0.043	0.034	0.009	0.021	0.034	0.026	0.011
(C)	**EXCHANGEABLE ANION**											
11.	Sulphate	mg/kg	28	18	27	53	27	35	29	48	37	21
12.	Nitrate	mg/kg	41.7	24.3	29.0	35.6	58.1	29.8	62.8	41.9	103.1	44.5
13.	Chloride	mg/kg	0.3	1.4	2.8	2.0	1.9	0.8	0.6	0.5	2.3	1.4
14.	Phosphate	mg/kg	0.86	0.59	0.47	0.27	1.05	0.56	0.17	0.19	0.08	0.17
(D)	**HEAVY METALS**											
16.	Chromium	mg/kg	0.03	0.12	0.27	0.02	0.25	0.61	0.21	0.32	0.01	0.11
17.	Zinc	mg/kg	1.034	1.550	1.056	0.992	1.430	0.112	0.431	0.027	0.569	0.436
18.	Iron	mg/kg	1.09	0.68	0.51	0.43	0.58	0.51	0.34	0.72	0.42	0.33
19.	Cupper	mg/kg	0.21	0.42	0.28	0.11	0.21	0.23	0.05	0.09	0.17	0.00
20.	Manganese	mg/kg	0.316	0.041	0.087	0.021	0.074	0.0360	0.022	0.020	0.138	0.009
21.	Cobalt	mg/kg	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22.	Mercury	ug.kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

23.	Lead	ug/kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
(E)	**SOIL CHARACTERISTICS**											
24.	Loam	%	58	63	54	73	49	36	69	51	58	61
25.	Sandy	%	29	21	28	11	34	47	14	28	21	30
26.	Clay	%	6	9	11	4	5	13	5	16	9	2
27.	Soil	%	3	9	12	14	8	9	3	2	8	5
(F)	**ORGANICS**											
28.	Phenols	mg/kg	0.037	0.041	0.031	0.123	0.018	0.002	0.056	0.002	0.043	0.001
29.	BTEX	mg/kg	0	0	0	0	0	0	0	0	0	0
30.	Oil & grease	mg/kg	0	0	0	0	0	0	0	0	0	0
(G)	**MICROBIOLOGICAL TEST**											
31.	E. coli	cfu/100/kg	15	21	18	4	23	5	22	7	7	5
32.	Fungal	cfu/100/kg	87	93	156	59	248	63	209	74	80	60

Table 7: Results of Water Sampling

S/N	PARAMAMETERS	UNIT	GROUND WATER	SURFACE WATER STREAM I	SURFACE WATER STREAM II	STREAM III		FMENT LIMIT
						UPSTREAM	DOWN STREAM	
(A)	**COORDINATES**							
1.	Latitude	N	8.996942	8.999127	8.999132	8.9997425	8.997413	-
2.	Longitude	E	7.41436	7.41639	7.41640	7.42041	7.42039	-
(B)	**PHYSICOCHEMICAL**							
3.	Colour	Tcu	Clear	Clear	Clear	Dark brownish	Cloudy	Clear
4.	Odour	-	Odourless	Odourless	Odourless	Odourless	Odourless	Unobjectionable
5.	Taste	-	Tasteless	Tasteless	Tasteless	ND	ND	Unobjectionable
6.	PH	-	7.55	7.52	7.56	7.13	7.14	6.5-8.5
7.	Total dissolve solid	mg/l	45	50	57	145	144	500
8.	Electrical conductivity	us/cm	90	100	114	293	293	1000
9.	Temperature	o c	29.9	30.8	29.6	30.0	30.1	Ambient
10.	Salinity	%	0.00	0.00	0.00	0.01	0.01	<1000

11.	Total suspended solid	mg/l	27	26	33	136	108	20
12.	ORP	mV	28	30	38	45	40	200-600
13.	Dissolve oxygen	mg/l	4.9	4.5	4.8	5.0	5.1	2-8
14.	B.O.D	mg/l	2.1	2.3	3.0	2.8	3.4	NS
(C)	**CHEMICAL TEST**							
15.	Calcium	mg/l	3.1	3.6	4.0	30.6	37.1	200
16.	Magnesium	mg/l	1.8	2.7	3.1	29.0	26.0	20
17.	Ammonium	mg/l						NS
18.	Potassium	mg/l	2.8	3.4	4.2	14.8	11.2	20
19.	Sulphate	mg/l	2.6	3.0	3.3	12.3	10.2	100
20.	Nitrate	mg/l	4.2	3.4	4.6	11.3	9.8	50
21.	Sodium	mg/l	7	11	6	18	13	20
22.	Phosphate	mg/l	3.6	4.4	3.8	7.4	8.2	NS
23.	Chloride	mg/l	0.05	0.06	0.09	1.55	1.16	150
24.	Nitrate	mg/l	0.012	0.016	0.017	0.262	0.248	0.2
(D)	**HEAVY METALS**							
25.	Zinc (Zn^{2+})	mg/l	0.12	0.13	0.11	0.48	0.35	3.0
26.	Iron (Fe^{2+})	mg/l	0.22	0.26	0.23	0.99	0.96	0.3
27.	Cupper (Cu^{2+})	mg/l	0.20	0.14	0.18	0.56	0.38	1.5
28.	Chromium (Cr^{3+})	mg/l	0.00	0.01	0.00	0.13	0.10	0.05
29.	Lead (Pb^{2+})	ug/l	0.006	0.003	0.005	0.076	0.045	0.001
30.	Cobalt (Co^{2+})	mg/l	0.018	0.023	0.020	0.398	0.364	0.2
31.	Mercury (Hg^{+})	ug/l	0.000	0.000	0.001	0.074	0.072	0.001
32.	Nickel (Ni^{2+})	mg/l	0.027	0.031	0.029	0.288	0.268	0.07
(E)	**ORGANIC**							
33.	Phenols	mg/l	0.000	0.001	0.000	0.143	0.126	0.05
34.	Oil and grease	mg/l	0	0	0	0	0	0
35.	BTEX	mg/l	0	0	0	0	0	0
(F)	**MICROBIOLOGICAL TEST**							
36.	E.coli	cfu/ml	2	11	10	16	13	Nil
37.	Total coliform	cfu/ml	7	53	56	301	296	10

Table 8: Air Quality and Noise Measurements

S/N	PARAMETERS	UNIT	AUST AQ1	AUST AQ2	AUST AQ3	AUST AQ4	AUST AQ5	AUST AQ6	AUST AQ7	AUST AQ8	AUST AQ9	AUST AQ10	
	Latitude	N	8.8997	8.999129	8.999339	8.995026	8.997413	8.997413	8.998221	8.997941	8.994381	8.995684	-
	Longitude	E	7.420392	7.416738	7.423771	7.416996	7.419716	7.42092	7.417915	7.418291	7.418625	7.418925	-
	Hydrogen cyanide	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
	Ammonia gas	ppm	0	0	0	0	0	0	0	0	0	0	0.02
	Nitrogen (iv) oxide		0.0	0.2	0.1	0.8	0.0	0.2	0.1	0.1	0.2	0.1	0.4
	TVOC	mg/m^3	0.05	0.009	0.014	0.006	0.013	0.004	0.003	0.006	0.009	0.006	-
	PM 2.5	ug/m^3	27	29	21	23	30	22	24	20	29	29	25
	HCHO	mg/m^3	0.009	0.019	0.015	0.016	0.015	0.008	0.011	0.046	0.016	0.009	-
	PM 10	ug/m^3	35	30	27	39	38	28	38	26	38	38	-
	Chlorine gas	ppm	0.0	0.1	0.2	0.0	0.3	0.3	0.4	1.3	0.1	0.1	0.02
	Carbon (ii) oxide	ppm	1	2	2	1	1	2	2	2	1	2	10
	Sulphide (iv) oxide	ppm	0.3	0.2	0.1	1.1	0.2	0.1	0.0	0.0	0.1	0.0	0.02
	Nitrous (NOx)	ppm	0.000	0.001	0.000	0.002	0.003	0.006	0.003	0.002	0.003	0.001	0.4
	Sound level	dB	62.3	69.2	63.3	59.8	61.3	60.2	62.8	64.0	61.1	65.4	85
	Phosphine	ppm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
	Methane	ppm	0	0	0	0	0	0	0	0	0	0	-
	AQI	-	Excellent	Excellent	Excellent	Good	Good	Excellent	Excellent	Good	Excellent	Excellent	

4.4 Biological Environment

Terrestrial Flora

The project area features the classic Guinea savanna vegetation, characterized by a mix of lush grasslands and scattered woodland trees. The vegetation within the Guinea Savanna and Sudan savanna transitional Eco region, characterized by open woodlands, tall grasses, and lush, drought resistant shrubs interspersed with expanding built u areas. The specific vegetation dyanamics include flora dominated by drought tolerant, deep rooted trees such as (*Parkia biglobosa* and *Daniella oliveri*) and a dense understory of guinea grass that goes green during the rainy season and turns dry during the harmattan.

Sampling Methodology and Data Acquisition

Vegetation Assessment

Sampling methods adopted for vegetation assessment were in accordance with the acceptable international standards. The "Belt Transects Method" (which allows for acquisition of information on density of flora composition of the area) was used for assessment of the vegetation at every sampling location. Both in-situ and ex-situ identification of plant specimens were conducted both in the field and herbarium respectively using appropriate Manuals and Monographs.

Representative samples of plant species in the study area were collected and prepared as standard herbarium specimens, using appropriate techniques. The preserved specimens would serve as permanent records of the vegetation and floristic composition of the study area. Each specimen would always be available for study or quick reference in connection with any future operations in any of the study locations referred to in the future.

Results

Vegetation assessment was carried out at the Project site. A transect size of 50 square meters was adopted for proper assessment of species. Assessment of vegetation at various sampling locations was based on the following:

- Vegetation types encountered
- Plant species distribution and richness
- Inventory of economic plants

The ecological status of the species encountered was evaluated and classified appropriately according to the following threat categories (*IUCN Red List of Threatened Species Version 2018-1*) as may be applicable (Table 9).

Table 9: Plant species, classification and IUCN status

S/N	BOT NAME	COMMON NAME	FAMILY	HABIT	IUCN STATUS	USES/ IMPORTANCE
1.	*Anacdium occidentale* L	Cashew	Anacardiaceae	Tree	Least concern (IUCN 3.1)	Fruit edible, seeds used as snacks and medicinal plants
2.	*Magifera indica* L	Mango	Anacardiaceae	Tree	Least Concern (IUCN 3.1)	Food and medicinal purposes
3.	*Chromolaena odorata* (L) R.M.King and H.Rob	Jack in the bush	Asteraceae	Shrub	Least Concern (IUCN 3.1	Traditional Medicinal uses.
4.	*Vitex doniana Sweet*	Black plum	Lamiaceae	Tree	Least Concern (IUCN 3.1)	Threatened and vulnerable.

5.	*Monoon longifolium* Sonn.BXue and R.M.K. Saunders	Masquerade plant. Indian Mast Tree	Annonaceae	Tree	Least Concern (IUCN 3.1)	Ornamental purposes and Medicinal uses.
6.	*Azadirachta indica* A.Juss	Neem	Meliaceae	Tree	Least Concern (IUCN 3.1)	Food, Insecticides and medicinal plant.
7.	*Parkia biglobosa (Jacq*) R.Br ex G.DonS	African locust bean	Fabaceae	Tree	Least Concern (IUCN 3.1)	Food, Animal feed and Medicinal uses.
8.	*Ficus* species (L)	Fig trees or Figs	Moraceae	Tree	Least Concern (IUCN 3.1)	Useful latex , agricultureand medicinal uses.
9.	***Tectona*** *grandis* L.f	Teak	Lamiaceae	Tree	Endangered (IUCN 3.1)	Wood and medicinal plant
10.	*Gmelina arborea* (Roxb)	Beechwood	Lamiacea	Tree	Least concern	Durable wood, furniture, construction and paper pulp. Traditional medicine and food.
11.	*Bauhinia variegata* (L) Benth.	Orchid tree and mountain ebony	Fabaceae	Tree	Least Concern (IUCN 3.1)	Traditional uses, medicine, landscaping and nutrition.
12.	*Piliostigma thonningii* (Schum.) Milne.Redh	Carmel´s foot tree and monkey bread.	Fabaceae	Tree	Unassessed globally but in Nigeria of National priority.	Traditional medicine, Ecological uses and materials and craft.
13.	*Phoenix dactilifera* L	Date alm	Arecaceae	Tree	unassessed	Food, traditional modern medicine
14.	*Daniella oliveri*(Rolfe) Hutch, and Dalziel	African coaida balsam tree	Fabaceae	Tree	Least Concern (IUCN 3.1)	Furniture, flooring, and plywood. Traditional medicine.
15.	*Senna siamea* (lam.) Irwin et Barneby	Cassia tree	Fabaceae	Tree	Least Concern (IUCN 3.1)	Decorative timber, excellent fuel wood, land restoration capabilities and medicinal plant.
16.	*Terminalia neotaliala* Capuron	Madagascar almond	Combretaceae	Tree	Vulnerable (IUCN 3.1)	Ornamental plant and medicinal plant.
17.	*Adansonia digitata* (L)	African baobab	Malvaceae	Tree	Least Concern (IUCN 3.1)	Food, water, health remedies and or places of shelter
18.	*Roystonea oleraceae* Kunth O.F. Cook	Royal alm	Arecaceae	tree	Least concern	Ornamental plant, oil, livestock, wood and medicinal uses
19.	*Dichrostachys cinerea* Wight et Arin	Sicklebush or Kalahari Christmas tree	Fabaceae	Shrub and small tree	Least concern	Medicinal plant

20.	*Terminalia neotaliala* Capuron	Madagascar almond tree	combretaceae	Tree	Least concern	Ornamental plant, provides shade and medicinal plant
21.	*Euhorbia kamerunica* Pax	Cactus	Euphorbiaceae	Shrub	Unassessed	Used for Fencing and medicinal uses.

*Crops grown in the area include Ground nut (Arachis hyogea)**,** Bambara nut (Vigna subterranea), Maize (Zea mays L) and Hibiscus vitifolius.*

Terrestrial Fauna

Field surveys were conducted to determine the types of wildlife present within the study area. Fauna species were taxonomically identified, and biodiversity statuses were verified.

The sampling methods adopted for wildlife assessment were in accordance with the acceptable international standards. Indirect survey methods (footprint, nest type, feeding site, voice, faecal samples and shell types) were used. Semi-structured interviews of locals were conducted to ascertain the diversity of fauna assemblage endemic to the study area. This was carried out to provide complementary information about the animals found in the study area. The study area recorded very minimal presence of fauna. Table 10 presents some of the species encountered in the study area.

Table 10: Fauna species within the study area

Fauna Species	Common name	Family	IUCN
Domestic animals within the study area			
Bos bovidae	Cow	Bovidae	LC
Ovis aries	Sheep	Bovidae	LC
Capra aegagrus hircus	Goat	Bovidae	LC
Canis lupus familiaris	Dog	Canidae	LC
Gallus gallus domesticus	Chicken	Phasianidae	LC
Numida meleagris	Guinea fowl	Numididae	LC
Wildlife in the study area			
Dilacodes lefebvrii.(Rambur)	Black percher	Libellulidae	LC
Phaon iridispennis	Glistening demoiselle	Calopterygidae	LC
Chilocorinae. mulsant	Lady bug	Coccinelloidae	LC
Papillio demodocus.Esper	Citrus swallow tail butterfly	Papilioidae	LC
Acheta domestics L	Noise making cricket	Gryllidae	LC
Spodoptera exempta.Walker	African army worm	Noctuidae	LC
Palpopleura lucia.Drury	Lucia widow	Libelloidea	LC
Danaus chrysippus L	Plain tiger butterfly	NymPhalidae	LC
*Agama agama.*L	Red headed rock agama	Agamidae	LC
Bufo bufo . L	Common toad	Bufonidae	LC
Rana temporaria L	Common frog	Ranidae	LC
Bird species in the study area			
Columbia guinea. LC	Speckled pigeon	Columbidae	LC
Columbia livia Gmelin J.J.F. LC	Rock dove	Columbidae	LC

***S**pilopelia senegalensis.L*	Laughing dove	Columbidae	LC
Streptopelia semitoquata Ruppell	Red Eyed dove	Columbidae	LC
Turtur afer L	Blue spotted wood dove	Columbidae	LC
Pycnonotus barbatus. Desfontaines	Common bulbul	Pycnonotidae	**LC**
Malvus migrans LC	Black Kite	Accipitriformes	**LC**
Corvus albus.L	Pied crow	Corvidae	**LC**
Lophoceros nastus L	African grey hornbill	Bucerotidae	**LC**
Uraeginthus bengalus. L	Red cheek cordon bleu	Estrrdidae	**LC**
Ploceus cucullata. LC	Village weaver	Ploceidae	**LC**
Euplectes franciscanus. Isert	Northern Red Bishop	Ploceidae	**LC**
A*pus barbatus.*Sclater, PL	Black swift	Apodidae	**LC**

4.5 Socio-Economic Assessment

This section covers the socioeconomic and health assessment of the identified communities and stakeholder groups within the project Area of Influence. The assessment provides a description of existing conditions which is essential to the identification of potential impacts of the proposed project on the human environment.

The socioeconomic environment around the project area is shaped by the presence of the African University of Science and Technology (AUST) and its associated institutional population comprising students, academic staff, non-academic staff within the campus premises, together with nearby stakeholder groups including the estate and the traders, transporters and commercial motorcyclists operating at the Galadimawa Roundabout. The broader Area of Influence is further characterised by the express road corridor linking the campus to Ring Road 2 and the Galadimawa Roundabout, which together define the economic and physical context of the surrounding environment.

Target Population for the Study and Sample Size

The target populations and stakeholders for this study comprise the university students and staff population, together with nearby stakeholder groups including the estate and the traders, transporters and commercial motorcyclists operating at the Galadimawa Roundabout. The study employed a sequential mixed methods research design, combining structured questionnaires for quantitative data gathering with Focus Group Discussions (FGDs), Key Informant Interviews (KIIs), and stakeholder consultations for qualitative data gathering. The primary population at AUST is the institutional community of students and staff who are the direct beneficiaries of the proposed project and who live and work within and around the project environment. A sample size of 100 respondents was determined using the Cochran Formula at a 95% confidence level and a 5% margin of error, with a 10% non-response rate adjustment. Respondents were selected using a systematic sampling technique to ensure fair representation across gender, age, occupation and community category.

Ethical Considerations

All interviews were undertaken with the informed written consent of participants. Confidentiality and anonymity were maintained through secure storage of data in password protected computers and under lock and key. Participation was voluntary and respondents were allowed to withdraw at any point they feel uncomfortable to continue with the study.

Socio-Economic Characteristics of Respondents

Gender Distributions

The gender distribution of respondents indicates that 40% are male and 60% are female, reflecting a female majority within the Project Area of Influence (PAI). This distribution highlights the need for gender-inclusive project planning to ensure equitable participation in stakeholder engagement, employment opportunities, and access to the benefits of the proposed 4 MW Solar Hybrid Mini-Grid Project.

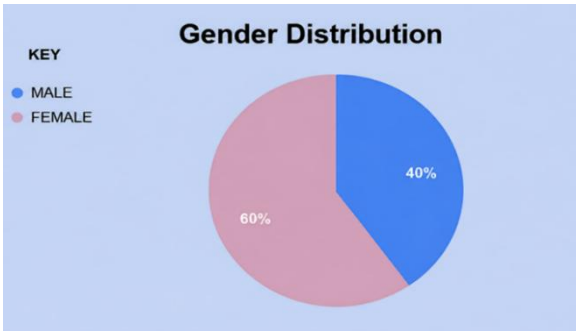

Figure 18: Gender Distribution

Age Distribution

Findings from the socio-economic survey conducted within the project's Area of Influence indicate that 5% of respondents are below 18 years of age, while 75% fall within the 18–30 age group. Additionally, 20% of respondents are aged 31–45 years while none fall within the 46–60 or above 60 years age categories. Overall, 95% of respondents are between 18 and 60 years of age, indicating that the survey population is predominantly composed of economically active individuals.

This distribution indicates a predominantly youthful and productive population engaged in academic, administrative and small-scale economic activities within the university and adjoining host communities. The proposed 4MW solar installation is expected to provide reliable power to support teaching, research, healthcare services and other socio-economic activities, while also stimulating small businesses and improving livelihoods within the project area of influence.

Furthermore, a reliable and stable electricity supply is expected to enhance learning outcomes, improve healthcare service delivery and strengthen security within the university and adjoining host communities through improved lighting and related infrastructure. It will also boost overall socio-economic productivity. The high proportion of working-age individuals provides a potential labor pool for temporary employment during construction as well as limited skilled and semi-skilled roles during the operational phase.

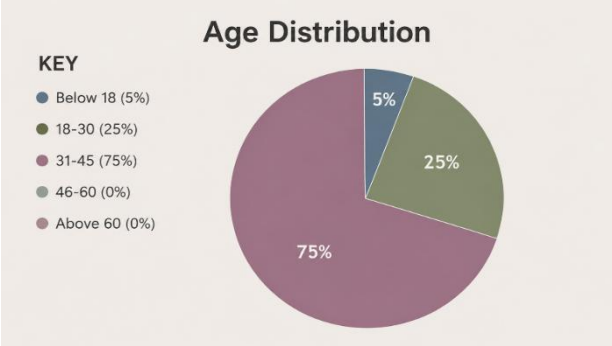

Figure 19: Age distribution

Educational Profile

Educational attainment within the Project Area of Influence (AOI) is high, reflecting the presence of the university. Most respondents (73%) have attained or are pursuing tertiary education, while 11% possess postgraduate qualifications. Secondary education accounts for 15% of respondents, only 1% reported having no formal education, and none identified primary education as their highest level of attainment.

The relatively high educational profile indicates a population with the capacity to support the adoption and effective use of modern infrastructure. The proposed 4 MW solar power project is expected to strengthen the learning environment by providing a more reliable electricity supply for teaching, research, laboratories, and digital learning, thereby supporting improved educational outcomes and institutional performance.

Economic Engagement / Occupation

The occupational profile of respondents reflects the university-based nature of the Project Area of Influence (PAI). Students constitute the largest proportion of respondents (45%), followed by university staff (30%). Other occupations include Traders (10%), Farmers (5%), Artisans (3%), Business owners (5%), and Civil servants (2%). This distribution indicates a socio-economically diverse population, with education-related activities dominating the local economy alongside small-scale trade, agriculture, entrepreneurship, and public service.

The proposed 4 MW solar power project is expected to provide temporary employment opportunities during the construction phase and support local economic activities through increased demand for goods and services. In the operational phase, improved energy reliability is expected to enhance teaching, research, administrative functions, and business productivity, thereby contributing to the socio-economic development of the AOI.

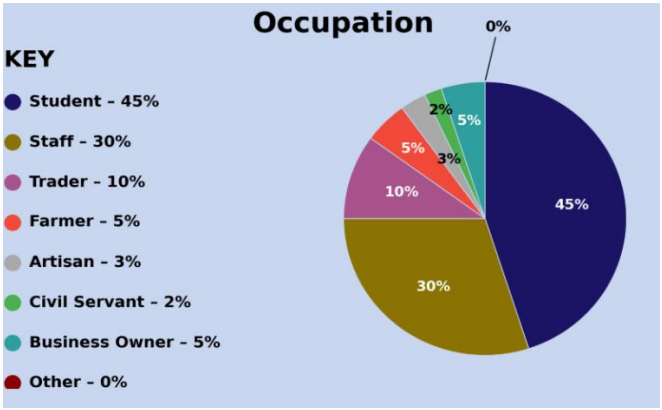

Figure 20: Occupation of respondents

Major Source of Electricity

The baseline survey indicates that 60% of respondents rely on the public electricity supply as their primary source of power, while 30% use solar energy and 10% depend on generators. None of the respondents reported having no source of electricity or relying on other sources.

The findings indicate that public electricity remains the dominant energy source within the Project Area of Influence (PAI), complemented by a notable level of solar energy adoption. The African University of Science and Technology (AUST) currently relies on alternative power sources to support its operations. These baseline conditions highlight the need for the proposed 4 MW solar photovoltaic installation, which will enhance energy reliability, reduce dependence on conventional power sources, and provide a more sustainable electricity supply for the university.

Income Levels

The income profile of respondents indicates a relatively diverse socioeconomic setting within the Project Area of Influence (PAI). The survey results show that 20% of respondents earn between ₦100,000 and

₦300,000 per month, while 25% reported monthly incomes above ₦300,000. No respondents reported earning below ₦100,000, and 55% preferred not to disclose their income level.

The findings suggest that while a significant proportion of respondents have moderate to high income levels, income disclosure remains limited among the surveyed population. In line with the AfDB Integrated Safeguards System (ISS), the proposed 4MW solar power project is expected to support socioeconomic development by improving electricity reliability, reducing dependence on costly alternative energy sources, and enhancing institutional and economic activities within the Project Area of Influence.

Waste management

Waste management within the AUST campus is handled through an organized institutional arrangement whereby a private waste management company licensed within the FCT collects and evacuates solid waste from the campus on a regular basis. This represents a more structured waste management system than is typical of peri-urban communities in the FCT, and reflects the institutional character of the project environment.

Access to Water:

AUST relies primarily on boreholes and water storage facilities to support academic activities, administrative operations, sanitation needs, and residential facilities. Sustained maintenance and management of this existing water infrastructure remains important to reliably meet the demand of the University's current student, staff and resident population. Overall, water supply within the Project Area of Influence is functional but requires continued upkeep to avoid pressure on existing resources.

Energy Source

Electricity supply within the African University of Science and Technology (AUST), Abuja and the surrounding Project Area of Influence (PAI) is currently characterized by limited reliability and dependence on alternative power sources. The university experiences challenges associated with inconsistent public electricity supply, which affects the smooth operation of academic, administrative, residential, and research activities.

Due to the unreliable nature of grid electricity, AUST relies on alternative energy sources, including diesel-powered generators, to maintain essential operations and ensure continuity of services. The intermittent power supply presents operational challenges for critical university facilities such as lecture rooms, laboratories, ICT infrastructure, administrative offices, and other facilities requiring stable electricity availability.

Similarly, surrounding communities, including Galadimawa community experience electricity supply limitations, resulting in increased reliance on alternative sources of energy. The inadequate power supply affects household activities, small-scale businesses, and local economic productivity, while also contributing to increased expenditure on fuel-based energy solutions.

The proposed 4MW Solar Hybrid Mini-Grid Project at AUST is expected to significantly improve energy security by providing a more reliable, sustainable, and cost-effective electricity supply for university operations. The project will support teaching, learning, research, and administrative activities, reduce dependence on diesel generators, lower operational costs, and contribute to improved socio-economic conditions within the Project Area of Influence.

Security and Conflict Situation

The security environment within the Project Area of Influence (PAI), comprising the African University of Science and Technology (AUST) and the surrounding Galadimawa community in the Federal Capital Territory (FCT), is generally stable. The area benefits from the presence of established security agencies, effective governance structures, and community-based security arrangements that support law and order. Baseline surveys, field observations, and stakeholder consultations indicate no recent incidents of armed conflict, terrorism, or significant communal unrest within the project area. Security at AUST is

maintained through institutional security personnel and controlled access, while Galadimawa relies on formal security agencies, community leaders, and local vigilante groups to address security concerns. Although occasional petty crimes associated with urban growth occur, these are not considered significant risks to project implementation.
During project implementation, appropriate security, occupational health and safety (OHS), stakeholder engagement, and grievance redress measures will be implemented to protect workers, students, and community members, while ensuring a safe and secure operating environment throughout the project lifecycle.

Socio-Cultural and Institutional Characteristics

Ethnicity, Language, Religion and Culture

Within the project Area of Influence, the AUST campus community comprises students, staff drawn from diverse ethnic, linguistic and religious backgrounds reflective of the University's national student intake, while the Galadimawa Roundabout stakeholder community, including traders, transporters and commercial motorcyclists, and the Knowledge Court residential estate, reflect the broader socio-cultural diversity characteristic of Abuja.

Institutional and Stakeholder Leadership Structures and Conflict Resolution

The Project Area of Influence does not fall under a traditional community leadership structure in the conventional sense, given that the University's internal population, students, and staff, is governed by AUST's institutional management structures, while the identified external stakeholder group at the Galadimawa Roundabout, comprising traders, transporters and commercial motorcyclists, operates under recognized trade unions led by elected union chairmen. These union chairmen provide leadership within their respective trade groups and play an important role in maintaining order, resolving disputes among members, facilitating group mobilization, and representing their members in engagement with external institutions and authorities.

Land Tenure and Ownership

Land tenure is the legal regime in which a parcel of land is possessed or occupied. In other words, the principal methods on land acquisition in Nigeria are inheritance, purchase, lease, pledge, exchange, and gift. Rights to land can only be exercised over when the piece of land must have been acquired in one way or another. The proposed Project site has been acquired by the state government for the establishment of the university. The University management has the authority to use the land for development projects to the benefit of the University. The site was allocated for the Project by the management and physical planning department of the University.

University Community Administrative Structure

The African University of Science and Technology (AUST), Abuja, operates under a structured administrative and academic management system appropriate to its status as a private, pan-African university. The University is headed by the President, who provides overall leadership for the University's academic, administrative, research and development activities. The President is supported by senior management officers, including the Bursar/Director of Finance, Academic Registrar, University Librarian, Director of Academic Planning and Associate Director of Operations, as well as Deans, Heads of Departments and heads of other academic and administrative units.

This administrative structure provides the institutional framework through which academic activities, university services and infrastructure development initiatives are coordinated and managed within the University environment. The Operations Unit, for example, is responsible for ensuring that University facilities and services remain functional and serviceable, including maintenance and related facility-management activities.

Governing Board and Institutional Governance

AUST's institutional governance is supported by a Board of Trustees, which is identified by the University as its governing board. The current Board of Trustees includes a Chairman/Director and other directors. The University's governance structure also includes the Governing Council, Senate and Student Council. AUST's President has identified the Board of Trustees as the highest decision-making body of the institution, with representation also drawn from the Governing Council, University Senate and Student Council. The Senate, comprising professors and Heads of Departments, provides oversight of academic matters, while the wider university governance structure supports institutional administration and decision-making. This governance framework provides the institutional basis for the planning, approval and implementation of University development initiatives, including infrastructure projects such as the proposed project.

4.5.1 Social Baseline Data Quality, Representation and Limitations

The socioeconomic assessment covered University management, academic and non-academic staff, students and stakeholder groups around the Galadimawa Roundabout. The existing draft provides useful qualitative information and graphical summaries; however, the final ESIA shall retain the underlying respondent counts and sex-, age- and stakeholder-disaggregated records so that the representativeness of the survey is transparent. No additional demographic values are introduced by this revision where the underlying survey dataset is not reproduced in the report.
The following information shall be retained in the final evidence file and, where available, summarized in the ESIA: sampling frame; number of respondents; male/female/other sex-disaggregated participation as appropriate; age categories; stakeholder category; location; livelihood/occupation; disability inclusion; vulnerable-group participation; consultation date; and principal issues raised. Any limitations arising from purposive or convenience sampling shall be disclosed rather than implying statistical representativeness.

