LAGOS AND OGUN STATES TRANSMISSION LINES AND ASSOCIATED SUBSTATIONS PROJECT:

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT - LOT 1

FINAL ESIA REPORT

February 2019

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List of Abbreviations and Acronyms

ACRS	Aluminum Alloy Conductor Steel Reinforced
AP	Angle Points
AC	Alternating Current
ALARP	As Low As Reasonably Practicable
APHA	American Public Health Association
API	American Petroleum Institute
AIDS	Acquired Immune Deficiency Syndrome
AQ	Air Quality
Ba	Barium
BP	Bank Procedures
BAT	Best Available Technology
BOD	Biological Oxygen Demand
BTEX	Benzene Toulene, Ethlybenzene, Xylene
BL	Base Line
BDL	Below Detection Limit
BMI	Body Mass Index
CEDAW	Convention on the Elimination of all Forms of Discrimination against Women
CO	Carbon monoxide
C of O	Certificate of Occupancy
CEMP	Construction Environmental Management Plan
COD	Chemical Oxygen Demand
CH_4	Methane
CST	Constant Separation Traversing
CEO	Chief Executive Officer
CS	Coarse Sand
Cu	Copper
Cd	Cadmium
Cr	Chromium
CEC	Cation Exchange Capacity
CEO	Chief Executive Officer
cfu/ml	Colony Forming Unit per Millilitre
cfu/g	Colony Forming Unit per Gram
DC	Direct Current
dB	Decibel
dB(A)	Aided Design and Drafting
DC	Double Circuits
DFRRI	Directorate of Food, Road and Rural Infrastructure
DPR	Department of Petroleum Resources
DRG	Digital Raster Graphic

dbh	Diameter at Breast Height
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental Social Management System
EIA	Environmental Impact Assessment
ECN	Energy Commission of Nigeria
EMF	Electromagnetic Force
EPC	Engineering Procurement Construction
ELF	Extremely Low Frequency
EMP	Environmental Management Plan
EC	Electrical Conductivity
EC	Electrical Conductivity
EHS	Environment, Health and Safety
FMEnv	Federal Ministry of Environment
FEPA	Federal Environmental Protection Agency
FGD	Focus Group Discussions
Fe	Iron
FAO	Food and Agricultural Organization
FRIN	Forestry Research Institute of Nigeria
FS	Fine Sand
GCNL	Godirra Chemicals Nigeria Limited
GHG	Greenhouse Gases Emissions
GW	Ground Water
GEMS	Global Environmental Monitoring system
GPS	Global Positioning System
HSE	Health Safety and Environment
HI	Hanna Instrument
HAZID	Hazard Identification and Inventorization
HEMP	Hazards and Effects Management process
HUF	Hydrocarbon Utilizing Fungi
HUB	Hydrocarbon Utilising Bacterial
HND	Higher National Diploma
HIV	Human Immunodeficiency Virus
H_2S	Hydrogen Sulphide
Hg	Mercury
ha	Hectare
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICCL	International Cement Company Limited
IEC	International Electrotechnical Commission
ITD	Inter Tropical Discontinuity
ISO	International Organization for standardization
IFC	International Finance Corporation

IUCN	International Union of Conservation of Nature and Nurture
ITCZ	Inter Tropical Convergence Zone
ILO	International Labour Organizations
IPP	Independent Power Project
JICA	Japan International Cooperation Agency
km	kilometre
Kmsq	Kilometre Square
kV/m	kilo volt per meter
KHz	Kilo Hertz
L	Liter
LRS	Line Route Study
LGAs	Local Government Areas
LILO	Loop-In-and-Loop-Out
MOU	memorandum of understanding
MD	Managing Director
MC	multi-circuits
mEq	Milliequivalent
mm	millimeter
mg/kg	milligram per kilogram
m/s	meter per second
MS	Medium Sand
m^2	meter square
MHz	MegaHertz
mg/L	milligram per liter
NERC	Nigerian Electricity Regulatory Commission
NESREA	National Environmental Standards & Regulations Enforcement Agency
NBET	Nigerian Bulk Electricity Trading
NSCDC	Nigeria Security and Civil Defence Corps
NIMET	Nigerian Meteorological Agency
ND*	Not Determined
NS	Not Stated
ND	Not Detected
NA	Not Applicable
NSDW	Nigeria Standard for Drinking Water
Ni	Nickel
NTU	Nephemetric Turbidity Unit
NGO	Non-Governmental Organization
NIPP	National Integrated Power Project
NO_2	Nitrogen (IV) Oxide
NO	Nitrogen II Oxide
NO_X	Oxide of Nitrogen
NURTW	National Union or Road Transport Workers

OP	Operational Policies
OFGW	Optical Fibre Ground Wire
OGEPA	Ogun Environmental Protection Agency
OPGW	Optical Ground Wire
OSEMA	Ogun State Emergency Management Agency
OGSME	Ogun State Ministry of Environment
OGSG	Ogun State Government.
O&M	Operation and Maintenance.
^{o}C	degree Celsius.
Ωm	ohm meter
PHCN	Power Holding Company of Nigeria
PIU	Project Implementation Unit
PCR	Physical Cultural Resources
PAH	Poly Aromatic Hydrocarbon
PM	Particulate Matter
PSD	Particle Size Distribution
PAPs	Project Affected Persons
Pb	Lead
PPE	Personal Protective Equipment
PCBs	Poly chloroBiphynol
PLS-CADD	Power Line Systems Computer
ppm	Part Per Million
QHSE	Quality Health Safety and Environment
QC	Quality Control
RAP	Resettlement Action Plan
REA	Rural Electrification Agency
ROW	Right of Way
RIV	Radio Influence Voltage
SCADA	Supervisory Control and Data Acquisition
SC	Single-circuit
SEP	Stakeholder Engagement Plan
SPM	Suspended Particulate Matter
SMCL	Secondary Maximum Containment Level
SP	Species
SS	Sample Station
SW	Surface Water
SD	Standard Deviation
SD	Sediment
SO_2	Sulphur (iv) Oxide
SF_6	Sulphur Hexafluoride
SO_4^{2-}	Tetra oxo sulphate (vi) acid
SPL	Sound Pressure Level

SFDCC	Strategic Framework for Development and Climate Change
STD	Sexually transmitted diseases
TCN	Transmission Company of Nigeria
TDP	Titled Deed Plan
ToR	Terms of Reference
TL	Transmission Line
TMP	Traffic Management Plan
THC	Total Hydrocarbon Content
TLROW	Transmission Line Right of Way
TDS	Total Dissolved Solid
TSP	Total Suspended Particulate
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solid
TROBIT	Tropical Biome in Transition
TBA	Traditional Birth Attendants
THB	Total Heterotrophic Bacteria
THF	Total Heterotrophic Fungi
UNFCCC	United Nation Framework Convention on Climate Change
UN	United Nations
UNICEF	United Nation International Children Emergency Fund
UNESCO	United Nations Scientific and Cultural Organization
UNEP	United Nation Environmental Programme
USDA	United States Department of Agriculture
URTI	Urinary tract Infection
UV	Ultra Violet
µPa	Micro Pascal
µS/cm	Micro Second per Centimeter
$\mu g/m^3$	Micro Second per Meter Cube
VOCs	Volatile Organic Compounds
VES	Vertical Electrical Sounding
VCS	Very Coarse Sand
VFS	Very Fine Sand
WGB	World Bank Group
WHO	World Health Organization
4WD	Four Wheel Drive
Zn	Zinc

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EXECUTIVE SUMMARY

Project Background

Nigeria has realized strong economic growth, until 2016 when the economy went into recession. However, stronger growth is projected for the future due the new anti-corruption posture of the Government as well as economic policies targeted at reducing capital flight. Meanwhile, power supply capacity is overwhelmingly insufficient. As a countermeasure of serious power shortage, Transmission Company of Nigeria (TCN) planned a project geared to achieving transmission capacity of 20,000 MW by 2020 in accordance with growth of generation capacity.

Presently, the transmission lines to the largest demand centre of Lagos are in a bottleneck situation so the generating capacities being built across the country cannot be fully utilized. Moreover, there are no detour routes for use when equipment failure occurs, and the system reliability is low.

The Lagos and Ogun States is targeted at improving power supply to Lagos and Ogun States, in line with the Transmission Lines network capacity development of achieving transmission capacity of 20,000 MW by 2020.This transmission line project in Lagos and Ogun States ("Lagos and Ogun States Transmission Project" or "the entire project") is to be financed through a loan (Japanese ODA loan) from Japan International Cooperation Agency (JICA). The Transmission Company of Nigeria (TCN) is the implementing agency and owners of the project when completed. This entire project plans reinforcement of transmission capacity, improvement of credibility of electricity supply and reduced electricity loss by installing transmission systems in southwest area Nigeria. It contributes acceleration of economy and development of the communities.

The entire project consists of about 203km high voltage transmission lines and 5 high voltage substations. For the purpose of ESIA and RAP study, the entire project is divided into 3 sections, Lot1, Lot 2 and Lot 3. Transmission Company of Nigeria (TCN) has mandated the Godirra Chemicals Nigeria Limited (GCNL) to conduct Line Route Study, Environmental and Social Impact Assessment (ESIA), Environmental and Social Management Plan (ESMP) and Resettlement Action Plan (RAP) for Lot 1 of the project (hereinafter "the project" or "proposed project") consisting of the following components as described in the TOR;

- Ejio (Arigbajo) – New Abeokuta 132kV D/C Transmission Line (35.38km).
- Olorunsogo – Ejio (Arigbajo) 330kV D/C Transmission Line (12.5km).
- Ejio (Arigbajo) – Ikeja West /Osogbo 330kV D/C Turn in-out (6.94km) at Sojuolu.

This type of project must undergo an environmental and social impact assessment as required by the EIA Act No. 86 of 1992. And in conformance with Nigerian legislations, JICA guidelines for environmental and social considerations, the World Bank environmental and social safeguard policies and International best practices, the project is subjected to a complete environmental study, along with RAP and an Environmental and Social Management Plan

(ESMP). The present document is the ESIA report of the Lagos and Ogun States Transmission Projects (Lot 1).

The Proponent

Transmission Company of Nigeria (TCN), wholly owned by the Federal Government of Nigeria was incorporated in November 2005, emerging 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 has eight Transmission Regions and a National Control Centre (NCC). Each of these is headed by a General Manager (Transmission), who is responsible for the running and maintenance of transmission and transformation facilities in their areas of operation. The Transmission Regions are Lagos, Osogbo, Kaduna, Bauchi, Benin. Shiroro, Enugu and Port Harcourt and the National Control Centre (NCC) located at Osogbo.

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 by the Nigerian Electricity Regulatory Commission (NERC) to carry out electricity transmission, system operation and electricity trading which is ring fenced.

Project Location

This is a linear project crossing three LGAs of Ogun State (Ewekoro, Ifo and ObafemiOwode). It consist of two 330Kv and one 132Kv lines; from Ejio to Olorunsogo, Ejio to Sojuolu and Ejio to New Abeokuta respectively. The substations are located at Ejio (proposed 330/132/33kV substation) in Ewekoro LGA and Kobape (existing 132/33kV substation) in ObafemiOwode LGA.

Policy, Legal and Institutional Framework

Section 20 of the constitution of Nigeria (1999), makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria. And Section 12 establishes, though impliedly, that international treaties (including environmental treaties) ratified by the National Assembly should be implemented as law in Nigeria. Furthermore, Sections 33 and 34 which guarantee fundamental human rights to life and human dignity, respectively, have also been argued to be linked to the need for a healthy and safe environment to give these rights effect.

National Environmental Policy

The policy specify 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.

National Energy Policy

The National Energy Policy seek to ensure the development of the nation's energy resources, with diversified energy resources options, for the achievement of national energy security and an efficient energy delivery system with an optimal energy resource mix.

National Land Policy

The legal basis for land acquisition and resettlement in Nigeria is the Land Use Act of 1978, modified in 1990. According to the act, all land in Nigeria is vested in the Governor of each State, to be held in trust for the use and common benefit of all people.
The administration of urban land is directly under the control and management of the Governor; whereas non – urban land is under the control and management of the Local Government Area. The Governor had the right to grant statutory rights of occupancy to land. Local Government has the right to grant customary rights of occupancy.

The Land Act gives government the right to acquire land by revoking statutory and customary rights to land for the overriding public interest. In doing so, the act specifies that the state or local government should pay compensation to the current holder or occupier with equal value. The act also requires the state or local government to provide alternative land for affected people who will lose farmlands and alternative residential plots for people who will lose their house.

Social Protection Policies

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

This is project will require land for the new substations as well as right of way for establishing the transmission lines. And this shall be done in compliance with this policy and the Land Use Act.

The Environmental Impact Assessment (EIA) Act Cap E12 LFN, 2004

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 effect on the environment. The Act sets the EIA objectives and the procedures for consideration of EIA of certain public or private projects.

This project is a major development, which is expected to have some impacts on the environment. Hence, full compliance with the EIA Act is required. The EIA guidelines (procedural and sectorial) issued by the FMEnv drives from this Act and the project proponents shall conduct their activities in conformance with these guidelines.

Land Use Act of 1978

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

- The Act vest every parcel of Land, in every State of the Federation, in the Executive Governor of the State. He holds such parcels of land in trust for the people and government of the State.
- All land irrespective of the category belongs to the State while individuals only enjoy a right of occupancy as contained in the Certificate of Occupancy up to the limit of 99 years.
- The administration of the urban land is vested in the Governor, while rural land is vested in the Local Government Councils.
- The Local Government Councils may grant customary rights of Occupancy for residential and other purposes, up to a limit of 500 hectares for agricultural purposes and 5,000 for grazing except with the consent of the Governor.
- The State is required to establish an administrative system for the revocation of the rights of occupancy, and payment of compensation for the affected parties.
- The holder or occupier of such revoked land is to be entitled to the value of the unexhausted development as at the date of revocation.
- A set of guideline was provided in the act on how to determine the amount of compensation.

Electric Power Sector Reform Act No. 6, 2005

The Act established the Nigerian Electricity Regulatory Commission (NERC) as an independent regulatory agency. NERC was inaugurated in October 2005, and is mandated to carry out:

- The monitoring and regulation of the electricity industry
- Issuance of licenses to market participants, and
- Ensure compliance with market rules and operating guidelines.

This Act also deals with acquisition of land and access rights. Section 77 of the Act empowers the NERC to make a declaration that land is required by a license for purpose of generation or distribution of electricity. Section 77 (9) states: "where the President issues a notice under sub-section 6, the Governor shall in accordance with the provisions of section 28(4) of the Land Use Act, revoke the existing right of occupancy respecting the land and grant a certificate of occupancy in favour of the concerned licensee in respect of the land identified by the commission in such notice who shall be entitled to claim compensation in accordance with the provisions of the Land Use Act".

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 repealed 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.

This project will comply with NESREA regulations, including conducting ESIA, environmental audit every three years after commissioning, obtain permit before disposing hazardous wastes, etc.

Other National Laws

Other National Laws Relevant to the project includes the following;

- The Nigerian Urban and Regional Planning Act CAP N138, LFN 2004; contain requirements for development planning
- Harmful Waste (Special Criminal Provisions) ACT CAP H1, LFN 2004; prohibits dumping of harmful wastes within Nigeria
- The Endangered Species Act, CAP E9, LFN 2004; protects endangered species.
- The Factories Act, 1987 (Factory Act cap 126, LFN, 1990); contain labour requirements, including occupational health, and similar matters.
- Labour Act - CAP. L1 L.F.N. 2004; specify requirements relevant to labour issues, including wages, recruitment, discipline, employee welfare, employment of women and child labour.
- Wages Board and Industrial Council Act, 1974; established the National Wages Board and Area Minimum Wages Committee for States and for Joint Industrial Councils for particular industries, which determines minimum wages.
- Workers' Compensation Act, 1987; provisions for the payment of compensation to workmen for injuries suffered in the course of their employment and compulsory insurance covers employees of all categories
- National Environmental Regulations established by NESREA based on Section 34 of the NESREA Act, 2007. Those relevant to this project include Effluent Limitations, management of Solid and Hazardous Waste and Pollution Abatement in Industries Generating Wastes.

The EIA Process in Nigeria

The Federal Ministry of Environment (FMEnv) developed procedural guideline as well as sectorial guideline for conducting ESIA in Nigeria in accordance with the EIA Act. The following steps sequentially summarises the entire process.

1. Project Initiation
2. Prepare/submit Project proposal
3. Screening
4. Scoping process
5. Site Verification/TOR approval
6. Conducting the study and submit reports to the Ministry
7. Review process, including public display and public hearing
8. Approval of the project or otherwise
9. Project commencement
10. Impact mitigation monitoring
11. ESIA certification

International Conventions

The international conventions, to which Nigeria is a signatory, relevant to this project are as follows:

- African Convention on the Conservation of Nature and Natural Resources
- Convention on Biological Diversity
- Endangered Species (Control of International Trade and Traffic)
- Conservation of Migratory Species of Wild Animals (1973)
- Convention to Combat Desertification (1994)
- United Nation Framework Convention on Climate Change (UNFCCC) 1992.
- International Union for Conservation of Nature and National Resources (IUCN) Guideline, 1996.
- The African Convention on the Conservation of Nature and Natural Resources, 1968.
- Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)
- Human and Peoples' Rights on the Rights of Women in Africa in 2005
- Civil and Political Rights Covenant
- Economic, Social and Cultural Rights Covenant
- Convention on the Elimination of All Forms of Violence Against Women
- Convention on the Rights of the Child
- ILO Occupational Safety and Health Convention, 1981
- ILO Conventions and Core Labour Standards

JICA Guidelines for Environmental and Social Considerations

The objectives of the guidelines are to encourage Project proponents etc. to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents etc., in order to facilitate the achievement of these objectives. In doing so, JICA endeavours to ensure transparency, predictability, and accountability in its support for and examination of environmental and social considerations.