4.5.2 Gender and Vulnerability Assessment

The project is being implemented in an active university environment where workers will interact with students, staff and nearby stakeholders. The ESIA therefore adopts a gender-responsive and vulnerability-sensitive approach. The draft records stakeholder expectations for inclusion of women in project-related opportunities and identifies GBV/SEA/SH as a major risk. The final implementation arrangements shall ensure that women, youth, persons with disabilities and other potentially vulnerable stakeholders have meaningful and safe access to information, consultation and grievance channels.

- Use sex- and age-disaggregated participation records for all subsequent consultations and training activities.
- Provide accessible consultation venues, communication formats and grievance channels for persons with disabilities and persons with limited literacy.
- Prohibit discrimination in recruitment, pay, training and promotion; apply transparent recruitment criteria and document local employment opportunities.
- Ensure confidential and survivor-centred handling of GBV/SEA/SH complaints, with referral to appropriate services and no requirement for survivors to disclose sensitive information through general grievance channels.
- Include women and vulnerable-group representatives in monitoring of project benefits, access and safety concerns.

4.5.3 Land Use, Land Tenure, Crops and Livelihood Screening

The proposed footprint is approximately 3 hectares within the secured AUST campus, and the baseline records do not show cultivated crops within the footprint. The fact that the project is located within the university perimeter is not, by itself, sufficient evidence that no third-party economic use or livelihood impact exists.

- Obtain documentary confirmation of the landholding/occupancy status of the 3-hectare footprint from AUST and the relevant competent authority.
- Complete a pre-clearance crop/user inventory identifying no land use by any individual or persons or household with a legitimate or customary use of the affected area.
- If no third-party rights, access restrictions or livelihood losses are confirmed, document the screening conclusion and evidence in the project file.
- If affected users or economic losses are confirmed, stop clearance of the affected area until the applicable AfDB OS5 and Nigerian compensation/livelihood requirements have been assessed and the required instrument is approved and implemented.
- No physical or economic displacement shall occur without completion of the applicable compensation and livelihood restoration process.

4.5.4 Cultural Heritage and Chance-Finds Screening

The draft does not identify known cultural heritage resources within the project footprint. Because construction will involve excavation and cable trenching, the final ESIA adopts a precautionary chance-finds procedure. This procedure applies even where no heritage resource was observed during reconnaissance.

1. Stop work immediately in the vicinity of a suspected archaeological, historical, burial or culturally significant discovery.
2. Secure and protect the discovery from disturbance, removal or unauthorized access.
3. Notify the Contractor E&S Manager, NEP-PMU/AUST representative and the competent cultural heritage authority, as applicable.
4. Arrange qualified specialist assessment and agree protection, documentation, salvage or other actions as required by the competent authority.
5. Resume work only after written/recorded authorization confirms that the required measures have been completed.

4.5.5 Traffic, Pedestrian and Campus Safety Baseline

The project is located within an active university campus, and equipment deliveries will interact with campus users and the Galadimawa access corridor. The existing draft identifies traffic and pedestrian safety risks but does not provide a quantified traffic count. The final contractor Traffic Management Plan shall therefore be preceded by a site verification of peak vehicle and pedestrian movements, delivery routes, crossing points and sensitive periods in the academic calendar. Where traffic count data are not available, the limitation shall be stated explicitly and controls shall be based on conservative site observations and actual delivery plans.

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 FIVE: POTENTIAL AND ASSOCIATED IMPACTS

5.1 Introduction

This chapter presents the assessment of the potential environmental and social impacts associated with the proposed Project at the African University of Science and Technology (AUST). The assessment identifies and evaluates the likely impacts that may arise from project activities across the different phases of implementation, namely pre construction, construction, operation, and decommissioning.

The impact assessment is based on the interaction between project activities described in Chapter Three and the baseline environmental and social conditions established in Chapter Four. It considers both adverse and beneficial impacts, with particular emphasis on identifying potential risks to environmental components such as soil, water, air quality, and biological resources, as well as social aspects including community health and safety, livelihoods, and institutional dynamics.

In line with the requirements of the African Development Bank (AfDB) 2023, the assessment evaluates impacts in terms of their magnitude, spatial extent, duration, reversibility, and overall significance. The chapter also highlights potential cumulative impacts that may arise from the interaction of the proposed project with other activities within the area of influence.

The outcome of this assessment provides the basis for the development of appropriate mitigation and enhancement measures, which are presented in subsequent chapters to ensure that the project is implemented in an environmentally and socially sustainable manner.

5.2 Impact Assessment Methodology

The assessment of potential environmental and social impacts associated with the proposed Solar Hybrid Mini-Grid Project was carried out through a systematic evaluation of the interactions between project activities and environmental and social receptors within the defined Area of Influence.
Potential impacts were identified by linking specific project activities (e.g., site clearing, civil works, equipment installation, operation and maintenance) with environmental and social components such as soil, water, air quality, biological resources, and community / socio-economic receptors**.**

5.2.1 Impact Characterization Criteria

Each identified impact was characterized using defined criteria to ensure a consistent and objective evaluation. The criteria applied in this assessment are presented in Table 11.

Table 11: Impact Characterization Criteria

Criteria	Description	Classification
Nature	Type of impact	Positive / Negative
Extent	Spatial coverage of impact	Site-specific / Local / Regional
Duration	Time scale of impact	Short-term (less than 1 year) / Medium-term (1 to 5 years) / Long-term (greater than 5 years)
Reversibility	Ability of environment to recover	Reversible / Irreversible
Likelihood	Probability of occurrence	Unlikely / Likely / Highly Likely

5.2.2 Magnitude of Impact

The magnitude (or intensity) of each identified impact was assessed based on the degree of change it is likely to cause to the baseline environmental or social conditions within the project area. This considers

the scale, intensity, and extent of the impact on the affected receptor. The criteria used for determining impact magnitude are presented in Table 12.

Table 12: Criteria for Determining Impact Magnitude

Magnitude	Description
Negligible	No measurable change to baseline conditions; impact is insignificant and does not affect the function or value of the receptor
Low	Minimal change to baseline conditions; impact is localized and of low intensity with no significant alteration to receptor function
Moderate	Noticeable change to baseline conditions; impact may alter the function or quality of the receptor but remains manageable with mitigation
High	Significant change to baseline conditions; impact substantially alters the function, integrity, or value of the receptor

5.2.3 Receptor Sensitivity

Receptor sensitivity refers to the degree to which an environmental or social component may be affected by project-related activities. It reflects the importance, vulnerability, and capacity of the receptor to withstand or recover from impacts**.** The classification of receptor sensitivity used in this assessment is presented in Table 13.

Table 13: Receptor Sensitivity Classification

Sensitivity	Description
Low	Receptors with low environmental or social value and high resilience (e.g., already disturbed land or modified environments)
Medium	Receptors of moderate value or sensitivity (e.g., vegetation, local infrastructure, institutional facilities)
High	Receptors of high importance or vulnerability (e.g., groundwater and surface resources, human population, sensitive ecosystems)

5.2.3 Impact Significance Evaluation

The significance of identified environmental and social impacts was determined as a function of impact magnitude and receptor sensitivity. Receptor sensitivity reflects the importance, vulnerability, and resilience of the affected environmental or social component within the project's area of influence.

The combination of these parameters provides a structured basis for evaluating the overall significance of each impact. A matrix approach was adopted to ensure a systematic and consistent assessment, as presented in Table 14.

Table 14: Impact Significance Matrix

Impact Magnitude ↓	Receptor Sensitivity →		
	Low	**Medium**	**High**
High	**Minor**	**Moderate**	**Major**
Medium	**Minor**	**Moderate**	**Major**
Low	**Negligible**	**Minor**	**Moderate**
Negligible	**Negligible**	**Negligible**	**Minor**

The resulting impact significance levels were classified as follows:

Table 15: Impact Significance Classification

Significance Level	Description
Negligible	No measurable change to baseline conditions
Minor	Low-level impact requiring minimal mitigation
Moderate	Noticeable impact requiring mitigation measures
Major	Significant impact requiring detailed mitigation and management

5.2.4 Quantitative Expression of Impact Significance

As part of the impact evaluation process, each identified impact has been assigned a quantitative significance value expressed as a percentage. This percentage represents the estimated proportion of the receptor affected by the identified impact, taking into account the magnitude of the impact and the sensitivity of the affected receptor as assessed in this chapter.

The percentage ranges adopted correspond directly to the qualitative significance ratings applied throughout the impact evaluation, as presented in Table 16 below.

Table 16: Significance Rating and Corresponding Percentage Range

Significance Rating	Percentage Range	Representative Value
Negligible	0 - 10%	5%
Minor	11 - 30%	20%
Moderate	31 - 60%	45%
Major	61 - 100%	75%

5.2.5 Assessment of Cumulative Impacts

Cumulative impacts were assessed by considering the combined effects of the proposed project and other existing or planned activities within the project's area of influence. This includes ongoing and future developments within the university and surrounding community. The assessment focused on determining whether the project could contribute to incremental environmental or social changes when considered alongside other activities, particularly in relation to land use, air quality, water resources, and community wellbeing**.**

5.2.6 Risk Assessment Approach

In addition to the impact assessment, a risk-based approach was adopted to evaluate potential environmental, health, and safety risks associated with the proposed project. Risk assessment was conducted using a Risk Assessment Matrix (RAM)**,** which evaluates risks based on the likelihood of occurrence and the severity of potential consequences.

The RAM provides a structured framework for identifying, analyzing, and prioritizing risks associated with project activities, particularly those related to occupational health and safety, accidental events, and environmental hazards. The likelihood of occurrence was categorized as rare, unlikely, possible, likely, or almost certain**,** while consequence severity was classified as insignificant, minor, moderate, major, or severe**,** as presented in Table 17.

Table 17: Risk Assessment Matrix (RAM)

Consequence ↓	Likelihood →				
	Rare	**Unlikely**	**Possible**	**Likely**	**Almost Certain**
Insignificant	Low	Low	Low	Low	Low
Minor	Low	Low	Medium	Medium	Medium
Moderate	Low	Medium	Medium	High	High
Major	Medium	Medium	High	High	Extreme
Severe	Medium	High	High	Extreme	Extreme

5.2.7 Residual Impact Assessment and Mitigation Hierarchy

Impact significance shall be reported both before and after mitigation. The final assessment shall distinguish inherent/pre-mitigation significance from residual significance after the mitigation hierarchy has been applied. Where an impact cannot be avoided, the preferred sequence is minimization, restoration/reinstatement and, only where required by the applicable safeguard framework, offset/compensation measures.

Impact	**Pre-mitigation significance**	**Principal controls**	**Residual significance**
Soil erosion/sediment runoff	Moderate	Topsoil management, silt fences, sediment traps, progressive reinstatement	Minor, subject to implementation and monitoring
Dust/particulate emissions	Moderate	Water suppression, covered loads, speed control, scheduling	Minor
Construction noise	Moderate	Academic-calendar coordination, daytime/off-peak noisy works, monitoring	Minor
Traffic/pedestrian safety	Major	Traffic Management Plan, 10 km/h campus limit, flagpersons, barriers, delivery scheduling	Moderate/Minor depending on location and compliance
GBV/SEA/SH	Major	Code of Conduct, induction, confidential reporting, referral, sanctions, supervision	Moderate residual risk; zero-tolerance does not mean zero inherent risk
Electrical/electrocution risk	Major	Competent electricians, LOTO, permit-to-work, barriers, testing and certification	Minor/Moderate
Battery fire/thermal runaway	Major	BMS, fire detection/suppression, thermal management, emergency response, trained operators	Minor/Moderate
E-waste/end-of-life batteries and panels	Moderate	Segregation, take-back/recycling arrangements, licensed handlers, records	Minor

Crop/land-use impact	To be confirmed	Pre-clearance land/user and crop verification; compensation/livelihood measures if triggered	To be confirmed after screening
Biodiversity/vegetation disturbance	Minor/Moderate	Avoidance, progressive clearing, native replanting and survival monitoring	Minor
Cumulative traffic/noise/water effects	To be confirmed	Cumulative management with other campus activities and periodic review	To be confirmed through implementation monitoring

5.3 Positive Impacts of the Proposed Project

The anticipated positive impacts include:

- The anticipated positive impacts include:
- Improved reliability and stability of electricity supply for academic buildings, laboratories, ICT centres, student hostels and administrative facilities across the AUST campus.
- Enhanced research capacity, particularly for science and technology programmes that depend on uninterrupted and stable power supply for computing systems, laboratory instruments and technical equipment.
- Improved learning conditions and academic performance through consistent access to lighting, digital resources and extended study hours, directly benefiting AUST's student population.
- Reduction in reliance on grid and diesel generator supply as the primary sources of campus electricity, leading to lower greenhouse gas emissions, reduced noise pollution from generator operation, and improved ambient air quality within the campus environment.
- Decrease in recurrent operational and energy costs over time, enabling the University to redirect financial resources to core academic, research and institutional development priorities.
- Creation of temporary direct employment opportunities during the construction and installation phases for skilled and semi-skilled labour including electricians, civil works operatives, technicians and support workers, with priority for qualified persons from the Galadimawa area.
- Indirect economic opportunities for local suppliers, service providers, transport operators and small-scale traders, including those operating at the Galadimawa Roundabout, during the construction period.
- Strengthening of institutional technical capacity in renewable energy installation, operation and maintenance through skills transfer and training opportunities for designated University staff and students in engineering and technology related disciplines.
- Improved energy security and operational resilience for AUST, providing more dependable infrastructure to sustain its academic and research activities and support continued institutional growth.
- Contribution to Nigeria's national renewable energy targets and the Federal Government's commitments under the Nationally Determined Contributions and the Energizing Education Programme objectives under the Desert-to-Power initiative.

5.4 Potential Negative Impacts

The potential adverse environmental and social impacts associated with the proposed Solar Hybrid Mini-Grid Project were identified based on the interaction between project activities and environmental and social receptors within the project's area of influence. These impacts are assessed across the different phases of project implementation, namely pre-construction, construction, operation, and

decommissioning. The identified impacts are grouped according to key environmental and social components, including: Land use and soil conditions; Air quality; Noise and vibration; Water resources; Biological environment (flora and fauna); Waste generation and management; Traffic and access; Socio-economic conditions; Community health and safety; and Occupational health and safety. The impacts under each of these components are discussed with emphasis on their nature, magnitude, sensitivity of affected receptors, and overall significance.

Preconstruction Phase

The pre-construction phase of the proposed project will involve activities such as site preparation, clearing of the cultivated farmland within the project footprint, and mobilization of personnel, equipment and materials to the AUST campus site. Although these activities are relatively low in intensity, they may result in localized environmental and social interactions within the project area and along the express road access corridor connecting to the Galadimawa Roundabout.

Site preparation activities will lead to the removal of cultivated plants within the 3-hectare project footprint. Given the disturbed and agricultural character of the site and the absence of protected or ecologically significant plant species, the impact on terrestrial flora is expected to be negligible. Faunal species within the area are largely common, mobile and adapted to human disturbance, and are therefore likely to relocate temporarily during site preparation activities.

Disturbance of the cultivated soil profile within the project footprint may increase susceptibility to surface erosion, particularly during wet season rainfall events given the flat, open nature of the site. Given the proximity of the stream (approximately 100 metres) and existing erosion and gully features (approximately 200 and 150 metres respectively), such impacts warrant close attention, though they are expected to remain manageable through standard erosion control measures.

Mobilization of personnel, equipment and materials may result in minor air quality impacts due to dust generation along the site access route and within internal campus roads, as well as a temporary increase in traffic movement within the university environment. Baseline air quality monitoring recorded PM2.5 exceedances at several points across the site, making dust management during this phase particularly important. Increased human and vehicular activity may also pose minor safety risks to students, staff, and informal traders along the access route within the campus environment.

Overall, impacts associated with the pre-construction phase are expected to be short term, site specific and of low significance. The identified adverse impacts arising from pre-construction activities, together with their corresponding magnitude, receptor sensitivity and significance ratings, are presented in Table 19.

Construction Phase

The construction phase of the proposed project will involve activities such as excavation for mounting structures, foundation works, installation of solar panels and associated infrastructure, trenching and laying of underground distribution cables, movement of construction machinery, and handling of materials. These activities represent the most intensive stage of project implementation and will result in a range of interactions with environmental and social receptors within the project area and along the cable corridor.

Construction activities will interact with soil, air quality, water resources and the biological environment. Given the cultivated soil conditions within the project footprint and the flat, open character of the site, there is potential for increased susceptibility to surface erosion particularly during earthworks and cable trench excavation activities, especially during wet season rainfall events. Given the proximity of the stream approximately 100 metres from the footprint, an already degraded receptor, storage and handling

of fuel, oil and construction materials require careful management to prevent spills that could add further pressure on this water body.

Dust generation from excavation and vehicle movement along the site access route and internal campus roads may affect ambient air quality within the site. Given the cultivated and disturbed character of the site and the absence of ecologically sensitive habitats or protected species, impacts on terrestrial flora and fauna are expected to be negligible and localized.

The construction phase will involve the presence of construction workers and increased movement of equipment and materials, which may interact with students and staff of the University. These interactions may result in temporary disruptions to movement along campus access routes and walkways, particularly during cable trench works, as well as minor community related impacts including unmet expectations regarding employment opportunities and potential grievances among Galadimawa Roundabout stakeholders. The express road access corridor may also experience temporary disruption during delivery of heavy equipment and materials.

Given that the project is located within the secured AUST campus with no involuntary displacement or land use conflicts within the footprint have confirmed willingness to vacate, social impacts are expected to be localized and manageable with appropriate mitigation. Construction activities present significant occupational health and safety and community safety risks, particularly in relation to excavation and trench works, operation of machinery, electrical installation works, and movement of heavy vehicles within the campus environment. Open trenches along the cable route pose a specific risk of unauthorized access and falls by students and campus users if not adequately secured. These risks require robust OHS management measures to protect both construction workers and campus users throughout the construction period.

The impacts associated with the construction phase are expected to be temporary and site specific, requiring effective management to minimize potential adverse effects. The identified adverse impacts arising from construction activities, together with their corresponding magnitude, receptor sensitivity and significance ratings, are presented in Table 20.

Operation Phase

During the operation phase, activities will primarily involve the generation of electricity through the solar PV system, operation of inverters and battery storage systems, routine monitoring, inspection and periodic maintenance of project infrastructure. These activities are less intensive than the construction phase and do not involve significant physical disturbance of the project site. Identified impacts during the operational phase are expected to be minimal, as solar PV systems generate no air emissions, noise or physical disturbance during normal operation. However, certain risks may arise from the operation and maintenance of battery storage systems and electrical components, particularly in relation to potential battery leakage or failure, improper disposal of damaged components, and generation of hazardous e-waste over the project lifecycle.

In addition, minor impacts may be associated with low level noise from inverters and transformers during operation, though these are negligible. There are significant occupational health and safety and community safety considerations during the operational phase, particularly in relation to electrical hazards from energized systems, battery related chemical and fire risks, and the potential for unauthorized access to restricted electrical infrastructure by students, staff or visitors within the AUST campus. These risks require appropriate operational control measures, access restriction, and safety signage to ensure the safety of both facility operators and campus users throughout the operational life of the installation. Overall, impacts associated with the operation phase are expected to be long term but of low to moderate significance and largely manageable through standard operational safety procedures, routine maintenance

protocols and the e-waste management provisions detailed in the ESMP. The identified adverse impacts arising from operation phase activities, together with their corresponding magnitude, receptor sensitivity and significance ratings, are presented in Table 21.

5.4.1 Negative Impacts: Pre-Construction Phase

Table 18: Preconstruction Phase Negative Impacts

Activity	Receptor	Potential Impact	Magnitude	Sensitivity	Significance	Impact Quantification (%)
Environmental Component						
Mobilization of construction materials and equipment to proposed university site	Air quality and Noise	Generation of dust along the university's access roads and within the project site due to movement of delivery trucks	Low	Medium	Minor	15%
		Exhaust fumes from vehicles resulting to environmental pollution and respiratory discomfort to project community	Low	Medium	Minor	15%
		Increase in ambient noise levels	Low	Medium	Minor	15%
Site clearing	Soil	Localized soil compaction and disturbance within areas designated for temporary material storage	Low	Medium	Minor	20%
		Disturbance of cultivated topsoil may increase erosion during wet season rainfall, with sediment runoff risk to the nearby stream (approx. 100m away), an already degraded receptor	Medium	High	Moderate	45%
	Biological (Flora & Fauna)	Removal of cultivated vegetation within the project footprint, with temporary disturbance to soil-dwelling and ground fauna.	Low	Low	Negligible	5%
Social Component						
Procurement of solar equipment	Workers within the supply chain / Project reputation	Potential procurement of equipment from OEMs or suppliers associated with forced labour, modern slavery, child labour or other human rights abuses within the supply chain.	Low	Medium	Minor	15%
Movement of vehicles and equipment	Traffic / Access	Temporary increase in vehicular movement along the express road and through the University's first gate access route, with minor disruption to campus movement and to informal traders operating near the gate	Low	Medium	Minor	15%
		Minor disturbance to students, staff and due to increased human activity and equipment movement within the campus	Low	Medium	Minor	15%

Handling and movement of equipment	OHS	Risk of minor accidents or injuries to workers during loading, unloading, and movement of equipment on site	Low	Medium	Minor	20%
		Influx of people (migrant workers, sub-contractors and suppliers) and increased pressure on existing social infrastructure	Low	Medium	Minor	20%
Project mobilization and initial engagement	Community	Minor safety risks to students, staff, and pedestrians along the express road and internal campus access routes, including informal traders near the main gate	Low	Medium	Minor	15%
	Security	Risk of unauthorized access to project site leading to potential theft of equipment and accidents	Low	Medium	Minor	20%

5.4.2 Negative Impacts: Construction Phase

Table 19: Construction Phase Negative Impacts

Activity	Receptor	Potential Impact	Magnitude	Sensitivity	Significance	Impact Quantification (%)
Environmental Component						
Excavation and foundation works for mounting structures	Soil	Soil disturbance increasing erosion susceptibility within the footprint	Moderate	Medium	Moderate	45%
Movement of construction vehicles and equipment within site		Soil compaction reducing permeability and affecting soil structure within frequently trafficked areas	Low	Medium	Minor	20%
Trenching for underground distribution cables		Exposed, loosely compacted soil along the cable trench route, raising erosion risk in wet season	Moderate	Medium	Moderate	45%
Site grading and leveling for panel installation	Soil / Drainage	Alteration of natural surface runoff patterns, leading to localized water concentration and erosion	Moderate	Medium	Moderate	45%
Trenching and cable laying across site		Temporary disruption of natural drainage paths	Moderate	Medium	Moderate	40%

Movement of vehicles and earthworks	Air quality	Dust generation from earthworks and vehicle movement along the trench route and site	Moderate	Medium	Moderate	45%
		Emission of exhaust gases from diesel-powered machinery	Low	Medium	Minor	20%
Operation of machinery and installation activities	Noise	Increased noise levels within the project environment,	Moderate	Medium	Moderate	40%
Installation of mounting structures and cable works	Flora	Removal of cultivated vegetation within the project footprint	Low	Low	Negligible	5%
Construction activities and human presence	Fauna	Temporary disturbance and displacement of small terrestrial fauna species	Low	Low	Negligible	5%
Storage and handling of fuel, oil, and materials	Soil / Water	Risk of spills contaminating soil or infiltrating the nearby stream (approx. 100m)	Low	High	Moderate	35%
Construction activities and material storage	Waste	Generation of construction waste (scrap materials, packaging, excavated soil) with potential for improper disposal and consequent environmental pollution.	Low	Medium	Minor	20%
Installation of mounting structures and foundations	Visual aesthetics	Temporary visual disturbance due to presence of equipment, materials, and exposed surfaces	Low	Medium	Minor	15%
Social Component						
Mobilization and presence of construction workers	University / premises	Temporary disruption to academic and administrative activities from increased site activity	Low	Medium	Minor	15%
Engagement of labour	Community	Unmet employment expectations stakeholders	Low	Medium	Minor	15%
Trenching and cable laying across campus	Access / Infrastructure	Temporary obstruction of walkways and internal access routes during trenching	Moderate	Medium	Moderate	40%
Presence of workforce (Labour Inlfux)	Public Health	Increased risk of communicable disease spread from worker interaction with students, staff, and roundabout stakeholders	Low	Medium	Minor	20%

	Social (Gender)	Unequal access to jobs for women, and SEAH/GBV risk from labour influx	Low	Medium	Minor	20%
	Local Services	Minor pressure on campus social amenities from labour influx	Low	Medium	Minor	15%
Project activities and expectations	Community Grievance	Complaints from perceived impacts or unmet expectations	Low	Medium	Minor	15%
OHS and Community Safety						
Excavation and trenching works	OHS (Workers)	Risk of injuries from trench collapse, slips, trips, and falls within excavation areas	Moderate	High	Major	75%
Installation of mounting structures and panels	OHS (Workers)	Risk of falls, cuts, and musculoskeletal injuries during installation activities	Moderate	High	Major	75%
Handling of construction materials and equipment	OHS (Workers)	Risk of injuries from improper lifting, falling objects, or equipment misuse	Moderate	High	Major	70%
Electrical installation works (cabling, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during installation of electrical components	Moderate	High	Major	75%
Operation of machinery and equipment	OHS (Workers)	Exposure to noise, vibration, and mechanical hazards	Moderate	Medium	Moderate	45%
Movement of construction vehicles within site and access roads	Community Safety	Risk of accidents involving pedestrians, workers, or other road users within the campus	Moderate	High	Major	75%
Open trenches and excavation areas	Community Safety	Risk of unauthorized access leading to falls or injuries	Moderate	High	Major	75%
Storage of fuel and hazardous materials	OHS / Community Safety	Risk of fire outbreak, explosion, or exposure to hazardous substances	Low	High	Moderate	35%

5.4.3 Negative Impacts: Operation Phase

Table 20: Operation Phase Negative Impacts

Activity	Receptor	Potential Impact	Magnitude	Sensitivity	Significance	Impact Quantification (%)
Battery storage and operation	Soil / Water	Risk of contamination from battery leakage or improper handling of electrolyte materials	Low	High	Moderate	35%
Operation of equipment (inverters, transformers)	Noise	Low level noise from inverters and transformers, negligible against site ambient baseline	Low	Medium	Minor	15%
Cleaning of solar panels	Water resources	Use of borehole water for panel cleaning, especially in harmattan, adding minor demand on campus supply	Negligible	Medium	Negligible	5%
Maintenance activities	Waste generation	Generation of minor waste such as damaged components, packaging, and maintenance residues	Low	Medium	Minor	20%
End-of-life components (batteries, panels)	Soil / Environment	Risk from improper disposal of spent batteries, degraded panels or failed inverters if not managed under EPR and NESREA e-waste regulations	Low	High	Moderate	40%
Operation of electrical systems (inverters, cables, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during operation and maintenance	Moderate	High	Major	75%
Battery storage and management	OHS (Workers)	Risk of chemical exposure, fire, or explosion in case of battery failure or improper handling	Moderate	High	Major	75%
Operation of facility within campus	Community Safety	Risk of unauthorized access to energized arrays, battery storage or electrical infrastructure, leading to injury or electrocution	Moderate	High	Major	70%

5.5 Cumulative Impacts

Cumulative impacts are those impacts resulting from the combined effects of past, present or reasonably foreseeable actions owing to the project's aspects and activities, together with actions 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 a receptor taken together can be significant. When a resource is nearing its tolerance threshold, a small additional change can push it over.

Given the nature of 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 are considered low.

5.5.1 Expanded Cumulative Impact Assessment

Cumulative impacts shall be assessed in relation to existing, approved and reasonably foreseeable activities within the project Area of Influence, rather than treating the solar installation in isolation. Relevant receptors include campus traffic and pedestrian safety, ambient noise, surface water and drainage, groundwater/water demand, waste management, vegetation and campus land use. The assessment shall be revisited if major concurrent campus construction or other infrastructure projects are identified during mobilization.

Receptor	**Existing/foreseeable activities**	**Project contribution**	**Cumulative management response**
Traffic and pedestrian safety	Campus operations, deliveries and other construction activities	Additional equipment deliveries and construction vehicles	Integrated delivery schedule, route control, flagpersons, speed limits and incident review
Noise	Existing campus operations, generators and other construction	Construction equipment and operational transformers/inverters	Coordinate schedules; monitor at sensitive receptors; investigate complaints
Surface water/drainage	Existing drainage works and nearby degraded stream/dumpsite conditions	Sediment runoff and temporary trench drainage interference	Sediment controls, drainage continuity, wet-season inspection and water-quality follow-up where required
Groundwater/water demand	Existing campus borehole use	Panel cleaning and construction water demand	Water-use records, efficient cleaning and borehole performance monitoring
Vegetation/land use	Existing cultivated/disturbed land and campus development	3-ha conversion and limited vegetation clearance	Strict footprint control, tree retention and restoration/replanting
Waste	Existing campus waste streams	Construction debris, packaging, e-waste and spent components	Segregation, licensed handling and

			cumulative waste tracking

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

5.6.1 Project-Specific Emergency and Major Accident Scenarios

The project emergency risk profile shall be managed through a scenario-based Emergency Preparedness and Response Plan integrated with the HSE Plan. The plan shall identify alarms, evacuation routes, assembly points, emergency contacts, first aid, fire response, isolation/shutdown procedures and reporting requirements.

Scenario	**Principal preventive controls**	**Immediate response**	**Key responsible parties**
Battery thermal runaway/fire	Battery Management System, thermal monitoring, fire detection/suppression, ventilation and separation	Alarm, isolate/stop system where safe, evacuate, activate fire response, call emergency services	O&M operator, AUST security/EHS, NEP-PMU
Electrical shock/arc flash	Certified electricians, LOTO, permit-to-work, testing and barriers	Isolate source, emergency medical response, preserve scene and report incident	EPC/O&M, AUST, NEP-PMU
Transformer/PV fire	Electrical protection, earthing, lightning/surge protection, inspection	Isolate, evacuate, fire response and incident investigation	O&M operator, AUST, emergency services
Fuel/chemical spill	Bunded storage, spill kits, trained personnel	Stop source if safe, contain, recover and dispose through approved channels	Contractor/O&M E&S team
Open-trench incident	Barriers, bridging, inspection and controlled access	Secure area, rescue/first aid, investigate and correct controls	EPC contractor, AUST

Severe storm/lightning/flooding	Drainage, lightning protection, weather monitoring and safe shutdown procedures	Suspend unsafe work, isolate equipment, evacuate exposed areas and inspect before restart	EPC/O&M, AUST, NEP-PMU
GBV/SEA/SH complaint	Code of Conduct, induction and confidential channels	Protect confidentiality, survivor-centred referral and case management; do not investigate through informal community channels	Designated safeguarding focal point/competent service providers

Project Specific Risks and Hazards

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

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. In addition, lightning strikes during extreme weather events may damage solar photovoltaic panels, inverters, transformers, and other electrical equipment, potentially resulting in electrical surges, equipment failure, fire, or service interruption if adequate protection systems are not provided. 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 runaway, which commonly leads to battery damage, fire, and, in severe cases, explosions. Deep discharging may also compromise battery integrity and increase fire risk. These risks will be minimized through the incorporation of appropriate lightning protection systems, surge protection devices, and adequate earthing of electrical installations as part of the project design. Any outbreak of uncontrolled fire within the facility could escalate to dangerous dimensions and is therefore classified as Severe.

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 minimally severe consequence and is thus classified as Moderate.

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 and is thus classified as Moderat**e**.

Gender-Based Violence, Harassment and Sexual Exploitation and Abuse (GBVH/SEAH)

The influx of construction workers into the AUST campus environment during the construction phase creates an elevated risk of gender-based violence, harassment, and sexual exploitation and abuse. Female

students and female staff are particularly vulnerable to these risks given the campus setting where workers will interact closely with a young student population. The presence of a large, predominantly male construction workforce within an active academic environment requires robust Code of Conduct enforcement, worker awareness training and accessible reporting mechanisms. This risk is classified as Major.

Child Labour

The construction phase carries a risk of child labour, particularly given the possibility that the project community may present underage dependants for employment opportunities during worker recruitment. The Child Rights Act 2003 strictly prohibits the engagement of persons under 18 years in hazardous construction work. The EPC Contractor shall implement a robust age verification and labour screening mechanism prior to engagement of any worker on the project site to eliminate this risk. This risk is classified as Moderate.

Security Risks

The project is located within the AUST campus off Ring Road 2, near the Galadimawa Roundabout, in the Federal Capital Territory, Abuja. The FCT benefits from a generally robust security infrastructure, with the Galadimawa Roundabout area maintaining an active community presence of transporters, traders and commercial motorcyclists throughout the day, which supports a level of informal surveillance around the campus surroundings. The campus itself is fully secured within a perimeter fence with a manned security post. Security risks associated with this project are therefore considered manageable relative to those typical of peri-urban or rural project environments. Residual risks during construction include potential theft of equipment and materials and unauthorized access to the project site, which shall be managed through enhanced access control, site security personnel and lighting. This risk is classified as Minor.

Contamination from Improper Management of Solar E-Waste

The operational and decommissioning phases of the project will generate electronic waste including spent lithium-ion battery modules, photovoltaic panels, inverters, cables, and associated electrical components. Improper handling, storage, or disposal of these materials poses a risk of soil and groundwater contamination from hazardous substances including heavy metals and chemical electrolytes. Given the 25-year operational lifecycle and the volume of end-of-life components anticipated, this risk is classified as Major**.**

CHAPTER SIX: MITIGATION MEASURES

6.1 Introduction

This chapter outlines the measures proposed to prevent, reduce and manage the environmental and social impacts associated with the proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology University (AUST), Federal Capital Territory, Abuja. The measures are based on the significance of impacts identified in Chapter Five and are designed to ensure that potential adverse effects are effectively controlled throughout the project lifecycle, from pre-construction through to decommissioning.

The development of mitigation measures follows the principles of the mitigation hierarchy as recommended by the African Development Bank Integrated Safeguards System 2023, ensuring a systematic approach to impact management that prioritizes avoidance, followed by minimization, restoration and offsetting where residual impacts remain. These measures are tailored to the specific conditions of the AUST project site.

In addition to addressing environmental concerns, the mitigation measures incorporate occupational health and safety considerations, community safety, gender-based violence prevention, child labour prohibition, e-waste management, and labour influx management specific to the campus institutional context. The measures have been developed in line with applicable national regulations including those of the Federal Ministry of Environment, the National Environmental Standards and Regulations Enforcement Agency, the Abuja Environmental Protection Board, and the Child Rights Act 2003, as well as international good practice standards and AfDB safeguard requirements.

6.2 Strategy and Principles

The selection of mitigation measures for the proposed project is guided by a structured approach aimed at managing risks in a practical and effective manner. This approach is based on the following principles:

- **Impact Avoidance:** Integration of environmental and social considerations into project design and planning to prevent adverse impacts where feasible;
- **Impact Reduction:** Application of appropriate construction methods and operational controls to limit the extent and intensity of unavoidable impacts;
- **Impact Control:** Implementation of site-specific measures to manage residual impacts during project execution;
- **Remediation and Compensation:** Restoration or compensation for significant residual impacts, where necessary and feasible.

Mitigation measures have also been designed with consideration for:

- the nature and scale of project activities;
- site-specific environmental sensitivities, including erosion-prone soils;
- interactions with ongoing construction within the university campus; and
- potential concerns of nearby communities.

This approach ensures that all identified risks are managed to acceptable levels while maintaining compliance with regulatory and institutional requirements.

6.3 Mitigation Measures by Project Phase

Pre-Construction Phase

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
Environmental Component				
Mobilization of construction materials and equipment to proposed university site	Air quality	Generation of dust along the University's access roads and within the project site due to movement of delivery trucks	• Apply water based dust suppression on all access routes and within the project site during dry and windy periods. • All vehicles transporting materials shall be covered with tarpaulins to prevent dust dispersion. • Restrict vehicle speeds on unpaved sections of campus roads to below 15 km/h. • Schedule delivery vehicles during off peak academic activity hours to minimize disruption.	Minor
Mobilization of construction materials and equipment to proposed university site	Air quality	Exhaust fumes from vehicles resulting in environmental pollution and respiratory discomfort to campus occupants	• All vehicles and machinery shall undergo routine maintenance and servicing to ensure efficient fuel combustion and reduced exhaust emissions. • Switch off engines when not in use. Avoid prolonged idling within the campus environment.	Minor
Mobilization of construction materials and equipment to proposed university site	Noise	Increase in ambient noise levels	• Schedule all noisy mobilization activities to avoid core academic hours, coordinating with University management and the academic calendar where possible. • Maintain construction equipment in good working order to reduce noise generation. • Notify University management in advance of activities likely to generate elevated noise levels.	Minor
Site clearing	Soil	Localized soil compaction and disturbance within areas designated for temporary material storage	• Restrict temporary material storage to designated areas only. • Install protective matting or boards in storage areas to minimize soil compaction. • Avoid stockpiling heavy materials on the same ground area for extended periods.	Minor
Site clearing	Soil	Disturbance of cultivated topsoil increasing erosion risk during wet season rainfall, with sediment runoff potential	• Install silt fences and sediment traps along the site perimeter, prioritizing the side facing the stream. • Limit soil exposure duration by clearing progressively rather than all at once.	Moderate

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
		toward the nearby stream (approx. 100m), an already degraded receptor	• Re-vegetate or stabilize cleared areas promptly where construction is not immediately following. • Avoid stockpiling excavated soil close to the stream or drainage paths.	
Site clearing	Biological (Flora & Fauna)	Removal of cultivated vegetation within the project footprint, with temporary disturbance to soil dwelling and ground fauna	• Limit clearing strictly to the minimum necessary footprint. • Mark and protect all vegetation outside the designated clearing boundary. • Conduct clearing progressively to allow fauna to relocate naturally before disturbance.	Negligible
Social Component				
Procurement of solar equipment	Workers within the supply chain / Project reputation	Potential procurement of equipment from OEMs or suppliers associated with forced labour, modern slavery, child labour or other human rights abuses within the supply chain	• Develop and implement a supply chain due diligence policy for all equipment suppliers and OEMs. • Require written declarations from all suppliers confirming absence of forced labour, modern slavery and child labour in their supply chains. • Include supplier compliance clauses in all procurement contracts. • Screen and audit key suppliers before contract award.	Minor
Movement of vehicles and equipment	Traffic / Access	Temporary increase in vehicular movement within the AUST campus internal road network and along the express road access route, with minor disruption to campus movement	• Develop and implement a site traffic management plan covering all vehicle routes within the campus and along the express road access corridor to the Galadimawa Roundabout. • Designate specific delivery time windows to avoid peak academic activity periods. • Install traffic management signage at all vehicle entry and movement points within the campus.	Minor
Movement of vehicles and equipment	Traffic / Access	Minor disturbance to students and staff due to increased human activity and equipment movement within the campus	• Notify all students and staff in advance of mobilization activities. • Maintain pedestrian access routes at all times during mobilization. • Designate a clear construction zone with barriers separating active work areas from pedestrian and academic areas. • Provide regular updates on construction schedules and any expected disruptions.	Minor
Handling and movement of equipment	OHS	Risk of minor accidents or injuries to workers during loading, unloading, and movement of equipment on site	• Develop and implement a site specific OHS Management Plan prior to mobilization. • Conduct pre mobilization safety induction for all workers before commencement.	Minor

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
			• Provide appropriate PPE including helmets, gloves, high visibility vests and safety boots to all workers.	
Handling and movement of equipment	OHS	Influx of people (migrant workers, sub-contractors and suppliers) and increased pressure on existing social infrastructure	• Develop and implement a Labour Influx Management Plan prior to worker mobilisation. • Brief all incoming workers on the campus Code of Conduct before commencement. • Maintain a worker register and verify identity and age of all workers before engagement. • Establish clear rules of engagement between workers and students, staff and Galadimawa Roundabout stakeholders.	Minor
Project mobilization and initial engagement	Community	Minor safety risks to students, staff, and pedestrians along the express road and internal campus access routes	• Install clearly visible safety signage and barriers at all construction entry points. • Establish a project grievance mechanism and communicate access to all stakeholders. • Brief campus security personnel on construction activity schedules.	Minor
Project mobilization and initial engagement	Security	Risk of unauthorized access to project site leading to potential theft of equipment and accidents	• Erect temporary security fencing around the mobilization and material storage areas. • Engage dedicated site security personnel during mobilization activities. • Conduct daily inventory checks of all equipment and materials on site. • Report any theft or security incidents to campus security and relevant authorities immediately.	Minor

Construction Phase

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
Environmental Component				
Excavation and foundation works for mounting structures	Soil	Disturbance of soil increasing erosion susceptibility within the footprint, with potential sediment runoff toward the nearby stream (approx.	• Strip and stockpile topsoil separately from subsoil and protect from erosion during works. • Install erosion control measures including silt fences along downslope perimeters of all excavation areas, prioritizing the side facing the stream.	Moderate

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
		100m), an already degraded receptor	• Reinstate excavated areas with compacted fill and ground cover immediately upon completion. • Conduct earthworks progressively and avoid leaving large areas of exposed soil overnight.	
Movement of construction vehicles and equipment within site	Soil	Soil compaction reducing permeability and affecting soil structure within frequently trafficked areas	• Restrict heavy vehicle movement to designated haul routes only. • Avoid repeated vehicle passes over the same unprotected ground areas. • Inspect and rip compacted areas after construction to restore soil permeability before reinstatement.	Minor
Trenching for underground distribution cables	Soil	Creation of exposed and loosely compacted soil zones along the cable trench route, increasing erosion potential especially during wet season rainfall	• Bench and shore trench walls appropriately to prevent collapse and soil disturbance. • Stockpile excavated materials away from the trench edge to prevent slippage. • Backfill and compact trenches progressively and reinstate surface cover immediately upon cable laying. • Install erosion control measures along the full length of the cable trench corridor.	Moderate
Site grading and levelling for panel installation	Soil / Drainage	Alteration of natural surface runoff patterns, leading to localized water concentration and erosion	• Design site grading to maintain natural drainage patterns where possible. • Install temporary drainage diversions and sediment traps to intercept and manage runoff. • Reinstate natural drainage patterns upon completion of grading works.	Moderate
Trenching and cable laying across site	Soil / Drainage	Temporary disruption of drainage paths along the cable trench route, given the campus drainage system currently under construction	• Install temporary culverts or bridging across existing drainage channels where the cable route crosses them. • Reinstate all disturbed drainage paths immediately after cable installation. • Monitor nearby drainage works for any signs of blockage or diversion caused by trenching activity.	Moderate
Movement of vehicles and earthworks	Air quality	Generation of dust due to earthworks along the cable trench route and vehicle movement within the site	• Apply water based dust suppression on all active earthworks areas and haul routes daily during dry periods. • Cover all vehicles transporting excavated soil or fine materials with tarpaulins. • Restrict vehicle speeds within the campus to below 15 km/h.	Moderate

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
			• Coordinate dust generating works with University management to minimise disruption near occupied buildings.	
Movement of construction equipment	Air quality	Emission of exhaust gases from diesel powered machinery	• Ensure all construction vehicles and machinery are regularly serviced and maintained. • Switch off engines when not in use. Avoid prolonged idling within the campus. • Use low emission equipment where available and practicable.	Minor
Operation of machinery and installation activities	Noise	Increased noise levels within the project environment	• Fit all construction machinery with functional silencers and mufflers. • Erect temporary noise barriers around high noise work areas adjacent to academic buildings. • Notify University management and students in advance of activities likely to generate elevated noise.	Moderate
Installation of mounting structures and cable works	Flora	Removal of cultivated vegetation within the project footprint	• Mark and protect vegetation outside the designated clearing boundary. • Reinstate cleared areas with appropriate ground cover immediately upon completion of installation works.	Negligible
Storage and handling of fuel, oil, and materials	Soil / Water	Risk of spills contaminating soil or infiltrating the nearby stream (approx. 100m), an already degraded receptor	• Designate a bunded fuel and materials storage area with impermeable base and secondary containment. • Store all fuels, oils and chemicals within the bunded area at all times. • Maintain spill response kits on site at all times. Train workers in spill response procedures. • Prohibit refuelling within 100m of the stream or campus Ground Water source.	Moderate
Construction activities and material storage	Waste	Generation of construction waste with potential for improper disposal and environmental pollution	• Implement waste segregation at source into general, recyclable and hazardous categories. • Contract a licensed waste collector for regular removal and disposal of all construction waste. • Prohibit open burning or unauthorized dumping of any construction waste within the campus. • Maintain a waste register tracking volumes generated, stored and disposed.	Minor
Installation of mounting structures and foundations	Visual aesthetics	Temporary visual disturbance due to presence of equipment, materials, and exposed surfaces	• Remove all construction materials, equipment and waste from site upon completion. • Reinstate disturbed surfaces and restore campus aesthetics upon completion of all works.	Minor

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
			• Maintain an orderly and clean construction site throughout the construction period.	
Social Component				
Mobilization and presence of construction workers	University / premises	Temporary disruption to academic and administrative activities within the AUST campus due to increased human presence and construction activity	• Designate clear construction zone boundaries with physical barriers separating works from academic areas. • Notify students, staff and University management in advance of all construction activities and schedules. • Coordinate construction scheduling with the academic calendar to avoid examination periods. • Maintain safe pedestrian access routes around all active work areas at all times.	Minor
Engagement of labour	Community	Potential for unmet expectations regarding employment opportunities among Galadimawa Roundabout stakeholders, causing grievances if local labour engagement commitments are not fulfilled	• Implement a grievance mechanism accessible to Galadimawa Roundabout stakeholders. • Develop and communicate a transparent local employment policy prior to construction commencement. • Establish a community liaison officer to manage employment enquiries from union chairmen. • Report local employment outcomes regularly to University management and stakeholder representatives.	Minor
Trenching and cable laying across campus	Access / Infrastructure	Temporary obstruction of walkways and internal access routes within the AUST campus during cable trench excavation and installation works	• Install clearly marked pedestrian diversions and alternative walkway routes for all affected campus paths. • Erect safety barriers and warning signs along the full length of open trench sections. • Backfill and reinstate walkways and access routes immediately after cable installation in each section. • Provide temporary bridging over open trenches at all major pedestrian crossing points.	Moderate
Presence of workforce	Public Health	Increased risk of communicable disease spread from interaction between construction workers and students, staff, and Galadimawa Roundabout stakeholders	• Implement a Worker Code of Conduct covering hygiene, behaviour and interaction with campus users. • Provide health awareness briefings to all workers before commencement, covering communicable disease prevention. • Establish adequate sanitation facilities for construction workers separate from campus facilities.	Minor

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
			• Conduct HIV/AIDS and communicable disease awareness sessions for workers during induction.	
Labour dynamics	Social (Gender)	Potential for unequal access to employment opportunities for women, and risk of sexual exploitation, abuse and harassment (SEAH) and gender based violence (GBV) associated with labour influx	• Implement an equal opportunity employment policy requiring non-discriminatory recruitment practices. • Establish and enforce a zero tolerance SEAH and GBV policy with clear reporting and response procedures. • Brief all workers on the Code of Conduct covering SEAH, GBV and respectful conduct toward female students and staff. • Ensure female workers and campus users have access to a confidential SEAH reporting mechanism.	Minor
Influx of workers	Local Services	Minor pressure on existing social amenities and services within the AUST campus due to labour influx during the construction phase	• Limit worker numbers on site to the minimum required for each construction activity. • Prohibit workers from residing within the campus unless formally arranged. • Coordinate with University management on any additional pressure on campus facilities from workers.	Minor
Project activities and expectations	Community Grievance	Potential for complaints arising from perceived impacts or unmet expectations	• Establish a project level grievance mechanism accessible to all campus users and Galadimawa Roundabout stakeholders. • Designate a community liaison officer to receive and respond to all project related complaints. • Log and respond to all grievances within 14 working days and report outcomes to complainants. • Conduct regular stakeholder update meetings with union chairmen and campus representatives.	Minor
OHS and Community Safety				
Excavation and trenching works	OHS (Workers)	Risk of injuries from trench collapse, slips, trips, and falls within excavation areas	• Ensure all excavation and trench works comply with applicable OHS standards for confined spaces and excavations. • Install shoring or benching for all trenches deeper than 1.2 metres. • Prohibit entry into unsupported trenches deeper than 1.2 metres. • Conduct daily inspection of all excavation areas before workers commence activities.	Major
Installation of mounting structures and panels	OHS (Workers)	Risk of falls, cuts, and musculoskeletal injuries during installation activities	• Enforce use of full PPE including harnesses, helmets and non-slip footwear for all installation works.	Major

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
			• Erect scaffolding or working platforms for all elevated installation activities. • Conduct toolbox talks on fall prevention and safe working at height before each shift. • Inspect all lifting equipment and tools daily before use.	
Handling of construction materials and equipment	OHS (Workers)	Risk of injuries from improper lifting, falling objects, or equipment misuse	• Train all workers in manual handling techniques and safe lifting practices before commencement. • Provide mechanical lifting aids for all loads exceeding 25kg. • Inspect all construction materials and equipment for defects before use. • Enforce hard hat and steel-toed boot requirements at all times on site.	Major
Electrical installation works (cabling, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during installation of electrical components	• Engage only certified and licensed electricians for all electrical installation works. • Implement lockout/tag out procedures for all electrical works. • Conduct pre-work electrical safety briefings before each shift involving electrical activities. • Test all electrical connections before energizing any component.	Major
Operation of machinery and equipment	OHS (Workers)	Exposure to noise, vibration, and mechanical hazards	• Provide hearing protection to all workers operating or working near noisy machinery. • Rotate workers away from high noise and high vibration tasks to limit exposure duration. • Conduct pre-employment and periodic medical screening for workers exposed to noise and vibration. • Maintain all machinery in good working order to minimize noise and vibration output.	Moderate
Movement of construction vehicles within site and access roads	Community Safety	Risk of accidents involving pedestrians, workers, or other road users within the campus	• Implement a site traffic management plan with designated vehicle and pedestrian zones. • Enforce a strict speed limit of 10 km/h for all vehicles within the campus. • Station flag persons at all vehicle-pedestrian conflict points. • Install speed bumps and warning signage at all campus vehicle entry and movement points.	Major
Open trenches and excavation areas	Community Safety	Risk of unauthorized access leading to falls or injuries	• Install physical barriers, hoarding and warning signs along the full length of all open trenches.	Major

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
			• Cover or bridge open trenches at all pedestrian crossing points before end of each working day. • Conduct daily inspections of all barriers and coverings before works commence. • Prohibit all unauthorized persons from entering the active construction zone.	
Storage of fuel and hazardous materials	OHS / Community Safety	Risk of fire outbreak, explosion, or exposure to hazardous substances	• Store all fuels and hazardous materials in a designated bunded area away from academic buildings. • Maintain fire extinguishers at all fuel storage and electrical works areas. • Prohibit smoking within 25 metres of any fuel storage or hazardous materials area. • Train workers in fire emergency response procedures during induction.	Moderate

Operation Phase

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
Battery storage and operation	Soil / Water	Risk of contamination from battery leakage or improper handling of electrolyte materials	• Inspect battery storage systems and connections monthly for signs of leakage, corrosion or damage. • Install battery containment trays with secondary containment capacity under all battery banks. • Maintain spill response kits in the battery storage room at all times.	Moderate
Operation of equipment (inverters, transformers)	Noise	Low level noise generation from operational inverters and transformers, negligible relative to the site ambient noise baseline	• Ensure inverters and transformers are installed within enclosed housing to contain operational noise. • Conduct periodic noise monitoring at the nearest sensitive receptor to confirm compliance with noise limits. • Schedule any high-noise maintenance activities during daytime hours only.	Minor
Cleaning of solar panels	Water resources	Use of borehole water for panel cleaning, especially in harmattan, adding minor demand on campus supply	• Use minimum water volumes necessary for effective panel cleaning. • Schedule panel cleaning during early morning hours to minimise evaporative water loss.	Negligible

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
			• Consider dry cleaning methods during the harmattan period to reduce water demand.	
Maintenance activities	Waste generation	Generation of minor waste such as damaged components, packaging, and maintenance residues	• Implement waste segregation at source separating general waste from hazardous maintenance residues. • Contract a licensed waste collector for regular removal of all maintenance waste from the campus. • Maintain a waste log recording types, quantities and disposal destinations of all waste generated. • Prohibit dumping of any maintenance waste within the campus or surrounding environment.	Minor
End-of-life components (batteries, panels)	Soil / Environment	Risk from improper disposal of spent batteries, degraded panels or failed inverters if not managed under EPR and NESREA e-waste regulations	• Develop and implement an e-waste management plan in accordance with NESREA Electrical and Electronic Sector Regulations 2011. • Engage a NESREA-licensed e-waste handler for collection and disposal of all end-of-life batteries, panels and inverters. • Ensure all equipment suppliers confirm Extended Producer Responsibility obligations at the point of procurement. • Store all end-of-life components in a designated and labelled hazardous waste storage area pending collection. • Maintain records of all e-waste transfers including quantities, dates and licensed handler details.	Moderate
Operation of electrical systems (inverters, cables, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during operation and maintenance	• Implement lockout/tagout procedures for all maintenance works on energized electrical systems. • Engage only certified and licensed electricians for all operation and maintenance electrical works. • Conduct quarterly electrical safety inspections of all inverters, cables and connections. • Provide appropriate PPE including insulated gloves and tools to all O&M electrical workers. • Train all O&M staff in electrical safety and emergency response procedures.	Major
Battery storage and management	OHS (Workers)	Risk of chemical exposure, fire, or explosion in case of battery failure or improper handling	• Install automated battery management systems with thermal monitoring and overcharge protection. • Conduct monthly inspections of battery banks for signs of swelling, overheating or electrolyte leakage.	Major

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
			• Install fire suppression systems and smoke detectors within the battery storage room. • Train O&M staff in battery fire emergency response and evacuation procedures. • Prohibit storage of flammable materials within 5 metres of the battery storage area.	
Operation of facility within campus	Community Safety	Risk of unauthorized access by students, staff or visitors to energized solar arrays, battery storage areas or electrical infrastructure within the AUST campus, leading to potential injury or electrocution	• Install perimeter fencing and lockable gates around the solar array, battery storage room and control room. • Install clearly visible warning signs on all energised equipment and restricted areas. • Brief campus security personnel on restricted access zones within the solar installation. • Conduct regular awareness sessions with students and staff on electrical safety within the installation.	Major

6.4 Supply-Chain Environmental and Social Due Diligence

Because solar PV modules, batteries, inverters and associated electronics may be sourced through international and complex supply chains, procurement shall include proportionate environmental and social due diligence. Supplier declarations are a minimum requirement and shall be supported by documentary verification appropriate to the risk.

- Include contractual E&S requirements covering prohibition of forced labour, child labour and modern slavery, non-discrimination, worker safety and lawful employment.
- Require suppliers to identify manufacturer and country-of-origin information for major equipment categories.
- Apply enhanced due diligence to high-risk components or suppliers where credible risk information is identified.
- Retain supplier declarations, certifications, audit records and corrective-action documentation in the project procurement file.
- Include contractual audit/access and corrective-action provisions, with escalation or termination where material non-compliance is not corrected.

6.5 Battery, PV and Electrical Equipment Lifecycle Management

The battery energy storage system and other electrical/electronic equipment require lifecycle controls from procurement through operation, maintenance, replacement and end-of-life. The final design and procurement documentation shall specify the battery chemistry, rated capacity, battery management system, thermal management, fire detection/suppression, ventilation, isolation and end-of-life arrangements before commissioning.

- Maintain an equipment register identifying battery type, capacity, serial numbers, installation date and replacement status.
- Provide secondary containment and spill-response equipment where the selected battery technology requires it.
- Inspect battery systems routinely for leakage, swelling, corrosion, overheating, alarms and physical damage.
- Maintain manufacturer-recommended fire protection, ventilation, thermal management and emergency shutdown systems.
- Pre-plan transport and recycling/return of spent batteries, PV modules, inverters and other e-waste through appropriately authorized handlers.
- Maintain chain-of-custody records for hazardous/e-waste movements and final treatment or recycling.

CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Overview

The Environmental and Social Management Plan (ESMP) provides a structured framework for implementing, monitoring, and managing the mitigation measures identified in this ESIA. It is designed to ensure that potential environmental and social impacts associated with the Solar Hybrid Mini-Grid Project at the African University of Science and Technology (AUST) are effectively controlled throughout the project lifecycle.

The ESMP also provides for periodic reporting, supervision, and adaptive management. Monitoring results will be documented and used to inform corrective actions where necessary, ensuring continuous improvement in environmental and social performance throughout the project lifecycle.

7.2 Objectives of the ESMP

The key objectives of the ESMP are to:

- Ensure the effective implementation of all mitigation measures identified in this ESIA;
- Promote compliance with applicable national environmental regulations and relevant international standards, including those of the Federal Ministry of Environment and the African Development Bank;
- Establish a monitoring framework to track environmental and social performance using clearly defined and measurable indicators;
- Promote community health and safety through effective management of project-related risks;
- Ensure transparent stakeholder engagement and provide mechanisms for addressing grievances;
- Promote fair and inclusive employment practices, including equal opportunity for qualified individuals;
- Facilitate capacity building through training, awareness, and continuous supervision of project personnel; and
- Provide a basis for corrective actions and continuous improvement in project implementation.

7.3 Scope and Content of the ESMP

The ESMP outlines the specific measures required to manage identified environmental and social impacts across the pre-construction, construction, and operation phases of the project. For each identified impact, the ESMP specifies:

- the proposed mitigation measures;
- monitoring indicators for assessing performance;
- frequency of monitoring and reporting;
- institutional responsibilities for implementation and supervision; and
- estimated costs associated with mitigation and monitoring measures.

The mitigation and monitoring measures are presented in a structured matrix format, covering environmental, social, occupational health, and community safety aspects of the project. These matrices provide a practical tool for guiding day-to-day implementation and ensuring accountability throughout the project lifecycle.