World Bank Safeguard Policies

The World Bank environmental and social safeguard policies include both Operational Policies (OP) and Bank Procedures (BP). Safeguard policies are designed to protect environment and society against potential negative effects of projects, plans, programs and policies. JICA has adopted the World Bank safeguard policies for this project.

The following policies apply to the project

- OP 4.01 Environnemental Assessment; Ensure proposed projects are environmentally and socially sound and sustainable
- OP 4.04 Natural Habitats; Ensure sustainability of services and products which natural habitats provide to human society
- OP 4.11 Physical Cultural Resources; Physical Cultural Resources (PCR) are identified and protected in World Bank financed projects. Implemented as an element in ESIA.
- World Bank policy regarding cultural property is not to finance projects that would significantly damage non-replicable cultural property
- OP 4.12 Involuntary Resettlement; Minimize displacement and treat resettlement as a development program
- OP 4.10 Indigenous Peoples (IP), To foster full respect for human rights, economies, and cultures of IP (distinct, vulnerable, social, and cultural group attached to geographically distinct habitats or historical territories, with separate culture than the project area, and usually different language)
- OP13.60 Monitoring and Evaluation

IFC Performance Standards for Investment

The Eight Performance Standards established by IFC for the life of an investment include:

Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts

Performance Standard 2: Labour and Working Conditions

Performance Standard 3: Resource Efficiency and Pollution Prevention

Performance Standard 4: Community Health, Safety, and Security

Performance Standard 5: Land Acquisition and Involuntary Resettlement

Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Performance Standard 7: Indigenous Peoples
Performance Standard 8: Cultural Heritage

TCN's HSE Policy

The TCN HSE policy is to ensure safety and health of workers and other persons relevant to its project as well as protecting the environment. The key objectives are as follows;

- Improve Project Safety, health, security, environmental protection/performance, particularly during construction
- Assure Project Quality and Reduce Project Life-Cycle Costs
- Reduce Project Schedules
- Properly plan logistics to ensure minimum rework caused by poor engineering/construction coordination
- Properly plan the contracting and procurement activities while supporting field construction requirements to ensure the reduced schedule and cost impacts are realized.
- Enhance Management of Risk
- Involve local communities in the construction process
- Foster an effective relationship with communities.

Gap Analysis: Nigerian EIA Act. 86 vs World Bank OP 4.01

Regarding legislative and institutional arrangement for EIA in general there is no difference in categorization, details of EIA study and EIA report, public participation, and information disclosure between the JICA Guidelines and Nigerian laws and regulations. On the other hand, the difference to be considered is that environmental items of social environment such as gender, children's right, local conflict of interests, misdistribution of benefit and damage are not included in laws and regulations related to public participation and information disclosure.

ESIA Terms of Reference

In line with the Nigeria's EIA procedural guidelines (FEPA, 1995), the Terms of Reference (ToR) for the ESIA of the proposed project approved by the FMEnv's had the following objectives:

- Define the relevant framework of legal and administrative requirements for EIA of the proposed project;
- Outline the general scope of the ESIA study including the overall data requirements on the proposed project and affected environment; and.
- Define the procedures and protocols for identification and assessment of associated and potential impacts and for selecting appropriate prevention, reduction, and control as well as enhancement measures for such impacts; and eventually developing an effective Environmental and Social Management Plan (ESMP) for the project.

Project Justification

Lagos and Ogun State to a certain extent are industrial nerve centers of Nigeria. Hence, account for significant proportion of load demand from the national grid. The new power plants in the South normally transmit to the North through the areas of highest demand (Lagos). And presently the transmission system around the area has limited capacity as a result they constitute bottlenecks. Hence, the need to expand the network to improve stability and reliability.

Envisaged Sustainability

The important factors considered to reach project sustainability include – technical, economic, environmental and social. They are related to practical aspects related to economic profitability, technical resources, and all, with an efficient management. With the growth in electricity demand that has occurred over the last decades, adequate and reliable energy supplies are important to economic development. Additional energy resources, including electricity generation and share, as well as infrastructure improvements are major aspects.

Analysis of Project Alternatives

Three options were considered; the first project option was the 'do-nothing' option. This option would result in in the continuation of the shortage of electricity supply, which has also been inefficient, inadequate, and unreliable. The use of domestic and industrial generators to power homes, offices and industries will escalate. And this will result in increased gaseous emissions with its associated health effects as well as increased greenhouse gas effects. Furthermore, economic growth will be stifled.

The second option was todelay Project Option and this would arise if a situation of civil unrest or public opinion is against the development, or the socio-economic and cultural impacts of the project are not favourable, given available mitigation options. This would mean that all planning and development activities would be stalled until conditions are more favourable and will lead to delayed more reliable electricity and slow down investments in generation plants, since power evacuation is delayed.

The third option considered was the execution of the proposed project as planned. This option was accepted because it will de-bottleneck the grid around the largest demand center of Lagos and provide a more secure and reliable energy supply with all the benefits. The first two options were therefore rejected in favour of the third. The chosen option was subsequently subjected to various project alternatives, principally based on substation sites and technology; and transmission line routes and capacity selection and technology.

Multi-criteria analyses were used to analyse the alternative line routes, which took into consideration of the economic, technical, environmental and social criteria to arrive at the optimal alternative.

Project Description

The proposed Lagos and Ogun transmission line project for Lot 1 consist of 35.38km 132kV DC transmission line from the proposed Ejio 330/132/33kV substation to the New Abeokuta 132/33kV substation, 12.5km 330kV DC transmission line from Olorunsogo Substation to the proposed Ejio substation and, the turning in-and-out of Ikeja West to Osogbo 330kV SC transmission line through the proposed Ejiosubstation at a distance of 6.94km.

Project Phases and Activities

The project activity order for the proposed Power Transmission Lines is given below. It is anticipated that construction of the transmission line will commence in 2019 and take approximately 36 months to complete. This does not however show the interdependencies of the activities.

A. Phase I: Pre-construction

This phase will involve feasibility studies (line-route, environmental and social impact assessment, resettlement and compensation, front end engineering design, EPC contract award, mobilization, check survey of EPC contractor, impact mitigation monitoring, transmission line and substation detail design, material production (transformers and accessories, tower members, conductors, insulators, line hardware), material testing and shipment.

B. Phase II: Construction Phase

This will involve clearing and grubbing of site at substations and along transmission lines corridor, impact mitigation monitoring, foundations for tower installation and substation construction, tower erection, substation construction and installations, conductor stringing, impact mitigation monitoring, commissioning and testing, reinstating and clean up, demobilization, impact mitigation monitoring, ready for handing over

C. Phase III: Operations and Maintenance Phase

The operations and maintenance phase will involve power transmission, maintenance of TL maintenance of SS compliance monitoring, period environmental audit and periodic systems audit.

D. Phase IV: Decommissioning/Closure

This last phase comes at the end of project's lifespan and will involve in the minimum, decommissioning audit, dismantling and removal of structures, site restoration.

Transportation

Transportation requirements during the construction period will vary per the work required at each tower site. For new structures, the vehicles likely to be used are articulated truck for steel sections and transformers delivery from Lagos (Tin Can or Apapa port where these offshore components of the required materials will be shipped through; non-articulated flatbed truck; concrete truck; track or 4WD mounted drill rig; crane; bulldozer/grader/excavator/backhoe; 4WD vehicles; elevated work platform; and brake and winch truck

Line Route Right-of-Way

A 50m width clearance for 330kV line and 30m width of right of way for 132kV line projects is allowed for Nigeria standard. The transmission line ROW acquired for this project is:

i. For 330kV Line (Ejio-Olorunsogo): $12.5 \times 1000 \times 50 = 625{,}000m^2$ (62.5 ha)
ii. For 330kV Line (Ejio-IkejaWest Turn in-turn out): $6.94 \times 1000 \times 50 = 347{,}000m^2$ (34.7 ha)
iii. For 132kV Line (Ejio-New Abeokuta): $35.38 \times 1000 \times 30 = 1{,}061{,}400m^2$ (106.14ha)

Giving a total of 2,033,400 m^2 = 203.34 hectares

Workforce and Hours of Operation

Labour requirements for this project will generally be a maximum of 32, comprising approximately 10 on access track and foundation work, 10 on structure erection and 12 on stringing work, with a number of others engaged on miscellaneous other activities.

Due to the nature of activities to be undertaken, most of the construction program will include work that will be done at night time and weekend periods as required.

Clean-Up and Final Inspection

The following steps will be taken to clean up the construction sites and conduct final inspection, preparatory to commissioning:
On completion of works, the concrete shall be thoroughly cleaned.
All packing and surplus materials from site and all rubbish and waste shall be removed as well as trees from transmission line right of way and access roads.
Required burning permits shall be obtained, to comply with government regulations.
There shall be no disposal of rubbish, waste or any debris in rivers and do not pile such materials in stream beds, river terraces, or any unauthorized place.
All irrigation facilities if any,shall be restored to the condition existing before arrival on site.
Natural drainage in areas where temporary facilities have been made for construction purposes shall be restored.
Any fences, gates, etc., which have been damaged during construction shall be restored.
Access roads shall be restored to their original conditions.

Operations and Maintenance of the Transmission Line

TCNshall be responsible for the maintenance of the proposed PTL. The maintenance process shall include:

Structure and Conductor Maintenance: upon completion of the transmission line, maintenance patrols will make periodic inspections of the structures, the easement and the conductor as well as line hardware, taking particular note of clearance conditions, damage to components or evidence of vandalism.

Easement Maintenance: As outlined in TCN Easement and Access Track Maintenance Policy maintenance of the transmission line easement is necessary to ensure that the safe electrical clearances are not infringed due to growth of vegetation.

Rehabilitation Program

Rehabilitation of work sites will be carried out as work proceeds and as soon as possible after the completion of work on each site. However, a rehabilitation plan shall be included in the project's ESMP.

Wastes Generation and Management

The list of envisaged project wastes and their potential sources:

i. Leaves, branches, trunks, grasses from the clearing of the vegetation along ROW and Substation spaces.
ii. Kitchen wastes from human feeding and activities involving many workforces.
iii. Scrap metals – from cuttings, fittings, pylon member, nuts, bolts, and welding etc.
iv. Concrete waste – from foundations and plinths, including housing complex and control room construction.
v. Nylons/Plastics – from human activities wrappings, water sachet, food etc.
vi. Oil spills from heavy duty machinery and equipment, transformers, breakers, and vehicle engines, either during normal runs of old machines or maintenance work.
vii. Human wastes – from activities of personnel involved in the work or secondary business group.
viii. Operational activities – nylons, paper materials/office, human waste etc.
Waste disposal methods will include:

a. solid waste (composting of biodegradables, selling metal, wood, and plastic scraps to buyers, reuse of materials e.g., packages, concrete, etc, dumping of remaining wastes at approved sites)
b. Liquid waste (sewage from site camps will be vacuum-sucked into septic tanked trucks and taken to any closest sewage treatment facility to the project location.
c. Spent oils generated during transformer fillings, retrofitting and maintenance work will be stored in oil trench and oil sump at the substations preparatory to evacuation by contractors licensed by the FMEnv for that purpose.

Project Schedule

TCN is strongly committed to the completion of the proposed PTLs, which have estimated life span of 50 years, and every effort is geared towards actualizing this goal. The proposed project construction commencement in 2019 and commissioning scheduled for 2022.

The primary project activities culminating in potential impacts considered in this assessment are:

- **Construction Phase**
  - Site preparation (resettlement and compensation, vegetation clearance, demolition of structures, earthworks, preparation of an access road in the RoW);
  - Transportation of construction material, establishment of a construction yard;
  - Assembly of machinery and equipment (towers, conductors, Transmission lines);
  - Use of natural resources (water, energy sources);
  - Disposal of waste materials (like eroded material) and wastewater; and
  - Non-routine events (e.g. spills, traffic accidents, occupational health & safety incidents).
- **Operation Phase**
  - Operation of the transmission line;
  - Routine maintenance of towers, conductions and lines; and
  - Non-routine events (e.g. tower collapse, line snapping, fire)
- **Decommissioning Phase**

Dismantling, demolition and abandonment of transmission line structures and gadgets.
The environmental indicators, receptors or resources affected by potential impacts that were considered: Biophysical Environment, Air quality; Noise, vibration & EMF; Soils and geology; Water resources; Terrestrial ecology. Human environment -: Visual amenities; Community level impacts; Community health, safety and security; Resettlement; Labour and working conditions; Infrastructure; Employment and economy; and Cultural Heritage.

Baseline Studies

Baseline field sampling/ studies of the components described; the physico-chemical environment (meteorology, geology, sediment/soil type and distribution, surface/groundwater characteristics), biological environment (location and distribution of benthos, plankton, fisheries, flora and fauna characteristics), as well as socio-economic and health conditions describing the demographic structure, culture, heritage sites, social and health status of the people and their environment was carried out between 18th and 23rd December, 2017.
This atmospheric conditions assessment, the measured meteorological parameters agree with the NIMET data in Ogun State.The results indicated that the project GHG assessment estimated amount of 2397.78 ktCO_2e is being anticipated. About 91.63% of the total figure is from the maintenance and operation phase.

Almost all the measured and extrapolated air quality parameters (NO_X, CO, SO_2 NH_3, VOCs, and PM) are within the known limits of both the Federal Ministry of Environment and that of the World Bank. Though Nigeria has no standard for PM_{10}, the calculated 24-hour concentrations from the 1-hour measured concentrations exceeded the World Bank limit of 80 $\mu g/m^3$in 57% of the sampling locations. Daily averaging concentration levels of TSP were within the FMEnv limit of 250 $\mu g/m^3$, but exceeded in AQ14. This is attributable to harmattan season and dust from vehicular movement and combustion sources in some locations The 10-minute noise measurements, at locations AQ1 – AQ14 with the minimum noise levels being 21.6 – 48.2 dB(A) and the maximum levels were of the range 46.6 – 81.2 dB(A).These minimum measured noise levels during the study were below both the sleep disturbance limit of 45 dB(A) and the WHO's limit of 55 dB(A) for ambient environment except for sampling point AQ14.

Regional geology showed that Ogun state comprises both sedimentary and basement formations as well as transitional zones. The assessment has revealed that there are no designated sites of geological importance within or adjacent to the site boundary. The proposed transmission lines will result in permanent alterations to the geology of the locations. However, the overall impact is considered to be negligible. The utilization of borrow pits and excavation of foundations could have adverse effects on the Local geological resource but the magnitude of this impact is considered to be negligible.

Based on this study, the proposed areas are suitable for transmission lines and associated substation installation. However, caution should be exercised during transmission line and associated substation installation so as to prevent hazards.

Groundwater results showed conformity with previous studies and regulatory standards (FMEnv. and WHO standards). Hydrocarbon analysis result indicated that ground water is not polluted.

A total of twenty (20 No) surface water samples were collected from identified eight (8No) streams/rivers along the transmission line. These include Osun Stream at Iludun, Osun stream at Abese, River Wagunu at Soderu, River Wagunu at Adubiaro,Sowunmi Stream, River Odoipa, Ogun River and Ototo Stream. Result of analysis indicated that the physico-chemical and hydrocarbon characteristics of the water bodies compared well with previous studies report and regulatory limits.

The flora and fauna species in the study location do not fall within IUCN Red lists of endangered; only *Albiziaferruginea, Terminaliaivorensis*and *Diospyrosbarteri*flora species were vulnerable and this does not have much impact on the flora and fauna diversities in the area. Therefore the location of Power line Project in the study area will create little or no impact on flora and fauna in the vegetation belt of the project.

The study area is rich in hydrobiological species such as zooplankton, phytoplankton and fishery resources. The fish composition of the project area include*Parachannaobscura, Tilapia spp, Malapteruruselectricus, Hepsetusodoe, and Clariasgariepinus.* Secondary data from the research work Adeosun (2012) and Odulate (unpublished) in Ogun river showed that *Chrysichthysnigrodigitatus,Coptodonzillii,Tilapia mariae, Mormyrusrume, Clariasgariepinus,Distichodusengycephalus* are also present in Ogunriver.

Bush bucks, Hare and Grass cutter, were the most abundant of all the mammals found. Other mammals found include: Mona monkey, Palm squirrel, Fruit bat, Forest Genet, but in low number.

Birds recorded include wood pecker, Morning dove, Cattle egret, Glossy sterlon, Senegal coucal, Village weavers. Other species include: lizard buzzard, Senegal parrot, Orange checked watbill and Willow wabler. Most of these species are classified as least concerned and are not threatened by the proposed project directly

The Social and Health determinants assessed include community social structure and status, occupation and levels of income, infrastructural facilities conditions, social habits and life style, religion and culture, cleanliness and hygiene, current prevalent diseases, health facilities, nutritional status and general environmental living conditions. A total of sixty five (65) communities located in three local government areas (Ifo, Ewekoro and ObafemiOwode LGAs) were studied.

Stakeholders' engagement and consultations were carried out to ensure community acceptability of the project.They were planned according to key stages, or decision moments, throughout the study where the informed participation of stakeholders were likely to make the most significant contribution to the on-going analysis.

Ethnic Composition

The 65 communities studied belong to the Yoruba ethnic group and speak the Yoruba language with the Egba dialect. Other ethnic groups were observed to be present within the project area. These ethnic groups are Yoruba,Egun, Igede,Ogoja, Aja, Itori, Ibo and Hausa.

Religion

The inhabitants in all the communities of study practice three religions namely Christianity, Islam (Muslim religion) and Traditional religion. In some communities Christianity is dominant while in others Islam is dominant. On the average only about 10% are the traditional religion worshippers in all the communities studied.

Traditional style

All the communities studied claimed that their ancestors migrated from Abeokuta in Ogun State to settle in their present day communities. They claimed that their forefathers were great farmers and till date farming is still their main occupation.

The major festivals of the communities is the New Yam Festival whereby they celebrate the harvest and the dawn of new farming year. The other major festivals are the worshipping of their gods at their various shrines.

Occupation

The major occupations of the people of the communities are farming (75%), trading (50%), fishing (40%), hunting (20%) labourers (10%) and others e.g. civil servants, skilled workers etc. (10%).Among the farmers, common crops grown are cassava, yams, cocoyam plantain/Banana, vegetables maize, rice and beans.

Industry

Olorunsogo Power Plant Phase 1 at Olorunsogo managed by Pacific Energy Company Limited, Olorunsogo Power Plant Phase II at Olorunsogo, Lafarge Cement Company Limitedat Olorunsogocommunity and Ice block fabrication industry at Abese are the most known industries in the area. However,cassava processing industries, oil palm processing industries, building block industries, pure water industries and bakeries are also present.

Income

The average monthly income in the communities was very poor and most people earned below ₦20,000 monthly. The breakdown of the income levels from respondents was as follows: Less than ₦10,000 per month (20%): ₦10,000 to ₦19,999 (50%): ₦20,000 to ₦29,999 (20%), and ₦30,000and above (10%).

Educational Level

The Educational status showed that about 70% of respondents have had at least primary education and can speak (i.e. communicate orally) as well as read and write using English Language.Those with no formal education is 30%.

Educational facility

Most communities do not have schools. A few have only the primary school while the secondary schools are even fewer.There are no tertiary institutions.

Water

Inhabitants of the impacted community obtain water from rivers, streams and wells (95%) while only about 5% use borehole water provided by some individuals (i.e. private boreholes).

Health care facility

There are few Primary Health Care Centre and private clinics. The private clinics are usually too expensive for the masses. There are also said to be a very few herbalists and Traditional Birth Attendants (TBA) in the communities.

Adult Health Problems

The common health problems identified among the adult population were malaria (36%), Gastroenteritis (32%). Dysentery/diarrhea (30%), Body pains/ Rheumatism (30%), Sores/injuries (23%) and Cough/URTI (22%).

Children Health Problems
Among the children the most common health problems were also malaria (20%), Dysentery/Diarrhoea (18%) Gastroenteritis (14%) worm infestation (14%) and cough (10%).

Impact Assessment and Mitigation
The potential and associated impacts of the proposed Transmission Line project have been identified and evaluated using standard proceduressuch as source reference materials: project environment baseline data, FMEnv. EIAsectorial guidelines for power transmission line projects, World Bank/IFC environmental assessment sourcebook/guidelines, etc. A summary of mitigation measures on various activities involved in the project development and the significant impacts associated with each of them on the environment and social concern at the Construction and Operation phase respectively Table E1 and E2.

Table E1: Environmental and Social Management and Mitigation Measure (Construction Phase)

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
Air quality	Localized impairment of air quality by exhaust emissions from vehicles and equipment engines (SO_2, CO, NO_x, CO_2, PM)	Affected communities in area of influence	×	×	Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations Stationary generators to be located to facilitate dispersion
	Elevated dust levels due to vehicle movements, wind, and handling of dusty material	Affected communities in area of influence	×	×	Cover properly loose materials and keep top layers moist Regular cleaning of equipment, drains and roads to avoid excessive buildup of dirt Spray surfaces prior to excavation Use covered trucks for the transportation of materials that release dust emissions Speed limits on-site of 15kph on unhardened roads and surfaces

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
Climate change	GHG emissions that could add to climate change effects	Global warming	×	×	Maintain and operate all vehicles and equipment engines in accordance with manufacturers specifications, location of stationary generators to facilitate dispersion, restriction of vegetation clearing to only the required area
Noise, vibration	Nuisance noise from construction activities	Affected communities in area of influence Construction workers	×	×	Select 'low noise' equipment or methods of work Use temporary noise barriers for equipment (e.g. sound proofing walls around stationary power generating sources). Maintain and operate all vehicles and equipment's in accordance with manufacturers recommendations Ensure periods of respite are provided in the case of unavoidable maximum noise level events Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the responsible person. Noisy activities (activities that can be heard in nearby communities) restricted to day-time working hours Provide appropriate PPE to construction workers and visitors

Indicator	Potential impact	Receptor	Project Component: Transmission Line	Project Component: Sub-station	Mitigation or enhancement measures
Soils, geology and land-use	Change to soil structure (erosion and compaction) as a result of excavation and backfilling and removal of vegetation	Soil on construction site	×	×	Construction of foundations to be undertaken in the dry period as reasonable as possible. Protect excavated soil materials from erosion (e.g. store the excavated soil at the location which is not affected by rain runoff). Ensure that the land is physically restored (include revegetation where possible) before leaving to next tower location and before the next rainy season. Use of existing road for transport of man and material to the extent possible.
	Potential contamination of soil from inadvertent release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, etc)	Soil on construction site, especially by each tower	×	×	Implement effective site drainage on the construction yard to allow for the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas. Install oil/water separators and silt traps before effluent, leaves the site. Minimise bare ground and stockpiles to avoid silt runoff. Bunding of areas where hazardous substances are stored (eg fuel, waste areas). Regular checking and maintenance of all plant and

Indicator	Potential impact	Receptor	Project Component: Transmission Line	Project Component: Sub-station	Mitigation or enhancement measures
					equipment to minimize the risk of fuel or lubricant leakages. Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques. Set-up and apply procedure regarding dealing with contaminated soils. Development and implementation of a Waste Management Plan to ensure that waste is disposed of correctly. Spread sheet underneath the tower structure prior to start any painting activity.
Water resources	Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater	Local groundwater-well and bore hole	×	×	See above measures to mitigate 'Potential contamination of soil' impact
	Potential impact on hydrological condition due to the construction activities including the construction of foundation as well as the access road within the swampy area.	Rivers and streams crossed	×		Natural flow of a River shall not be blocked Based on an appropriate project design, avoid erecting towers within wetlands. If unavoidable, select the most optimized site for each tower considering human uses and areas of higher ecological integrity. Prohibit construction of permanent access roads along river banks, in swamps or in areas

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
					where soils are saturated Consider and Select the engineering design for construction work, including construction of foundation as well as access road, which would minimize the impact on hydrological condition.
Terrestrial ecology	Vegetation loss and disturbance to habitats, fauna and flora by construction activities	Flora and fauna and habitat in the area of influence Flora and fauna and habitat in the area of influence	×	×	Minimize the construction of new access roads. Promote the use of existing access roads for machinery and vehicle movements. Promote the use of existing roads for transporting material and tower parts to the construction sites in order to reduce the project's footprint and minimize the need for new access roads Herbicides should not be used for vegetation clearing Clearing should be minimised and restricted to the area required for construction purposes only and disturbance to adjacent vegetation communities and/or remnant trees within the corridor should be strictly controlled. Revegetation will be carried out, as necessary. Revegetation will use species locally native to the site. The site of revegetation shall be identified and provided by the relevant government agency.

Indicator	Potential impact	Receptor	Project Component: Transmission Line	Project Component: Sub-station	Mitigation or enhancement measures
	Vegetation clearing will cause habitat disturbances that could create suitable conditions for invasive species to spread	Flora and fauna and habitat in the area of influence	×		Implementation of the invasive species management plan as part of the Vegetation Management Plan.
	Potential avian collision	Birds in the area of influence	×	×	Consult with relevant agency (e.g local NGO) to seek any advice for mitigation measures to be considered for the design and construction of the transmission line. "Bird diverters" on the top (ground) wire to make the lines more visible to birds shall be installed. Complete tree and/or brush cutting prior to or after the core nesting season
	Loss of species that offer Provisioning Services	Local communities who rely on provisioning service, especially around swampy area.	×		Site clearance activities to be restricted to the minimum required area Provide a training/education for the sustainable livelihood practice to local communities, as necessary, with cooperation of relevant agency.
Aquatic ecology	Loss/disturbance of aquatic species	Rivers/streams /Swampy area crossed	×		Natural flow of a River shall not be blocked Conduct activities during the dry period to minimize disturbance of sensitive shoreline and wetland

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
					areas Adjust pylon siting to span rivers and wetlands areas, or limit equipment access in wetlands, wherever possible. Perform all vegetation clearing work manually along streams/rivers and swamps. Avoid vegetation clearing along stream shores and on steep slopes. Based on an appropriate project design, avoid erecting towers within wetlands. If unavoidable, select the most optimized site for each tower considering human uses and areas of higher ecological integrity. Prohibit construction of permanent access roads along river banks, in swamps or in areas where soils are saturated Dismantle temporary access roads built for construction phase in swamps and wetland areas. Perform this dismantlement during the dry season and dispose of materials outside wetland areas; Avoid equipment and vehicle movements in rivers, floodplains and wetland areas. If unavoidable, reduce access to a minimum length in wetlands and floodplains and select the most optimized site for the access considering human

Indicator	Potential impact	Receptor	Project Component: Transmission Line	Project Component: Sub-station	Mitigation or enhancement measures
					uses and areas of higher ecological integrity
Visual amenities	Temporary presence of an active construction site with storage of materials and equipment within the ROW and/or the site for the substation.	People living close to the construction sites.	×	×	Maintain construction site in orderly condition and do not distribute material over many sites before usage.
Land planning and use	Change in land use cause by land take for towers, vegetation clearance, and access restriction	Land on the RoW	×		Site clearance activities to be restricted to the minimum required area. Provision of predefined route, barriers or boundary markings to prevent incursion of machinery and workers into neighboring areas See below measures under 'Resettlement'
Stakeholder and Community expectation/ relations Management	Community concerns linked to impacts associated with construction phase issues (like air and dust emissions, traffic, influx and community safety/security, noise/vibration, etc) and adverse impact/inconveniencies resulting from it.	Affected communities in area of influence	×	×	Follow mitigation for construction phase air quality, water quality, noise and traffic. Inform communities about details of construction activities (e.g., employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by billboards, posters and community meeting Set-up and effectively monitor construction grievance redress mechanism Engage communities in the

Indicator	Potential impact	Receptor	Project Component: Transmission Line	Project Component: Sub-station	Mitigation or enhancement measures
					monitoring activities to enhance transparency and involvement.
Community Health, Safety and Security	Increased risks of traffic safety incidents on public roads	People living close to access roads and road users	×	×	Implement a traffic management plan including design of access point, signalization, speed limits, training of drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines), maintain log of traffic related incidents, sensitization of road users and people living close to the construction site.
	Temporary influx of outside workers in the communities, risking tensions between outside (partly possibly expatriate) labour and local population, due to differences in wealth and culture.	Affected communities in area of influence	×	×	Priority of employment shall be given to locals. A Local Content Plan should be prepared to facilitate involvement of local labour. Develop a code of behaviours for workers. All workers to receive training on community relations and code of behaviour. Periodic refreshing as needed based on community liaison/grievance mechanism feedback.
	Potential for increase in prevalence of sexually transmitted diseases in local communities and other diseases	Affected communities in area of influence	×	×	Do sensitization and awareness to all EPC workers regarding sexually transmitted diseases Provide Sexually transmitted disease awareness material to all EPC workers and host communities
Resettlement	Land acquisition	Affected properties and	×	×	Follow principles and procedures of Resettlement Action Plan

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
		livelihood			(RAP), including way forward, micro-plans per affected household.
Labour and working conditions	Exploitation of workers	Labour force	×	×	Develop transparent human resources policies and procedures for recruitment process, working conditions and Terms of Employment wages, worker-employer relations, Grievance Redress Mechanism, non-discrimination, monitoring, roles and responsibilities following Nigerian Labour Law and ILO conventions. Provide reasonable, and if applicable negotiated, working terms and conditions. Establish worker's grievance redress mechanism, so that potential conflicts can be dealt with in an early and proper way. No use of child labour (workers under age 18) or forced labour Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. Provide proper work place facilities for water/sanitation/rest rooms etc. A worker's grievance redress mechanism will be in place.
	Activities and staff at site may create	Workers and local	×	×	Liaise with community security structure

Indicator	Potential impact	Receptor	Project Component: Transmission Line	Project Component: Sub-station	Mitigation or enhancement measures
	security risk (e.g. infiltration of criminal)	communities			Provision of security during the construction work Make security plan and emergency response and contacts with security forces. Coordinate if applicable with TCN security measures for their site. Provide the identification tag for all workers and visitors.
	Creation of tension between security personel and local communities	Local communities	×	×	Provide the training and awareness to security personnel Establish the communication with local communities and awareness
	Risk of health & safety incidents amongst labour force, including minor incident's such as cuts and major incidents such as loss of life	Construction labour force	×	×	Develop project specific health and safety procedure, including provisions for training and certifications to be followed by all workers including subcontractors.
Employment and economy	Creation of temporary jobs for locals residents and Nigerian nationals with skilled trades	Local residents of affected communities and Nigerian nationals	×	×	Prepare a local content plan to enhance ability to locate local hires and Nigerian nationals. Include provisions for hiring women and youth and for "equal pay for work of equal value". A local hiring office (or offices) to be set-up for use by all contractors to advertise positions, receive applications, and provide guidance to applicants.
	Supply chain opportunities for Nigerian companies	Nigerian companies and	×	×	Prepare a local content plan to facilitate identification and selection of qualified local and

Indicator	Potential impact	Receptor	Project Component: Transmission Line	Project Component: Sub-station	Mitigation or enhancement measures
	that can provide goods and services needed by the company	local shops			Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities.
Infrastructure	Influx of outside workers may pose additional pressure on social infrastructure, like medical posts, emergency services, water supply, solid waste management	Affected communities in area of influence	×	×	Coordinate with medical posts and emergency services to prepare for water supply and waste management. Install proper and independent facilities at construction site for water supply, sanitation, solid and liquid waste, so that pressure on community infrastructure is limited.
Cultural heritage	shrines are located within the RoW along the transmission line and need to be relocated.	Affected cultural heritage	×		The shrines will be relocated to outside the RoW, where the local communities will continue to use them. The exact location and ceremony for relocation will be managed by the communities
	Potential interactions between construction works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities along the RoW and substation	×	×	Consult with local communities on festivals and potentials for interaction with construction works. If required cease works on the specific dates.

Table E2: Environmental and Social Management and Mitigation Measure (Operations Phase)

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
Air pollution / Climate Change:	Accidental significant leaks of SF6 from aging equipment, and gas losses occur during equipment maintenance and servicing	Air quality	×	×	Impact of SF6 shall be mitigated through the improvements in the leak rate of new equipment, refurbishing older equipment, and the use of more efficient operation and maintenance techniques.
Noise, vibration & EMF	Noise & EMF from overhead line due to Corona effect and EMF effect	Affected communities along the RoW and Substations	×	×	Avoiding over loading Transmission Lines Keep residences and other permanent structures such as schools, shops or offices out of the RoW to minimize exposure to Noise and EMFs.
Terrestrial ecology	Impairments of natural habitats and associated flora communities	Flora and fauna around the ROW	×		Maintain all maintenance work inside the footprint of RoW to reduce encroachment on natural habitats Clearly mark the extent of vegetation control in the ROW. Identify and mark the vegetation to be preserved along sections of the ROW Undertake selective control of the vegetation in order to keep low scrubby and herbaceous species that do not represent a risk for the powerline (species that cannot grow more than 4m in height) Use mechanical method for vegetation control inside the ROW.

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
					Forbid use of chemical pesticides to control vegetation in the ROW
		Bats and Birds in the area of influence	×		Schedule RoW maintenance activities to avoid breeding and nesting seasons of bird species with special status Develop and implement a mortality monitoring program, as necessary, with cooperation of local NGO.
	Potential Impact due to introduction of alien species	Flora and fauna around the ROW	×		Develop and implement vegetation management plan to control the introduction of alien species A monitoring program of invasive species propagation within the right-of-way should be instituted and, if present, shall be removed.
	Loss of species that offer Provisioning Services	Local communities who rely on provisioning service, especially around swampy area.	×		Undertake monitoring of natural resources exploitation and implement a sensitization program in order to educate and increase local communities' awareness on natural resources protection
Aquatic ecology	Degradation of aquatic species	River crossings along the ROW	×		Wastes shall not be disposed along water courses or sensitive areas. Existing access roads shall be utilized during maintenance of the ROW. Avoid equipment and vehicle movements in rivers, floodplains and wetland areas as reasonable as

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
					practicable. Forbid use of chemical pesticides to control vegetation in the ROW
Visual amenities	Transmission lines and towers will be visible from far and become an extrinsic element in the landscape.	Communities around the project area	×		Vegetation will be felled, but if possible smaller trees can be kept. .
Stakeholder and Community expectation/ relations Management	Management of Community concerns linked to impacts associated with operation phase issues	Affected communities in the area of influence	×	×	Set-up, manage and manage grievance redress mechanism Engage communities in the monitoring activities to enhance transparency and involvement. Prepare and implement Stakeholder Engagement Plan(SEP). Enhance ongoing consultations with local communities by TCN to create continuous dialogue, trust and planning of community development activities according to SEP. Explain effects of electromagnetic fields to communities to limit concerns. Keep fields within limits of International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
Community Health, Safety and Security	External safety risks of electrocutions, bush fires, line snapping, tower collapses	Affected communities along the RoW and substations	×	×	Develop an emergency response plan following TCN and international best practice including provisions for prevention and response to electrocution, fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with emergency services of LGAs Keep residences and other permanent structures such as schools, shops or offices out of the wayleave to minimize exposure to EMFs Communicate to communities in RoW the safety risks of the transmission lines and provide response measures. Put sign boards on towers about electrocution risk. Implement the anti-climbing device for on the Transmission Tower.
Labour and working conditions	Exploitation of workers	Labour force for maintenance work	×	×	Develop transparent human resources policies and procedures for recruitment process, working conditions and Terms of Employment wages, worker-employer relations, Grievance Redress Mechanism, non-discrimination, monitoring, roles and responsibilities following Nigerian Labour Law and ILO conventions. Provide reasonable, and if applicable negotiated, working terms and conditions. Establish worker's grievance mechanism, so that potential conflicts can be dealt with in an early and proper way.