7.4 ESMP Matrix

ESMP: Pre-Construction Phase

Activity	Receptor	Potential Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
Environmental Component									
Mobilization of construction materials and equipment to proposed university site	Air quality	Generation of dust along the University's access roads and within the project site due to movement of delivery trucks	Minor	• Apply water based dust suppression on all access routes and within the project site during dry and windy periods. • All vehicles transporting materials shall be covered with tarpaulins to prevent dust dispersion. • Restrict vehicle speeds on unpaved sections of campus roads to below 15 km/h. • Schedule delivery vehicles during off peak academic activity hours to minimize disruption.	Dust levels on access routes and within site. Visual observation of vehicle tarpaulin compliance. Speed limit compliance.	Daily during mobilization	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	200,000
	Air quality	Exhaust fumes from vehicles resulting in environmental pollution and respiratory discomfort to campus occupants	Minor	• All vehicles and machinery shall undergo routine maintenance and servicing to ensure efficient fuel combustion and reduced exhaust emissions. • Switch off engines when not in use. Avoid prolonged idling within the campus environment.	Vehicle and equipment maintenance records. Observation of engine idling compliance. Worker PPE usage.	Weekly	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer		
	Noise	Increase in ambient noise levels	Minor	• Schedule noisy mobilization activities during daytime hours only, between 7:00am and 6:00pm.	Noise levels within campus during mobilization activities. Compliance with daytime only work schedule.	Weekly / as required	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	-	-

Activity	Receptor	Potential Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				• Maintain construction equipment in good working order to reduce noise generation. • Notify University management in advance of activities likely to generate elevated noise levels.	University management notification records.				
Site clearing	Soil	Localized soil compaction and disturbance within areas designated for temporary material storage	Minor	• Restrict temporary material storage to designated areas only. • Install protective matting or boards in storage areas to minimize soil compaction. • Avoid stockpiling heavy materials on the same ground area for extended periods.	Visual inspection of material storage areas. Evidence of protective matting installation. Soil condition in storage zones.	Weekly	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	200,000
Site clearing	Soil	Disturbance of cultivated topsoil increasing erosion risk during wet season rainfall, with sediment runoff potential toward the nearby stream (approx. 100m), an already degraded receptor	Moderate	• Install silt fences and sediment traps along the site perimeter, prioritizing the side facing the stream. • Limit soil exposure duration by clearing progressively rather than all at once. • Re-vegetate or stabilize cleared areas promptly where construction is not immediately following. • Avoid stockpiling excavated soil close to the stream or drainage paths.	Visual inspection of erosion control measures. Sediment trap condition. Stream water clarity observation near the site.	Weekly, and after significant rainfall events	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	1,000,000	200,000
Site clearing	Biological (Flora & Fauna)	Removal of cultivated vegetation within the project footprint, with temporary disturbance to soil dwelling and ground fauna	Negligible	• Limit clearing strictly to the minimum necessary footprint. • Mark and protect all vegetation outside the	Area of vegetation cleared versus designated footprint. Evidence of fauna relocation measures.	Once prior to and once post clearing	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	100,000

Activity	Receptor	Potential Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				designated clearing boundary. • Conduct clearing progressively to allow fauna to relocate naturally before disturbance. • Reinstate cleared areas with appropriate ground cover upon completion of works.	Ground cover reinstatement status.				
Social Component									
Procurement of solar equipment	Workers within the supply chain / Project reputation	Potential procurement of equipment from OEMs or suppliers associated with forced labour, modern slavery, child labour or other human rights abuses within the supply chain	Minor	• Develop and implement a supply chain due diligence policy for all equipment suppliers and OEMs. • Require written declarations from all suppliers confirming absence of forced labour, modern slavery and child labour in their supply chains. • Include supplier compliance clauses in all procurement contracts. • Screen and audit key suppliers before contract award.	Supplier declaration records on file. Procurement contract compliance clauses. Audit reports for key suppliers.	Prior to procurement and at contract award	Mitigation: Contractor / REA PMU Monitoring: NEP (PMU)	-	-
Movement of vehicles and equipment	Traffic / Access	Temporary increase in vehicular movement along the express road access route and within the AUST campus internal road network, with minor disruption to campus movement	Minor	• Develop and implement a site traffic management plan covering all vehicle routes within the campus and along the express road access corridor to the Galadimawa Roundabout. • Designate specific delivery time windows to avoid peak academic activity periods. • Install traffic management signage at all vehicle entry	Traffic management plan in place and implemented. Number of traffic incidents reported. Signage installation records.	Daily during vehicle movement activities	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	700,000	200,000

Activity	Receptor	Potential Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				and movement points within the campus.					
Movement of vehicles and equipment	Traffic / Access	Minor disturbance to students and staff to increased human activity and equipment movement within the campus	Minor	• Notify all students and staff in advance of mobilization activities. • Maintain pedestrian access routes at all times during mobilization. • Designate a clear construction zone with barriers separating active work areas from pedestrian and academic areas. • Provide regular updates on construction schedules and any expected disruptions.	Advance notification records to students and staff. Pedestrian access routes maintained. Number of disturbance complaints received.	Weekly / Continuous	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	100,000
Handling and movement of equipment	OHS	Risk of minor accidents or injuries to workers during loading, unloading, and movement of equipment on site	Minor	• Develop and implement a site specific OHS Management Plan prior to mobilization. • Conduct pre mobilization safety induction for all workers before commencement. • Provide appropriate PPE including helmets, gloves, high visibility vests and safety boots to all workers. • Designate a trained first aider and maintain a first aid kit on site at all times.	OHS Management Plan approved and on site. Worker induction records. PPE provision and usage records. First aid kit availability.	Prior to mobilization and weekly thereafter	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	600,000	200,000
Handling and movement of equipment	OHS	Influx of people (migrant workers, sub-contractors and suppliers) and increased pressure on existing social infrastructure	Minor	• Develop and implement a Labour Influx Management Plan prior to worker mobilisation. • Brief all incoming workers on the campus Code of	Labour Influx Management Plan approved. Worker register maintained. Code of Conduct briefing records.	Prior to mobilization and weekly thereafter	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	200,000	100,000

Activity	Receptor	Potential Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				Conduct before commencement. • Maintain a worker register and verify identity and age of all workers before engagement. • Establish clear rules of engagement between workers and students, staff and Galadimawa Roundabout stakeholders.	Worker age verification records.				
Project mobilization and initial engagement	Community	Minor safety risks to students, staff, and pedestrians along the express road and internal campus access routes	Minor	• Install clearly visible safety signage and barriers at all construction entry points. • Conduct community notification meetings with Galadimawa Roundabout stakeholders and within the AUST campus before activities commence. • Establish a project grievance mechanism and communicate access to all stakeholders. • Brief campus security personnel on construction activity schedules.	Safety signage installed at all entry points. Community notification meeting records. Grievance mechanism communicated and accessible. Number of safety incidents reported.	Prior to mobilisation and monthly thereafter	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer, AUST Security	500,000	200,000
	Security	Risk of unauthorized access to project site leading to potential theft of equipment and accidents	Minor	• Erect temporary security fencing around the mobilization and material storage areas. • Engage dedicated site security personnel during mobilization activities. • Conduct daily inventory checks of all equipment and materials on site.	Security fencing installed and maintained. Security personnel deployment records. Daily equipment inventory records. Number of theft or security incidents reported.	Daily	Mitigation: Contractor Monitoring: NEP (PMU), AUST Security	500,000	200,000

Activity	Receptor	Potential Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				• Report any theft or security incidents to campus security and relevant authorities immediately.					
Total cost for Pre-construction Phase								**4,500,000**	**1,500,000.**

ESMP: Construction Phase

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
Environmental Component									
Excavation and foundation works for mounting structures	Soil	Disturbance of soil increasing erosion susceptibility within the footprint, with potential sediment runoff toward the nearby stream (approx. 100m), an already degraded receptor	Moderate	• Strip and stockpile topsoil separately from subsoil and protect from erosion during works. • Install erosion control measures including silt fences along downslope perimeters of all excavation areas. • Reinstate excavated areas with compacted fill and ground cover immediately upon completion. • Conduct earthworks progressively and avoid leaving large areas of exposed soil overnight.	Topsoil and subsoil stockpile records. Silt fence installation inspection. Visual evidence of progressive earthworks. Reinstatement status of excavated areas.	Daily during excavation works	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	800,000	200,000
Movement of construction vehicles and equipment within site	Soil	Soil compaction reducing permeability and affecting soil structure within frequently trafficked areas	Minor	• Restrict heavy vehicle movement to designated haul routes only. • Avoid repeated vehicle passes over the same unprotected ground areas.	Vehicle movement records on designated haul routes. Visual inspection of trafficked soil areas. Post construction soil	Weekly	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	-	-

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				• Inspect and rip compacted areas after construction to restore soil permeability before reinstatement.	permeability assessment.				
Trenching for underground distribution cables	Soil	Creation of exposed and loosely compacted soil zones along the cable trench route, increasing erosion potential especially during wet season rainfall	Moderate	• Bench and shore trench walls appropriately to prevent collapse and soil disturbance. • Stockpile excavated materials away from the trench edge to prevent slippage. • Backfill and compact trenches progressively and reinstate surface cover immediately upon cable laying. • Install erosion control measures along the full length of the cable trench corridor.	Trench shoring installation records. Daily trench inspection records. Backfill and compaction records. Erosion control installation along cable corridor.	Daily during trenching works	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	700,000	100,000
Site grading and levelling for panel installation	Soil / Drainage	Alteration of natural surface runoff patterns, leading to localized water concentration and erosion	Moderate	• Design site grading to maintain natural drainage patterns where possible. • Install temporary drainage diversions and sediment traps to intercept and manage runoff. • Reinstate natural drainage patterns upon completion of grading works.	Drainage pattern inspection before and after grading. Sediment trap installation records. Runoff observation during rainfall events.	Weekly during grading works	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	100,000
Trenching and cable laying across site	Soil / Drainage	Temporary disruption of drainage paths along the cable trench route.	Moderate	• Install temporary culverts or bridging across existing drainage channels where the cable route crosses them.	Drainage reinstatement inspection records. Culvert installation records. Observation of nearby drainage works.	Daily during cable laying works	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	600,000	200,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				• Reinstate all disturbed drainage paths immediately after cable installation. • Monitor nearby drainage works for any signs of blockage or diversion caused by trenching activity.					
Movement of vehicles and earthworks	Air quality	Generation of dust due to earthworks along the cable trench route and vehicle movement within the site	Moderate	• Apply water based dust suppression on all active earthworks areas and haul routes daily during dry periods. • Cover all vehicles transporting excavated soil or fine materials with tarpaulins. • Restrict vehicle speeds within the campus to below 15 km/h.	Dust levels on haul routes and at earthworks areas. Vehicle tarpaulin compliance records. Speed limit compliance observation.	Daily during earthworks	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	200,000	100,000
Movement of construction equipment	Air quality	Emission of exhaust gases from diesel powered machinery	Minor	• Ensure all construction vehicles and machinery are regularly serviced and maintained. • Switch off engines when not in use. Avoid prolonged idling within the campus. • Use low emission equipment where available and practicable.	Vehicle and machinery maintenance service records. Engine idling observation. Exhaust emission visual inspection.	Weekly	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	-	-
Operation of machinery and installation activities	Noise	Increased noise levels within the project environment	Moderate	• Fit all construction machinery with functional silencers and mufflers. • Erect temporary noise barriers around high noise	Silencer and muffler installation records. Noise barrier installation records. Construction activity timing log.	Weekly / Continuous	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	-	-

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				work areas adjacent to academic buildings. • Notify University management and students in advance of activities likely to generate elevated noise.					
Installation of mounting structures and cable works	Flora	Removal of cultivated vegetation within the project footprint	Negligible	• Mark and protect vegetation outside the designated clearing boundary. • Reinstate cleared areas with appropriate ground cover immediately upon completion of installation works.	Area of vegetation cleared versus designated footprint. Reinstatement status of cleared areas.	Once pre clearing and once post installation	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	100,000
Storage and handling of fuel, oil, and materials	Soil / Water	Risk of spills contaminating soil or infiltrating the nearby stream (approx. 100m), an already degraded receptor	Moderate	• Designate a bunded fuel and materials storage area with impermeable base and secondary containment. • Store all fuels, oils and chemicals within the bunded area at all times. • Maintain spill response kits on site at all times. Train workers in spill response procedures. • Prohibit refuelling within 100m of the stream or campus Ground Water source.	Bunded storage area inspection records. Spill kit availability and condition. Worker spill response training records. Refuelling location compliance.	Weekly	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer, AEPB	500,000	100,000
Construction activities and material storage	Waste	Generation of construction waste with potential for improper disposal and environmental pollution	Minor	• Implement waste segregation at source into general, recyclable and hazardous categories. • Contract a licensed waste collector for regular	Waste segregation compliance observation. Licensed waste contractor removal records. Waste register log.	Weekly	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer, AEPB	500,000	100,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				removal and disposal of all construction waste. • Prohibit open burning or unauthorized dumping of any construction waste within the campus. • Maintain a waste register tracking volumes generated, stored and disposed.	Evidence of no open burning.				
Installation of mounting structures and foundations	Visual aesthetics	Temporary visual disturbance due to presence of equipment, materials, and exposed surfaces	Minor	• Remove all construction materials, equipment and waste from site upon completion. • Reinstate disturbed surfaces and restore campus aesthetics upon completion of all works. • Maintain an orderly and clean construction site throughout the construction period.	Site cleanliness observation. Materials and waste removal records upon completion. Campus aesthetics reinstatement inspection.	Upon completion of works	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	100,000
ɔcial Component									
Mobilization and presence of construction workers	University / premises	Temporary disruption to academic and administrative activities within the AUST campus due to increased human presence and construction activity	Minor	• Designate clear construction zone boundaries with physical barriers separating works from academic areas. • Notify students, staff and University management in advance of all construction activities and schedules. • Coordinate construction scheduling with the academic calendar to avoid examination periods.	Construction zone boundary inspection. Advance notification records. Pedestrian access route maintenance. Number of campus disturbance complaints.	Weekly / Continuous	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	-	200,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				• Maintain safe pedestrian access routes around all active work areas at all times.					
Engagement of labour	Community	Potential for unmet expectations regarding employment opportunities among Galadimawa Roundabout stakeholders, causing grievances if local labour engagement commitments are not fulfilled	Minor	• Develop and communicate a transparent local employment policy prior to construction commencement. • Establish a community liaison officer to manage employment enquiries from union chairmen. • Implement a grievance mechanism accessible to Galadimawa Roundabout stakeholders. • Report local employment outcomes regularly to University management and stakeholder representatives.	Local employment policy communicated. Community liaison officer appointment records. Grievance register. Employment outcome reports.	Monthly	Mitigation: Contractor Monitoring: NEP (PMU), AUST Management	500,000	100,000
Trenching and cable laying across campus	Access / Infrastructure	Temporary obstruction of walkways and internal access routes within the AUST campus during cable trench excavation and installation works	Moderate	• Install clearly marked pedestrian diversions and alternative walkway routes for all affected campus paths. • Erect safety barriers and warning signs along the full length of open trench sections. • Backfill and reinstate walkways and access routes immediately after cable installation in each section. • Provide temporary bridging over open	Pedestrian diversion signage and barriers installed. Temporary bridging at crossing points. Walkway reinstatement records after each trench section.	Daily during trench works	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	100,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				trenches at all major pedestrian crossing points.					
Presence of workforce	Public Health	Increased risk of communicable disease spread from interaction between construction workers and students, staff, and Galadimawa Roundabout stakeholders	Minor	• Implement a Worker Code of Conduct covering hygiene, behaviour and interaction with campus users. • Provide health awareness briefings to all workers before commencement, covering communicable disease prevention. • Establish adequate sanitation facilities for construction workers separate from campus facilities. • Conduct HIV/AIDS and communicable disease awareness sessions for workers during induction.	Worker Code of Conduct briefing records. Sanitation facility provision and maintenance. Health awareness session attendance records. Disease incident reports.	Monthly	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	100,000
Labour dynamics	Social (Gender)	Potential for unequal access to employment opportunities for women, and risk of sexual exploitation, abuse and harassment (SEAH) and gender based violence (GBV) associated with labour influx	Minor	• Implement an equal opportunity employment policy requiring non-discriminatory recruitment practices. • Establish and enforce a zero tolerance SEAH and GBV policy with clear reporting and response procedures. • Brief all workers on the Code of Conduct covering SEAH, GBV and respectful conduct toward female students and staff. • Ensure female workers and campus users have	Equal opportunity recruitment records. SEAH/GBV zero tolerance policy communicated. SEAH reporting mechanism accessible and functioning. Number of SEAH incidents reported and resolved.	Monthly	Mitigation: Contractor Monitoring: NEP (PMU), AUST Management	-	200,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				access to a confidential SEAH reporting mechanism.					
Influx of workers	Local Services	Minor pressure on existing social amenities and services within the AUST campus due to labour influx during the construction phase	Minor	• Limit worker numbers on site to the minimum required for each construction activity. • Prohibit workers from residing within the campus unless formally arranged. • Coordinate with University management on any additional pressure on campus facilities from workers.	Worker numbers on site versus approved complement. Worker residential arrangement records. Coordination meeting records with University management.	Weekly	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	-	-
Project activities and expectations	Community Grievance	Potential for complaints arising from perceived impacts or unmet expectations	Minor	• Establish a project level grievance mechanism accessible to all campus users and Galadimawa Roundabout stakeholders. • Designate a community liaison officer to receive and respond to all project related complaints. • Log and respond to all grievances within 14 working days and report outcomes to complainants. • Conduct regular stakeholder update meetings with union chairmen and campus representatives.	Grievance mechanism established and accessible. Community liaison officer operational. Grievance register with response timelines. Stakeholder update meeting records.	Monthly	Mitigation: Contractor Monitoring: NEP (PMU), AUST Management	300,000	100,000
HS / Community Safety									
Excavation and trenching works	OHS (Workers)	Risk of injuries from trench collapse, slips,	Major	• Ensure all excavation and trench works comply with applicable OHS standards	Trench shoring installation records. Daily excavation	Daily during excavation works	Mitigation: Contractor Monitoring: NEP	-	-

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
		trips, and falls within excavation areas		for confined spaces and excavations. • Conduct daily inspection of all excavation areas before workers commence activities.	safety inspection records. Prohibited entry compliance. Injury incident reports.		(PMU), Site Engineer		
Installation of mounting structures and panels	OHS (Workers)	Risk of falls, cuts, and musculoskeletal injuries during installation activities	Major	• Enforce use of full PPE including harnesses, helmets and non-slip footwear for all installation works. • Erect scaffolding or working platforms for all elevated installation activities. • Conduct toolbox talks on fall prevention and safe working at height before each shift. • Inspect all lifting equipment and tools daily before use.	PPE usage inspection. Scaffolding installation records. Toolbox talk attendance records. Fall incident reports.	Daily	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	-	-
Handling of construction materials and equipment	OHS (Workers)	Risk of injuries from improper lifting, falling objects, or equipment misuse	Major	• Train all workers in manual handling techniques and safe lifting practices before commencement. • Provide mechanical lifting aids for all loads exceeding 25kg. • Inspect all construction materials and equipment for defects before use. • Enforce hard hat and steel-toed boot requirements at all times on site.	Manual handling training records. Lifting aid availability. Equipment defect inspection records. OHS incident reports.	Daily	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	200,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
Electrical installation works (cabling, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during installation of electrical components	Major	• Engage only certified and licensed electricians for all electrical installation works. • Implement lockout/tagout procedures for all electrical works. • Conduct pre-work electrical safety briefings before each shift involving electrical activities. • Test all electrical connections before energizing any component.	Electrician certification records. Lockout/tagout procedure compliance. Pre-work electrical safety briefing records. Electrical incident reports.	Daily during electrical works	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	-	-
Operation of machinery and equipment	OHS (Workers)	Exposure to noise, vibration, and mechanical hazards	Moderate	• Provide hearing protection to all workers operating or working near noisy machinery. • Rotate workers away from high noise and high vibration tasks to limit exposure duration. • Conduct pre-employment and periodic medical screening for workers exposed to noise and vibration. • Maintain all machinery in good working order to minimize noise and vibration output.	Hearing protection provision and usage records. Worker exposure duration rotation records. Medical screening records. Machinery maintenance logs.	Weekly	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	-	-
Movement of construction vehicles within site and access roads	Community Safety	Risk of accidents involving pedestrians, workers, or other road users within the campus	Major	• Implement a site traffic management plan with designated vehicle and pedestrian zones.	Traffic management plan implementation. Speed limit compliance observation. Flag person deployment	Daily	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer, AUST Security	-	-

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				• Enforce a strict speed limit of 10 km/h for all vehicles within the campus. • Station flag persons at all vehicle-pedestrian conflict points.	records. Vehicle accident incident reports.				
Open trenches and excavation areas	Community Safety	Risk of unauthorized access leading to falls or injuries	Major	• Install physical barriers, hoarding and warning signs along the full length of all open trenches. • Cover or bridge open trenches at all pedestrian crossing points before end of each working day. • Conduct daily inspections of all barriers and coverings before works commence. • Prohibit all unauthorized persons from entering the active construction zone.	Physical barriers and warning signs installed along open trenches. Pedestrian crossing bridging in place before end of each working day. Daily barrier inspection records. Unauthorized access incidents.	Daily	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer, AUST Security	-	-
Storage of fuel and hazardous materials	OHS / Community Safety	Risk of fire outbreak, explosion, or exposure to hazardous substances	Moderate	• Store all fuels and hazardous materials in a designated bunded area away from academic buildings. • Maintain fire extinguishers at all fuel storage and electrical works areas. • Prohibit smoking within 25 metres of any fuel storage or hazardous materials area. • Train workers in fire emergency response	Bunded fuel storage area inspection. Fire extinguisher availability and condition. No smoking zone compliance. Fire emergency drill records.	Weekly	Mitigation: Contractor Monitoring: NEP (PMU), Site Engineer	500,000	200,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				procedures during induction.					
Total cost for Construction Phase								**6,600,000**	**2,000,000**

ESMP: Operation Phase

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
Battery storage and operation	Soil / Water	Risk of contamination from battery leakage or improper handling of electrolyte materials	Moderate	• Inspect battery storage systems and connections monthly for signs of leakage, corrosion or damage. • Install battery containment trays with secondary containment capacity under all battery banks. • Prohibit storage of batteries directly on unprotected soil surfaces. • Train O&M staff in battery leak detection and emergency spill response procedures. • Maintain spill response kits in the battery storage room at all times.	Monthly battery inspection records. Secondary containment integrity checks. Spill kit availability and condition. Staff training records on spill response.	Monthly	Mitigation: Contractor / O&M Operator Monitoring: NEP (PMU), AUST Management, AEPB	1,500,000	200,000
Operation of equipment (inverters, transformers)	Noise	Low level noise generation from operational inverters and transformers, negligible relative to the site ambient noise baseline	Minor	• Ensure inverters and transformers are installed within enclosed housing to contain operational noise. • Conduct periodic noise monitoring at the nearest sensitive receptor to	Periodic noise measurement at nearest sensitive receptor. Inverter and transformer housing inspection. High noise maintenance	Quarterly	Mitigation: O&M Operator Monitoring: NEP (PMU), Site Engineer	200,000	100,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				confirm compliance with noise limits. • Schedule any high-noise maintenance activities during daytime hours only.	activity scheduling records.				
Cleaning of solar panels	Water resources	Use of borehole water for panel cleaning, especially in harmattan, adding minor demand on campus supply	Negligible	• Use minimum water volumes necessary for effective panel cleaning. • Schedule panel cleaning during early morning hours to minimize evaporative water loss. • Consider dry cleaning methods during the harmattan period to reduce water demand.	Volume of water used per panel cleaning session. Borehole water level monitoring. Evidence of dry cleaning methods during harmattan period.	Per cleaning event	Mitigation: O&M Operator Monitoring: NEP (PMU), AUST Management	-	-
Maintenance activities	Waste generation	Generation of minor waste such as damaged components, packaging, and maintenance residues	Minor	• Implement waste segregation at source separating general waste from hazardous maintenance residues. • Contract a licensed waste collector for regular removal of all maintenance waste from the campus. • Maintain a waste log recording types, quantities and disposal destinations of all waste generated. • Prohibit dumping of any maintenance waste within the campus or surrounding environment.	Waste segregation compliance observation. Licensed waste contractor removal records. Waste log maintained and up to date. Evidence of no unauthorized dumping.	Monthly	Mitigation: O&M Operator Monitoring: NEP (PMU), AUST Management, AEPB	300,000	100,000
End-of-life components (batteries, panels)	Soil / Environment	Risk from improper disposal of spent batteries, degraded panels or failed inverters if not managed under	Moderate	• Develop and implement an e-waste management plan in accordance with NESREA Electrical and	E-waste management plan in place and implemented. Licensed e-waste handler engagement	Per end-of-life event / Annually	Mitigation: O&M Operator Monitoring: NEP (PMU),	1,000,000	200,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
		EPR and NESREA e-waste regulations		Electronic Sector Regulations 2011. • Engage a NESREA-licensed e-waste handler for collection and disposal of all end-of-life batteries, panels and inverters. • Store all end-of-life components in a designated and labelled hazardous waste storage area pending collection. • Maintain records of all e-waste transfers including quantities, dates and licensed handler details.	records. E-waste storage area inspection. E-waste transfer records.		NESREA, AEPB		
Operation of electrical systems (inverters, cables, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during operation and maintenance	Major	• Implement lockout/tagout procedures for all maintenance works on energized electrical systems. • Engage only certified and licensed electricians for all operation and maintenance electrical works. • Conduct quarterly electrical safety inspections of all inverters, cables and connections. • Provide appropriate PPE including insulated gloves and tools to all O&M electrical workers. • Train all O&M staff in electrical safety and emergency response procedures.	Lockout/tagout procedure compliance records. Electrician certification records. Quarterly electrical safety inspection reports. PPE provision records. OHS training records.	Quarterly	Mitigation: O&M Operator Monitoring: NEP (PMU), Site Engineer	400,000	100,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
Battery storage and management	OHS (Workers)	Risk of chemical exposure, fire, or explosion in case of battery failure or improper handling	Major	• Install automated battery management systems with thermal monitoring and overcharge protection. • Conduct monthly inspections of battery banks for signs of swelling, overheating or electrolyte leakage. • Install fire suppression systems and smoke detectors within the battery storage room. • Train O&M staff in battery fire emergency response and evacuation procedures. • Prohibit storage of flammable materials within 5 metres of the battery storage area.	Automated battery management system operational status. Monthly battery bank inspection records. Fire suppression system and smoke detector tests. Staff emergency response training records.	Monthly	Mitigation: O&M Operator Monitoring: NEP (PMU), Site Engineer	-	-
Operation of facility within campus	Community Safety	Risk of unauthorized access by students, staff or visitors to energized solar arrays, battery storage areas or electrical infrastructure within the AUST campus, leading to potential injury or electrocution	Major	• Install perimeter fencing and lockable gates around the solar array, battery storage room and control room. • Install clearly visible warning signs on all energized equipment and restricted areas. • Maintain adequate security lighting around the installation area throughout the night. • Brief campus security personnel on restricted access zones within the solar installation.	Perimeter fencing and lockable gates installed and maintained. Warning signs visible on all energized equipment. Security lighting operational. Security briefing records. Awareness session records.	Monthly	Mitigation: O&M Operator Monitoring: NEP (PMU), AUST Security, AUST Management	200,000	100,000

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost - Mitigation (₦)	Cost - Monitoring (₦)
				• Conduct regular awareness sessions with students and staff on electrical safety within the installation.					
Total Cost for Operation Phase								**2,700,000**	**800,000**

7.5 Roles, Responsibilities and Accountabilities

The Rural Electrification Agency Project Management Unit (NEP-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 21 indicates the Roles and Responsibilities of the Stakeholders in the Implementation, Monitoring and Review of the ESMP

Table 21: Institutional Roles & Responsibilities for ESMP Implementation

S/N	Stakeholder	Roles and Responsibilities
1.	AUST Director Physical Planning:	**Pre-Construction Phase** • Earmark the areas for the project development from the survey land • Appoint a Site Engineer • Arrange and ensure adequate training is carried out for the Site Engineer • Review the ESMP from the consultant • Ensure the University's commitment to the ESMP implementation • Implement the restoration of livelihood to affected persons before mobilization to site **Operational Phase** • Supervise the activities of the Site Engineer by reviewing reports on ESMP issues • Suggest ESMP improvements to O&M Contractor and PMU to address noncompliance and upcoming issues
2.	NEP-PMU	**Pre-Construction Phase** • Provide technical support to the University in the final selection of sufficient and suitable land for construction of power plant and training centre • Appoint an EPC contractor • Supervise the activities of the EPC contractor • Review the ESMP from the consultant • Ensure REA's commitment to the ESMP implementation **Construction phase** • Supervise the activities of the EPC contractor by reviewing reports on ESMP issues • Discuss ESMP improvements with AUST Director of Physical Planning to address non-compliance and upcoming issues • Monitor the implementation of the ESMP • Supervise the activities of the EPC contractor and ensure compliance ESMP with mitigation measures • Report to AUST Director of Physical Planning on ESMP compliance and noncompliance issues **Operational** • Appoint an O&M Contractor • Supervise the activities of the O&M Contractor by reviewing reports on ESMP issues • Discuss ESMP improvements with AUST Director of Physical Planning to address non-compliance and upcoming issues
3.	Site Engineer	**Pre-Construction Phase** • Attend adequate training on ESMP implementation • Supervise the activities of the EPC contractor and ensure compliance ESMP with mitigation measures • Report to AUST Director of Physical Planning on ESMP compliance and noncompliance issues **Operational phase**

		• Appoint a O&M Contractor • Supervise the activities of the O&M Contractor by reviewing reports on ESMP issues • Discuss ESMP improvements with AUST Director of Physical Planning to address non-compliance and upcoming issues
4.	EPC Contractor	• Familiarize with ESMP requirements • Ensure that all personnel are made aware of the management measures/plans that are to be implemented • Report to the NEP-PMU, POE and AUST Site Engineer on ESMP compliance and noncompliance issues • Implement ESMP requirements relevant to work being undertaken **Construction phase** • Implement ESMP requirements relevant to work being undertaken • Hire a Gender/GBV officer • Report to the REA-PMU, POE and AUST Site Engineer on ESMP compliance and noncompliance issue
5.	O&M Contractor	• Implement ESMP requirements relevant to work being undertaken • Hire a Gender/ GBV officer • Report to the NEP-PMU, POE and AUST Site Engineer on ESMP compliance and non-compliance issue
6.	FMEnv Representatives	• Monitor the implementation of ESMP requirements (impact mitigation monitoring) relevant to work being undertaken • Discuss ESMP improvements with AUST Director of Physical Planning and NEP-PMU to address non-compliance and upcoming issues • Operational phase
7.	NESREA Representatives	• Monitor the implementation of ESMP requirements (environmental compliance monitoring) relevant to work being undertaken • Discuss ESMP improvements with O&M Contractor, AUST Director of Physical Planning, and NEP-PMU to address non-compliance and upcoming issues
8.	AEPB Representatives	• Monitor the implementation of ESMP requirements (impact-mitigation monitoring) relevant to work being undertaken • Discuss ESMP improvements with AUST Director of Physical Planning and NEP-PMU to address non-compliance and upcoming issue
9.	Safeguards Unit	**Environmental Aspects** • Analyze potential community/individual sub-projects and their environmental impacts; • Ensure that project activities are implemented in accordance to best practices and guidelines set out in the site specifics; • Identify and liaise with all stakeholders involved in environment related issues in the project; and • Be responsible for the overall monitoring of mitigation measures and the impacts of the project during implementation. **Social Aspects** • Develop, coordinate and ensures the implementation of the social aspects of the ESMP; • Implement the grievance mechanism on the project • Identify and liaise with all stakeholders involved in social related issues in the project; • Conduct impact evaluation and beneficiaries' assessment; and • Establish partnerships and liaise with organizations, Community Based Organizations (CBOs) and Civil Society Organizations (CSOs).
10.	EPC and Works Contractor	• After receiving and committing to the environmental procedures and Management Plans, • Contractors must fully carry out the measures of the environmental protection, health and safety procedure as indicated; • Any changes related to Environment, health and safety procedure must be referred to PMU for approval

		• In case of any violations on arising works either detected by Environmental consultant, Safeguard Specialists, or new arising works proposed by contractors, they must be reported to PMU for further actions. • If contractors decided to not follow instruction from PMU, construction activities will be halted until necessary actions are taken. • Contractors must assign at site, personnel in charge of Environment, health and safety procedure. • Compliance to BOQ specification in procurement of material and construction Provide oversight function during construction and decommissioning

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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:

- Labour Management Plan (LMP) (Annex 6)
- Waste Management Plan (WMP) (Annex 4)
- Grievance Redress Mechanism (GRM) (chapter 9)
- Stakeholder Engagement Plan (SEP) (chapter 9)
- Health and Safety Plan (H&S Plan) (Annex 7)
- Climate Change Adaptation and Mitigation Plan (Annex 5)

7.7 Monitoring and Evaluation Plan

The monitoring plan (Internal and External Monitoring) for the ESMP is presented in the Table 22 below. Monitoring results shall be documented with preventive/corrective actions to be implemented.

Table 22: Monitoring Plan for the ESMP

Monitoring	Action	Responsibility	Period	Performance Indicator
Internal Monitoring	Regular site visit to ensure that the mitigation measures and actions specified in the ESMP are implemented and as bound by the contract is satisfactorily implemented.	E&S team of the NEP PMU	During Preconstruction, Construction and Operation Phases	Monitoring Reports and documentation as described below
	Daily monitoring of the contractor performance and adherence to GBV/SEA/SH obligations	Supervision Consultant, GBV Specialist	During Preconstruction and Construction phases	Monitoring Reports presented to the PMU.
	Site visits for supervision and inspection to ensure contractor adhere strictly to the E&S requirements of the project	Supervising Consultant Environmental, Social, GBV specialists	During Preconstruction and Construction phases	Observations and Monitoring Reports presented to the PMU.
External Monitoring	Periodic site visit to ensure project is implemented in an environmentally & socially sustainable manner using the monitoring indicators specified in the ESMP Matrix and other national and international environmental & social requirements	FMEnv, NESREA, Federal Ministry of Environment, AUST Campus representatives, and other relevant MDAs.	During Preconstruction, Construction and Operation Phases	Inspect monitoring reports from the PMU Provide feedback on observations. Enforce corrective actions where necessary.

	Periodic monitoring of timely, mandatory and confidential reporting for E&S activities	Third Party Monitors	During Preconstruction, Construction and Operation Phases	Monitoring Reports presented to the AfDB

7.8 Training, Awareness and Capacity Building for Zonal Offices

REA - NEP shall identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environmental or social conditions. It is important that employees at each relevant phase of the project are 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 appointment;
- Specialist training (as required for specific job role); and
- Refresher training as required.

Training for local community on general environmental awareness and ESMP mitigation measures pertaining to community health, safety and security shall 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 23.

Table 23: Proposed Capacity Building Plan

	Training Content	Participants	Delivery	Cost (Naira)
1.	Specific training on Environmental & Social Safeguards	Environmental & Social Safeguard Officer	PMU Consultant	2,000,000.00
2.	Training on ESMP Implementation: mitigation, roles & responsibilities	Project Team	PMU Consultant	1,000,000.00
3.	Training for contractors on ESMP mitigation measures, Code of Conduct, OHS requirements	Contractors' management and workers	PMU Consultant	1,000,000.00
4.	Training of Contractor Drivers, fleet management, traffic control within AUST etc.	Contractor, contractor drivers, HSE officer, ESO	School of Transport, AUST / Security Management	2,000,000.00
5.	GBV/SEA/SH Prevention and Response Mechanisms	Project team Environmental &	PMU Consultant	2,000,000.00

		Safeguard Officer, Contractors		
6.	Grievance Redress Mechanism	Grievance Redress Committees: project level and management level GRCs , Contractors	PMU Consultant	2,000,000.00
			Total	**10,000,000.00**

The capacity-building cost estimate is an all-inclusive budget. It covers facilitator/resource person fees, venue and logistics, participant transportation or local travel support, training materials and printing, audio-visual/technology support, refreshments, documentation, reporting, and post-training follow-up. The final cost breakdown shall be confirmed during implementation planning, but the estimate has been included to ensure that all key training-related expenditures required for ESMP implementation are budgeted.

7.9 Implementation Schedule and Reporting

The project has an estimated completion period of 12-18 months as outlined in activities related to the ESMP Matrix as seen above should to be integrated into the overall construction schedule.

Implementation will be in line with the finalized overall project schedule, as all activities are integrated into the project design. This will take place from the planning stages to ensure quality equipment and support services are sourced, through construction, commissioning, operation to decommissioning phases. Once monitoring begins, any observation of an environmental problem, such as non-compliance or adverse impacts will be reported immediately by the officers responsible to respective authorities in REA and corrective/ remedial actions will be taken without delay to ensure optimal performance of the project while promoting environmental sustainability.

Also, REA shall keep the relevant regulatory authorities, including FMEnv, NESREA, the Abuja Environmental Protection Board (AEPB), informed of the project performance through reports that will be made available to the regulators when required. REA will provide appropriate documentation of HSE related activities, including internal inspection records, training records, and reports to the relevant authorities. These periodic HSE reports summarizing the status of the environment in the plant will be submitted to FMEnv. Any values exceeding regulatory limits will be specifically identified, together with an explanation of the circumstances involved and corrective measures to ensure compliance in the future.

Table 24: ESMP Implementation Schedule

S/No	Activity	Responsibility	Months											
			1	2	3	4	5	6	7	8	9	10	11	12 – 18
1	ESMP Disclosure	Project Team												
2	Develop Environmental/Social Requirements in Bid Documents	Project Team												
3	Finalization and Approval of Engineering Designs	Design Consultant/ Project Team												
4	Allocate budget for ESMP Monitoring	Project Team												
5	Appoint Support Staff for ESMP	Project Team												

6	Review and Approval of Contractor's HSE, WMP, TMP etc	ESO/SSO												
7	Capacity building	Project Team												
8	Implementation of Environmental and Social Mitigation Measures	Contractor												
9	Supervision of pre-Construction and Construction activities	Project Team												
10	Supervision of ESMP Implementation	ESO/SSO and Engineering Consultant												
11	Environmental and Social Monitoring and Auditing	FMEnv, SMEnv,												
12	Reporting on ESMP Implementation	ESO/SSO												

7.10 ESMP Disclosure

Following the ESMP clearance by the Bank, the PMU shall disclose the ESIA in line with the Nigerian EIA laws. This will include a formal registration of the ESIA with the FMEnv and receipt of guidelines for the disclosure from the EA department including the locations to disclose the documents. At a minimum, this will include the following:

Table 25: ESMP Disclosure

s/n	Entity	Disclosure Requirements
1	Federal Ministry of Environment (FMEnv). Disclosure according to Country System in line with Nigeria EIA Act Cap E12 LFN, 2004	The PMU will disclose the ESIA for 21 days as required by the Nigeria EIA public notice and review procedures in the following offices: - FMEnv Office, - Abuja Environmental Protection Agency - NEP-PMU Office Disclosure will also include advert in 2 newspapers: one national and one local (state) newspapers and Radio Jingles. The purpose will be to inform stakeholders about the project activities; environmental and social impacts anticipated and proposed environmental and social mitigation measures.
2	AfDB	Following clearance by the AfDB, the ESIA/ESMP shall be disclosed in accordance with the disclosure requirements applicable to the project's environmental and social categorization under the AfDB Integrated Safeguards System.

7.11 ESMP Budget

The total costs of the ESMP implementation including costs for mitigation, monitoring and capacity building is estimated as: **₦30,910,000.00** (Thirty Million, Nine Hundred and Ten Thousand Naira, only.*)* which converts to **$22,694.56** (Twenty-Two Thousand, Six Hundred and Ninety-Four Dollars, Fifty-Six Cents), as detailed in Table 29 below:

Table 26: ESMP Budget

ITEM	RESPONSIBILITY	COST ESTIMATE	
		NAIRA (₦)	USD ($)
Cost of Mitigation	Contractor	13,800,000.00	10,132.16
Cost of Monitoring	NEP-PMU, MDAs	4,300,000.00	3,157.12

Capacity Building	NEP- PMU/Contractor	10,000,000.00	7,342.14
Sub-total		28,100,000.00	20,631.42
Contingency (10% of sub-total)		2,810,000.00	2,063.14
TOTAL		**30,910,000.00**	**22,694.56**

Exchange Rate $1.00(USD) = ₦1,362 (NGN) – CBN rate as at August, 2026

7.12 Additional Management Plans and Performance Requirements

The following management instruments shall be treated as controlled project documents and incorporated into EPC/O&M contractual requirements before the relevant activity starts. Where a plan is prepared by the contractor, it shall be reviewed and accepted by the NEP-PMU/AUST E&S function before implementation.

Management instrument	**Minimum content**	**When required**	**Owner / accountable party**
Contractor ESMP (C-ESMP)	Method statements, risk controls, roles, emergency procedures, monitoring, reporting and corrective action	Before EPC mobilization	EPC Contractor; NEP-PMU oversight
Traffic Management Plan	Routes, delivery windows, speed limits, pedestrian segregation, flagpersons, signage, incident response	Before equipment mobilization	EPC Contractor / AUST
GBV/SEA/SH Action Measures	Risk assessment, Code of Conduct, confidential reporting, referral, training, sanctions and monitoring	Before workforce mobilization	EPC Contractor / NEP-PMU
Land/Crop/User Verification Record	Land tenure confirmation, user/crop inventory and OS5 screening outcome	Before site clearance	REA/NEP-PMU/AUST
Biodiversity/Tree Management Plan	Tree inventory, no-go areas, progressive clearing, replanting, survival monitoring	Before vegetation clearance	EPC Contractor / AUST
Waste and E-waste Management Plan	Segregation, storage, transport,	Before construction and updated before operation	EPC/O&M Contractor

	licensed handling, battery/PV lifecycle and records		
Emergency Preparedness and Response Plan	Battery fire, electrical incidents, spill, flood/storm, trench incident, medical emergency and safeguarding incidents	Before construction; test periodically	EPC/O&M / AUST
Stakeholder Engagement Plan	Stakeholder mapping, disclosure, inclusive consultation, feedback tracking and reporting	Before construction and throughout lifecycle	NEP-PMU/AUST
Worker GRM	Accessible confidential worker complaint channels, escalation and non-retaliation	Before worker mobilization	EPC/O&M Contractor
Chance Finds Procedure	Stop-work, protection, notification, assessment and clearance protocol	Before excavation/trenching	EPC Contractor / AUST

7.13 ESMP Outcome Indicators and Corrective Action

Monitoring shall include both implementation/process indicators and outcome indicators. Non-compliance shall be recorded, assigned a responsible party and closed within a defined timeframe. Repeated non-compliance shall trigger management review and, where necessary, revision of the relevant method statement or management plan.

Performance area	Outcome indicator	Target / trigger	Frequency
OHS	Lost-time injuries; recordable incidents; near misses	Zero fatalities; investigate all serious incidents and recurring near misses	Monthly / immediate for serious incidents
Traffic and community safety	Vehicle-pedestrian incidents; speed compliance	Zero serious incidents; investigate all complaints/incidents	Weekly during construction / monthly reporting
Dust/noise	Monitoring results at sensitive receptors and complaints	Within applicable standards/approved project limits; corrective action for exceedances	As specified in ESMP and complaint-triggered

Water/soil	Evidence of sediment release/spills; relevant monitoring results	No uncontrolled discharge; immediate containment and corrective action	Weekly visual checks / periodic analytical monitoring
Waste/e-waste	% segregated; licensed transfer records; chain of custody	100% controlled hazardous/e-waste movements	Monthly
GBV/SEA/SH	Training coverage; availability of confidential channels; case-management process	100% workforce trained before site access; confidential handling of complaints	Monthly
Grievances	% acknowledged and resolved within approved timeframe	Track all grievances; escalation where unresolved	Monthly
Local employment/gender	Local recruitment and female participation where roles are available	Report disaggregated recruitment data without discriminatory quotas	Monthly during construction
Biodiversity/tree restoration	Tree survival/replanting success	Monitor survival and replace failed plantings as required	Quarterly/seasonally
Energy/climate	Diesel consumption, generator runtime and renewable generation	Trend against verified pre-project baseline and design expectations	Monthly operational monitoring

CHAPTER EIGHT: REMEDIATION PLAN AFTER DECOMMISIONING/ CLOSURE

8.1 Introduction

The proposed solar-hybrid mini-grid is expected to have an operational design life of approximately twenty-five (25) years, subject to proper operation, maintenance and replacement of major components such as batteries and inverters. At the end of the project's operational life, or where major components are permanently taken out of service, decommissioning shall be planned and implemented in accordance with applicable Nigerian regulatory requirements, the AfDB Integrated Safeguards System, the FMEnv National Guidelines for Decommissioning of Facilities in Nigeria, and good international industry practice.

8.2 Decommissioning Activities

A detailed decommissioning and closure plan shall be prepared before decommissioning activities commence and submitted to the relevant regulatory authorities for review and approval. The plan shall define the scope of decommissioning, the components to be removed, the method of dismantling, waste streams to be generated, handling and recycling arrangements, occupational and community health and safety measures, site rehabilitation requirements, implementation schedule, institutional responsibilities and estimated costs.

Decommissioning activities shall include:

i. Dismantling and removal of photovoltaic panels, mounting structures, inverters, transformers, batteries, switchgear, control equipment, cables and associated infrastructure;
ii. Removal or safe abandonment of underground cables and subsurface installations, where applicable;
iii. Segregation, inventory and management of decommissioned materials, including reusable components, scrap metal, electrical and electronic waste, batteries and general demolition waste;
iv. Transportation of spent batteries and e-waste through licensed handlers to approved recycling, take-back or disposal facilities in accordance with applicable NESREA regulations and Extended Producer Responsibility requirements;
v. Restoration and stabilization of disturbed areas, including erosion control, backfilling, grading and revegetation where required;
vi. Consultation with AUST and other relevant stakeholder including regulatory authorities, before commencement of decommissioning; and
vii. Post-decommissioning inspection and monitoring to confirm that the site has been left in a safe, environmentally sound and socially acceptable condition.

8.3 Management of Decommissioning Activities

In the event of decommissioning, NEP, in conjunction with the leadership of the African University of Science and Technology (AUST), 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
  - 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 shall be carried out before any demolition and shall 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 operational phase) and the measures to minimize the effects by:
- 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.

8.4 Abandonment Plan

Prior to site abandonment, NEP 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 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 NEP-Project Management Unit, the Department of Works and Physical Planning in AUST, and the Federal Ministry of Environment. 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.

8.5 Roles, Responsibilities and Accountabilities

The key personnel and institutions with major roles in the implementation and monitoring of environmental and social measures for the Project decommissioning/closure are as follows:

A. Contractor(s) Engaged for Decommissioning Activities

- Implement environmental and social measures and management actions put in place for the decommissioning activities.

B. NEP-PMU

- Supervise the activities of the contractor(s) engaged for decommissioning purpose by ensuring that the recommended environmental and social and management actions are implemented.
- Discuss environmental and social management plan improvements with the Director of Works and Physical Planning Department in AUST to address noncompliance and upcoming issues.

C. AUST Site Manager

- Directly monitor the activities of the contractor(s) engaged for decommissioning and ensure compliance to the implementation of environmental and social measures and management actions put in place to address potential impacts and risks associated with the decommissioning activities.
- Report to the Director of Works and Physical Planning Department in AUST on contractor's performance regarding the implementation of environmental and social measures.

D. Director of Works and Physical Planning Department in AUST

- Jointly supervise the activities of the contractor(s) engaged for decommissioning
- Suggest environmental and social management plan improvements to NEP-PMU to address non-compliance issues and upcoming issues.

E. Federal Ministry of Environment Representatives

- Approve the decommissioning plan for the Project
- Monitor the implementation of environmental and social measures and management actions documented in the decommissioning plan.
- Discuss environmental and social management plan improvements to NEP-PMU to address non-compliance issues and upcoming issues.

8.6 Detailed Closure and Lifecycle Commitments

Although the project is expected to have an indicative life of approximately 25 years, decommissioning planning shall not be deferred entirely. The closure strategy shall be reviewed at least five years before anticipated closure and updated to reflect technology, regulation, waste-management capacity and stakeholder expectations at that time.

- Prepare a decommissioning inventory of PV modules, batteries, inverters, transformers, cables, structures and hazardous materials.
- Prioritize reuse, manufacturer take-back and recycling before disposal, subject to applicable requirements and available facilities.
- De-energize and isolate electrical systems before dismantling; use competent and authorized personnel.
- Prevent contamination during removal of batteries, oils, fuels and other hazardous materials; retain waste-transfer records.
- Remove or safely close civil structures as agreed with AUST and restore disturbed ground, drainage and vegetation where appropriate.
- Undertake post-closure inspection and, where warranted by the closure risk assessment, environmental monitoring until agreed closure criteria are met.
- Consult AUST, regulators and affected stakeholders before final closure and disclose the closure programme and grievance arrangements.

CHAPTER NINE: STAKEHOLDER ENGAGEMENT AND GRIEVANCE REDRESS MECHANISM

9.1 Stakeholder Engagement

Stakeholders are defined as individuals, groups, or institutions that may be directly or indirectly affected by the proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology (AUST), or that have an interest in its planning and implementation. These stakeholders play an important role in providing relevant information, local knowledge, and feedback that can influence project design and decision-making. In line with national ESIA requirements and international best practices, including those of the African Development Bank Integrated Safeguards System 2023 particularly Operational Safeguard (OS) 10 on Stakeholder Engagement and Disclosure, stakeholder engagement was carried out as an integral part of the ESIA process. The engagement process commenced at the early stage of project planning and continued throughout the assessment phase.

Consultations were conducted using a combination of approaches including stakeholder meetings, site visits, key informant interviews, focus group discussions, and administration of socioeconomic questionnaires. Engagements were conducted in both English and Hausa to ensure effective communication across all stakeholder groups. These engagements provided an opportunity to inform stakeholders about the proposed project, obtain their views and concerns, and incorporate relevant inputs into the impact assessment and project design. The consultation process covered University management and staff, students, the Galadimawa Roundabout stakeholder groups including traders, transporters and commercial motorcyclists represented through their union chairmen, and relevant Ministries, Departments and Agencies.

9.1.1 Objectives of Stakeholder Engagement

The objectives of public participation in an ESIA are to provide sufficient and accessible information to potentially interested and affected parties/stakeholders in an objective manner to assist them identify issues of concern, and provide suggestions for enhanced benefits and alternatives. The stakeholder engagement process was designed to conform to the Nigerian EIA Act and international standards. For this Project, the key objectives for stakeholder engagement are:

- 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.

9.1.2 Stakeholder Analysis and Identification

Stakeholder analysis was undertaken to identify relevant stakeholders, understand their roles, and assess their level of influence and interest in relation to the proposed project. This process is important for determining stakeholder capacities, concerns, and potential contributions to project planning, decision-making, and implementation.

The analysis recognizes that different stakeholders exert varying degrees of influence on project outcomes. While some institutions and regulatory bodies may have significant authority in policy formulation and approvals, other groups such as local communities and end-users may have limited formal influence but play a critical role in day-to-day interactions that can affect project implementation and sustainability. To better understand these dynamics, stakeholders were assessed based on their level of influence and interest in the project. This approach provides useful insight into how different stakeholder groups should be engaged, ensuring that appropriate strategies are adopted to enhance participation, address concerns, and support effective project implementation.

Table 27: Stakeholder Identification and Categorization

Stakeholder Category	Stakeholders
Primary Stakeholders (Directly Affected / Beneficiaries)	African University of Science and Technology (AUST) Management, University Academic and Non-Academic Staff, Students (End Users), On-campus Facilities and Departments, within the Project Footprint, Iddo Sarki Community (Nearest Host Community), Traditional Rulers and Community Leaders, Contractors and Sub-contractors
Implementing Agency	Rural Electrification Agency (REA) through the Nigeria Electrification Project (NEP) Project Management Unit
Regulatory Institutions	Federal Ministry of Environment (FMEnv), National Environmental Standards and Regulations Enforcement Agency (NESREA), Abuja Environmental Protection Board (AEPB), FCT Environmental Planning and Protection Department (FCT EPPD), Federal Capital Development Authority (FCDA), National Universities Commission (NUC), Nigerian Electricity Regulatory Commission (NERC), Federal Ministry of Power, FCT Area Council (Abuja Municipal Area Council)
Financing / Oversight Institution	African Development Bank

9.1.3 Stakeholder Engagement Plan

Stakeholder engagement is a continuous and essential process for the successful and sustainable implementation of the proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology (AUST), Abuja. In this regard, a Stakeholder Engagement Plan (SEP) has been developed to guide interactions with all relevant stakeholders throughout the project lifecycle. The SEP provides a structured approach for ensuring that stakeholders are adequately informed, consulted, and involved at appropriate stages of project planning, construction, and operation. It outlines mechanisms for effective communication, stakeholder consultation, and grievance redress, with the aim of promoting transparency, inclusiveness, and accountability.

The plan also ensures that stakeholder concerns, expectations, and feedback are systematically identified, documented, and integrated into project decision-making processes. This approach is consistent with national regulatory requirements and international best practices, including those of the African Development Bank.

Table 28: Proposed Stakeholder Engagement Plan

Project Phase	Key Activities	Target Stakeholders	Method of Engagement

Design / Preparation Phase	• Disclosure of ESIA findings- • Stakeholder identification and consultation • Integration of stakeholder inputs into project design	• Afric University of Science and Technology (AUST) Management • University Staff and Students • Rural Electrification Agency (REA) – NEP-PMU • Federal Ministry of Environment • Host Community (nearby residents) • Traditional Leaders and Community Representatives	• Formal stakeholder meetings- • Key informant interviews- • Site visits- • ESIA disclosure sessions- • Emails and official correspondence- • Public notices (where applicable)
Construction Phase	• Implementation of ESMP and mitigation measures • Environmental and social monitoring- • Labour management and community relations- • OHS supervision and compliance- • Ongoing stakeholder engagement and grievance management	• Host Community including youth and Women Groups • Local Labour and Workers • Contractors and Sub-contractors-AUST Management- • NEP • Federal Ministry of Environment • Project Owner's Engineer (POE) / Supervising Engineer	• Community meetings and sensitization sessions- • Toolbox meetings (for workers)- • Grievance Redress Mechanism (GRM)- • Site inspections and monitoring visits- • Posters, signage, and notices on site- • Regular progress meetings
Operation Phase	• Operation and maintenance of the mini grid system • Monitoring of environmental and social performance- • Continued stakeholder engagement- • Management of grievances and feedback- • Periodic audits and reporting	• AUST Management and Facility Operators- • University Staff and Students (users)- • Host Community- • NEP • Federal Ministry of Environment (as applicable)-	• Periodic stakeholder meetings- • Feedback and complaint channels (GRM)- • Routine inspections and audits- • Reports and official communication- • Continuous engagement through university channels

9.1.4 Inclusive and Lifecycle Stakeholder Engagement

Stakeholder engagement shall continue through design finalization, construction, commissioning, operation and closure. Engagement shall be proportionate to risk and shall provide timely information about project schedules, access restrictions, noisy works, traffic changes, outages, employment opportunities, safety controls and grievance channels.

Stakeholder group	**Key information/concerns**	**Engagement method**	**Frequency**	**Responsible party**
AUST management and staff	Schedule, access, safety, outages, performance	Meetings, notices, technical coordination	Monthly during construction; quarterly operation	AUST/NEP-PMU
Students	Safety, construction disturbance, access, power interruptions	Campus notices, briefings, signage, digital	Before major works and as needed	AUST/EPC

		communicatio n		
Nearby communities/Knowled ge Court Estate	Traffic, noise, employment, safety, grievances	Community meetings, notice boards, contact channels	Before mobilizatio n; monthly during intensive works; as needed	NEP-PMU/EPC
Transporters/traders	Delivery routes, traffic safety, timing	Briefings and route notifications	Before mobilizatio n and when routes change	EPC/AUST
Women/youth/PWD and vulnerable groups	Accessible participation, employment, safety, grievances	Targeted small-group consultations and accessible channels	At key project milestones	NEP-PMU/AUS T
Regulators	Compliance, monitoring, incidents, approvals	Formal submissions, inspections and meetings	As required by approvals and monitoring programme	NEP-PMU
Workers	Conditions, hazards, rights, GRM, Code of Conduct	Induction, toolbox talks, worker meetings and GRM	Before work and routinely	EPC/O&M

9.2 Grievance Redress Mechanism

This section shall describe the grievance redress mechanism for general grievances and GBV/SEA related grievances (including a GBV action Plan). The standard GRM of REA-NEP will support but not replace the site-specific grievance mechanisms established at subproject level.

Grievance redress mechanism (GRM) is a framework which enables local communities and relevant stakeholders of a project to raise issues (including logging, tracking, and grievances resolution) about the project which are addressed efficiently and effectively while issues as regards implementation are resolved. The GRM will be communicated to all stakeholders in the course of project development and implementation and will make publicly available a record documenting the responses to all grievances received. The GRM shall be maintained throughout the project life cycle.

9.2.1 Grievance Redress Mechanism: Reporting Channels and Process

The Grievance Redress Mechanism process as presented in figure 21 below, has been adopted to provide a structured and transparent process for receiving, addressing, and resolving complaints or concerns from stakeholders. This process is designed to ensure that all grievances are handled in a timely, fair, and consistent manner, thereby enhancing trust, accountability, and effective stakeholder engagement throughout the project lifecycle.

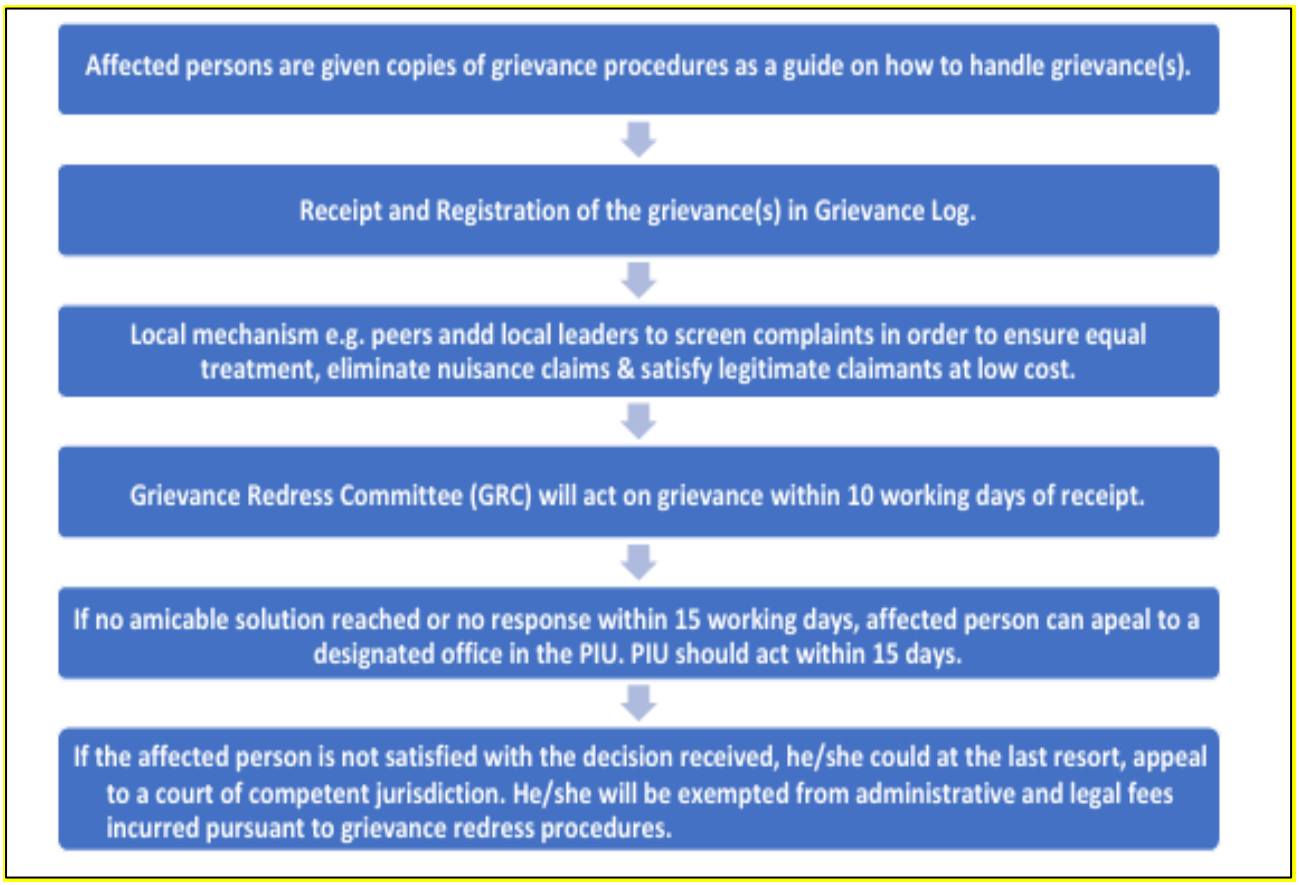

Figure 21: GRM process

9.2.2 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.

9.2.3 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 (in the format given in Table 29) 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 presented in the table below:

Table 29: 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 informed that they must pass all grievances, communications to the Grievance Officer (discussed in the following section) on site as soon as possible after they are received. Details of the person lodging the grievance shall be noted and passed along with the grievance. The Grievance Officer in turn will communicate all grievances to the Social Standard Officer/Manager for the project. For assisting the communication of grievances, a Register will be maintained at the project office and site camp, at which any individual/group can come have their complaint registered.

9.2.4 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.

9.2.5 Acknowledgment of Grievance

Upon the completion of the recording of the grievance, the stakeholder will be provided with an acknowledgment of the receipt, along with a summary of the grievance. In case the grievance is assessed to be out of the scope of the GRM, a communication towards the same shall be made to the grievant, and an alternative mode of redressal shall be suggested.

This receipt is acknowledgement of grievance registration by_____, resident of -community/staff of -------- department _____ on date _____. His/her case number is _____ and the date for response is _____.

Full name & signature of recording person

9.2.6 Site Inspection and Resolution

For the purpose of verifying and resolving the grievances received, site inspection may not be required in all the cases. Depending upon the sensitivity of the issue, requirement of a site inspection will be identified.

A site inspection will be undertaken by the site level community liaison officers or the project member assigned by the Social Safeguard Officer/ Manager. The purpose of the site inspection will be to check the validity and severity of the grievance. For this purpose, the personnel may also undertake discussions with the concerned external stakeholder. The inspection will be undertaken within ten days of receiving the grievance. The assigned individual will then work with other relevant members of the Project team to investigate the problem and identify measures to resolve the grievance as appropriate. The personnel to be involved in the grievance resolution shall be dependent upon the nature of the grievance, as discussed in the table 30.

Table 30: Classification and Categorization of External Grievances

S/N	Nature of Grievance	Categorization
1.	Compensation	Environmental and Social Safeguard Officer
2.	Resettlement implementation related	Project Management, Social Safeguard Officer and Contractor,
3.	Compensation on account of damage to community forest / property/.	Contractor, Social and Environmental Safeguard Officer
4.	Environmental impact, Community health, culture and customs /access to site etc	Project Management, Environmental and Social Safeguard Officer
5.	Migrant worker related issues	Contractor, Social Safeguard Officer
6.	Sexual harassment / GBV	Human Resource Executive of Contractor/ Social Safeguard Officer of PMU
7.	Others	Contractor, Environmental and Social Safeguard Officers, Project Manager

9.2.7 Resolution, Escalation, and Closure

Based on the understanding thus developed, the social safeguard officer/ manager, in consultation with the concerned departments, shall identify a suitable resolution to the issue. This could involve provision of information to clarify the situation, undertaking measures to remedy actual problems or compensate for any damage that has been caused either by financial compensation or compensation in-kind, and introduction of mitigation measures to prevent recurrence of the problem in the future. This resolution shall be accordingly communicated to the grievant within 10 working days of completing the site investigation.

In case the issue is beyond the purview of the social safeguard officer/ manager, it should be escalated to the Head PMU of NEP (as appropriate). A communication regarding the same shall be provided to the grievant. The Head PMU of the NEP shall in turn endeavour to resolve the grievance within 10 working days of the escalation.

If, however, the grievance remains unsettled, and the Head PMU of NEP is not able to identify an adequate resolution for the grievance, then an adequate response shall be given to the grievant along with a suggested alternative resolution to the grievance including to take the matter to the citizens' rights mediation-centre for the settlement before a law court is considered.

If at any stage, the grievant is not satisfied with the solution, s/he may choose to ask for an escalation of the grievance to the next level. Where a grievance is found to be not a real problem a clear explanation will be provided to the complainant.