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
					No use of child labour (workers under age 18) or forced labour. Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. A worker's grievance mechanism will be in place.
	Occupational H&S risks in operation and maintenance	Labour force	×	×	TCN should follow their Occupational HSE plan following Nigerian and international requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height and electrocution in maintenance and repair works, emergency prevention and management. Use personal protection equipment. Have medical emergency equipment at hand.
Employment and Economy	Improved electricity supply for the national grid, creating opportunities for businesses and economic development in the country.	National level Nigeria	×	×	Regular maintenance of the project to ensure reliable production of power
Cultural heritage	Potential interactions between maintenance works and cultural festivals due to traffic, noise and/or	Affected communities in the RoW	×		Consult with local communities on festivals and potentials for interaction with maintenance works. If required cease works on the specific dates.

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
	vibration impacts				

Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) has been developed to meet international standards on environmental and social management performance, specifically those set out by the World Bank, IFC and JICA Guidelines.

The plan details the mitigation and enhancement measures TCN have committed to implement through the life of the Project and includes desired outcomes; performance indicators; targets or acceptance criteria; monitoring and timing for actions and responsibilities (chapter seven of this report.

Decommissioning

The proposed transmission line project with the facilities and their ancillary installations is anticipated to be in operation for >25 years. Following the operational term of the project, a decision will be made by TCN the project proponent to decommission. The decommissioning will be done in accordance with a plan and TCN standard procedures that meet local regulatory requirements and international standards.

Conclusion

This ESIA has identified and assessed both positive and negative impacts of the proposed project and accordingly evaluated the associated and potential negative effects on the environment (biophysical), socio-economic and health characteristics of the project area in detail and mitigation measures have also been prescribed for significant negative impacts.

The Environmental and Social Impact Assessment of the TCN transmission line project revealed that the project will have significant transformative impacts on the socio-economic life of the host communities and Ogun State in particular as well as the national economy in general.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

1.1.1 The Project

The Transmission Company of Nigeria (TCN) is one of the companies unbundled from the defunct Power Holding Company of Nigeria (PHCN), and the only one wholly owned by the Government. TCN is charged with the responsibility of transmitting electric power from the various power stations to the load centres across the country and beyond, ensuring efficient and cost-effective transmission, system operation, and improved service delivery. TCN is also responsible for the management of assets of the High Voltage Transmission System Operations, generation dispatch functions, as well as the development of the network through the construction of new transmission lines and substations for efficient transmission and system operations.

Nigeria has realized strong economic growth, until 2016 when the economy went into recession. However, stronger growth is projected for the future due the new anti-corruption posture of the Government as well as economic policies targeted at reducing capital flight. Meanwhile, power supply capacity is overwhelmingly insufficient. As a countermeasure of serious power shortage, Transmission Company of Nigeria (TCN) planned a project geared to achieving transmission capacity of 20,000 MW by 2020 in accordance with growth of generation capacity.

Presently, the transmission lines to the largest demand centre of Lagos are in a bottleneck situation so the generating capacities being built across the country cannot be fully utilized. Moreover, there are no detour routes for use when equipment failure occurs and the system reliability is low.

The Lagos and Ogun States is targeted at improving power supply to Lagos and Ogun States, in line with the Transmission Lines network capacity development of achieving transmission capacity of 20,000 MW by 2020.This transmission line project in Lagos and Ogun States ("Lagos and Ogun States Transmission Project" or "the entire project")is to be financed through a loan (Japanese ODA loan) from Japan International Cooperation Agency (JICA). The Transmission Company of Nigeria (TCN) is the implementing agency and owners of the project when completed. This entire project plans reinforcement of transmission capacity, improvement of credibility of electricity supply and reduced electricity loss by installing transmission systems in southwest area Nigeria. It contributes acceleration of economy and development of the communities.

The entire project consists of about 203km high voltage transmission lines and 5 high voltage substations. For the purpose of ESIA and RAP study, the entire project is divided into 3 sections, Lot1, Lot 2 and Lot3.Transmission Company of Nigeria (TCN) has mandated the Godirra Chemicals Nigeria Limited (GCNL) to conduct Line Route Study, Environmental and Social Impact Assessment (ESIA), Environmental and Social Management Plan (ESMP) and Resettlement Action Plan for Lot 1 of the project (hereinafter "the project" or "proposed project") consisting of the following components as described in the TOR;

- Ejio (Arigbajo) – New Abeokuta 132kV D/C Transmission Line (35.38km).
- Olorunsogo – Ejio (Arigbajo) 330kV D/C Transmission Line (12.5km).
- Ejio (Arigbajo) – Ikeja West /Osogbo 330kV D/C Turn in-out (6.94km) at Sojuolu.

Specifically, following studies shall be conducted.
Carry out the Line Route Study (LRS), to determine the optimum route for the lines.
Conduct the ESIA to identify and assess the potential environmental and social impacts and recommend appropriate mitigation strategies and prepare ESMP.

Prepare out the Resettlement Action Plans (RAP), based on the international standards and principles presented in the Resettlement Policy Framework.

The project is financed through a loan from Japan International Cooperation Agency (JICA), as part of the development of power transmission infrastructure in the South-Western Region of Nigeria.

This type of project must undergo an environmental and social impact assessment as required by the EIA Act No. 86 of 1992. And in conformance with Nigerian legislations, JICA guidelines for environmental and social considerations, the World Bank environmental and social safeguard policies and International best practices, the project is subjected to a complete environmental study, along with RAP and an Environmental and Social Management Plan (ESMP).

1.1.2 The Proponent

Transmission Company of Nigeria (TCN), wholly owned by the Federal Government of Nigeria and having its headquarters at 14, Zambezi Crescent, Maitama, Abuja, is the project proponent. The company was incorporated in November 2005, emerging 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 has eight Transmission Regions and a National Control Centre, NCC. Each of these is headed by a General Manager (Transmission), who is responsible for the running and maintenance of transmission and transformation facilities in their areas of operation. The Transmission Regions are Lagos, Osogbo, Kaduna, Bauchi, Benin. Shiroro, Enugu and Port Harcourt and the National Control Centre (NCC) located at Osogbo.

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 by the Nigerian Electricity Regulatory Commission (NERC) to carry out electricity transmission, system operation and electricity trading which is ring fenced.

The mandate of TCN includes the following:-

Management of assets of the High Voltage Transmission System Operations as well as generation dispatch functions.

Operate as the provider of open access transmission service based on regulated transmission tariff and non-discriminatory system operations and economic dispatch services within a regulatory framework provided by the Nigerian Electricity Regulatory Commission (NERC), the Grid Code and the Market Rules.

Load forecasting and system expansion planning.
Acquiring the necessary ancillary service for defined reliability and quality service standards.

Managing the market settlement system.
Development of the network through the construction of new transmission lines and substations for efficient Transmission and System operations, hence all stakeholders should observe the Grid Code, Distribution Code and Market rules.

TCN has a Health Safety and Environment (HSE) Department, headed by a General Manager. The department is responsible for environmental and social safeguards of the company's activities and operations. The department also facilitates liaisons with communities as well as government agencies and local government departments to facilitate stakeholder consultations, as well as interfaces with the Federal Ministry of Environment for the approval of the ESIA.

1.1.3 Project Location

The entire project consists of about 203km high voltage transmission lines and 5 high voltage substations located in Lagos and Ogun State, as shown in figure1.1 and 1.2. The entire project is divided into three (3) Lots and the proposed project subject to this ESIA is Lot 1, which is a linear project crossing three LGAs of Ogun State (Ewekoro, Ifo and Obafemi Owode). The transmission lines has a total length of 54.82 km, consisting of 35.38km from Ejio (Arigbajo) – New Abeokuta 132kV D/C Transmission line which will traverse some communities, forest, farmlands, river/streams etc. and terminate at New Abeokuta substation in Kobape area Obafemi Owode LGA. Then 12.5km from Olorunsogo – Ejio (Arigbajo) 330kV D/C Transmission Line will emerge from Olorunsogo Power Station in Ifo LGA traversing Agricultural farmlands, railway line, Gas pipeline, major road etc. and terminates at the proposed Ejio (Arigbajo) substation in Ewekoro LGA. Finally 6.94km fromEjio (Arigbajo) – Ikeja West/Osogbo 330kV D/C turn in- turn out transmission line will traverse few communities, major road, forest etc. and terminates at Sojuolu also in Ewekoro LGA. See figure 1.3.

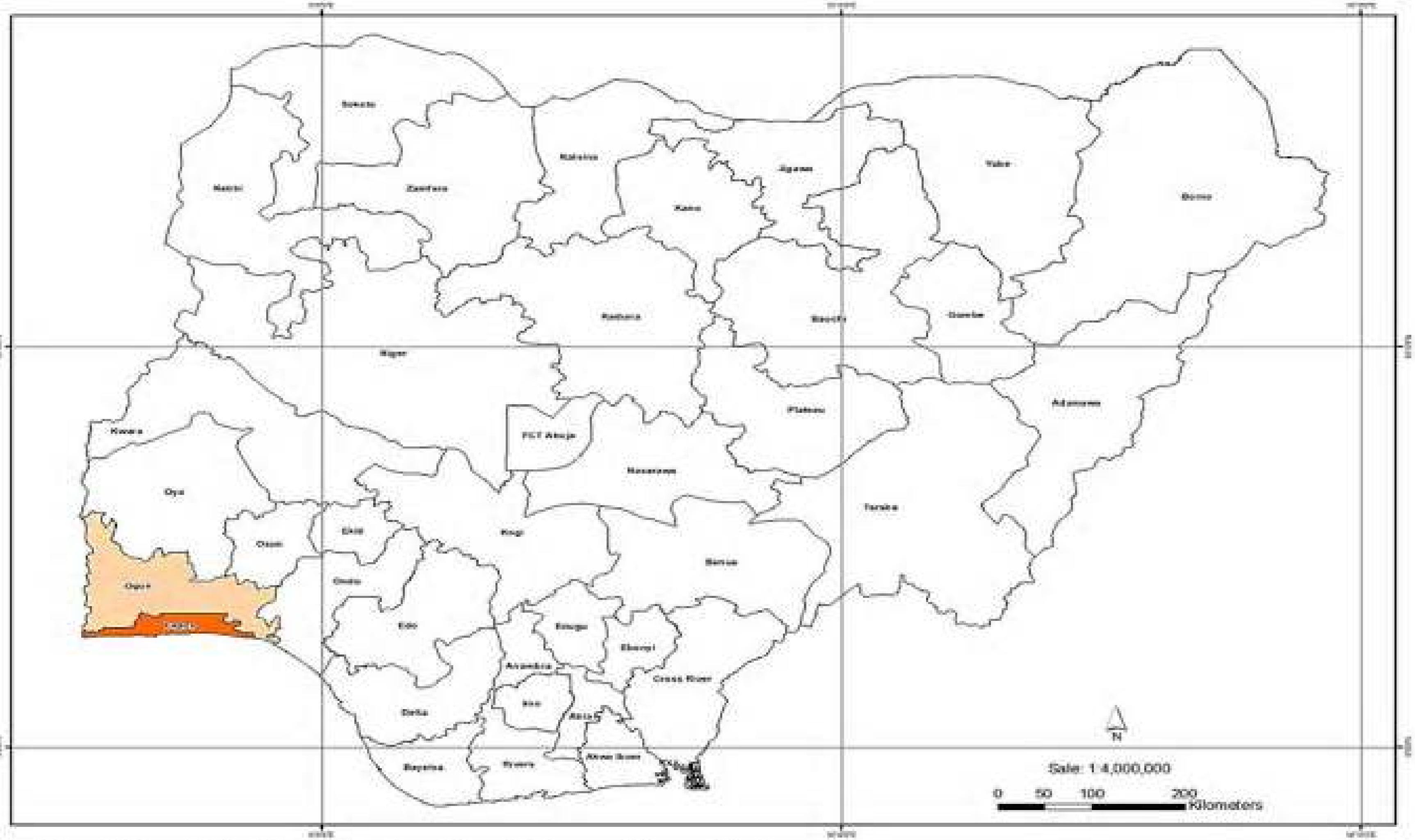


Figure 1.1 Map of Nigeria showing Location of Ogun and Lagos States

Figure 1.2: Location Map of the Project Site

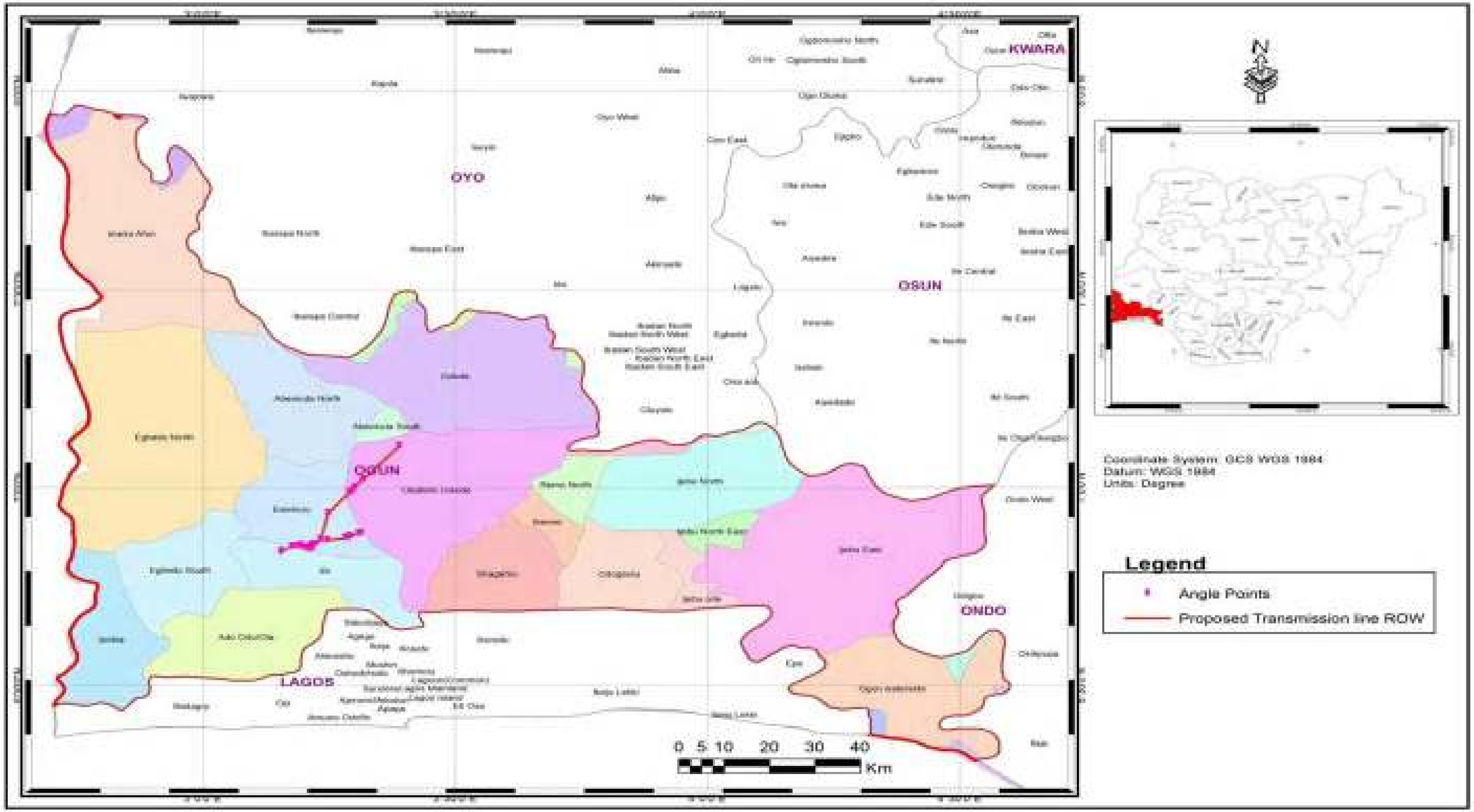


Figure 1.3: Map of Ogun State showing the proposed project (lot 1)

1.2 Objectives of the ESIA

The objectives of the ESIA are as follows:

- Ensure compliance with national environmental regulations and policies, JICA guidelines for environmental and social considerations, World Bank Safeguard Policies, and industry best practice and standards;
- Generate baseline data to characterize existing environment as well as socio-economic and health conditions and for subsequent monitoring and evaluation of how well the mitigation measures have been implemented during the project life cycle;
- Identify and analyze alternatives to the proposed projects, including sites, technology, layout, etc;
- Identify and assess the anticipated environmental and social impacts of the proposed projects – both positive and negative;
- Propose mitigation measures for negative impacts and enhancement measures for positive impacts to be undertaken during and after the implementation of the proposed projects;
- Recommend cost effective measures to be used to mitigate against the anticipated negative impacts;
- Consultation to seek the views of affected persons and stakeholders;
- Prepare an Environmental and Social Management Plan (ESMP), include budget for implementation;

1.3 ESIA Scope of Work

The ESIA will inform the Government of Nigeria, TCN as project developer and as project sponsor as well as interested and affected parties and other stakeholders about potential environmental and social impacts associated with the development of the project components.

The ESIA should be prepared under meaningful consideration of information gathered from stakeholders, relevant government agencies, and with the active participation of and consultation with all groups of potentially affected people.

The Environmental and Social Impact Assessments (ESIA) will cover at minimum, but will not be limited to the following aspects:

- Description of the entire Project and detailed Project Description.
- Analysis of the National Legal Framework.
- Analysis of applicable international policies, guidelines and standards (Japan International Cooperation Agency (JICA) environmental guidelines as well as International Conventions/Guidelines/Agreements to which Nigeria is a signatory, WB social and environmental safeguards, relevant IFC social and environmental safeguards).
- Baseline Description: environmental and social baseline conditions (identification / census of the economic/person affected to be compensated)
- Assessment of project impacts disaggregated to construction, operation and decommissioning; disaggregated into temporary and permanent impacts.
- Identification of Project Affected People and of severity of impacts; assessment of adverse as well as of beneficial impacts

- Analysis of alternatives, with an overall description of related impacts
- Assessment of the cumulative potential impacts
- Overview on environmental and social measures for mitigation of adverse impacts and enhancement of beneficial impacts including an outline for monitoring and evaluation procedures
- Institutional arrangements for environmental and social management , including staffing and capacity building plan
- Stakeholder Engagement Provisions, including planning for public information, consultation, participation and disclosure, a transparent and accessible grievance mechanism, monitoring provisions and reference to institutional set ups and responsibilities for the different activities under stakeholder engagement
- Projects Registration with Federal Ministry of Environment (FMEnv) and payment of all required statutory fees for certification.