9.2.8 Update of Records

The records of the grievance register shall be updated every working week with the present status of the grievance. Once the grievance is resolved, and the same has been communicated to the grievant, the grievance shall be closed in the grievance register. The grievance register should also provide an understanding of the manner in which the grievance was resolved. These instances shall then serve as references for any future grievances of similar nature. Where there is evidence of recurring issues or grievance coming up on the project, it is necessary to flag this up to Head PMU of the NEP in order to assess if the project design requires updating.

9.2.9 Separate Worker and Community GRM and Confidential Safeguarding Channel

The project shall maintain distinct but coordinated channels for community/stakeholder grievances and worker grievances. GBV/SEA/SH complaints shall not be processed through an open grievance register that could disclose survivor information. The general grievance register shall record only the minimum non-identifying information necessary for trend monitoring, while confidential case records shall be maintained by the designated safeguarding mechanism.

- Community GRM: accessible in-person, telephone and written/digital channels, with acknowledgement, investigation, response, escalation and closure.
- Worker GRM: confidential channel for employment, welfare, OHS and workplace concerns, with non-retaliation protection.
- GBV/SEA/SH: confidential reporting, survivor-centred referral, informed consent and restricted access to case information.
- All channels shall be publicized during induction and stakeholder meetings and displayed at appropriate campus/project locations.
- GRM performance shall be reported using aggregated, non-identifying data: number received, category, response time, status and lessons learned.

9.3 Summary of Public Consultations.

The proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology (AUST) Abuja, is expected to generate both positive and adverse environmental and socio-economic impacts during its construction and operation phases. These impacts may affect various stakeholders directly or indirectly, including the university community and nearby residents. As such, stakeholder consultations were undertaken to ensure that the views, concerns, and expectations of relevant stakeholders were adequately captured and considered in the ESIA process.

The consultation process focused on providing information about the project scope, planned activities, and implementation approach, as well as clarifying the roles of key stakeholders. It also provided an opportunity to obtain feedback, identify potential concerns, and incorporate stakeholder inputs into project planning and impact assessment. Engagement methods included stakeholder meetings, key informant interviews, site visits, and interactive discussions with community representatives and relevant institutions.

The specific objectives of the public consultations were to:

- Inform stakeholders about the proposed project and its components;
- Raise awareness within the university environment and surrounding communities;
- Obtain stakeholder views, concerns, and expectations regarding the project; and
- Ensure that the concerns of potentially affected groups are identified and addressed.

As part of the ESIA study, consultation activities were conducted at different stages of the assessment process. The sections that follow present a summary of the key issues raised by stakeholders and how these have been addressed in the project design and mitigation measures.

Table 31: Consultation with University Community

Consultation at the African University of Science and Technology (AUST), FCT Abuja	
Date	14th July, 2026
Location	School Campus, Galadimawa District

Attendees:	AUST University Management, Staff, and Students

Summary of Consultation

Consultations were conducted at the African University of Science and Technology (AUST) Key issues raised by University management and students included concerns about the proposed solar site's proximity to the football pitch and the uncompleted clinic building. Additional concerns included construction impacts, possible soil erosion around the project site, and local employment opportunities. These issues will be addressed through appropriate mitigation measures, continued stakeholder engagement, and inclusive project implementation.

School Administration and Staff

- The School Administration and Staff demonstrated strong support for the proposed project, stating that it is a welcome development for the University, as power instability has posed significant limitations for the school for quite some time.
- The School Administration and Staff expressed their readiness to provide all information and support necessary to facilitate the smooth development of the ESIA as well as project implementation.

Students

- Students expressed concerns about the frequency and duration of power outages during the transition to the hybrid system and the solar installation works. They were informed that the project plans to schedule major installation activities during school holidays to minimize disruptions to power supply.
- The students expressed concern over the potential impact on the football pitch located close to the project site.

Consultant's Response

- Stakeholders were informed that potential noise impacts will be minimized through appropriate siting, routine maintenance, and the implementation of mitigation measures outlined in the Environmental and Social Management Plan (ESMP).
- Stakeholders were informed that the football pitch, located approximately 200 metres from the project site, will not be encroached upon by the proposed solar installation, and that construction related impacts such as noise and dust will be actively managed given the close proximity of these structures. Stakeholders were further informed that the solar installation will be fenced off from surrounding campus structures, including the football pitch, to prevent any unauthorized access or interaction between the facility and campus users.

Table 32: Community-Wide Consultation

Consultation at Galadimawa District	
Date	15th July, 2026
Location	Galadimawa District
Attendees:	Chairman, Association of Tricyclists (Transporters Union), Galadimawa Roundabout; Knowledge Court Estate Chairman and Representatives; ESIA Consultant Team

Summary of Consultation

Consultations were conducted with stakeholders at Galadimawa District, comprising the Transporters Union operating at the Galadimawa Roundabout and representatives of the Knowledge Court Estate, as part of the ESIA. The engagement provided an opportunity to identify concerns and gather input relevant to project planning.

Transporters Union

- The Chairman of the Association of Tricyclists at Galadimawa Roundabout expressed concern over the safety of tricyclists and traders, noting that the presence of contractors and the increased movement of construction trucks through the busy roundabout during project activities could pose safety risks.
- The Chairman expressed strong interest in employment opportunities during construction, requesting priority for some of the unskilled jobs.
- The Chairman sought clarity on the availability of long-term employment opportunities, particularly maintenance roles, after project completion.

Knowledge Court Estate Representatives

- The Estate Chairman acknowledged and welcomed the proposed project, stating that the estate, which is in close proximity to the university, maintains a very good relationship with the school management, and assured that the estate will provide project support where needed.
- The Estate Chairman reiterated that the estate entrance has a separate route from the University's route, and hence there will be no hindrance to estate occupants, though he noted the need to maintain good traffic management along the express road.

Consultant's Response

- The consultant acknowledged all concerns raised and stated that appropriate measures will be put in place to minimize any negative impact.
- The consultant stated that the project will prioritize the employment of qualified local community members, particularly youths, during construction and installation, and that contractors will be encouraged to adopt a local-first approach for non-specialized roles, with basic training provided to support local participation and long-term benefits.
- The ESIA Team acknowledged the Chairman's concerns and confirmed that appropriate mitigation measures would be implemented through the Traffic Management Plan (TMP) and Community Health and Safety Plan (CHSP), both of which form part of the Environmental and Social Management Plan (ESMP) for the project.
- These measures include the regulation of contractor vehicle movements, enforcement of speed restrictions, use of designated haulage routes, and other appropriate control measures to minimize traffic related risks to tricyclists, traders, and the general public around the Galadimawa Roundabout during construction activities.

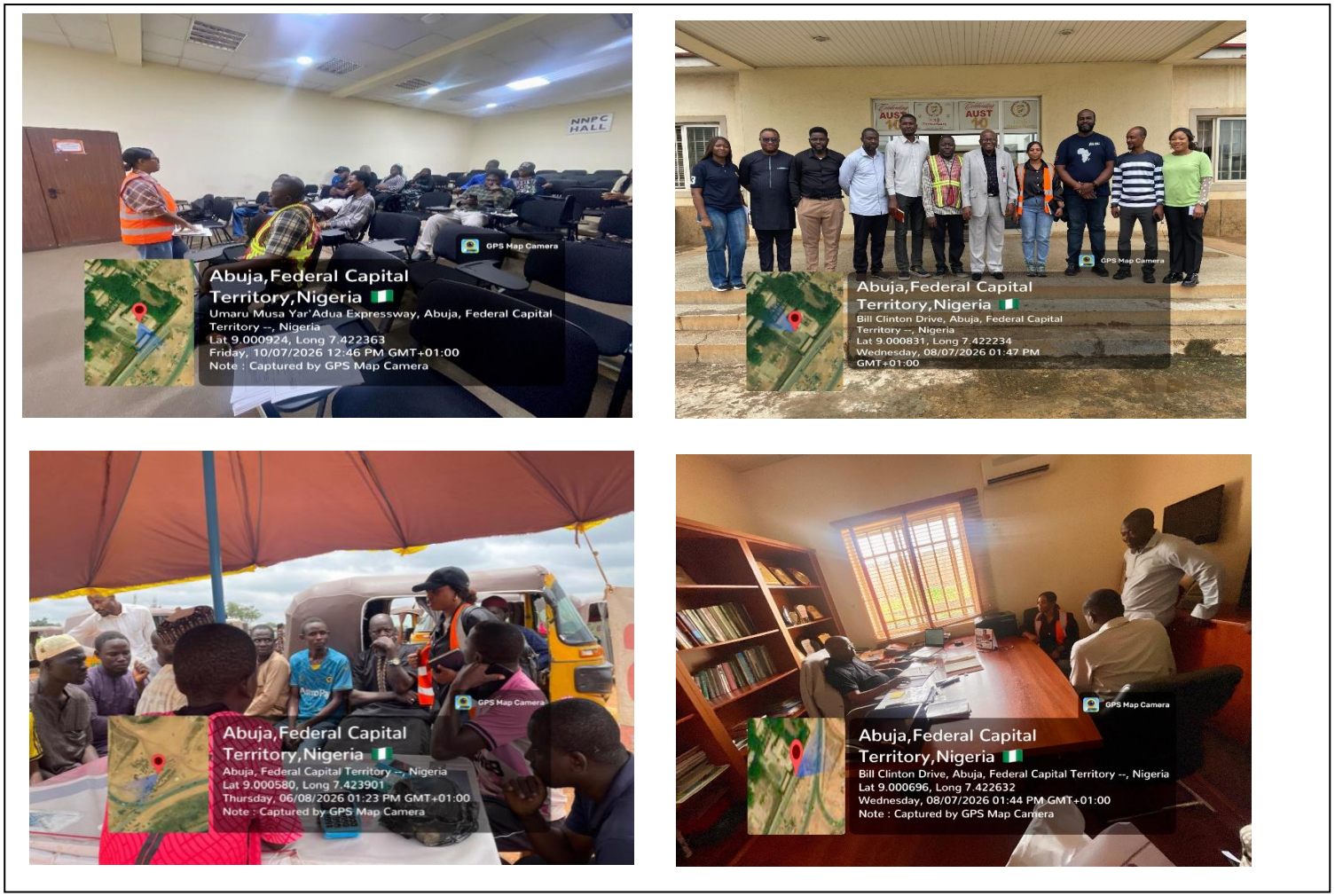

Figure 22: Stakeholder Consultation Photos

CHAPTER TEN: CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion

This Environmental and Social Impact Assessment has evaluated the environmental, social, occupational health and safety risks and benefits associated with the proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology (AUST), Abuja. The assessment confirms that the project has a strong development rationale because it is intended to improve electricity reliability, reduce dependence on diesel generation and support academic, research, administrative and campus operations.

The baseline assessment indicates that the project footprint is a disturbed and cultivated area within the secured university campus. Key environmental receptors include soil and drainage, nearby surface water, groundwater, air quality and noise, vegetation and common fauna. The baseline also identified pre-existing water-quality concerns in Stream III near an active dumpsite and air-quality parameter exceedances that require careful interpretation and, where necessary, follow-up verification so that project-related impacts are not confused with pre-existing conditions.

The principal project risks are associated with construction disturbance, traffic and pedestrian safety, excavation and trenching, electrical hazards, battery fire/thermal runaway, waste and e-waste, labour and worker welfare, GBV/SEA/SH, stakeholder expectations, and potential crop/land-use impacts. The project will apply the mitigation hierarchy through avoidance, minimization, restoration and, where applicable, compensation or other measures required by the applicable safeguard framework.

On the basis of the information presently available, the project is considered capable of being implemented with manageable environmental and social risks, provided that the conditions and actions identified in this revised ESIA are completed before the corresponding project activities occur. In particular, land/user verification, inclusive social and gender monitoring, project-specific emergency preparedness, lifecycle battery/e-waste management, residual-impact monitoring, cumulative-impact review, and implementation of the AfDB safeguard compliance matrix shall be treated as binding project commitments.

10.2 Recommendations

To ensure the successful and sustainable implementation of the proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology (AUST), the following recommendations are provided:

Environmental Management

- All mitigation measures identified in Chapter Six shall be fully implemented by the EPC Contractor under the supervision of the REA Project Management Unit and the designated Environmental and Social Safeguard Officer.
- Site specific measures shall be adopted to control dust generation along the cable corridor and campus access routes, prevent soil erosion within the project footprint, and manage surface runoff

particularly during the wet season, with particular attention to protecting the nearby stream from additional sediment or contamination.

- Proper waste management practices including segregation, storage and licensed disposal of solid waste and hazardous e-waste from batteries, panels and inverters shall be strictly enforced in compliance with NESREA Electrical and Electronic Sector Regulations 2011 and AEPB requirements within the FCT.

Occupational Health and Safety

- A comprehensive Health, Safety and Environment plan shall be developed and implemented by the EPC Contractor prior to mobilization, in accordance with applicable national OHS standards and AfDB good practice requirements.
- All workers shall be provided with appropriate Personal Protective Equipment and trained on its correct use before commencing any site activities.
- Regular safety training, toolbox talks and site inspections shall be conducted throughout the construction period, with particular attention to excavation and trench works, electrical installation activities and equipment handling.
- Adequate safety signage, physical barriers and restricted access controls shall be maintained at all construction zones and energized electrical infrastructure throughout both the construction and operational phases.

Social Management

- The project shall prioritize engagement of local labour from the Galadimawa Roundabout stakeholder groups, as well as from within the AUST campus community, for all unskilled and semi-skilled roles during construction, in line with AfDB safeguard standards on local employment.
- A functional Grievance Redress Mechanism shall be established, communicated to all stakeholders and maintained throughout the project lifecycle, with grievances logged and responded to within clearly defined timeframes.
- A robust Code of Conduct shall be developed, signed by all workers and enforced throughout the construction period, with specific provisions prohibiting gender based violence, sexual exploitation and abuse, sexual harassment and child labour.
- The construction schedule shall be coordinated with the AUST academic calendar to avoid examination periods, consistent with commitments made during stakeholder consultations.

Monitoring and Reporting

- Environmental and social monitoring shall be carried out in accordance with the ESMP, using the defined monitoring indicators, frequencies and institutional responsibilities specified in Chapter Seven.
- Regular monitoring reports shall be prepared by the Environmental and Social Safeguard Officer and submitted to REA PMU, FMEnv and AfDB at the intervals specified in the ESMP.
- Corrective actions shall be taken promptly where monitoring identifies non-compliance, exceedance of environmental standards or unforeseen impacts, and such actions shall be documented and reported.

10.3 Conditions for Implementation and Safeguard Closure

The following actions are conditions for implementation of the project and shall be tracked through the NEP-PMU/AUST environmental and social management system. Closure evidence shall be retained before the relevant project activity proceeds.

No.	Condition / action	Timing	Closure evidence	Responsible party
1	Confirm land tenure, land-use rights and crop/user status within the 3-ha footprint and determine whether OS5 is triggered.	Before site clearance	Signed land/user screening record; compensation/livelihood instrument if triggered	REA/NEP-PMU/AUST
2	Confirm final detailed design, battery chemistry/capacity and fire, thermal, ventilation and electrical safety systems.	Before procurement/commissioning	Approved design/specifications and inspection/certification records	EPC/NEP-PMU/AUST
3	Approve Contractor ESMP, Traffic Management Plan, Emergency Preparedness and Response Plan, Waste/E-waste Plan and safeguarding measures.	Before EPC mobilization	Approved plans and contractual clauses	NEP-PMU/EPC
4	Verify baseline air/water anomalies and document QA/QC and applicable standards before relying on results for trend analysis.	Before construction monitoring programme is finalized	Laboratory/field QA/QC verification note	E&S consultant/NEP-PMU
5	Operationalize worker, community and confidential GBV/SEA/SH grievance channels and communicate them to stakeholders.	Before workforce mobilization	GRM materials, contact channels, training/communication records	NEP-PMU/EPC/AUST
6	Implement biodiversity/tree	Before relevant works	Approved method statement; toolbox	EPC/AUST

	controls and chance-finds procedure before vegetation clearance/excavation.		records; inspection records	
7	Establish outcome-based monitoring and monthly/periodic reporting, including diesel consumption, renewable generation, incidents, waste, grievances and environmental performance.	From construction through operation	Monitoring reports and corrective-action register	EPC/O&M/NEP-PMU/AUST
8	Apply management-of-change screening for any material change to footprint, technology, routing, financing or environmental/social risk.	Throughout lifecycle	Change-control/E&S screening record	NEP-PMU/AUST

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ANNEX ONE: TERMS OF REFERENCE

1 INTRODUCTION/ BACKGROUND

The Federal Government of Nigeria (FGN), through the Rural Electrification Agency (REA), is implementing the Nigeria Electrification Project Phase II (Desert-to-Power) with financial support from the African Development Bank (AfDB). The project's primary objective is to accelerate Nigeria's electrification efforts by deploying sustainable, off-grid and grid-connected solar-powered renewable energy solutions. By leveraging Nigeria's vast solar energy resources, the initiative aims to provide clean, reliable, and long-lasting electricity to Federal Universities and their affiliated teaching hospitals. The broader goal is to enhance academic performance, support research initiatives, and improve healthcare service delivery.

As part of the Energizing Education Programme, the Rural Electrification Agency (REA) intends to provide sustainable solar-hybrid mini-grid systems for selected tertiary institutions under the AfDB-financed Nigeria Electrification Project (Desert-to-Power) Phase II. The Government intends to apply part of the proceeds toward engaging a qualified Environmental and Social Consulting Firm to prepare Environmental and Social Impact Assessments (ESIAs) for three (3) tertiary institutions under the programme.

The ESIAs shall be prepared in accordance with the African Development Bank's Integrated Safeguards System (ISS, effective 31 May 2024), the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, relevant FMEnv Procedural Guidelines (2017), Nigerian Climate Change Act (2021), other relevant and associated Nigerian regulations, and international good practice (IFC Performance Standards, ISO 14001, ISO 45001).

Table 1: List of Tertiary Institutions Under (LOT 2) the AfDB Desert-to-Power Programme for ESIA Study

S/N	Institution	State	Geo-political Zone	Lot
1	African Aviation and Aerospace University	FCT-Abuja	North Central	Lot 1
2	National University of Science and Technology	FCT-Abuja	North Central	Lot 2
3	Admiralty University, Ibusa	Delta	South-South	Lot 2

2 DESCRIPTION OF THE PROJECT

The Desert-to-Power (DtP) project builds on lessons from NEP-I, focusing on three main components:

1. Energizing Education Programme: Electrification of selected tertiary institutions through solar-hybrid mini-grid systems exceeding 1 MW capacity per site. The assignment covered under this Terms of Reference relates specifically to the three (3) institutions listed in Table 1..
2. Energizing Healthcare Facilities: Deployment of reliable energy to health centres in underserved regions.
3. Interconnected Mini-Grids for Cooperatives: Supporting local electricity cooperatives via Minimum Subsidy Tenders and Performance-Based Grants.

Each Institution system will include solar PV arrays, battery energy storage systems, control systems, distribution infrastructure, and backup generation, with appropriate operation and maintenance plans.
The ESIA will consider the full lifecycle — design, construction, operation, and decommissioning — including waste management (solar panels, batteries, oils, packaging, etc.), community safety, and resilience to climate risks.

3 STATUTORY LEGAL AND ADMINISTRATIVE FRAMEWORK

The statutory (legal and administrative) frameworks within which the consultancy activities shall be executed are provided in the following regulations, guidelines and standards (Note: these regulations are not exhaustive):

- African Development Bank's Integrated Safeguards System (2024)
- The regulations, guidelines and standards of the Federal Ministry of Power as it concerns high voltage power transmission in Nigeria.

- Environmental Impact Assessment Act Cap E12 LFN 2004
- FMEnv EIA Procedural Guidelines (2017)
- The regulations, guidelines and standards of the Federal Ministry of Environment concerning power generation and transmission activities in Nigeria.
- National Environmental (Solar Energy) Regulations (2017)
- NESREA Act (2007) and sectoral guidelines
- Labour Act (2004) and Employee Compensation Act (2010)
- Land Use Act (1978) and Urban and Regional Planning Act
- Climate Change Act (2021);
- Occupational Safety and Health (Factories) Regulations (2010)
- National Gender Policy (2006) and Discrimination Against Persons with Disabilities Act (2018)
- All International Conventions/Treaties on Environmental Protection/Social Welfare to which Nigeria is a party: Paris Agreement (2015), Convention on Biological Diversity, ILO Conventions, and the UN Guiding Principles on Business and Human Rights
- The regulations, guidelines and standards of the various State Ministries of Environment and Social Welfare.

The Consultant shall ensure all studies align with FMEnv, relevant State Environmental Protection Agencies, and Local Government Authorities.

4 OBJECTIVES OF THE ASSIGNMENT

The objective of this consultancy is to conduct site-specific ESIAs for the proposed solar-hybrid power systems and associated infrastructure at the three (3) selected tertiary institutions to:

- Establish environmental and socio-economic baselines for each site;
- Identify, predict, and evaluate environmental, social, health, and safety impacts (positive and negative);
- Recommend mitigation and enhancement measures;
- Ensure compliance with AfDB and Nigerian E&S standards;
- Develop site-specific Environmental and Social Management Plans (ESMPs); and
- Facilitate environmental approvals, and stakeholder acceptance.
- Support REA in securing FMEnv ESIA certification and AfDB no-objection;
- Conduct inclusive stakeholder engagement (including women, youth, and persons with disabilities); and
- Build local institutional capacity for ESMP implementation.

Special attention shall be given to vulnerable groups, gender equality, disability inclusion, resettlement risks, occupational health and safety, and climate resilience.

This must be in line with the requirements of the Federal Government of Nigeria and the African Development Bank's Integrated Safeguards System to ensure that any adverse effects on the environment and wellbeing of people are properly identified and mitigated. Each institution represents a unique environmental, social and institutional setting. Accordingly, standalone Environmental and Social Impact Assessments (ESIAs) shall be prepared for each institution to capture site-specific environmental and social risks, stakeholder concerns and applicable regulatory requirements under the Environmental Impact Assessment Act (Cap E12 LFN 2004) and the African Development Bank Integrated Safeguards System (ISS). This modular approach ensures:

- Tailored mitigation and management measures suitable for each region and site;
- Independent FMEnv certification and public disclosure;
- Alignment with AfDB Category 2 project requirements under the Integrated Safeguards System (ISS);

- Easier monitoring and adaptive management during implementation.

5 SCOPE OF THE ASSIGNMENT – METHODOLOGY AND GENERAL APPROACH

The Consultant, who shall be duly registered with the Federal Ministry of Environment, towards achieving the objectives noted under section 4 above, shall carry out the following activities:

Phase 1 – Desk Review and Scoping

- Review prior NEP documentation, feasibility studies, conceptual project design and maps.
- Conduct preliminary stakeholder identification and risk screening.
- Prepare forms and register the project with the FMEnv.
- Prepare and submit detailed work plans

Phase 2 – Baseline Studies

- Biophysical: Air, water, soil, noise, flora, fauna, hydrology.
- Socio-economic: Demography, livelihoods, gender, land tenure, cultural heritage, transport/traffic studies.
- Laboratory analysis shall be performed by FMEnv-accredited laboratories.
- GIS and remote sensing tools shall be used for mapping and sensitivity analysis.

Phase 3 – Impact Assessment

- Identify and evaluate direct, indirect, and cumulative impacts.
- Assess greenhouse gas emissions and pollution pathways.
- Use AfDB's and FMEnv's risk rating methodology (high, moderate, low).
- Develop mitigation hierarchy (avoid, minimize, mitigate, offset).

Phase 4 – Stakeholder Engagement

- Conduct Free, Prior, and Informed Consultations (FPIC) with communities, institutions, and Federal/ state agencies.
- Ensure inclusive participation of women, youth, and persons with disabilities.
- Maintain engagement logbooks with signatures, photos, and feedback.
- Establish and operationalize a multi-tier costed Grievance Redress Mechanism (GRM).
- Develop a costed stakeholder engagement plan.

Phase 5 – ESMP Development: Each ESMP shall include:

- Mitigation measures and performance indicators;
- Roles, responsibilities, and institutional arrangements;
- Monitoring framework and schedule;
- Capacity-building plan;
- Estimated costs and financing sources;
- Integration strategy into EPC contracts.

Phase 6 – Reporting and Disclosure

- Submit inception, draft, and final ESIA reports all in soft and hard copies

- Facilitate public disclosure in line with FMEnv procedures (public notice, hearing, gazette publication).
- Ensure AfDB disclosure on its website and InfoShop portal via the PMU E&S Unit.
- Payment of Final access charge and IMM fees.
- Issuance of ESIA Approval Letters and certificates by the FMEnv

NOTE: The successful consultant for this assignment is responsible for the payment of Federal Ministry of Environment's regulatory fees. Hence, all costs related to this should be factored as part of reimbursable expense in its financial submission.

6 DELIVERABLES AND PAYMENT SCHEDULE

The successful consultant shall work closely and report to the Head, Project Management Unit (HPMU) of the Nigeria Electrification Project through the Environmental & Social (E&S) team of the NEP Project Management Unit (PMU). The Consultant is expected to work closely with the E&S unit of the PMU towards successfully executing the assignment.

Schedule: The following reports shall be submitted by the Consultant to the Rural Electrification Agency and FMEnv:

#	Deliverables	Timeline *(After contract signing in weeks)*	*Payment (%age of Total Remuneration)*
1.	**A. Inception Report:** - This should include methodology and work plan with clearly defined strategy for carrying out the assignment with timelines for the various outputs. The report should include: • Detailed Project including plan for the on-site activities • Complete Work plan document • Draft Survey Tools • Evidence of registration of project sites (by state) with the Federal Ministry of Environment. The Consultant must submit (3) hard copies and a soft copy of the inception report. **B. Progress Report:** An update on the progress of the Baseline survey and plans for completion of the survey and next activities. The consultant must submit electronic copies of this progress report	2 weeks	20%
2.	**Draft ESIA Report:** - A draft report containing detailed assessment and survey information in line with the approved reporting outline of the FMEnv to be reviewed by the AfDB and PMU. The consultant shall submit electronic copies of the draft ESIA report to the PMU and Bank for internal reviews.	Week 2-14	30
3	**Resubmission of Draft ESIA Report:** Upon completion of review by the PMU and incorporation/finalization of recommended changes, the revised Draft Report shall be resubmitted to the REA, Bank and FMEnv for review and disclosure	Week 14-16	20

4.	**A. In house Panel Review:** - Presentation of the ESIA at a Panel to be held by the Federal Ministry of Environment (as required) **B. Review of the draft report** in line with the comments from the FMEnv. **C. Draft Final ESIA report** as approved by the FMEnv will be produced separately for each of the three (3) institutions covered under this Terms of Reference The consultant shall submit the required number of copies to the FMEnv, and one hard copy and one soft copy (in a flash drive) of each final ESIA reports D. ESIA approval letters and certification from the FMEnv for each of the project sites shall be obtained by the Consultant	Week 16-20	30

Note: Each of the three (3) institutions shall be registered separately with the Federal Ministry of Environment, and a standalone ESIA report shall be prepared and disclosed for each institution..

Report Structure: The Environmental and Social Impact Assessment (ESIA) report for the project will be structured in line with FMEnv and AfDB guidelines, including all necessary management plans and supplementary documentation. The report must include detailed analysis, mitigation measures, and management strategies for addressing environmental and social impacts. Below is a sample structure for the ESIA report, to be considered, and improved on as necessary.

1. Executive Summary

- Purpose of the Project: A concise overview of the project, its objectives, scope, and alignment with sustainable development goals.
- Key Findings: Summary of the significant environmental and social impacts identified, including proposed mitigation measures.
- Recommendations: A summary of the recommended actions for project implementation and ongoing compliance with environmental and social safeguards. In addition, the consultant shall provide summary of cost of the measures and the institutional arrangements for implementation.

2. Introduction

- Project Background: Description of the project's goals, location, and key stakeholders.
- ESIA Purpose and Scope: The specific objectives of the ESIA, focusing on identifying, assessing, and mitigating the environmental and social impacts of the project.
- Regulatory Framework: Reference to the relevant Nigerian regulations (e.g., EIA Act Cap E12 LFN 2004), AfDB's Integrated Safeguards System (ISS), Nigerian Climate Change Act (2021), and international standards (e.g., IFC Performance Standards, ISO 14001, ISO 45001).

3.1 Project Description

- Project Components: A detailed description of the project components, including all infrastructure and technologies (e.g., solar-hybrid mini-grid systems, energy storage, etc.). Also, the consultant shall describe the proposed project and its geographic, environmental, social, and temporal context, including associated facilities, third parties, and any offsite investments that may be required.
- Project Phases: Explanation of all phases of the project lifecycle, including planning, construction, operation, and decommissioning.
- Project Activities: A breakdown of project activities and their potential environmental and social implications.
- Includes a map of sufficient detail showing the project site and the area that may be affected by the project's

direct, indirect, and cumulative impacts.

- Presents the basis for selecting the project design proposed, including for applying the mitigation hierarchy.

3.2 Analysis of Project Alternatives

- Evaluates a reasonable range of feasible project alternatives to meet the project's purpose and needs (e.g. location, technology options, or timing) and their E&S implications, including a no project alternative.
- During the project scoping process, Borrowers shall consult stakeholders and the public and allow for their participation in the identification of feasible project alternatives through public consultation meetings and the opportunity to comment.
- Assesses the alternatives' feasibility of mitigating the E&S impacts, the capital and recurrent costs of alternative mitigation measures, and their suitability under local conditions, and the institutional, training, and monitoring requirements for the alternative mitigation measures.
- Evaluates a reasonable range of feasible project alternatives to meet the project's purpose and needs (e.g. location, technology options, or timing) and their E&S implications, including a no project alternative.
- During the project scoping process, Borrowers shall consult stakeholders and the public and allow for their participation in the identification of feasible project alternatives through public consultation meetings and the opportunity to comment.
- Assesses the alternatives' feasibility of mitigating the E&S impacts, the capital and recurrent costs of alternative mitigation measures, and their suitability under local conditions, and the institutional, training, and monitoring requirements for the alternative mitigation measures.

4. Legal and Institutional Framework

- National Legislation: Overview of Nigerian laws, including the EIA Act, Nigerian Climate Change Act (2021), and other FMEnv regulations. In addition, the E&S institutional and regulatory framework is comprehensively analyzed, not focusing only on environmental and land laws but including social protection policies/strategies, and the project's sector relevant standards/norms related to E&S health and safety.
- AfDB Safeguard Policies: Summary of the AfDB's Integrated Safeguards System (ISS), including the environmental and social safeguard policies that must be adhered to.
- International Standards: Reference to IFC Performance Standards, ISO 14001, and ISO 45001, which guide the ESIA process.
- Permits and Approvals: A list of the necessary permits and clearances required by local authorities and the relevant ministries for the project.
- Analyses the legal and institutional framework for the project within which the ESA is carried out, consisting of:
    - the host country's applicable policy framework, national and local laws and regulations, and the respective institutional capabilities (including implementation) concerning E&S issues;
    - national environmental or social action plans or strategies, and obligations of the country directly applicable to the project under relevant international and regional treaties and agreements;
    - applicable requirements under the OSs and the African Development Bank's Integrated Safeguards System (ISS) Guidance Notes;

- the identification of differences between the Borrower's existing Environmental and Social Framework, and requirements relating to the project that may affect how the project is carried out in a manner consistent with the OSs;
- a description of how any deficiencies in the host framework can be addressed through administrative, legislative or regulatory change, institutional strengthening, and capacity building.