Scopes of project component for Lot 1 are as follows;–

- Ejio (Arigbajo) – New Abeokuta 132kV D/C Transmission Line.
- Olorunsogo – Ejio (Arigbajo) 330kV D/C Transmission Line.
- Ejio (Arigbajo) – Ikeja West / Osogbo 330kV D/C Turn in- turn out at Sojuolu.

1.4 Policy, Legal and Institutional Framework

The constitution of Nigeria (1999), as the national legal order, recognizes the importance of improving and protecting the environment and makes provision for it in the following relevant sections:

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

1.4.1 Policy Framework

1.4.1.1 National Environmental Policy

Launched by Government in November 1989, this document 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.

Some specific regulations include:

- The S.I.9 is cited as National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991.
- National Environmental (Sanitation and Wastes Control) Regulations, S.I.28 of 2009,
- National Environmental (Noise Standards and Control) Regulations, S.I.35 of 2009;
- National Environmental (Surface and Groundwater Quality) Regulations, S.I.22 of 2011;
- National Environmental (Electrical/Electronic Sector) Regulations, S.I.23 of 2011;
- National Environmental (Control of Bush/Forest Fire and Open Burning) Regulations, S.I.15 of 2011; and
- National Environmental (Soil Erosion and Flood Control) Regulations, S.I.12 of 2011

The project will have effects on biophysical and human environment; as a result it shall comply with the relevant provisions of this policy.

1.4.1.2 National Energy Policy

The National Energy Policy approved by the Executive Council of the Federation in 2003 and launched in 2005 has the following objectives:

- To ensure the development of the nation's energy resources, with diversified energy resources options, for the achievement of national energy security and an efficient energy delivery system with an optimal energy resource mix.
- To guarantee increased contribution of energy productive activities to national income.
- To guarantee adequate, reliable, and sustainable supply of energy at appropriate costs and in an environmentally friendly manner, to the various sectors of the economy, for national development.

The policy dealt with five focal areas.

- Energy Sources: Oil and Gas and Other Conventional (Coal & Tar Sands) Energy Sources such as Nuclear Renewable Energy.
- Energy Utilization: electricity, industry, agriculture, and transport.
- Energy Issues: Environment, Energy Efficiency and Conservation, Research, Development and Training, Energy Manpower Development; Bilateral, Regional and International Cooperation, Energy Databank.
- Energy Financing: Indigenous participation. Financing.
- Planning and Policy Implementation: energy planning, policy implementation, prioritization of strategies into short, medium, and long term, monitoring and evaluation.

The project is about improving energy supply, as a result it shall comply with the relevant provisions of this policy.

1.4.1.3 National Land Policy

The legal basis for land acquisition and resettlement in Nigeria is the Land Use Act of 1978, modified in 1990. According to the act, all land in Nigeria is vested in the Governor of each State, to be held in trust for the use and common benefit of all people.

The administration of urban land is directly under the control and management of the Governor; whereas non – urban land is under the control and management of the Local Government Area.

The Governor had the right to grant statutory rights of occupancy to land. Local Government has the right to grant customary rights of occupancy.

The Land Act gives government the right to revoke statutory and customary rights to land for the overriding public interest. The act gives the government the right to acquire land by revoking both statutory and customary rights of occupancy for the overriding public interest.

In doing so, the act specifies that the state or local government should pay compensation to the current holder or occupier with equal value. The act also requires the state or local government to provide alternative land for affected people who will lose farmlands and alternative residential plots for people who will lose their house.

The need for an integrated approach towards land use planning is highlighted. The coordination of activities of all stakeholders in land use planning is emphasized. In particular, the involvement of land owners, community groups, women, youth and the less privileged in making land use related decisions that affect them is regarded as being critical in the successful implementation of the policy.

The project will involve land take for the line route and the new substation sites. Hence, the process for the land acquisition shall comply with the national land policy.

1.4.1.4 Social Protection Policies

Social protection policy has been on the agenda since 2004, when the National Planning Commission, supported by the international community, drafted a social protection strategy. More recently, the National Social Insurance Trust Fund drafted a social security strategy.

The social protection policy approached social protection using a life-cycle and gender lens, recognizing both economic and social risks, including, for example, job discrimination and harmful traditional practices. The policy was organized around four main themes: social assistance, social insurance, child protection and the labour market.

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

- the conditional cash transfer In Care of the People (COPE) (funded initially through the DRG fund) targeted at households with specific social categories (those with children of school-going age that are female-headed or contain members who are elderly, physically challenged, or are fistula or HIV/ AIDS patients
- the health fee waiver for pregnant women and children under five (financed through the DRG fund)
- the community-based health insurance scheme, which was redesigned in 2011 because the previous scheme had design challenges Other social assistance programmes are implemented in an ad hoc manner by various government ministries, departments, and agencies at state level, and some are funded by international donors. These include conditional cash transfer programmes for girls' education (in three states), child savings accounts, disability grants, health waivers, education support (such as free uniforms) and nutrition support. HIV and AIDS programming at state level also include social protection sub-components (although not as the primary objective), including nutrition, health and education support labour market programmes include federal-and state-level youth skills and employment programmes, and Nigeria also has agricultural subsidies/inputs.

The project will have effects on the social aspects of the people around the area, as a result it shall comply with the relevant provisions of this policy.

1.4.2 Legal Framework

1.4.2.1 National Legislations

i. **The Environmental Impact Assessment (EIA) Act Cap E12 LFN, 2004**

The EIA Act 86 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 effect on the environment. The Act sets the EIA objectives and the procedures for consideration of EIA of certain public or private projects.

The project is a major development, which is expected to have some impacts on the environment. Hence, full compliance with the EIA Act is required. The EIA guidelines (procedural and sectoral) issued by the FMEnv. derived from this Act and the project proponent (TCN) shall conduct its activities for the development of this project in conformance with these guidelines.

ii. **National Resource Conservation Action Plan, 1992**

The plan was established to set out objectives for living resources conservation through:

maintaining genetic diversity in order to ensure permanence in the supply of materials to satisfy basic human needs and thus improve the well-being of society;

promoting the scientific value of natural ecosystems, the study of which is required to enhance conservation itself, to improve the management of man-made systems, and to provide clues to technical innovations in agriculture, medicine and industry; regulating environmental balance in such factors as carbon dioxide and radiation levels and the bio- geo chemical cycles; maintaining ecological services through the protection of catchment's areas in order to enhance water resources and check soil erosion and flooding, protection of grazing lands against desert encroachment and the stabilization of coastal zones and; enhancing the amenities values of natural resources, including aesthetic, heritage, religious, sentimental, ethical and recreational values on which tourism may be built.

iii. Land Use Act of 1978

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

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

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

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

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

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

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

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

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

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

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

It follows from the foregoing that compensation is not payable on vacant land on which there exist no physical improvements resulting from the expenditure of capital or labour.

The compensation payable is the estimated value of the unexhausted improvements at the date of revocation.

Payment of such compensation to the holder and the occupier as suggested by the Act may appear confusing as it raises the following question: Does it refer to holder in physical occupation of the land or two different parties entitled to compensation perhaps in equal shares? The correct view appears to follow from the general tenor of the Act.

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

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

The Act must, in making this provision, have proceeded on the basis that the committee is a distinct body quite different from the Governor or the Local Government. It is submitted, however, that it will be difficult to persuade the public that this is so since the members of the committee are all appointees of the Governor.

Where a right of occupancy is revoked for public purposes within the state of the Federation; or on the ground of requirement of the land for the extraction of building materials, the quantum of compensation shall be as follows:

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

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

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

This project will require acquisitions of land for the substation sites and ROW for the transmission lines. Hence, will comply with the requirements of this law.

iv. **Electric Power Sector Reform Act No. 6, 2005**

The Act established the Nigerian Electricity Regulatory Commission (NERC) as an independent regulatory agency. NERC was inaugurated in October 2005, and is mandated to carry out:

- The monitoring and regulation of the electricity industry
- Issuance of licenses to market participants, and
- Ensure compliance with market rules and operating guidelines.

This Act also deals with acquisition of land and access rights. Section 77 of the Act empowers the NERC to make a declaration that land is required by a license for purpose of generation or distribution of electricity. Section 77 (9) states: "where the President issues a notice under sub-section 6, the Governor shall in accordance with the provisions of section 28(4) of the Land Use Act, revoke the existing right of occupancy respecting the land and grant a certificate of occupancy in favour of the concerned licensee in respect of the land identified by the commission in such notice who shall be entitled to claim compensation in accordance with the provisions of the Land Use Act".

v. **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, repealed 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, N1, 000,000 (One Million Naira) and an imprisonment term of 5 years. In the case of a company, there is an additional fine of N 50,000, for every day the offence persists.

This project will comply with NESREA regulations, including conducting ESIA, environmental audit every three years after commissioning, obtain permit before disposing hazardous wastes, etc.

vi. **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 become instructive:

- 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 N10, 000 (Ten thousand naira) and in the case of a company, a fine not exceeding N50, 000.
- Section 72 provides for the preservation and planting of trees for environmental conservation.

The project shall be implemented in line with requirements of this Act, including obtaining development permit from Ogun and Lagos State Governments.

vii. **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.

The project will generate wastes including construction wastes and transformer oils at substations and other harmful wastes. These wastes shall be handled, treated, and disposed of in accordance with the relevant requirements of this Act.

viii. **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.

Certain sections of the line route of this project, will pass through natural areas that serve as wildlife habitats which will be impacted by the project. Hence, the project activities shall be carried out to comply with relevant provisions of this Act.

ix. **The Factories Act, 1987 (Factory Act cap 126, LFN, 1990)**

The factories Act, as contained in the Laws of the Federation of Nigeria 1990, seeks to legislate, and regulate the conduct of health and safety in the Nigerian workplaces. It was enacted in June1987 with the desire to protect the workers and other professionals against exposure to occupational hazards. The director of factories at the Federal Ministry of Employment, labor and productivity is responsible for the administration of the provisions or requirements of this Act. Section 13 allows an inspector to take emergency measures or request that emergency measures be taken by a person qualified to do so, in cases of pollution or nuisances.

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

x. **Labour Act - CAP. L1 L.F.N. 2004**

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

xi. **Wages Board and Industrial Council Act, 1974**

The Act provides for the establishment of a National Wages Board and Area Minimum Wages Committee for States and for Joint Industrial Councils for particular industries. It empowers the Minister to order or direct that an industrial wages board be established to perform, in relation to the workers described in the order and their employers, the functions specified in the provisions of this Act, including minimum wage. The minimum wage is currently NGN 18,000.00 per month, and all workers employed for this project shall not earn less than the minimum wage. Hence, all workers engaged by the project shall be paid a minimum of N18,000 per month.

xii. **Workers' Compensation Act, 1987**

The Act to make provisions for the payment of compensation to workmen for injuries suffered in the course of their employment. The compulsory insurance covers employees for injury or death resulting in the course of work or in work places. All types of workers are covered including working under a contract of service or apprenticeship with an employer, whether by way of manual labour, clerical work or otherwise, and whether the contract is expressed or implied, is oral or in writing. The project will employ both skilled and non-skilled labour and shall be subject to this law as applicable.

xiii. **National Inland Waterways Authority Act, 1997**

This Act provides for the administration and management of inland waterways of Nigeria, establishes the National Inland Waterways Authority, defines the Authority's functions, powers and internal organization, provides for the use of land adjacent to waterways, prescribes offences relating to obstruction and pollution of waterways and prescribes penalties for such offences.

xiv. **EIA Procedural Guidelines**

This procedure prescribes the steps to be followed in the EIA process from project conception to commissioning and post commissioning impact mitigation, to ensure that the project is implemented with maximum consideration for environment. This EIA study was conducted in compliance with this guideline.

The EIA Process in Nigeria: The Federal Ministry of Environment (FMEnv) developed guidelines to be used by project proponents in conducting EIA, in compliance with the EIA Act. Accordingly, the EIA process, illustrated in **Figure 1.4**, shall follow the following steps sequentially as outlined in the procedural guideline.

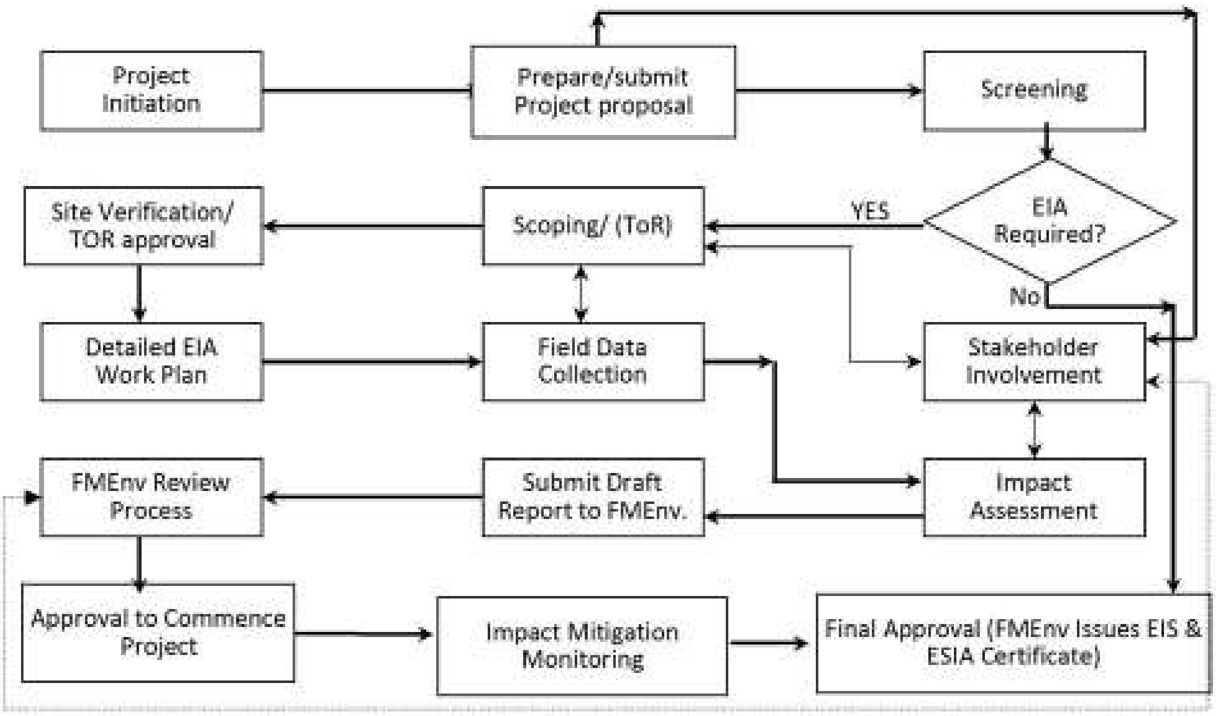


Figure 1.4 The EIA Process of FMEnv.

xv. **EIA Sectoral Guidelines (Infrastructures)**

This provides general guidelines for EIA of projects in infrastructure sectors of Nigeria, with specific details for sub-sectors. The Electrical transmission sub-sector applies to this project.

xvi. **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 regulations relevant to the project are as follows:

- S.I.8 National Environmental Protection (Effluent Limitation) Regulations, 1991, makes it mandatory for industries to install anti-pollution and pollution abatement equipment on site. The regulation is specific for each category of waste generating facility with respect to limitations of solid and liquid discharges or gaseous emissions into the environment.
- S. I.15 National Environmental Protection (Management of Solid and Hazardous Waste) Regulations, 1991, defines the requirements for groundwater protection, surface impoundment, land treatment, waste piles, and landfills. It describes the hazardous substances tracking program with a comprehensive list of acutely hazardous chemical products and dangerous waste constituents. It also states the requirements and procedure for inspection, enforcement and penalty.

- S.I.9 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes)Regulations1991, imposes restrictions on the release of toxic substances and stipulates requirements for pollution monitoring units, machinery for combating pollution and contingency planning by industries, submission of lists and details of chemicals used by industries to FMEnv, permits for the storage and transportation of harmful or toxic waste and the waste generator's liability.

The Act also provides regulations on strategies for waste reduction, permissible limits of discharge into public drains, protection of workers and safety requirements, environmental audit (or environmental impact assessment for new industries) requirements and penalties for contravention.

1.4.2.2 Ogun State Laws

Ogun State Environmental Protection Agency (OGEPA) Law of 1995: This law established Ogun State Environmental Protection Agency as a parastatal under ministry of environment with the responsibility to protect the environment in the state.

Ogun State Urban and Regional Planning Law No 20 of 2005: Established the Ogun State Urban and Regional Planning Board as the agency responsible for development control in the state. The substation sites as well as the ROW in Ogun State needs to approved by the board as part of the process for granting right of occupancy by the Governor. The State Ministry of Urban and Physical Planning also derives its statutory functions from section 3 line 246 of this law as the policy arm of the government related to physical planning in the State.

Ogun State Environmental Management (Miscellaneous) Provisions Law, 2004: Section 8 of the state environmental managements (miscellaneous) provisions Law, 2004 empowers the Ministry of Environment to register all Environmental Management contractors such as Waste managers and waste vendors as well as environmental consultants.

1.4.2.3 International Conventions

The international conventions, to which Nigeria is a signatory, relevant to this project are as follows:

i. African Convention on the Conservation of Nature and Natural Resources
ii. RAMSAR Convention on Wetlands of International Importance
iii. Convention on Biological Diversity
iv. Endangered Species (Control of International Trade and Traffic)
v. Conservation of Migratory Species of Wild Animals (1973)
vi. Convention to Combat Desertification (1994)
vii. United Nation Framework Convention on Climate Change (UNFCCC) 1992.
viii. International Union for Conservation of Nature and National Resources (IUCN) Guideline, 1996.
ix Convention on Wetlands of International Importance (Ramsar 1971)
x The "Equator Principle"
xi World Bank Operational Policies.
xii Public Health Legislations and Regulations.

xiii The Rio Declaration on Environment and Development
xiv The Kyoto protocol, Montreal Protocol on Substances that Deplete the Ozone Layer, 1987.
xv The African Convention on the Conservation of Nature and Natural Resources, 1968.
xvi Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)
xvii Human and Peoples' Rights on the Rights of Women in Africa in 2005
xviii Civil and Political Rights Covenant
xix Economic, Social and Cultural Rights Covenant
xx Convention on the Elimination of All Forms of Violence against Women
xxi Convention on the Rights of the Child
xxii ILO Occupational Safety and Health Convention, 1981

ILO Conventions and Core Labour Standards

The International Labour Organisation (ILO) is a tripartite organisation consisting of trade unions, governments and companies, and is part of the United Nations system. In 1998, the ILO produced the Declaration on Fundamental Principles and Rights at Work. In the Declaration, ILO member states including Nigeria agreed that they should all respect, promote, and realise core labour standards (whether they have been ratified or not).

- The core labour standards consist of five standards, laid out in eight conventions:
- Freedom of association and the effective recognition of the right to collective bargaining (Convention No. 87 & No. 98)
- The elimination of all forms of forced and compulsory labour (Convention No. 29 & No. 105)
- The effective abolition of child labour (Convention No. 138 & No. 182)
- The elimination of discrimination in respect of employment and occupation (Convention No. 100 & No. 111)

TCN as well as its contractors shall comply with these requirements, as well as the following internationally recognized labour rights: the right to a living wage based on a regular working week that does not exceed 48 hours; humane working hours with no forced overtime; a safe and healthy workplace free from harassment; and a recognised employment relationship with labour and social protection.

1.4.2.4 JICA Guidelines for Environmental and Social Considerations

The objectives of the guidelines are to encourage Project proponents etc. to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents etc., in order to facilitate the achievement of these objectives. In doing so, JICA endeavours to ensure transparency, predictability, and accountability in its support for and examination of environmental and social considerations.

1.4.2.5 World Bank Safeguard Policies

The World Bank environmental and social safeguard policies include both Operational Policies (OP) and Bank Procedures (BP). Safeguard policies are designed to protect environment and society against potential negative effects of projects, plans, programs and policies.

1.4.2.6 IFC Performance Standards for Investment

The Eight Performance Standards established by IFC for the life of an investment include:

i. Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
ii. Performance Standard 2: Labour and Working Conditions
iii. Performance Standard 3: Resource Efficiency and Pollution Prevention
iv. Performance Standard 4: Community Health, Safety, and Security
v. Performance Standard 5: Land Acquisition and Involuntary Resettlement
vi. Performance Standard 6: Biodiversity Conservation and Sustainable Managementof Living Natural Resources
vii. Performance Standard 7: Indigenous Peoples
viii. Performance Standard 8: Cultural Heritage

1.4.2.7 TCN's HSEQ POLICY

TCN has a comprehensive Health, Safety and Environment policy as well as a protocol developed for third-party contractors and all parties involved in construction works of grid stations and transmission lines. All parties that will be involved in this project must comply with the HSEQ Policy of TCN.

Particular consideration shall be given to the Safety, Health, Environment, Security (SHE&S) and Regulatory (SHES&R) of all project personnel at all stages of planning, execution and management of the project. The following sections identify how the project shall be planned to achieve SHE&S objectives, through the implementation of procedures relating to SHE&S Planning and Execution. SHE&S is the project's highest priorities and the responsibility of every individual associated with the project. The SHE&S Philosophy is:

- Nobody Gets Hurt during project planning and execution.
- Safety and security are the project's highest priorities.
- Any work performed at a facility must be done in the safest manner possible.
- Safety is an integrated part of SHE&S policies, procedures and requirements and those are required to safely operate and maintain operating facilities.
- Safety is everybody's concern and responsibility.

The Construction SHE&S Management System is to be established prior to construction based on the above philosophy and the requirements of following at minimum:

ix. OHSAS18001:2007 Occupational Health and Safety Management Systems Requirements;
x. ISO9001:2008 Quality management systems: Requirements
xi. ISO14001:2004 Environmental management systems: Requirements with guidance for use;
xii. Local Norms, Rules and Regulations for Health, Safety and Environmental Protection;

xiii. Workmen's Compensation Decree/1987;
xiv. Electrical Regulations/1988.

The objectives and strategies for the construction phase of the Project are aligned with the overall Project Objectives and Strategies (POS). Construction Objectives are:

- Improve Project Safety, health, security, environmental protection/performance, particularly during construction
- Assure Project Quality
- Reduce Project Life-Cycle Costs
- Reduce Project Schedules
- Properly plan logistics to ensure minimum rework caused by poor engineering/construction coordination
- Properly plan the contracting and procurement activities while supporting field construction requirements to ensure the reduced schedule and cost impacts are realized.
- Enhance Management of Risk
- Involve local communities in the construction process
- Foster an effective relationship with communities.

1.4.2.8 Gap Analysis against JICA guideline

Regarding legislative and institutional arrangement for EIA, in general there is no difference in categorization, details of EIA study and EIA report, public participation, and information disclosure between the JICA Guidelines and Nigerian laws and regulations as shown in Table 1.1

Table 1.1 Gap Analysis between Nigerian Laws and World Bank E & S Policies

Item	Outline of EIA Legislation in Nigeria	Differences/Measures
Category	According to the EIA Decree and EIA Procedural Guidelines 1992, all the proposed projects are classified into three categories considering extent, nature and location of the projects. (a) Category I for which EIA is mandatory; the project is likely to significantly affect the environment (almost same as the category A of JICA Guidelines) (b) Category II for which a partial EIA will be required; the project is likely to not significantly but somewhat affect the environment (almost same as the category B of the JICA Guidelines).and,(c)Category III for which EIA is not required; the project is unlikely to affect the environment (almost same as the category C of the JICA Guidelines) In addition, the proposed projects in Sensitive Areas as shown in 3.1.1.3 2) are also classified as category I.	No difference in general
Screening	Screening should be conducted by FMEnv. after site survey.	No difference in general
Scoping and preparation of TOR	Proponent should make environmental scoping and TOR for EIA study and submit to FME.	No difference in general

Item	Outline of EIA Legislation in Nigeria	Differences/Measures
Environmental Items	Environmental items, on which impacts due to the project to be identified and evaluated are not described in the EIA Decree. However, items of major negative impacts due to power transmission line project are indicated to such items as land acquisition/resettlement and way-leave, landscape, ecological system, noise and vibration are indicated as major negative impacts due to power transmission line project according to EIA Sectoral Guidelines for Transmission Line.	No difference in general
Contents of EIA report	Mentioned in Article 4 of the EIA Decree - AnEnvironmentalImpactAssessmentshallincludeatleastthefollowingminimum matters: (a) Proposed activities (b)Potential affected environment including specific information necessary to identify and assess the environmental effects of the proposed activities (c) Practical activities, as appropriate (d)An assessment of the likely or potential environmental impacts on the proposed activity and the alternatives, including the direct or indirect cumulative, short-term and long-term effects (e) An identification and description of measures available to mitigate adverse environmental impacts of proposed activity and assessment of those measures (f)An indication of gaps in knowledge and uncertainly which may be encountered in computing the required information (g)An indication of whether the environment of any other State, Local Government Area or areas outside Nigeria is likely to be affected by the proposed activity or its alternatives (h)A brief and non-technical summary of the information provided under paragraph (a) to (g).	No difference in general
Environmental Management Plan (EMP) and Environmental Monitoring Plan	Although the term of "environmental management plan" is not found in the EIA Decree, it is used in the EIA Sectoral Guidelines (Transmission Line). Although the term of "environmental monitoring" is not found in the EIA Decree, the term of "follow-up program" is used as follows: (a) Article 16 - the design and implementation of a follow-up program, (b) Article 17 –mandatory study must include a discussion of the need for and the requirements of any follow-up program.	No difference in general
Information disclosure and public participation	Term of "stakeholder" or "public participation" is not found in the EIA Decree. However, subjects relating to public involvement are described from screening process to reviewing draft final report of EIA study for EIA approval in the EIA Decree. In general: Article 7 - FME shall give opportunity to government agencies, members of the public, experts in any relevant discipline and interested groups to make comment. (b) Screening process. (c)	In the transmission line project (2012) by World Bank stakeholder meetings were held for communities and villages. In the

Item	Outline of EIA Legislation in Nigeria	Differences/Measures
	Public hearing.(d) Public comments. However, it is not mentioned about public involvement conducted by the proponent itself during scoping phase and EIA study phase.	proposed project stakeholder meetings will be held at the scoping phase and at the stage of preparing draft final report of EIA study.
Comparison of alternatives	Mentioned in the EIA Decree. For example: (a) Article 4 - an EIA shall include an assessment of the likely or potential environmental impacts on the proposed activity and the alternatives, including the direct or indirect cumulative, short-term and long-term effects. (b) Article 17 - every mandatory study of a project by review panel shall include a consideration of alternative means of carrying out the project.	No difference in general

1.4.2.9 Institutional and Administrative Framework

Responsibilities for the ESIA and its implementation are shared between multiple stakeholders, including concerned ministries, competent authorities, the project implementation unit (PIU), the TCN and the contractors. These include the following;

- The Federal Government of Nigeria (FGN)
- Federal Ministry of Power
- Federal Ministry of Environment
- Transmission Company of Nigeria (TCN)
- JICA Project Implementation Unit (PIU)
- Nigerian Bulk Electricity Trading (NBET) Company
- Ibadan Electricity Distribution Company
- Ogun State Ministry of Environment
- Ogun State Environmental Protection Agency ("OGEPA")
- Ogun State Bureau for Lands and Survey
- Ogun State Power Unit, Office of Governor
- Local Government Authority (LGA):
  - ✓ Ewekoro Local Government Area
  - ✓ Ifo Local Government Area
  - ✓ Obafemi Owode Local Government Area
- The Customary District Councils headed by Obas of each Kingdom affected
- Village Chiefs (Baale) of Affected Communities

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

1.4.2.10The Federal Government of Nigeria

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

1.4.2.11Federal 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 in discharging this mandate is guided by the provisions of the National Electric Power Policy (NEPP) of 2001, the Electric Power Sector Reform (EPSR)Act of 2005, and the Roadmap for Power Sector Reform of August 2010.

The following parastatals are under the ministry:
Energy Commission of Nigeria (ECN)
Nigerian Electricity Regulatory Commission (NERC)
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
- Implementing renewable energy progammes/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

1.4.2.12Federal Ministry of Environment

The Federal Ministry of Environment is responsible for the overall environmental policy of the Country. It has the responsibility for ESIA implementation and approval, in accordance with the EIA Act. 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. And they can 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.

1.4.2.13Transmission Company of Nigeria (TCN)

TCN as the implementation agency for the project on behalf Federal Government of Nigeria established the Project Implementation Unit (PIU) for the end to end delivery of the project. The Project Manager heading the PIU reports to the CEO of TCN through a General Manager. (Project Coordinator) for all donor funding project.

1.4.2.14Project Implementation Unit

Is a unit established by TCN with responsibility for the end to end delivery of all JICA funded projects, including planning, feasibility, ESIA and RAP, engineering, procurement and construction (EPC). PIU is headed by a substantive Project Manager.

Furthermore, the PIU shall ensure:

- The ESIA and RAP studies are conducted in line with legal requirements as well as requirements of the lender
- Proper implementation of the ESMP
- Supervise the EPC contractor in conjunction with the Owner Engineers in Project Department to ensure implementation of management measures.
- Provision of information on activities and consultations with the PAPs.
- Maintain an inventory of the assets to be resettled and a detailed valuation of the compensations.
- Ensure proper information and participation of PAPs and affected communities.
- Management of compensation payments.
- Monitoring the resettlement work.
- Implementation of community-approved projects financed through the EPC contractors.
- Production of monitoring reports to appropriate government authorities, TCN and the contractor in charge of the line construction and the Lender.

1.4.2.15 Nigerian Bulk Electricity Trading (NBET) Company

NBET was incorporated on July 29, 2010 in line with the "Roadmap to Power Sector Reform" and, in fulfillment of the requirements of Electric Power Sector Reform Act (EPSRA), 2005 for a "trading licensee holding a bulk purchase and resale license" to "engage in the purchase and resale of electrical power and ancillary services from independent power producers and from the successor generation companies".

The objectives of the NBET are to:

- Put in place an effective transaction environment which minimizes risk and allocates it fairly to the parties best able to manage it;
- Implement a procurement process that is transparent and will result in the economic procurement of needed power;
- Have all existing and new power capacity under contract by 2016, although the commercial operation date when this capacity comes on line may be later;
- Ensure efficient settlement in the short term until this function is subsumed under the market operator;
- Become sustaining as soon as practical, thereby minimizing the cost to the Federal Government;
- Be ready to notate contracts and wind up as soon as the suppliers are ready to take on their own procurement; and

- Enter into contracts that are well structured and managed in a manner that precludes recourse to any credit guarantee instrument.

1.4.2.16Ibadan Electricity Distribution Company

Ibadan Electricity Distribution Company is part of 11 distribution companies unbundled from defunct PHCN during electricity reform in 2005. They are responsible for distributing electricity to homes and other consumers within the Ogun State Region. This role makes them the direct customers of TCN and a major stakeholder in ensuring improved electricity supply to consumers and realizing other objectives of this project.

1.4.2.17Ogun State Ministry of Environment

The Ministry of Environment was established in July 2003 with the aim of creating better living and conducive environment for the entire people of Ogun State. The Ministry has five (5) departments and two (2) sister Agencies namely, Ogun Environmental Protection Agency (OGEPA) and Ogun State Emergency Management Agency (OSEMA).

- Department of Administration & Supplies: is involved in the management, co-ordination and facilitation of the activities of other Departments.
- Department of Environmental Conservation & Resources Management: is responsible for environmental Sanitation, landscaping and beautification, environmental and natural resources conservation, meteorological services, water shed management and water quality monitoring, climate change, etc.
- Department of Planning, Research & Statistics: plan, undertake research and gather data or information which will allow the Ministry to grow and develop.
- Department of Finance & Accounts: responsible for budgeting and other financial management responsibilities.
- Department of Flood & Erosion Control: Management of flood and erosion issues, including planning, designing, and construction and maintenance of control structures.

1.4.2.18Ogun State Bureau for Lands and Survey

This bureau is responsible for the issuance of right of way (ROW) and certificate of occupancy (C of O) for portions of line route and substation sites that falls within Ogun State. Other functions of the Agency include

- Preparation and issuance of Certificates-of-Occupancy and other certificate evidencing titles.
- Preparation and issuance of Right-of-Occupancy.
- Production and printing of Titled Deed Plan (TDP).
- Street naming and house numbering in Ogun State.
- Provision of Geospatial information infrastructure.
- Textual and graphic data on Ogun State, including land record, aerial photographs, satellite images, engineering drawing, and scanned pictures of building.
- Property search and verification of land record.
- Land application processing and administration.

1.4.2.19Ministry for Physical Planning

The Ministry is the apex body of Physical Planning in Ogun State. It is responsible for the formulation of Physical Planning policies and the coordination of physical development within the State. It derives its statutory functions from section 3 line 246 of the State Urban and Regional Planning Law No.20 of 2005. Though the Ministry is the policy making body, it has the Urban and Regional Planning Board as its parastatal.

1.4.2.20The Ogun State Urban and Regional Planning Board:

This Board is a parastatal of the Ministry of Urban and Physical Planning established the enactment of Ogun State Urban and Regional Planning law No.20 of 2005. The Board, which have 20 Zonal Town Planning Offices spread across the State, is responsible for:

- Controlling all various physical developments be it Residential, Commercial, Industrial, Public, and Institutional uses.
- Monitoring all the development in order to control the growth of Urban Sprawl in Ogun State.

1.4.2.21Ogun State Ministry of Women Affairs and Social Development:

The ministry has the responsibility

- To promote Gender Equality and provide Empowerment facilities for Socio-economic Development
- To promote the survival, protection, participation and development of children
- To promote family harmony and reduce juvenile delinquency
- To provide care, support, rehabilitation and empowerment for the vulnerable groups(challenged persons, older persons, destitute and the likes)
- To collaborate and network with Non-Governmental Organizations, Professional Institutions and other MDAs on issues affecting women, children/vulnerable ones.

1.4.2.22Ogun State Ministry of Agriculture

This Ministry is the organ of Government responsible for formulating policies on food and agriculture for the State. The ministry is to enhance self-sufficiency in food production, provide raw materials for agro-based industries, generate employment opportunities and obtain desirable levels of export in order to improve the country's foreign exchange earnings.
Ogun State has 1.2million hectares of arable land which is 74% of the State's total land area. Only 30% of this arable land or 35,000 hectares is under cultivation. The major crops grown or cultivated in the State include: Cassava, Rice, Maize, Oil-Palm, Cocoa, Rubber, Citrus, Cotton, Soya-Bean, Vegetable, Pine apple, Sugar-Cane, among others. Livestock and fish farming are strong and viable in the State.

The Mandate of the Ministry includes;

- Formulating and implementing agricultural policies and programmes for Ogun State.
- Regulation of farm practice and certification of farm produce.

- Ensuring food safety and food security.
- Promotion of mechanized agriculture.
- Ensuring availability and provision of quality agricultural inputs
- Coordinating agricultural cooperative societies and commodity groups
- Promoting and managing Irrigation Schemes
- Delivery of agricultural research proven technologies to farmers for adoption through effective Extension Services
- Promoting the development of the Livestock and Fishery industries in the State.