5. Baseline Environmental and Social Conditions

- Environmental Baseline: The environmental baseline should:
  - Describe how climate change is affecting or likely to be affecting the project area and how this may influence the nature of project risks and impacts.
  - Describe how the project may be affecting or contributing to climate change and its associated risks and impacts.
  - Overview of climate, topography, hydrology, land use, and vegetation.
  - Assessment of biodiversity, water quality, and air quality.
  - Identification of sensitive environmental receptors (e.g., protected areas, species of concern).
- Social Baseline:
  - Overview of local communities, demographics, socio-economic conditions, and existing infrastructure.
  - Description of land tenure, livelihoods, cultural heritage, and public health.

6. Stakeholder Engagement

The consultant shall identify and characterize individuals and groups that are, due to circumstances, vulnerable, discriminated against, and underserved in, or excluded from, mainstream society. Disaggregated data on all such social groups should be provided to the extent that personal and group safety and data confidentiality and privacy are not compromised.

In addition, the consultant shall describe contextual risks (e.g. the political economy) that may affect the ability of the project to be carried out in a manner consistent with the AfDB OSs and other requirements such as international human rights obligations.

Other aspect to consider include:

- Stakeholder Identification: A comprehensive list of key stakeholders, including local communities, governmental bodies, NGOs, and other interested parties.
- Stakeholder Consultation Process: Description of consultation methods (e.g., meetings, surveys, public hearings), frequency, and topics discussed.
- Stakeholder Concerns: Summary of key concerns raised by stakeholders and how these concerns have been addressed in the ESIA process.

7. Impact Assessment

To the extent demonstrable, characterize residual impacts in terms of their magnitude, extent, duration, reversibility, and significance. The levels of impacts will be assessed using the following key tools:

- Methodology: A thorough impact analysis (***quantitative NOT generic***) and identification of feasible measures addressing each significant and moderate impact and risk.
- Environmental Impacts: Analysis of potential environmental impacts (e.g., land degradation, water and air quality, noise, waste generation, etc.).
- Social Impacts: Evaluation of potential social impacts, including displacement, changes to local livelihoods, public health, and community wellbeing.

- Cumulative Impacts: Assessment of how the project may interact with other projects or activities in the region, and the cumulative impacts on the environment and society.

8. Environmental and Social Risks and Opportunities

- Risk Assessment: Identification of key risks to the environment and local communities, including legal, environmental, social, and economic risks.
    - Potential environmental risks (e.g., habitat destruction, resource depletion)
    - Social risks (e.g., community resistance, displacement, health impacts)
    - Legal and regulatory non-compliance risks
    - Economic risks, including project delays or cost overruns
- Opportunities: Identification of potential benefits arising from the project, such as:
    - Job creation and local employment
    - Community development (e.g., infrastructure, healthcare, education)
    - Improved energy access and sustainability
    - Contribution to local and national economic growth

9. Mitigation and Management Plans

- **Mitigation Measures:** Identify avoidance, minimization and mitigation measures and significant residual impacts that cannot be mitigated and, to the extent possible, assesses the acceptability of these residual impacts. This should also include specific actions to mitigate the identified environmental and social impacts, including design modifications, operational best practices, and technological solutions. Other measures to note are thus:

  • Identify measures to enhance positive impacts and opportunities.
  • Identify differentiated measures so that adverse impacts do not fall disproportionately on the vulnerable.
  • Assess the feasibility of mitigating the E&S impacts, the capital and recurrent costs of proposed mitigation measures, and their suitability under local conditions, and the institutional, training, and monitoring requirements for the proposed mitigation measures.
  Specify issues that do not require further attention, providing the basis for this determination.

- Environmental and Social Management Plan (ESMP): A detailed plan to monitor and manage the implementation of mitigation measures, including roles and responsibilities, timelines, and resources.
- Climate Change Mitigation and Adaptation: Address the project's approach to mitigating climate change impacts and adapting to potential climate risks.

10. Monitoring and Evaluation

- Monitoring Plan: Framework for monitoring the implementation of the mitigation measures and ESMP, including frequency, parameters, and responsible entities.
- Performance Indicators: Identification of key performance indicators (KPIs) to track the effectiveness of the mitigation measures and the overall environmental and social performance of the project.
- Adaptive Management: Plans for adjusting project activities based on monitoring results and feedback from stakeholders.

11. Conclusions and Recommendations

- Summary of Findings: A concise summary of the key environmental and social impacts, along with the proposed mitigation measures.
- Project Justification: Justification for the project's viability and positive outcomes relative to its environmental and social risks.

- Further Actions: Recommendations for additional studies, monitoring, or mitigation measures that may be necessary.

Appendix: Detailed Management Plans and Supporting Documentation

The following plans and documents must be included as part of the ESIA report to ensure comprehensive environmental and social management throughout the project lifecycle:

- **Labour Management Plan (LMP)**: A detailed plan for managing labor-related impacts, including workforce accommodation, health and safety, working conditions, and grievance mechanisms for workers.
- **Waste Management Plan (WMP)**: A strategy to manage waste generated by the project, detailing waste minimization, segregation, storage, transportation, and disposal procedures.
- **Grievance Redress Mechanism (GRM)**: A clear culturally appropriate and accessible process for receiving, addressing, and resolving grievances from local communities and other stakeholders throughout the project.
- **Stakeholder Engagement Plan (SEP)**: A plan outlining how stakeholder engagement will be carried out throughout the project lifecycle, including consultation methods and feedback loops.
- **Biodiversity Management Plan (BMP)**: A strategy for managing impacts on biodiversity, including mitigation measures for habitat loss, species protection, and ecosystem restoration.
- **Health and Safety Plan (H&S Plan)**: A plan to ensure the health and safety of workers, local communities, and other stakeholders, covering site safety procedures, emergency response protocols, and health monitoring.
- **Climate Change Adaptation and Mitigation Plan**: A plan for assessing and addressing climate risks, reducing the project's carbon footprint, and enhancing resilience to climate change.

In addition, the following supporting documentation shall be included in the report:

- A list of the individuals or organizations that prepared or contributed to the ESA.
- References listing the written materials, both published and unpublished, that have been used.
- A record of meetings, consultations, and surveys with stakeholders, including those with affected people and other interested parties. The record specifies the means of stakeholder engagement that were used to obtain the views of affected people and other interested parties.
- Tables presenting the relevant data referred to or summarized in the main text.
- A list of associated reports or plans.

7 DURATION OF THE ASSIGNMENT

The Consultant shall prepare time schedules to be submitted to the E&S unit of the PMU in accordance to this TOR. The time frame for the entire consultancy services is within four (4) months of contract signing.

ANNEX TWO: ENVIRONMNETAL AND SOCIAL ASSESSMENT CHECKLIST

Project Alternatives – On-Site Checklist

Item	What to Verify on Site	Method / Evidence	Daily Check (✓)	Remarks
Alternative Location	Other feasible locations within location	Walk-through, GPS points, maps		
Land Availability	Alternative sites free of encumbrance	Physical inspection, interviews		
Proximity to Sensitive Receptors	Distance to hostels, labs, water bodies	GPS, mapping		
Technology Options	Other renewable/energy options considered	Engineer input, design notes		
Battery Technology	Alternative battery types assessed	Vendor info, safety review		
Timing Option	Construction timing alternatives assessed	Academic calendar review		
E&S Implications	Environmental & social pros/cons documented	Field notes		

2. BASELINE ENVIRONMENTAL CONDITIONS – DAILY FIELD CHECKLIST

2.1 Climate Change Considerations

Item	What to Check	Method	Daily check ✓	Remarks
Climate Risk	Flooding, heat, wind exposure	Community interview, observation		
Climate Impact on Project	Effect on PV, batteries, access roads	Engineer + climate expert		
Project GHG Contribution	Diesel backup, logistics emissions	Inventory checklist		
Climate Adaptation Measures	Drainage, elevation. ventilation.	Design review		

2.2 Physical Environment

Parameter	What to Verify	Method	Daily Check	Remarks
Climate	Rainfall pattern, temperature	Local data, observation		
Topography	Slope, elevation, flood risk	GPS, visual survey		
Land Use	Academic, residential, open land	Mapping, inspection		
Vegetation	Type and density	Transect walk		

2.3 Environmental Quality

Parameter	What to Verify	Method	Daily Check	Remarks

Biodiversity	Flora/fauna presence	Ecological survey		
Water Quality	Surface & groundwater condition	Sampling + visual inspection		
Air Quality	Dust, emissions	Instrument + observation		
Noise	Ambient noise levels	Sound meter		

2.4 Sensitive Environmental Receptors

Item	What to verify	Method	Daily check	Remarks
Protected Areas	Nearby protected sites	GIS, authority consultation/GPS Cordinates		
Flora of Concern	Threatened species	Ecologist input		
Fauna of Concern	Wildlife presence/movement	Observation, interviews		

3. SOCIAL BASELINE – DAILY CHECKLIST

Item	What to verify	Method	Daily check	Remarks
Local Communities around the project sites	Host & adjacent communities	Mapping, interviews		
Demographics	Population structure	Surveys, records		
Socio-Economic Conditions	Livelihoods, income sources	FGDs, questionnaires		
Existing Infrastructure	Roads, power, water, health	Physical inspection		

4. STAKEHOLDER ENGAGEMENT

4.1 Vulnerable Groups & Context

Item	What to verify	Method	Daily check	Remarks
Vulnerable Groups	Widows, elderly, PWDs identified	Community mapping		
Inclusion Measures	Separate or assisted sessions	Observation		
Political Economy	Power dynamics, conflicts	Key informant interviews		

4.2 Stakeholder Identification & Engagement

Item	What to verify	Method	Daily check	Remarks
Stakeholder List	Communities, NGOs, institutions	Stakeholder register		
Consultation Technique	Meeting, survey, hearing	Engagement log		
Frequency	Adequate & documented	Attendance sheets		

5. STAKEHOLDER CONCERNS – ISSUE-BASED CHECKLIST

Concern area	What to check	Evidence	Daily Check	Remarks
Water Quality	Boreholes, streams condition	Physical inspection		
Air Quality	Dust, fumes	Observation, monitoring		
Noise	Disturbance risk	Measurement		
Waste Generation	Type & volume of waste	Site inspection		

6. DAILY SUMMARY OF FINDINGS

Items	Summary
Key Environmental Issues	
Key Social Issues	
Stakeholder Concerns Raised	
Immediate Mitigation Actions	
Issues for ESMP	

ANNEX THREE: STAKEHOLDERS CONSULTATION ATTENDANCE SHEET

STAKEHOLDER CONSULTATION ATTENDANCE SHEET

Environmental and Social Impact Assessment

National University of Science and Technology (NUST)

Nigeria Electrification Project Phase II (Desert-to-Power) | Energizing Education Programme | Rural Electrification Agency | AfDB

Date of Consultation:	07-07-2026.
Venue / Location of consultation:	AUST
Time:	10.50 am

ATTENDANCE REGISTER

No.	Full Name	Gender (M/F)	Organization / Designation	Phone Number	Signature / Thumbprint
1	Prof Afukaawe Onoriode U	Male	President	08037431697	
2	Ineboose Orina	Male	AUST Registrar	081 6055 0867	
3	Abdulhakeem Bello	~	AUST / DOTP / TG. VPA	08058 72737	
4	Engr. Mehinde Brenus'	Female	AUST / Works & Physical Plg	07032740686	
5	Mr Solomon Ibeun	Male	AUST / Procurement	081 6540 0[illegible]	
6	Mr Adewale Saheed	Male	AUST / Works & Planning	08067 95495	
7	Dr. Ugonna Os-Emenwa	Male	AUST / HOD	08169 0847[illegible]	
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STAKEHOLDER CONSULTATION ATTENDANCE SHEET

Environmental and Social Impact Assessment

National University of Science and Technology (NUST)

Nigeria Electrification Project Phase II (Desert-to-Power) | Energizing Education Programme | Rural Electrification Agency | AfDB

Date of Consultation:	10-07-2026
Venue / Location of consultation:	AUST
Time:	2:00 pm

ATTENDANCE REGISTER

No.	Full Name	Gender (M/F)	Organization / Designation	Phone Number	Signature / Thumbprint
1	Olowu Emmanuel	M	AUST / Student	08186077895	
2	Husna Auwal Muhammad	F	AUST / student	09039302390	
3	Akinde Temiloluwa	m	AUST / student	08175067815	
4	Raval Ugorji	M	AUST / Student	09076201505	
5	Saradatu Ojajam	F	AUST / Student	07041061710	
6	Sumaiya Sulaiman	F	AUST / student	09105392276	
7	Zainab Wakkala	F	AUST / student	09122837316	
8	Asha Mustapha Liberty	F	AUST / Student	08032568099	
9	Oscar Joshua	M	AUST / Student	08148729224	
10	Moronfolu Bamidele .O.	M	AUST / Student	07033647134	
11	Joy Isaac	F	AUST / Student	07039625[illegible]	
12					

STAKEHOLDER CONSULTATION ATTENDANCE SHEET

Environmental and Social Impact Assessment

National University of Science and Technology (NUST)

Nigeria Electrification Project Phase II (Desert-to-Power) | Energizing Education Programme | Rural Electrification Agency | AfDB

Date of Consultation:	08-07-2026
Venue / Location of consultation:	AUST
Time:	10:30am

ATTENDANCE REGISTER

No.	Full Name	Gender (M/F)	Organization / Designation	Phone Number	Signature / Thumbprint
1	Engr. Masaud Aliyu Tenmi	Male	AAMU / Director	08023842470	
2	Engr. Sani Kabir Lele	Male	AAMU / Deputy DPP	08169530[illegible]	
3	Aliyu Ibrahim Atoka	Male	AAMU / Admin Officer	08149058[illegible]	
4	Daniel Sambo	Male	AAMU / QS	07037690130	
5	Opeyemi Ifeoluwa	Female	AAMU Staff	0902-1681841	
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STAKEHOLDER CONSULTATION ATTENDANCE SHEET

Environmental and Social Impact Assessment

National University of Science and Technology (NUST)

Nigeria Electrification Project Phase II (Desert-to-Power) | Energizing Education Programme | Rural Electrification Agency | AfDB

Date of Consultation:	10th July, 2026
Venue / Location of consultation:	AUST
Time:	1:33 p.m

ATTENDANCE REGISTER

No.	Full Name	Gender (M/F)	Organization / Designation	Phone Number	Signature / Thumbprint
1	Bolade Igbagbo	F	AUST STAFF	09070343138	[illegible]
2	Ugwumba Onyinye	F	AUST ✓	08108337314	[illegible]
3	Chinyere Ofilie	F	AUST ✓	08035906404	[illegible]
4	Solomon Ibrahim	M	AUST ✓	08165414068	[illegible]
5	Dr Ugonna Obi-Enenuwa	M	AUST ✓	08169908478	[illegible]
6	Michael Anastesia Folashade	F	AUST ✓	08100748587	[illegible]
7	Okalo Nkem	F	AUST ✓	07050210677	[illegible]
8					
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STAKEHOLDER CONSULTATION ATTENDANCE SHEET

Environmental and Social Impact Assessment

National University of Science and Technology (NUST)

Nigeria Electrification Project Phase II (Desert-to-Power) | Energizing Education Programme | Rural Electrification Agency | AfDB

Date of Consultation:	06-08-2026
Venue / Location of consultation:	Galadimawa Community
Time:	1:30pm

ATTENDANCE REGISTER

No.	Full Name	Gender (M/F)	Organization / Designation	Phone Number	Signature / Thumbprint
1	UMAR DAUDA	M	CHAIRMAN	08069135118	[illegible]
2					
3	KAWALE SHEHU	M	Napep busnes	07044878582	
4	Mukhtar Haruna	M	bushes	07010401939	
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12	Ohenekaro Ovwigbo	F	✓	08133364192	[illegible]
13	Amelia Essien	F	business		[illegible]
14	Imo Umena	F	Trader		[illegible]

ATTENDANCE REGISTER

No.	Full Name	Gender (M/F)	Organization / Designation	Phone Number	Signature / Thumbprint
1	Bala M Audu	M	Trade	07032101935	[illegible]
2	Mohammed Buba	M	– ✓		
3	Ali Ahmed Adamu	M			[illegible]
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12					[illegible]
13					
14					
15					

ANNEX FOUR: WASTE MANAGEMENT PLAN

BACKGROUND

This Waste Management Plan (WMP) has been developed as part of the Environmental and Social Impact Assessment (ESIA) for the proposed solar hybrid mini-grid at the African University of Science and Technology, FCT Abuja, under the Energizing Education Programme III of the Nigeria Electrification Project Phase II (Desert-to-Power), financed by the African Development Bank (AfDB).

The purpose of this plan is to ensure that effective procedures are implemented for the generation, handling, storage, transportation, and disposal of all waste streams arising from project activities across all phases. The plan prescribes measures for waste collection, temporary storage, safe management, and disposal, and includes provisions for recovery, reuse, and recycling in accordance with the waste management hierarchy.

This WMP has been prepared with due cognizance of the AfDB Integrated Safeguards System 2023, the World Bank Environmental, Health and Safety (EHS) Guidelines on Waste Management, the NESREA Act 2018 and applicable subsidiary regulations, and the National Environmental (Sanitation and Wastes Control) Regulations 2009. It shall be reviewed and updated as further detail on waste quantities and categorisation becomes available during construction and operational stages.

2.0 Regulatory and Policy Framework

The preparation and implementation of this Waste Management Plan is guided by the following regulatory instruments:

- AfDB Integrated Safeguards System 2023, Operational Safeguard 3 on Pollution Prevention and Control
- World Bank Environmental, Health and Safety General Guidelines on Waste Management
- National Environmental Standards and Regulations Enforcement Agency (NESREA) Act 2018
- National Environmental (Sanitation and Wastes Control) Regulations 2009
- NESREA National Environmental Regulations on the Electrical and Electronic Sector 2011
- Federal Ministry of Environment (FMEnv) Guidelines on Hazardous Waste Management
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, to which Nigeria is a signatory

3.0 General Waste Management Strategy

An integrated approach to waste management is required across all phases of this project. Waste management is premised on the principle of a management hierarchy, ranging from the most desirable to the least desirable option, as follows:

- Reduce: Avoid waste generation by minimizing the quantity of materials used. This is the most preferred and cost-effective option.
- Reuse: Use products or materials again for the same or similar purpose without reprocessing, thereby reducing waste generation and energy consumption.
- Recycle: Process waste into a usable non-waste product, conserving energy and reducing landfill pressure.
- Dispose: Where reduction, reuse, and recycling are not feasible, waste shall be removed and disposed of at a licensed landfill or appropriately approved facility.

The following overarching good management practices shall apply across all project phases:

- Waste generation shall be limited to the lowest practicable level at all times.
- Non-hazardous wastes shall be segregated from hazardous wastes at source.
- Wastes destined for recycling shall be segregated by type.
- Hazardous materials use shall be minimized; personnel handling hazardous waste shall be trained accordingly.
- Spills of hazardous materials shall be prevented through sensible materials management and regular equipment inspections.
- Waste storage areas shall have secondary containment or spill trays.
- Under no circumstances shall waste be burnt or disposed of on site.

4.0 Classification of Wastes

Project activities will generate both non-hazardous and hazardous waste streams, as described below.

Non-Hazardous Wastes

Non-hazardous wastes expected from project activities include domestic waste, recyclable materials such as paper, glass, metals, wooden waste, and tin cans, packaging waste, waste tyres, and excavation and concrete waste generated from civil works and foundations.

Hazardous Wastes

Hazardous wastes expected from project activities include electrical wastes such as damaged or expired batteries, accumulators, inverters, and PV panels, waste oil from equipment and vehicle maintenance, waste paint and chemical residues, and other hazardous waste related to operation, maintenance, and decommissioning activities. These wastes require dedicated management given their potential to cause significant environmental and human health harm if improperly handled.

5.0 Waste Streams by Project Phase and Management Method

The tables below present the expected waste streams for each project phase, their classification, and the prescribed management method.

5.1 Pre-Construction Phase

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
Pre-Construction	Vegetation clearing	Vegetation, logs, mulched timber, weeds	General Solid (Non-putrescible)	Reuse as compost, soil conditioner, or woodchip mulch on site
	Site clearing and preparation	Excavated materials and topsoil	General Waste	Beneficial reuse on site; balance cut and fill earthworks to optimise reuse
	Site clearing and preparation	Potentially contaminated soils	Hazardous Waste	Off-site disposal at an approved FMEnv or NESREA-licensed facility
	Site clearing and preparation	Scrap metal from site preparation	General Solid (Non-putrescible)	Off-site recycling
	Mobilization of equipment	Packaging materials (wood, plastic, cardboard)	General Solid (Non-putrescible)	Off-site disposal at an approved facility
	Mobilization of equipment	Domestic waste from workers (food packs, cans, bottles)	General Solid (Putrescible)	Off-site disposal at an approved facility

5.2 Construction Phase

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
Construction	Civil works and foundations	Concrete, brick, asphalt and gravel	General Solid (Non-putrescible)	Crushed and used as backfill or road base
	Civil works and foundations	Steel reinforcing and scrap metal	General Solid (Non-putrescible)	Off-site recycling
	Civil works and foundations	Timber formwork	General Solid (Non-putrescible)	Reuse on site where possible; off-site recycling otherwise
	Civil works and foundations	Sediment from earthworks and excavations	General Solid (Non-putrescible)	Beneficial reuse on site as fill material

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
	Electrical and cabling works	Conduits, pipes and bulk electrical cabling	General Solid (Non-putrescible)	Off-site recycling
	Electrical and cabling works	Packaging materials (wood, plastic, cardboard, metals)	General Solid (Non-putrescible)	Off-site disposal at an approved facility
	Electrical and cabling works	Empty oil and chemical drums	General Solid (Non-putrescible)	Off-site recycling by licensed contractor
	Electrical and cabling works	Spill clean-ups, waste paint and chemicals	Hazardous Waste	Off-site disposal at an approved FMEnv or NESREA-licensed facility
	Equipment maintenance	Waste oil, grease, fuel and other fluids	Liquid Hazardous Waste	Off-site disposal at an approved facility; no discharge to ground or water
	Equipment maintenance	Used air and oil filters, worn components and rags	General Solid (Non-putrescible)	Off-site disposal at an approved facility
	General site operations	Domestic waste from workers (food packs, cans, bottles)	General Solid (Putrescible)	Off-site disposal at an approved facility
	General site operations	Sanitary waste and sewage	General Solid (Putrescible)	Off-site disposal at approved facility or on-site sewer system
	General site operations	Wastewater and stormwater	Liquid	Off-site disposal or on-site sewer system; no uncontrolled discharge
	Office operations	Paper, cardboard and plastic	General Solid (Non-putrescible)	Off-site recycling
	Office operations	Glass bottles and aluminium cans	General Solid (Non-putrescible)	Off-site recycling
	Office operations	Ink cartridges and toner	General Solid (Non-putrescible)	Off-site recycling by licensed contractor

5.3 Operation and Maintenance Phase

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
Operation and Maintenance	Routine O&M activities	Waste oil and lubricants from equipment servicing	Liquid Hazardous Waste	Off-site disposal at an approved facility; no discharge to ground or water
	Routine O&M activities	Used filters, worn mechanical components and rags	General Solid (Non-putrescible)	Off-site disposal at an approved facility
	Routine O&M activities	General site waste (cardboard, paper, plastic, tins)	General Solid (Non-putrescible)	Off-site recycling or disposal at approved facility
	Battery and e-waste	Damaged or expired batteries and battery accumulators	Hazardous Waste (E-waste)	Stored in dedicated bonded containment; handed to NESREA-licensed e-waste handler or returned to supplier under EPR arrangement
	Battery and e-waste	End-of-life or damaged inverters	Hazardous Waste (E-waste)	Managed under EPR plan; handed to NESREA-licensed e-waste handler

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
	Battery and e-waste	Damaged or degraded PV panels	Hazardous Waste (E-waste)	Managed under EPR plan in accordance with NESREA Electrical and Electronic Sector Regulations 2011
	Battery and e-waste	Waste electrical and electronic components	Hazardous Waste (E-waste)	Off-site disposal through certified e-waste management facility in compliance with Basel Convention
	General site operations	Domestic waste from operational staff	General Solid (Putrescible)	Off-site disposal at an approved facility
	General site operations	Sanitary waste and sewage	General Solid (Putrescible)	Off-site disposal at approved facility or on-site sewer system

5.4 Decommissioning Phase

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
Decommissioning	Dismantling of solar arrays	PV panels and mounting structures	Hazardous Waste (E-waste)	Inventoried; reusable components redirected for refurbishment; remainder disposed through certified e-waste facility in compliance with Basel Convention
	Dismantling of electrical systems	Battery banks, inverters and transformers	Hazardous Waste (E-waste)	Inventoried; managed under EPR and NESREA Electrical and Electronic Sector Regulations 2011
	Dismantling of electrical systems	Electrical cabling and conduits	General Solid (Non-putrescible)	Off-site recycling by licensed contractor
	Demolition of structures	Concrete, brick and rubble	General Solid (Non-putrescible)	Crushed for reuse as fill or road base; remainder to licensed landfill
	Demolition of structures	Scrap metal from structural components	General Solid (Non-putrescible)	Off-site recycling
	Site remediation	Contaminated soils (if any)	Hazardous Waste	Off-site disposal at approved FMEnv or NESREA-licensed facility
	Site remediation	General demolition waste and debris	General Waste	Off-site disposal at a licensed landfill by certified contractor

6.0 Phase-Specific Waste Management Requirements

6. Pre-Construction and Construction Phase

6.1.1 Waste Assessment and Inventory

The Environmental Officer shall develop, implement, and maintain a waste inventory reflecting all waste generated during pre-construction and construction, covering both general and hazardous waste streams. Construction methods and materials shall be carefully considered to maximise opportunities for waste reduction, reuse, and recycling. Targets for waste recovery shall be established once the inventory is in place.

6.1.2 Waste Collection, Handling, and Storage

Each contractor and subcontractor shall implement a waste segregation system using separate bins for food waste, plastics, paper, wood, glass, cardboard, and metals. Waste collection bins and hazardous waste containers shall be provided by the principal contractor and placed at designated locations across the site. A dedicated waste storage area shall be established on site for the temporary storage of all waste streams prior to removal.

Colour coding and signage shall be used to differentiate disposal bins by waste stream type. Hazardous waste shall be stored within a bonded containment area constructed in accordance with FMEnv requirements, and the volume of waste stored shall not exceed 110 percent of the bund capacity. Waste storage areas shall be positioned away from water courses and covered with tarpaulins or roofing to prevent water ingress. Portable sanitation facilities shall be monitored and maintained daily. Under no circumstances shall waste be burnt on site.

6.1.3 Disposal

Waste shall be removed from site on a regular basis as determined by the Environmental Officer, taking into account the volumes generated at different stages of construction. All waste removal shall be undertaken by a registered and licensed contractor, who shall provide waste manifests for all removals at least once a month and supply proof of appropriate disposal at a licensed landfill or approved facility.

6.1.4 Record Keeping

Documentation including waste manifests and certificates of safe disposal shall be maintained, detailing the quantity, nature, and fate of all regulated waste for audit purposes. Waste management shall form part of monthly reporting requirements, covering volumes generated, waste types, storage arrangements, and final disposal.

6.1.5 Training

Training and awareness on waste management shall be provided to all employees and contractors as part of on-site induction and periodic awareness sessions.

6.2 Operation and Maintenance Phase

During the operational phase, waste generation is expected to be limited, consisting primarily of general waste such as cardboard, paper, plastic, tins, metals, and vegetation materials. Limited hazardous waste from end-of-life electrical and electronic equipment may also arise during maintenance activities.

The O&M Contractor and Site Manager shall develop and maintain a waste inventory covering all general and hazardous waste streams generated during operations. Separate bins shall be provided for general and hazardous waste, and recyclable materials shall be removed from the waste stream and stored separately. All waste shall be removed regularly by a licensed contractor and disposed of at an appropriately licensed landfill, with proof of disposal retained.

6.3 Battery and Electronic Waste (E-Waste) Management

The solar hybrid mini-grid involves the installation and long-term operation of battery energy storage systems, inverters, PV panels, and associated electrical and electronic equipment. These components are a significant source of hazardous e-waste over the project lifecycle, particularly at end of life or upon damage during operation. Their management requires dedicated attention given the toxic constituents they may contain, including lead, cadmium, lithium, and other heavy metals.

Battery waste and e-waste generated across all project phases shall be managed in accordance with the NESREA National Environmental Regulations on the Electrical and Electronic Sector 2011, the FMEnv guidelines on hazardous waste management, and the Extended Producer Responsibility (EPR) framework. At the point of procurement, the EPC Contractor shall confirm and document the EPR obligations of all equipment suppliers, including take-back and end-of-life management arrangements for batteries, inverters, and PV modules.

During the operational phase, damaged, expired, or end-of-life batteries and inverters shall be classified as hazardous waste and stored separately in a dedicated, covered, and bonded containment area prior to collection and disposal. No battery or electronic component shall be dismantled, buried, or disposed of on site under any circumstances. All such waste shall be handed over to a NESREA-licensed e-waste handler or returned to the equipment supplier under the applicable EPR arrangement, with waste transfer documentation retained for audit purposes.

During the decommissioning phase, all PV panels, battery banks, inverters, transformers, and electrical cabling removed from the site shall be inventoried and categorised by waste type prior to disposal. Reusable components shall be identified and redirected for reuse or refurbishment where feasible. All remaining e-waste shall be disposed of through certified and licensed e-waste management facilities in compliance with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.
The Environmental Officer shall maintain a dedicated e-waste register recording the type, quantity, storage location, collection date, and final disposal destination of all battery and electronic waste generated throughout the project.

6.4 Decommissioning Phase
The project is expected to operate for a minimum of 25 years and potentially up to 40 years with proper maintenance. Waste management during decommissioning shall include notifying the appropriate ministries including FMEnv and NESREA prior to commencement of decommissioning activities, applying best practices in demolition and dismantling to prevent pollution or contamination from improper waste handling, managing all associated e-wastes under the EPR framework and NESREA Electrical and Electronic Sector Regulations 2011, and disposing of all other waste types through certified waste managers at appropriately licensed landfills.

7.0 Monitoring of Waste Management Activities
Records shall be kept of the volumes and mass of the different waste streams collected from the site throughout the project lifecycle. The appointed waste contractor shall provide monthly reports to the operator containing the following information:
- Monthly volumes and mass of the different waste streams collected
- Monthly volumes and mass of waste disposed of at a landfill site
- Monthly volumes and mass of waste recycled
- Data illustrating progress compared to previous months

These reports will aid in monitoring the effectiveness of the waste management procedures in place and identify any need for revision or corrective action.

8.0 Waste Management Cost
Finances have been allocated for proper waste management across all project phases. The cost of mitigation and monitoring for waste management from pre-construction through to operations and maintenance has been factored into the respective phase budgets in the ESMP, covering training, personal protective equipment, receptacles, containment areas, and disposal costs. The cost of waste management during the decommissioning phase shall be developed at that stage, reflecting the specific quantities and types of waste to be managed at that time.

9.0 Conclusion
This Waste Management Plan has been prepared to ensure that all wastes generated from the proposed solar hybrid mini-grid project at AUST are effectively managed, minimised, and disposed of in an environmentally responsible manner consistent with applicable Nigerian regulations and AfDB safeguard requirements. The effectiveness of the plan depends on prompt and systematic waste management practices, the use of appropriately licensed contractors, and adequate supervision by the REA-PMU and relevant regulatory authorities throughout the project lifecycle.

ANNEX FIVE: CLIMATE CHANGE ADAPTATION AND MITIGATION PLAN

Introduction

This Climate Change Adaptation and Mitigation Plan has been developed for the proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology, FCT Abuja The plan outlines measures to enhance the project's resilience to climate variability and change, while also contributing to climate change mitigation through reduced greenhouse gas (GHG) emissions.

The plan is prepared in line with national climate policies and international best practices, including the requirements of the African Development Bank.

Climate Context of the Project Area

AUST, in Abuja, lies within the Guinea Savannah ecological zone and is characterized by:

- High temperatures, particularly during the dry season
- Seasonal rainfall with increasing variability
- Occasional intense rainfall events leading to localized erosion and flooding
- Increasing risk of prolonged dry periods

These conditions present potential risks to infrastructure performance and environmental sustainability.

Climate Change Risks to the Project

Climate Risk	Potential Impact on Project
Increased temperature	Reduced efficiency of solar panels and battery systems
Intense rainfall events	Soil erosion, flooding of trenches, damage to infrastructure
Strong winds	Damage to solar panel mounting structures
Prolonged dry periods	Increased dust generation affecting panel efficiency
Extreme weather events	Disruption of construction and operation activities
Lightning strike	Damage to solar PV panels, inverters, transformers, and other electrical equipment, resulting in service interruption, fire hazards, and increased maintenance requirements.

Climate Change Mitigation Measures

The project inherently contributes to climate change mitigation through the use of renewable energy. Additional measures include:

Reduction of Greenhouse Gas Emissions

- Deployment of solar photovoltaic (PV) systems to reduce reliance on diesel generators
- Optimization of hybrid system design to minimize fossil fuel backup usage
- Promotion of energy efficiency within the university facilities

Sustainable Construction Practices

- Use of well-maintained equipment to reduce emissions
- Minimization of material wastage during construction
- Efficient logistics planning to reduce fuel consumption

Waste Management

- Proper handling and disposal of construction waste
- Safe management of hazardous materials (e.g., batteries)
- Promotion of recycling where feasible

Protection Against Lightning and Extreme Weather Events

- Incorporation of lightning protection systems for solar PV arrays and associated electrical infrastructure.
- Installation of surge protection devices (SPDs) to safeguard electrical equipment against transient overvoltages.
- Provision of adequate earthing and grounding systems for all PV installations and electrical equipment.
- Routine inspection and maintenance of lightning protection and earthing systems to ensure continued effectiveness.

Climate Change Adaptation Measures

Infrastructure Design and Siting

- Elevation of critical equipment (e.g., inverters, batteries) to prevent flood damage
- Design of adequate drainage systems to manage stormwater runoff
- Use of corrosion-resistant and heat-tolerant materials

Erosion and Soil Management

- Stabilization of exposed soils through compaction and vegetation where applicable
- Installation of erosion control measures (e.g., sandbags, drainage channels)

Solar Panel Efficiency Management

- Regular cleaning of solar panels to reduce dust accumulation
- Proper spacing and orientation to optimize airflow and reduce overheating

Structural Stability

- Design and installation of mounting structures to withstand local wind conditions
- Regular inspection and maintenance of structural components

Operational Resilience

- Development of maintenance schedules to ensure system reliability
- Training of personnel on climate-related risks and response measures

Institutional Responsibilities

Activity	Responsible Party
Implementation of mitigation measures	Contractor / Operator
Monitoring of climate risks	REA- NEP / Supervising Engineer
Compliance with standards	Federal Ministry of Environment
Oversight and reporting	African Development Bank / REA

Monitoring Indicators

Aspect	Indicator	Frequency
Solar efficiency	Energy output vs expected performance	Monthly
Erosion control	Presence of erosion features	After rainfall
Drainage performance	Absence of flooding or waterlogging	During rainy season
Structural integrity	Condition of mounting structures	Quarterly
Waste management	Proper disposal records	Monthly

Capacity Building and Awareness

- Training of workers on climate-resilient construction practices
- Awareness programs for facility operators on system maintenance under varying climatic conditions
- Integration of climate considerations into routine operational procedures
- reducing greenhouse gas emissions while ensuring reliable and climate-resilient energy supply.

ANNEX SIX: LABOUR MANAGEMENT PLAN

1.0 Introduction

This Labour Management Plan (LMP) has been developed for the proposed Solar Hybrid Mini-Grid Project at the African University of Science and Technology, FCT Abuja. The LMP outlines the approach to managing labour and working conditions in a manner that promotes fair treatment, non-discrimination, and safe working environments throughout the project lifecycle.

The plan is prepared in line with national labour laws and international best practices, including the requirements of the African Development Bank.

2.0 Types of Project Workers

The project is expected to engage the following categories of workers:

Direct Workers

- Personnel engaged by the Rural Electrification Agency (REA) and project consultants
- Supervising engineers (including Project Owner's Engineer – POE)

Contracted Workers

- Workers employed by contractors and sub-contractors for construction and installation activities
- Skilled and unskilled labour for civil, electrical, and mechanical works

Community Workers (Where Applicable)

- Local labour engaged for minor site activities (e.g., clearing, logistics support)

3.0 Key Labour Risks

Risk Category	Potential Issues
Occupational Health and Safety (OHS)	Injuries from equipment, electrical hazards, falls, trenching risks
Labour influx	Pressure on local resources, potential community tension
Worker misconduct	Conflict with host community, inappropriate behaviour
Child labour	Engagement of underage workers
Forced labour	Unfair or coercive employment practices
Gender-based risks	Sexual Exploitation and Abuse (SEA), Sexual Harassment (SH)
Poor working conditions	Lack of PPE, inadequate welfare facilities

4.0 Labour Management Measures

- **Employment Principles**
  - Equal opportunity employment based on qualifications and competence
  - No discrimination based on gender, religion, ethnicity, or social status
  - Preference for local labour where feasible

- **Working Conditions**
  - Clear terms of employment (contracts, wages, working hours)
  - Compliance with national labour regulations
  - Provision of adequate welfare facilities (water, sanitation, rest areas)

- **Occupational Health and Safety (OHS)**
  - Development and implementation of a site-specific Health, Safety and Environment (HSE) Plan
  - Mandatory use of appropriate Personal Protective Equipment (PPE)
  - Regular toolbox talks and safety briefings
  - Provision of first aid kits and emergency response procedures
  - Safe handling of equipment and electrical systems

- **Code of Conduct**

All workers shall sign and adhere to a Code of Conduct that includes:

- Respect for local communities and cultural norms
- Prohibition of SEA/SH and gender-based violence (GBV)
- Prohibition of child labour and forced labour
- Compliance with safety rules and regulations

- **Prevention of Child and Forced Labour**
  - Minimum employment age of 18 years for hazardous work
  - Verification of worker age through valid identification
  - Voluntary employment without coercion

- **Gender and Social Inclusion**
  - Promotion of women participation where feasible
  - Awareness programs on GBV, SEA, and SH
  - Safe and inclusive working environment for all workers

5.0 Worker Grievance Redress Mechanism (GRM)

A dedicated grievance mechanism shall be established for workers to raise concerns related to:

- Working conditions
- Wages and benefits
- Harassment or discrimination
- Safety concerns
- **GRM Features:**
- Accessible and confidential
- Timely response and resolution
- Proper documentation of grievances
- No retaliation against complainants

6.0 Roles and Responsibilities

Entity	**Responsibilities**
Contractor	Implementation of LMP, worker management, OHS compliance
Supervising Engineer / POE	Monitoring compliance with labour and safety requirements
Rural Electrification Agency (REA)	Oversight and enforcement of labour standards
African Development Bank	Monitoring compliance with safeguard requirements

7.0 Monitoring Indicators

Aspect	**Indicator**	**Frequency**
PPE usage	% of workers using PPE correctly	Daily
Safety training	Number of toolbox talks conducted	Weekly
Incidents	Number of accidents/incidents recorded	Monthly
Labour conditions	Availability of contracts and welfare facilities	Monthly
GRM	Number of grievances received and resolved	Monthly
Gender inclusion	% of female workers (where applicable)	Monthly

ANNEX SEVEN: HSE PLAN

1.0 INTRODUCTION

All projects present inherent health, safety, and environmental (HSE) risks that must be effectively managed to prevent accidents, injuries, and environmental harm. This HSE Plan has been developed for the proposed Solar Hybrid Mini-Grid Project at African University of Science and Technology, FCT Abuja to ensure compliance with applicable Occupational Health and Safety (OHS) standards and best practices.

The plan provides a structured framework for identifying, assessing, and managing HSE risks associated with the project. The project team shall ensure high performance standards and full compliance with contractual and regulatory requirements by implementing HSE measures in a systematic, proactive, and continuous manner throughout the project lifecycle.

2.0 PROJECT DESCRIPTION

The proposed project involves the installation and operation of a Solar Hybrid Mini-Grid system within the permanent campus of the African University of Science and Technology, FCT Abuja. The project components include site preparation, installation of solar photovoltaic (PV) panels, battery energy storage systems, inverters, and associated electrical infrastructure, as well as trenching and cabling for power distribution within the campus.

Construction activities will include site clearing, civil works, equipment installation, and electrical connections, while the operational phase will involve routine maintenance, system monitoring, and facility management.

2.1 Purpose

The purpose of this HSE Plan is to outline the occupational health, safety, and environmental management requirements for the project, and to define the procedures, control measures, and responsibilities necessary to prevent incidents and ensure a safe working environment.

Specifically, this plan aims to:

- Identify potential HSE risks associated with project activities;
- Establish appropriate risk control and mitigation measures;
- Ensure compliance with applicable national OHS laws and international best practices, including those of the African Development Bank;
- Promote a strong safety culture among all project personnel; and
- Provide guidelines for safe work practices throughout the project lifecycle.

2.2 HSE Objectives

The Objectives for this plan are to:

- Adopt a positive Health & Safety Culture.
- Adopt the principles of prevention to avoid risk.
- Complete the project without incident (Zero fatalities, Zero Lost Time Injury (LTI) or occupational illness).

2.3 Scope of Work

The Project Occupational Health and Safety (OHS) plan covers the scope of works defined in the contract. This includes Preconstruction, Construction, Operation & Maintenance and decommissioning phases.

2.4 Policy Statement

In addition to the existing HSE policy, other policies shall be developed which includes:

- Substance Abuse Policy – Prohibiting the consumption or possession of narcotics, drugs, alcohol and other banned substances
- Emergency Response Policy – Stating commitment to ensure adequate resources and arrangement are in place in the case an emergency.
- Community Affairs Policy – Stating commitment to foster healthy relationships with communities through observance of the highest standard of conduct.
- Road Safety Policy–Stating commitment to complying with Road Traffic regulations and continuously improving its road safety performance by implementing a Road Safety Management Plan (RSMP)

3.0 KEY RESPONSIBILITIES

Involvement of all in implementing, maintaining and continually improving OHS processes is the key to successful completion and achievement of quality objectives set by the management. All project personnel shall therefore be required to be familiar with the content of this OHS plan and shall participate in implementing, maintaining and improving the management system.

It is the responsibility of the project manager and all key personnel to ensure that the requirements for quality are fulfilled for works under their responsibility.

All new staff and staff who are given new responsibilities are to be inducted into the requirements set out in this plan in general and into their function and responsibilities in particular.

3.1 Project Manager Responsibilities

- Set good example in HSE issues.
- Ensure the availability of resources essential to establish, implement, maintain and improve the OHS Management System.
- Define, document and communicate roles, allocate responsibilities and accountabilities, delegating authorities, to facilitate effective OHS management.
- Ensure that all of the activities undertaken in the Project conform to Nigerian legislation, client requirements or international standards when applicable.
    - Review objectives achievements throughout the year.

3.2 Project Supervisors Responsibilities

- Enforcing all phases of the established HSE plan.
- Set good example in HSE issues.
- Preparing Job Hazard Analysis when required.
- Ensuring the safety of all workers associated with the site.
- Conducting HSE inspections.
- Ensuring workers are competent for their allocated tasks.
- Attending and participating in HSE meetings.
    - Participating in accident investigations.

3.3 HSE Manager/Supervisor Responsibilities

- Prepare relevant OHS documentation and procedures.
- Monitor the efficient implementation of OHS requirements.
- Participate and organize the OHS risk assessments.
- Advise management of compliance and of conditions requiring attention.
- Conduct regular HSE inspections.
- Make thorough analysis of statistical data and inspections; delineates problem areas; and makes recommendation for solutions.
- Take part in the review of all OHS incidents and assist in investigating incident.

- Monitor the efficient implementation of the Project's OHS requirements.
- Organize the Project's OHS risk assessment exercises.
- Check on the use of all types of personal protective equipment specifies the use of appropriate PPE for the various work activities. Evaluates their effectiveness and suggests improvements where indicated.

3.4 HSE Advisor Responsibilities

- Check on the use of all types of personal protective equipment specifies the use of appropriate PPE for the various work activities. Evaluates their effectiveness and suggests improvements.
- Conduct independent inspections to observe conformance with established OHS Plan and determines the effectiveness of individual elements of the plan (pre-task briefing, weekly toolbox talk, etc)
- Establish contact with Subcontractors with the objective of maintaining good relations and coordination of accident prevention activities and compliance with the established OHS plan.
- Correct unsafe acts and unsafe conditions.
- Deliver HSE induction/orientation course to all employees, including subcontractors.
- Deliver HSE awareness course and toolbox talk.
- Advise employees on OHS matters.

3.5 All employees Responsibilities

- Take all reasonable and practical steps to care for their own health and safety and avoid affecting the health and safety of co-workers and the general public.
- Follow all instructions and use the equipment properly
- Not interfere with any safety arrangements.
- Report any circumstances which may not comply with the project's OHS management system.

4.0 Competency

All personnel required to operate or work with any equipment or machine must be competent, be tested for each equipment that he/she shall be operating. All personnel who as part of their profession require licensing or certification must obtain the necessary certification before he/she shall be allowed to work on the site.

5.0 Fitness

All personnel working on site shall be required to be certified medically fit to do so by an approved medical facility or Medical Doctor (pre-employment medical examination)

6.0 HSE Training

6.1 Induction/Orientation

Every new or rehired employee and Subcontractors employees must undergo mandatory OHS orientation / induction. The purpose of the Induction is to educate workers and make them aware of the major potential hazards he or she shall come into contact with while working on the site; also, it is one more opportunity to stress the importance of HSE being the first priority in the operations.

The content of the HSE orientation / induction shall cover the following subjects:

- Site safety rules.
- Personnel protective equipment requirements (PPE).
- Environmental sensitivity and protection.
- Preparation and planning of the job (Daily Pre-task talk).
- Emergency plan and muster points.

6.2 Project Specific HSE Training

In addition to the HSE orientation /induction, there shall be specific site HSE trainings which shall cover the following topics:

- Manual handling.
- Electrical Safety

- Emergency Prevention, Preparedness and Response
- Work at height training
- First Aid training (for site First Aiders)
- Lifting and Rigging
- Safe Driving techniques (for drivers)

7.0 Hazard identification & HSE risk assessment

7.1 Project HSE Risk Assessment

The project HSE risk assessment shall be developed and recorded. The Project's HSE risk assessment shall be conducted by a team consisting of HSE Manager/ Supervisor and technical managers/supervisors. It must be approved by the Project manager.

7.2 Fire Risk Assessment

A fire risk assessment shall be developed and recorded. A fire safety plan shall be in place in the site.

7.3 Job Hazard Analysis

Job hazard analysis is required when the hazards and risks associated with a specific task is to be identified so as to implement control measures. The HSE department together with the technical managers/supervisors shall develop a job hazard analysis when applicable.

8.0 EMERGENCY PREPAREDNESS AND RESPONSE

Emergency procedures and evacuation plan shall be developed by the HSE Department and displayed on the notice board. These procedures shall be communicated to all staff. Also each section/department shall have at least a trained first aider at all times.

9.0 HSE IMPLEMENTATION AND PERFORMANCE MONITORING

9.1 HSE Meetings

HSE management meetings shall be held once a month. The meeting is to help identify safety problems, develop solutions, review incident reports, provide training and evaluate the effectiveness of our safety program. Some of the meetings shall be:

- Project/Site Management HSE Meeting for management and supervision (Monthly).
- Tool box talk meetings for all workforce (Weekly).
- Pre-task briefing for all workforces (Daily).
- Special situation meeting (As required).

9.2 HSE Reporting

All incidents and illnesses must be reported to site supervisor after which investigation shall commence and recorded so that appropriate corrective actions shall be implemented to prevent any re-occurrence and report findings shall be forwarded to management for review. Reporting requirements shall include notification of incident, investigation report, and monthly report. Notification of Incident form shall be developed which shall be filled and submitted to HSE department for investigation.

9.3 HSE Inspection and Audits

For continual improvement of HSE management system, HSE inspection and audit shall be conducted. An inspection checklist shall be developed. This is to ensure that the HSE management system is being adhered to. The inspection shall be conducted by the HSE department together with site management.

9.4 Corrective and Preventive Actions and Non-Conformities

During the cause of inspections, concerns raised shall be addressed and closed out. It is expected that in a period of two weeks, a close out inspection shall take place to verify that the corrective actions have been closed.

10.0 PROJECT HSE RULES

The project HSE rules shall be developed and supervision shall develop specific rules and procedures when necessary.

The following site rules shall be implemented at all times. The Site Manager shall draw these rules to the attention of their own workmen or staff. All sub-contractors must ensure that these rules are drawn to the attention of their workmen and staff.

The Principal Contractor may implement additional site rules during the contract programme. Any such additional rules shall be notified to all personnel engaged on the project prior to their implementation. The HSE rules shall include but not limited to:

1. Personal Protective Equipment must be worn at all times.
2. All instructions issued by the Site Manager regarding the storage, handling or cleaning of materials, plant and equipment must be followed.
3. All vehicles must be parked in the designated areas.
4. Any workman suffering from a medical condition that might affect his work and/or that could require specific Medical treatment must inform the supervisor before commencing work.
5. All site tools shall either be battery operated or 110 volts.
6. No one shall be permitted on site if it is believed that they are under the influence of alcohol or drugs.
7. Vehicles must not reverse without a banksman in attendance.
8. All visitors to site must undergo a site-specific induction and operative Identity badges must be worn at all times.
9. All excavations must be secured.
10. Smoking and eating shall only be permitted in the designated area. This area shall be identified during induction.
11. No hot works operations are permitted without a hot work permit in place.
12. There shall be no radios or other music playing devices on site.
13. Good housekeeping practices to be adopted**.**
14. Compliance with all Ethical Power Permit to Work systems
15. The site keyed access procedure must be strictly adhered to.
16. All Contractors must comply with Site Health & Safety Guidelines / Site Safety Method Statement
17. No untrained worker shall be permitted to operate heavy machineries.

11.0 SAFE WORK PRACTICES

Implementing safe work practices is one of the keys to achieving our HSE objectives and some of these safe work practices include:

11.1 Personal Protective Equipment (PPE)

The basic PPE required for the project shall be Safety Glasses, Safety Boots, Hand Gloves, Hard Hat and Coverall. Any other PPE shall be used as applicable. Management is responsible for the provision of PPE and usage shall be enforced at all time. PPE shall be provided in circumstances where exposure to hazards cannot be avoided by other means or to supplement existing control measures identified by a risk assessment. An assessment shall be made to ensure that the PPE is suitable for purpose and is appropriate to the risk involved. Information, instruction & training shall be given to all employees on safe use, maintenance and storage of PPE. Employees shall, in accordance with instructions given, make full use of all PPE provided and maintain it in a serviceable condition and report its loss or defect immediately to the maintenance department where it shall be replaced. PPE shall be replaced when it is no longer serviceable and returned on a new for old basis. Employees shall sign to state that they have received PPE when issued.

12.0 WELFARE FACILITIES

The provision of welfare facilities on the site shall be communicated to all operatives at site induction.

A cleaning regime shall be implemented and maintained for the duration of the construction phase to ensure the site welfare facilities remain in a clean and tidy condition.

If mains drinking water becomes unavailable during the construction phase bottled water shall be brought to site for all operatives for the necessary period.

13.0 SIGNAGE

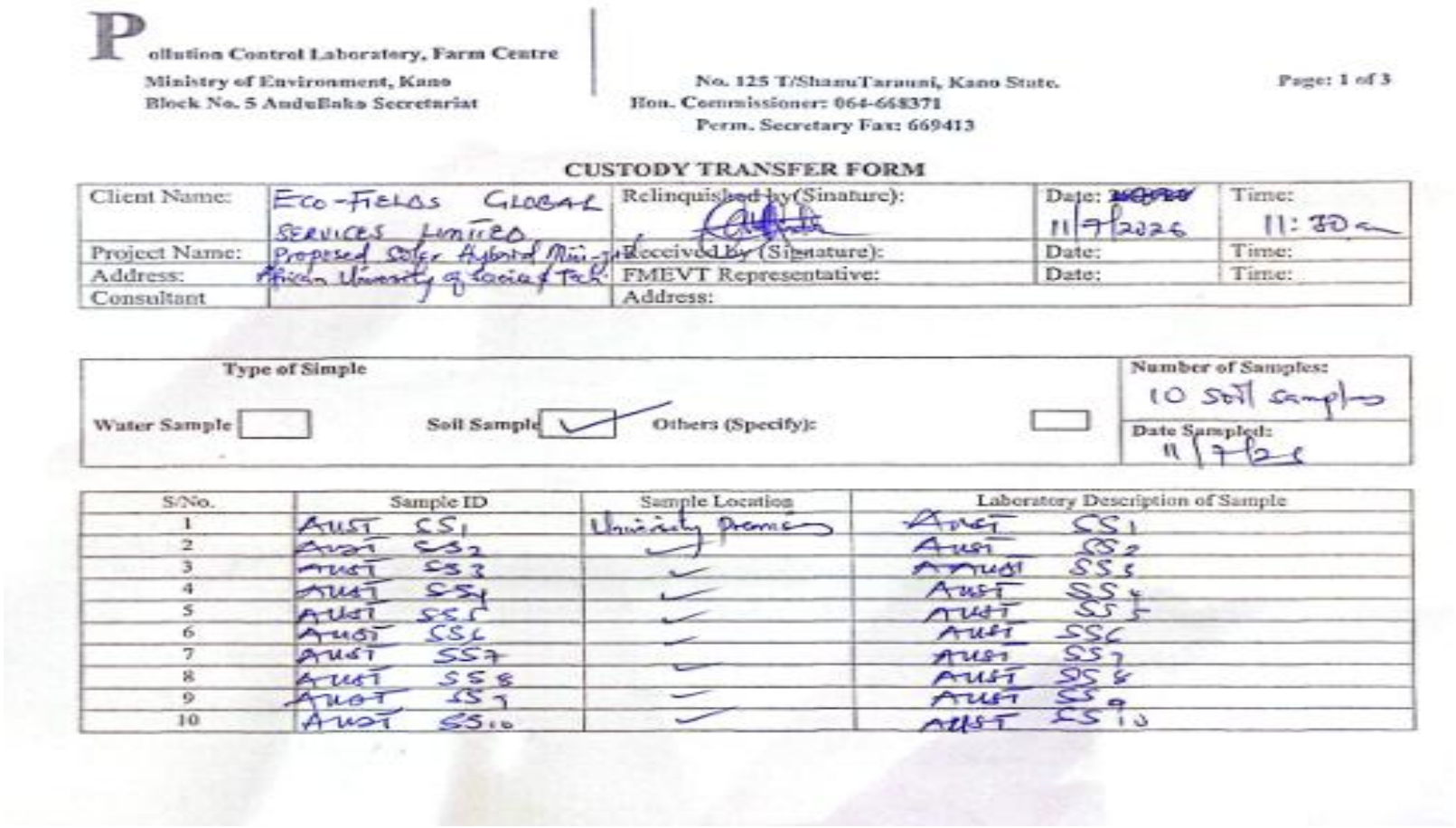
Adequate provision for warning and directional signs shall be made.

14.0 PROJECT HSE PROCEDURES

OHS procedures shall be developed. Project activities shall generally be controlled in accordance with OHS Procedures. These procedures shall include:

- Lifting and Rigging Procedure
- HSE Reporting Procedure
- Working at Height Procedure.
- Emergency Procedure.

ANNEX EIGHT: LABORATORY ANALYTICAL REPORTS AND CHAIN OF CUSTODY DOCUMENTATION.



Pollution Control Laboratory, Farm Centre
Ministry of Environment, Kano
Block No. 5 AnduBaka Secretariat

No. 125 T/ShanuTarauni, Kano State.
Hon. Commissioner: 064-668371
Perm. Secretary Fax: 669413

Page: 1 of 3

CUSTODY TRANSFER FORM

Client Name:	Eco-Fields Global Services Limited	Relinquished by(Sinature):	Date: 11/7/2026	Time: 11:30 a
Project Name:	Proposed Solar Hybrid Mini-g	Received by (Signature):	Date:	Time:
Address:	African University of Socia & Tech.	FMEVT Representative:	Date:	Time:
Consultant		Address:		

Type of Simple

Water Sample ☐ Soil Sample ☑ Others (Specify): ☐

Number of Samples: 10 Soil samples

Date Sampled: 11/7/26

S/No.	Sample ID	Sample Location	Laboratory Description of Sample
1	AUST SS1	University Premises	AUST SS1
2	AUST SS2	✓	AUST SS2
3	AUST SS3	✓	AUST SS3
4	AUST SS4	✓	AUST SS4
5	AUST SS5	✓	AUST SS5
6	AUST SS6	✓	AUST SS6
7	AUST SS7	✓	AUST SS7
8	AUST SS8	✓	AUST SS8
9	AUST SS9	✓	AUST SS9
10	AUST SS10	✓	AUST SS10

African University of Science and Technology (AUST) Abuja.

In-situ parameters of water.

S/N	Parameters	Unit	Ground water	Surface Stream I	Surface Stream II	Upstream	Downstream
1	PH	–	7.55	7.52	7.56	7.13	7.14
2	Temperature	°C	29.9	30.8	29.6	30.0	30.1
3	Dissolve Oxygen	mg/L	4.9	4.5	4.8	5.0	5.1
4	Electrical Conductivity	μs/cm	90	100	114	293	293

11/7/2024.

Laboratory Representative

Project: ESIA of the proposed Solar-hybrid mini-grid System
Site Address: African University of Science and Technology (AUST) Abuja Annex to power (DtP)
Date: 11/7/2026

Ambient Air Quality Measurements

Station Code	Stations	Latitude	Longitude	Elevation	Parameters									
				CO_2	NO_2 (ppm)	CO (ppm)	H_2S (ppm)	SO_2 (ppm)	HCN (ppm)	NH_3 (ppm)	CL_2 (ppm)	PM_{10} (ppm)	$PM_{2.5}$ (ppm)	(AQI)
1	AUST AQ1			773	0.0	1	0.0	0.3	0.0	0	0.0	35	27	Excellent
2	AUST AQ2			415	0.2	2	0.0	0.2	0.0	0	0.1	30	29	Excellent
3	AUST AQ3			512	0.1	2	0.0	0.1	0.0	0	0.2	27	21	Excellent
4	AUST AQ4			440	0.8	1	0.0	1.1	0.0	0	0.0	39	23	Excellent
5	AUST AQ5			408	0.0	1	0.0	0.2	0.0	0	0.3	38	30	Excellent
6	AUST AQ6			407	0.2	2	0.0	0.1	0.0	0	0.3	28	22	Excellent
7	AUST AQ7			407	0.1	2	0.0	0.0	0.0	0	0.4	38	24	Excellent
8	AUST AQ8			411	0.1	2	0.0	0.0	0.0	0	1.3	26	20	Excellent
9	AUST AQ9			403	0.2	1	0.0	0.1	0.0	0	0.1	38	29	Excellent
10	AUST AQ10			402	0.1	2	0.0	0.0	0.0	0	0.1	38	29	Excellent
11														
12														
13														

CLIENT REPRESENTATIVE — DATE

CONSULTANT REPRESENTATIVE — DATE

ENERGY AGENCY LABORATORY — DATE 11/7/26

Project: ESIA For the Proposed Solar-hybrid Mini-grid system
Site Address: African University of Science & Technology (AUST) under Desert to power Program (DtP)
Date: 11/7/2026.

Ambient Air Quality Measurements

Station Code	Stations	Latitude	Longitude	Elevation	Parameters									
					HCL (ppm)	TVOC (ppm)	O_3 (ppm)	C_2H_4 (ppm)	PH_3 (ppm)	PM1.0 (ppm)	HCHO (ppm)	Temp (°C)	HUM (%)	Noise (dB)
1	AUST AQ_1				0·01	0·005	0·00	0	0·0	14	0·001	33·4	76	62·3
2	AUST AQ_2				0·33	0·019	0·00	0	0·0	18	0·002	35·2	61	69·2
3	AUST AQ_3				0·22	0·014	0·00	0	0·0	13	0·000	35·1	60	63·3
4	AUST AQ_4				0·11	0·006	0·00	0	0·0	19	0·001	35·1	60	59·8
5	AUST AQ_5				0·05	0·003	0·00	0	0·0	20	0·003	34·8	66	61·3
6	AUST AQ_6				0·10	0·004	0·00	0	0·0	18	0·001	35·1	61	60·2
7	AUST AQ_7				0·00	0·003	0·00	0	0·0	22	0·000	33·6	61	62·8
8	AUST AQ_8				0·02	0·006	0·00	0	0·0	17	0·003	34·0	56	64·0
9	AUST AQ_9				0·15	0·009	0·00	0	0·0	19	0·002	34·0	56	61·1
10	AUST AQ_{10}				0·36	0·006	0·00	0	0·0	22	0·001	34·3	66	65·4
11														
12														
13														

PROJECT REPRESENTATIVE

DATE

CONSULTANT REPRESENTATIVE

DATE

11/7/26

DATE