1.4.2.23Local Government Authority (LGAs)

The project will pass through three LGAs in Ogun State -Ewekoro, Ifo and Obafemi Owode. These LGAs are involved in the ESIA approval process. According to the EIA act, the LGAs will have representatives in the panel that will review the report and advise the Minister to make decisions on the project. The LGAs also have roles in the administration of lands in rural areas and hence, will be involved in the resettlement process as well as sites for the substations.

1.4.2.24The Customary District Councils

The line route will pass through the Chiefdoms as several villages under them. The Obas (traditional head of chiefdom) and Village Heads (Baales) have important role to play in the project with respect to mobilization of the community members to support the project, grievance redress, peace and security of personnel, equipment and facilities to be installed. Close contact and regular consultation shall be maintained with customary chiefs throughout the life of the project

1.4.2.25Witness NGO

To enhance transparency and trust from PAPs it is suggested that a witness NGO, recognized and credible in the project area, be retained, through a public proposal and selection process, by the PIU to provide independent advice and report on RAP implementation and management focusing on consultation activities, compensation and resettlement related activities and grievances management. This NGO could be a recognized and credible Human Right advocacy group or an NGO active in environmental management or rural development.

This outside look will ensure that proper procedures and stated compensation processes are followed, that PAP grievances are well taken care of, and that PAPs are treated with fairness. This mode of supervision was experienced in other projects and gave good results in terms of reduction of grievances in particular[1].

This NGO will revise reports of compensation payment process, meet with PAPs, check implementation of the measures, reconstruction, etc. in the field, and provide comments and recommendations. All PAPs will be informed of the NGO role and function and need to have access to its representatives, in a confidential manner if necessary, to explain and discuss their difficulties of grievances.

1.4.2.26Contractors

Each contractor shall appoint a qualified environmental manager who, after approval by the PIU will be responsible for daily management on-site and for the respect of management measures from the ESMP and RAP. This manager will report regularly to the environment specialist of the PIU during the entire construction period.

Contractors must hold all necessary licenses and permits before the work begins. It will befall on them to provide the PIU with all the required legal documents, including the signed agreements with owners, authorizations for borrow pits and for temporary storage sites, etc.

1.4.2.27TCN HSE Department

The HSE department of TCN shall be responsible for ensuring implementation of management measures during operation phase (post-commissioning), including audits, compliance monitoring, preparation of periodic reports required by regulations.

1.5 ESIA Terms of Reference

In line with the Nigeria's EIA procedural guidelines (FEPA, 1995), a Terms of Reference (ToR) for the ESIA of the proposed project was developed, for the FMEnv's approval, at the early stages of the study based on an initial assessment of the environmental issues relating to the proposed project. The specific objectives of the ToR were to:

- Define the relevant framework of legal and administrative requirements for EIA of the proposed project;
- Outline the general scope of the ESIA study including the overall data requirements on the proposed project and affected environment; and.
- Define the procedures and protocols for identification and assessment of associated and potential impacts and for selecting appropriate prevention, reduction, and control as well as enhancement measures for such impacts; and eventually developing an effective Environmental and Social Management Plan (ESMP) for the project.
- The ToR has been approved by the FMEnv (Appendix 1).

1.6 Structure of the ESIA Report

The ESIA Report is presented in eight chapters.

- **CHAPTER ONE** is an introduction containing relevant background information and the legal and administrative framework for ESIA in Nigeria among other information, international conventions ratified by Nigeria and the World Bank environmental and social sustainability policies.

- The **CHAPTER TWO** presents the project justification, the need/value and its envisaged sustainability as well as the project development and site/route options considered.
- **CHAPTER THREE** contains detailed description of the proposed project including its location, overall layout, basis for design, type and specifications of equipment/facilities to be installed and operation/maintenance of the proposed power project.
- In **CHAPTERFOUR** the baseline, ecological and socio-economic status of the study area respectively is described. Information on consultation with stakeholders is presented in this chapter.
- **CHAPTER FIVE** discusses the identified potential and associated environmental impacts of the proposed project.
- **CHAPTER SIX** presents the various mitigation measures TCN is committed implement against the identified significant impacts.
- **CHAPTER SEVEN** provides a cost-effective environmental and social management plan that would be adopted throughout the project's lifecycle. It also enumerates the environmental monitoring programme, the waste management programme.
- **CHAPTER EIGHT** talks about the project's decommissioning/remediation plan.
- **CHAPTER NINE** concludes the report and requests approval for project implementation.

The preliminary sections of the report include status page, the table of contents, list of tables, list of figures, list of plates, list of abbreviations and acronyms, list of ESIA preparers, acknowledgement page and the executive summary. The concluding sections include the references and various appendices.

CHAPTER TWO

2.0 PROJECT JUSTIFICATION AND ALTERNATIVE ANALYSIS

2.1 Need for the Project

Due to significant shortage of power supply capacity compared to demand, load allocation has been implemented nationwide in Nigeria. If all power stations currently being constructed under the Nigerian National Integrated Power Project (NIPP) become operational, the installed generation capacity will become above 10,000 MW by the end of 2018 and it will be expected to increase greatly. The existing and proposed transmission line system in Nigeria is shown in Figure 2.1.

The transmission lines that run from the Niger Delta in the south to the north via the largest demand center of Lagos are in a bottleneck situation so the generating capacity in the south cannot be fully utilized. Moreover, there are no detour routes for use when equipment accidents occur, and the system reliability is low.

Furthermore, as was mentioned above, the capacity of generating equipment is expected to increase greatly in the coming years, however, because transmission capacity is unable to keep up with generating capacity, there is an urgent need to strengthen the transmission infrastructure. As a countermeasure of serious power shortage, Transmission Company of Nigeria (TCN) planned a project geared to achieving transmission capacity of 20,000 MW by 2020 in accordance with growth of generation capacity.

Nigeria has the largest population among African countries. After coming out of recession last year, the economy of the country is expected to grow steadily in in the coming years. However, social infrastructure is far behind the economic development. In particular, electricity supply is extremely in short, being serious impediment to economic development.

Therefore, it is most urgent and essential to secure sufficient and stable supply of electricity as the platform for the economic development.

According to a report "preparatory survey for power transmission project in the Federal Republic of Nigeria" by JICA published in 2016, the implicit peak demand for the national grid is estimated at 11.0GW in 2014, and will increase to 16.4GW in 2020 and 23.6GW in 2025. The report also projected High Case with revised assumptions. Under the High Case projection, the implicit peak demand for the national grid will grow from 11.0GW in 2014 to 17.3GW in 2020 and 26.3GW in 2025. The electricity demand for the grid is projected to grow at annual 7.2% between 2014 and 2025 for the Base Case and 8.5% for the High Case.

Furthermore, according to the Lagos State Electricity Board, the electricity demand in the Lagos region is presently 1,250MW, however, the average supply capacity is 650MW, resulting in an absolutely short supply.

Power supply is seriously in short even in the central part of Lagos State, and supply rotation is implemented almost daily. Because of this situation, everybody keeps generator at home and office. Large users of electricity such as large factories and hotels fully depend on their own generators, without depending on the grid, in consideration of the quality of electricity. As result of this it increases cost of living as well as air pollution due emissions from generators.

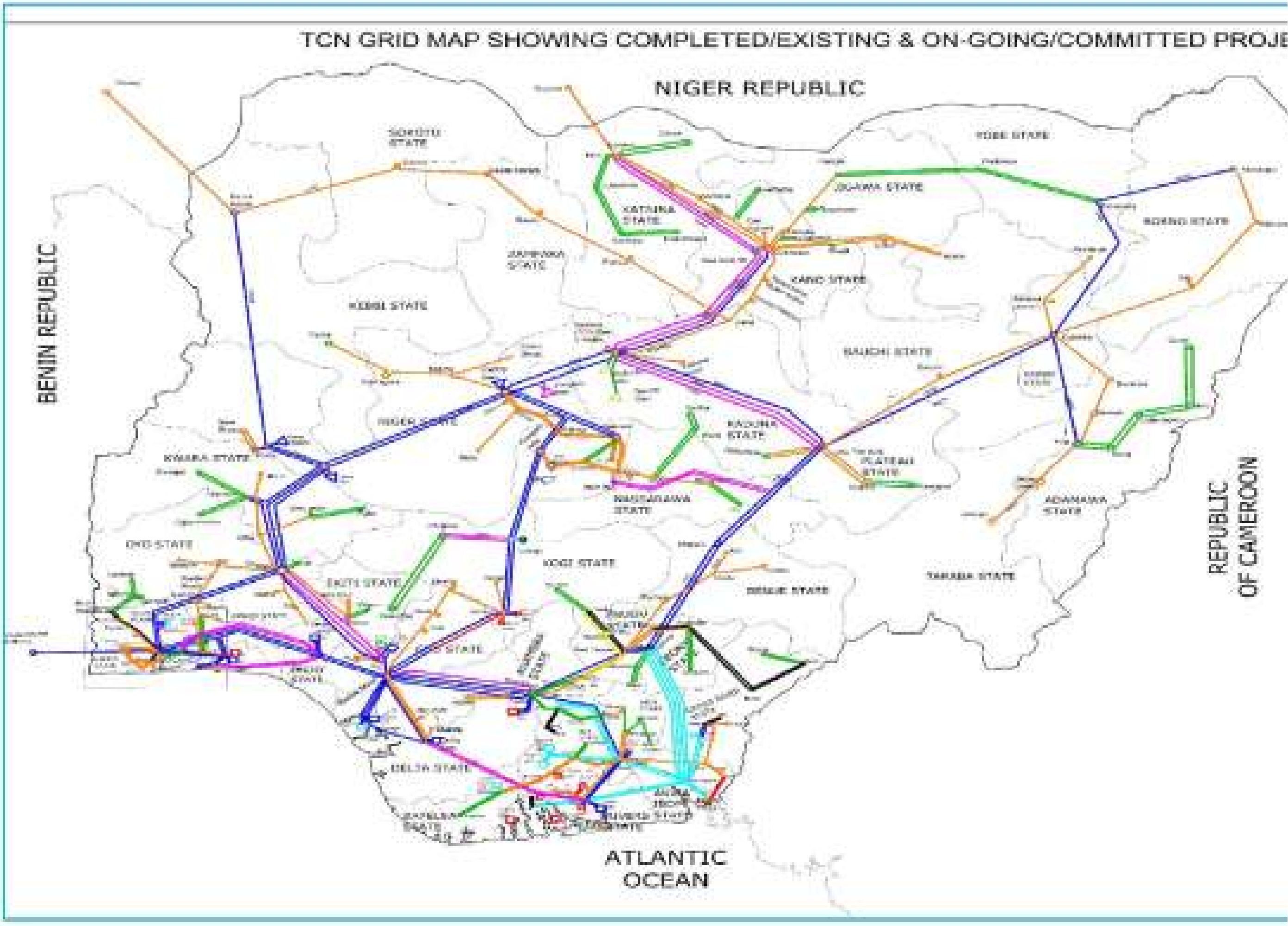
Since the central part of Lagos State is already fully developed with commercial and industrial facilities, the megalopolis is now expanding to the periphery under a policy of "Decentralize the Large City," to the east, Lekki, to the west towards Badagry, and to the north towards Ogun and Oyo States.

2.2 Benefits of the Project

Energy is the raw material needed to fuel any country's economy growth. *"Energy is the golden thread that connects economic growth, increased social equity and a healthy environment. Sustainable development is not possible without sustainable energy,"* -UN Secretary-General Ban Ki-moon.

The benefits of this project for the people of Lagos and Ogun State in particular, and the economy of Nigeria in general are numerous. The following few are worth mentioning;

- Improved and more reliable electric power supply.
- Enhances productivity and efficiency in both public and private organizations
- It helps to develop and promote small, medium, and large-scale enterprises thereby creating direct and indirect employment opportunities.
- It helps to improve the security of lives and properties.
- General contribution to climate change through overall reduction of the used of personal power generating sets.
- General improvement of the standard of living for the populace.



a. ***Figure 2.1*** ***Existing, On-Going and Completed Transmission and System Operation Infrastructure***
Source: TCN, 2016

2.3 Envisaged sustainability

Some factors are important to consider to reaching project sustainability. They are related to practical aspects related to economic profitability, technical resources, and all, with an efficient management. With the growth in electricity demand that has occurred over the last decades, adequate and reliable energy supplies are important to economic development. Additional energy resources, including electricity generation and share, as well as infrastructure improvements, are key. Consequently, the investments which will be carried out should be useful primarily economically speaking, for the supply of the local load.

2.3.1 Technical Sustainability

The proposed project shall be technically viable because, it is professionally designed,the technology employed is readily available. It shall also employ adequate and qualified manpower with several years of experience in similar project during execution to ensure adequate implementation.The proposed route selection has also considered the accessibility for maintenance works after commissioning.

2.3.2 Economic Sustainability

The proposed transmission line project shall be economically sustainable because the proponent is seeking to finance the projectthrough a loan by JICA. Talks has reached advanced stage. Also, there is high demand of the power and the Return on Investment (ROI) is long term but surely high, to ensure effective pay back of the loan in line with loan agreement.

2.3.3 Environmental Sustainability

The line routes and the substation sites has been carefully selected by considering sensitive ecosystems along the proposed PTL route and to avoid built-up areas as much as possible. In addition, practical mitigation measures have been proffered for the identified environmental impacts of the proposed PTL project and TCN is fully committed to comply with the relevant applicable national environmental laws, applicable international conventions and world bank environmental safeguard policies. Furthermore, TCN is also committed toimplementing the ESMP developed to further guarantee the environmental sustainability. TCN has full department that handles environmental matters. The HSE department is headed by a General Manager who reports directly to the CEO. Significant number of ESIAs and environmental audits have been conducted in the past by TCN. Hence, they have the technical skills needed to manage the mitigations that are determined for the identified impacts of this project.

2.3.4 Social Sustainability

The project has secured its first social license – the host communities' acceptance of the proposed project their eagerness to see it succeed. The proposed transmission line project shall create job opportunities for unemployed indigenes and Nigerians.

In addition, TCN is committed to effective and continuous stakeholders' engagements and consultations and effective implementation of the RAP.

TCN is committed to comply with applicable national social laws, relevant international conventions and World Bank social safeguard policies. Furthermore, TCN has a Social Specialist as a member of the PIU, but will require training on World Bank involuntary resettlement policy as well as the new environmental and social management framework

2.4 Project Alternatives

2.4.1 Project Options

- Do-Nothing' Option

The first project option considered was the 'do-nothing' option. This option would result in in the continuation of the shortage of electricity supply, which has also been inefficient, inadequate, and unreliable. The use of domestic and industrial generators to power homes, offices and industries will escalate. And this will result in increased gaseous emissions with its associated health effects as well as increased greenhouse gas effects. Furthermore, economic growth will be stifled. Therefore, this option was rejected.

- Comparison of no-project option and the socioeconomic environment

The no-action alternative is crucial in the assessment of impact and is often defines the base case information because other alternatives are weighed with reference to it. Without the project, the environmental situation in the project area will neither improve nor remain same in the long run. We can rather say that the environment will necessarily deteriorate. In the short run, disruptions of the activities of people in and around the transmission line route will occur during construction. However, these will be will managed. Moreover, compensation for these will eliminate the undesirable short-term impacts.

This option also means that there will be no occurrence of harmful incidents arising from malfunction or interference with the normal working of such electric power.

This no-projection option may however lead to the following (general) major negative and long term impacts:

- The targeted consumers will continue to suffer from shortages or unstable power supply, especially as demand and population grows.
- Generation of employment opportunities through expansion of business activities that would have been spurred by availability of electric power will not occur.
- Back fall of economic and industrial activities which is dependent on adequate electric power supply
- Information flow and public education awareness through electronic media, especially the television, will have been hampered.

- The federal government will be seen to have reneged on its promise to provide electric energy to more of its citizens through and working towards achieving vision 2020.
- There will be loss of productivity and reduced ability to create wealth.

Comparison of the negative as well as the positive impacts of the proposed project clearly indicates that the long term positive effects of the proposed project would far outweigh the negative ones. The negative effects arising from the project can easily be mitigated.

- Delayed Project Option

This would arise if a situation of civil unrest, or public opinion is against the development, or the socio-economic and cultural impacts of the project are not favourable, given available mitigation options. This would mean that all planning and development activities would be stalled until conditions are more favourable.

This option would therefore delay access to more reliable electricity and slow down investments in generation plants, since power evacuation is delayed. The use of domestic and industrial generators to power homes, offices and industries will also be prolonged. And this will result in increased gaseous emissions with its associated health effects as well as increased greenhouse gas effects. Therefore, this option was rejected.

- Project Implementation Option

The third option considered was the execution of the proposed project as planned. This option was accepted because it will de-bottleneck the grid around thelargest demand center of Lagos and provide a more secure and reliable energy supply with all the benefits listed under Section 2.2.

2.4.2 Analyses of Alternatives

2.4.2.1 Design/ Technology Alternatives

A) SUBSTATIONS

a. Gas-insulated Substation (GIS)

This technology is described in chapter 3 [section 3.10.1 (ii)]. It has the advantage of needing a little space, where land availability poses a challenge but much more expensive than the AISdue to its technology. However, due to the location of the substation in a local area, there are available space for the location of the substation.

b. Air-insulated Substations (AIS)

This technology is described in chapter 3 [section 3.10.1 (i)]. It has the advantage of being less expensive than the GIS although needing more space. This is the more economical alternative, where land is available.

c. Hybrid

This technology combines the advantages of being less expensive than the GIS with needing less space than the AIS.

The option to be used for the project is the air insulated technology, because the size of land for the substations can contain it with land still available for future expansion.

B) LINES

a. Number of Circuits Alternatives

This presents the alternatives of using the single-, double-, or multi-circuit transmission lines.

- The single-circuit (SC) TL combines the immediate advantage of low construction cost with maintenance convenience, although it becomes more expensive on the long run, requiring more land take for corridors. This alternative was rejected entirely.
-
- The multi-circuits (MC) TL requires the least space for corridor per unit power transmitted than the SC and DC TLs. It is the highest initial capital outlay, although eventually, the most economical. However, in the event of need for maintenance, power outage has farther reaching impacts on consumers than both SC and DC TLs.
- The double-circuits TL minimizes land take per unit power transmitted than the SC, requires more initial cost than the SC but it is more economical, eventually.
- Furthermore, multi circuit tower is utilized for a length of about 6.94km on the 330kV line. This is from Ejio substation to the crossing of the single circuit Osogbo to Ikeja West at Sojuolu Town. This is necessary because it is difficult to cross lines of the same voltage, hence, the Osogbo to Ikeja West line will be looped in and out of the Ejio substation utilizing the same towers with the Ejio to Ajegunle line.

b. Towers Types (Tubular / Lattice) Alternatives

There are two basic tower types, namely the tubular and the lattice steel towers. The choice of tower type was based on considerations of available corridor width and cost. The tubular towers are more compact than the lattice type, requiring shorter width but shorter spans and therefore more number of towers. Against this background, therefore, the lattice type will be used for the entire 330kV DC line.

c. Underground versus surface transmission Alternatives

The underground transmission is very expensive and is often necessary where there is not enough land for the required corridor for the surface tower infrastructure. It is also aesthetically wholesome and reduces environmental risks and impacts. On the other hand, the surface transmission alternative is cheaper, easier to construct and maintain and equally

sustainable when all identified impacts and risks are eliminated or minimized. Hence surface transmission was selected.

2.4.3 Site and Line Route selection technical/Social/Economic Criteria

In the course of determining the best alternative for the transmission lines route for the proposed projects, at least four (4) routes were considered for each transmission line. To ensure an economic, technical and environmentally friendly option, the following points are taken into consideration during this analysis.

- The terrain should be as even as possible and steep slopes and mountainous should be avoided. The steep gradient of the approaches should be avoided. The approach roads for construction and maintenance should not involve, major activity which would be costly and delays the project.
- To the extent possible, the line should have proximity for approaches like roads preferably parallel.
- The route should preferably not pass through forests if not possible to do so it should be kept at bare minimum
- No human habitation, utility services like play grounds schools etc. should be disturbed due to the transmission line.
- Monument of cultural or historical importance, sanctuaries, national park etc., should be avoided.
- The wetlands, lakes natural river courses should be avoided or should have minimum crossings.
- The power line crossings and telecommunication crossing should be minimized.
- National highway and railway crossings, if unavoidable should be perpendicular to the line route.
- The densely populated areas, good farming areas, gardens, plantations should be avoided were possible.

2.4.3.1 Criteria for Route Selection

The criteria used for the selection of the best line route for this project is based on the technical, economic, social and environmental considerations along the line route options. These are described as follows

a) Technical/Economic Criteria

i) What is the proposed shortest distance between the pre-determined sub-station?
ii) Is the route near roads for easy approach & accessibility during construction and maintenance of the line?
iii) Does the transmission line pass through tough inaccessible areas and where?
iv) Is the future load near the proposed route so that the line can be easily connected?
v) Is the line aligned suitably so that it can be diverted / looped in looped out (LILO) to cater for possible future loads / substations along the route?
vi) What is the separation distance from the parallel communication lines (telephone, communication, signalling lines, circuit of the communication, etc.) if any?

vii) Does the transmission line cross any railway tracks or pass near any railway station?
viii) Does the transmission line pass near any aerodromes /airports / airstrips / helipads? If any, what is the distance of clearance allowed?
ix) Does the proposed line cross any existing power lines? If any, what is the voltage of the existing power line?
x) Any other notable issues?

b) Social Criteria

i) Does the line pass near towns and villages? If so, what is the distance margin that is allowed?
ii) Does the line pass through wooded areas with high trees or fruit bearing trees involving payment of heavy compensations for cutting of the trees?
iii) Does the line pass through areas which involve risk to human life, damage to public & private properties, religious places, cremation grounds, quarry sites and underground mines, gardens, orchards and plantations?
iv) Does the line pass through rifle shooting areas and other protected areas such as army / defense installations and ammunition depots? Please indicate if any.
v) Does the line pass through buildings / storage areas for explosives or inflammable materials, bulk oil storage tanks, oil or gas pipelines, etc.? Please indicate if any.
vi) Any other notable issues?

c) Environmental Criteria

i) Does the line pass through areas subject to floods, gushing streams during rainy seasons, tanks, ponds lakes, etc. and natural hazards? Please indicate if any.
ii) Does the proposed transmission line pass through any forest? What is the length covered?
iii) Does the line pass through swaps and shallow lands subject to flood, marshy areas, low lying lands, river beds, and earth slip zones, etc. involving risk to stability to foundations? If any, indicate the distance covered.
iv) Does the line pass through high hillocks / hilly areas / sand dunes and areas involving abrupt changes in levels and requiring too many long spans?
v) Is the route direct for the hilly/mountainous type of terrain or in thickly populated areas, if not so, what is the angle allowed?
vi) Does the line pass through a series of irrigation wells?
vii) Does the line pass through areas which will create problems of right of way and way leaves? Please indicate if any.
viii) Any other notable issues?

2.4.4 The Alternative Line Routes

Line route alternative analysis is targeted to determine a final corridor route based on the criteria listed above. JICA have also proposed the best route corridor for each of the transmission line under consideration but those JICA options have been modified based on technical, economic, social and environmental consideration during the line route study.

Table 2.1 to 2.3 below shows the transmission line corridor matrix for the different options considered during the line route study and the options considered by JICA study.

Table 2.1 Alternative analysis 1: Section between Ejio and Olorunsogo Substation

		JICA OPTIONS		CONSULTA	
		Route 1	Route 2	Route 1	R
Description		Straight route with the lowest construction cost. Crossing with the existing line at two points.	It runs along the existing line and part of way leave is shared.	It runs along the existing line and shares way leave. The line route is longer because of consideration of the actual substation orientation (orientation 2) of the substation layout.	It runs alon line. The lin smaller thar proposed le consideratio substation c
Distance (km)		12	12.9	12.9km	12.5km
Social Aspect	Number of Buildings in Way Leave (Estimated)	2	0	0	
Natural Aspect	Access Road	Some existing roads are present, but construction of access roads may be necessary in some areas.	Some existing roads are present, but construction of access roads may be necessary in some areas.	Share way leave with existing transmission line, existing roads will also be used, however construction of access roads may be necessary in a few areas	Share wa existing tr existing ro used, howe of access necessary ir
	Land Use	Farmlands, vegetation, existing transmission line	Farmlands, vegetation	Farmlands, vegetation	Farmlands,
	Impacts on Natural Environment	Some vegetation needs to be cleared. No difference from the other route.	Some vegetation needs to be cleared. No difference from the other route.	Some vegetation needs to be cleared. No difference from the other route.	Some veget cleared. No the other ro

	JICA OPTIONS		CONSULTANT OPTIONS		
	Route 1	**Route 3**	**Route 1**	**Route 2**	**Route 3**
Geographical Conditions (Topography, ground stability, etc.)	None in particular	None in particular	None in particular	None in particular	None in particular
Natural Disaster Risk	None	None	None	None	None
Technical Aspect	At the crossing points with the existing line, stopping power is inevitable during construction.	Since the line does not cross with the existing line, there is no need to stop power during construction.	No transmission line crossing, high way leave economy	No transmission line crossing, high way leave economy	No transmission line crossing, high way leave economy
Cost	●	●	●	●	●
Recommended Route				●	

Cost Legend
● = Most Expensive
● = Second most expensive
● = Moderate
● =Second least expensive
● = Least Expensive

Reasons for the Recommended Route

Optimization of the line route was done by comparing the best approach of the line route entry into Ejio Substation (orientation 1) bearing in mind that there are other several lines which will come into the substation whether now or in future. Our substation expert prepared the draft orientation of Ejio Substation taking into consideration several options for the incoming and outgoing 330kV and 132kV lines before we arrived the optimal line route entry.

The JICA option cannot be used because it did not consider the entry point of this line into Ejio substation. The recommended option after critical analyses of the content of the above route matrix is consultant route 2. This option provide effective use of the land space between the existing 330kv DC Ejio - Olorunsogo line thereby making the free land space to be together in one place. This is so important for risk assessment management of the communities along the line route. Keeping the line route together along the same route, so that any village is not left in-between two high tension line. It also create room for corridor for future expansion of Ejio substation because there will be corridor for future incoming line which will not be too possible if consultant route 1 & 3 are being used. Route 2 also reduces the cost for procuring tower members because it has a reduced number of angle points compared to Option 1 and 3. Route 2 is also more accessible than all other option when we compare in terms of length of access roads to the line route and obstruction on the route.

Route Variations from JICA proposal

In absence Ejio substation layout, all line proposed in JICA proposal were terminated in some places which can't be match with substation configuration (from point of substation design),for this line, the following variations occurred.

i. JICA's 31-5 is on the pipeline but our proposed route between AP1 – AP4 takes into account avoidance of built up areas fig (2.2), crossing pipeline and railway line at almost 90 degree

ii. JICA's 31-2 and 31-5 crosses the pipeline in almost perpendicular way which is not the best practice while crossing a pipeline. But our proposed route crosses the pipeline at almost right angle (AP6 – AP7) (fig 2.2).

iiiJICA option is 12.9km while our option is 12.5km.

Fig 2.2: Ejio to Olorunsogo transmission line route alternatives

Table 2.2: Alternative analysis 2: Section between Ejio and New Abeokuta Substation

		JICA OPTIONS		CONSULTANT OPTIONS	
		Route 1	Route 2	Route 1	Route 2
	Description	Straight route with the lowest construction cost	It goes along the existing main road and shares way leave with Component 32-2/-3 Route 3.	The route passed all built up areas, and also considered the orientation of Ejio substation.	The route is shorter than JICA options because it maintained a straight line towards Abeokuta, it bypassed all built up areas, and also considered the orientation of Ejio substation.
	Distance (km)	34.6	37.5	38.9	35.38
Social Aspect	Number of Buildings in Way Leave (Estimated)	13	15	5	4
Natural Aspect	Access Road	Some existing roads are present, but construction of access roads may be necessary in some areas.	Some existing roads, including the main road, are present by substations, but construction of access roads may be necessary in some areas.	Require construction of access roads in some areas, Existing road are present but less than proposed JICA option	Require construction of access roads in some areas, Existing road are present but less than proposed JICA option

Land Use	River, farmlands, vegetation, small settlements	Farmlands, vegetation, small settlements	Farmlands, vegetation, small settlements	Farmlands, vegetation, small settlements
Impacts on Natural Environment	Some vegetation needs to be cleared, if access roads are required. Some impacts on the Ogun river.	Some vegetation needs to be cleared	Some vegetation needs to be cleared but reduced environmental impact compared to JICA proposed route	Some vegetation needs to be cleared but reduced environmental impact compared to JICA proposed route
	JICA OPTIONS		**CONSULTANT OPTIONS**	
	Route 1	**Route 2**	**Route 1**	**Route 2**
Geographical Conditions (Topography, ground stability, etc.)	Crossing the river at several points. Considerations on tower locations, design, construction methods are required.	None in particular	Few Marshy areas along the line. Foundation design and access road strengthening in this areas.	Few Marshy areas along the line. Foundation design and access road strengthening in this areas.
Natural Disaster Risk	Some risks to towers to be considered if the river is flooded.	None	None	None

Technical Aspect	No difference from the other alternative.	No difference from the other alternative.	No difference from the other alternative.	Reduced construction cost due to shorter line length compared to JICA proposed route
Cost	●	●	●	●
Recommended Route				●

Cost Legend
● = Most Expensive
● = Second most expensive
● = Moderate
● = Least Expensive

Reasons for the Recommended Route

Consultant routes 2 have reduced number of angle points compared to JICA routes and other Options. This results in the reduction of cost for procuring tower members. Route 2 also have the shortest length of transmission line thereby reducing the cost of transmission line conductors and other line material required to construct the line. JICA recommended option cannot be implemented because the route study did not consider the line route entry corridors into Ejio substation. Consultant route 2 also create room for future expansion of Ejio substation because there will be corridor for future incoming line which will not be too possible if route 1 is used. Therefore, the recommended option for this transmission line is consultant route 2.

Route Variations from JICA proposal

In absence of Ejio substation layout, all line proposed in JICA proposal were terminated in some places which can't be match with substation configuration (from point of substation design). In all, the objective of every project is to minimize cost and have an effective way for maintenance purposes; this is what our route has been able to achieve compare to JICA option. The variations from JICA proposed route is as follows;

- Our preferred option 2 (AP1 – AP5) passes through a save environments with reduced impacts on the environment while JICA 28-1 to 28-2 passes through very built up areas (fig 2.3).
- JICA option 28-1 was position in an area with incorrect position for line route entry into the substation while our preferred option(AP1) route passes through the well-arranged substation orientation plan /scheme (Fig 2.3).
- There are too many sharp angles in JICAs option which will lead to an increase cost of materials e.g. 28-3, 28-5, 28-6 and 28-7. While all our angle points (AP5, AP6 & AP7) are position in such a way that we have a minimum deflection angle at every turning.
- JICA's route crosses an existing NIPP line route at 28-6 & 28-7 while our route option did not. Our route is position (AP7) at a distance from the substation switchyard in such a way that we can move around in future to accommodate a route entry.
- Our proposed route length is 35.38km while JICA's option is 37.7km.

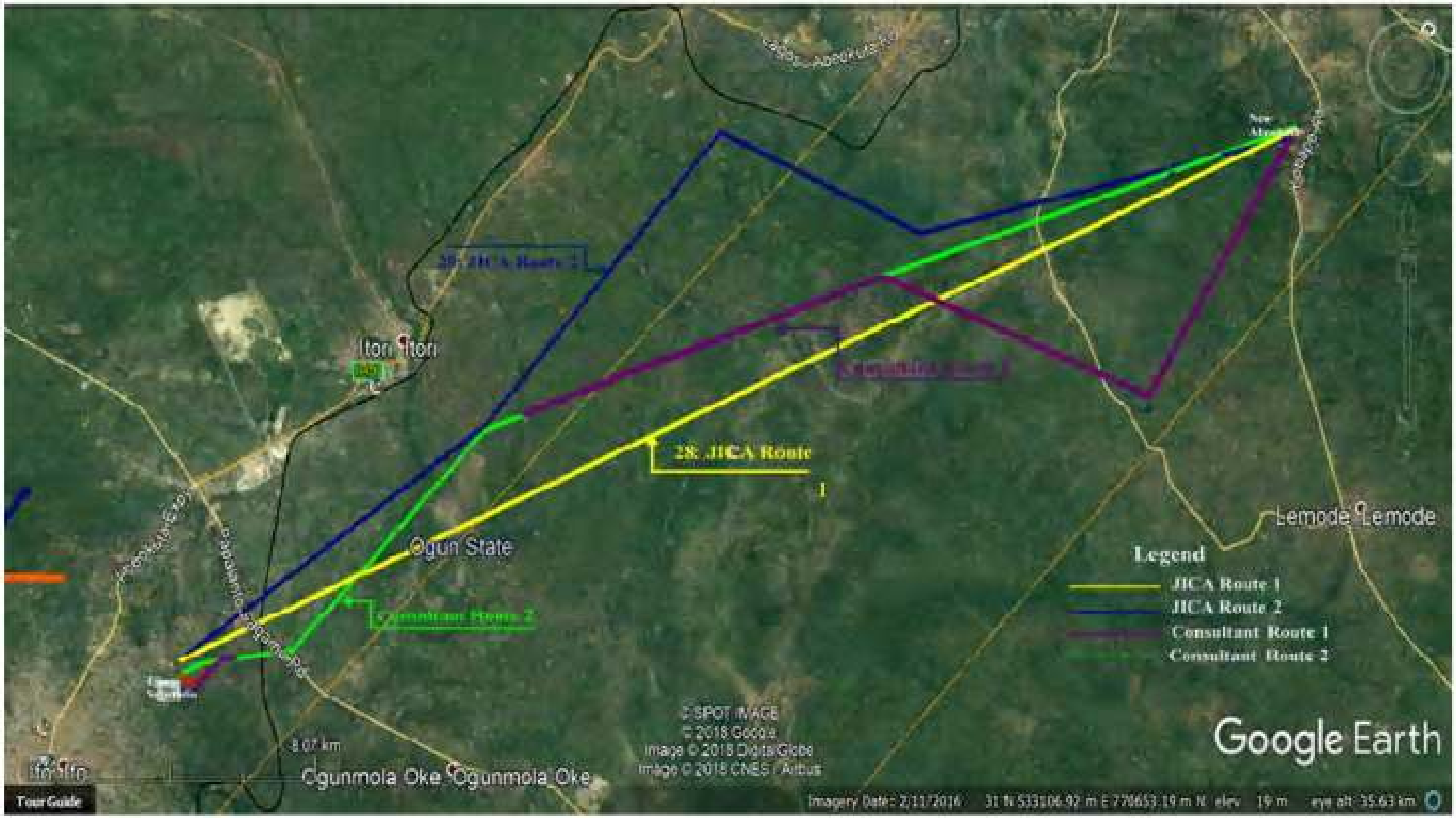


Fig 2.3: Ejio to New Abeokuta transmission line route Options

Table 2.3: Alternative analysis: Section between Ejio and Ikeja West-Osogbo line

		JICA OPTIONS			CONSULTANT OPTIONS	
		Route 1	Route 2	Route 3	Route 1	Route 2
	Description	Straight route with the lowest construction cost. It shares way leave for 3km with Component 24, Route 3.	It avoids the Arigbajo town area.	It avoids the Arigbajo town area. It shares way leave for 3km with Component 28, Route 2.	It avoids Arigbajo town and built up areas, also considered the orientation of Ejio substation.	Shares way leave with Ejio to New Agbara (SN 24) line in its entire route, Aviod built up areas and also considered the orientation of Ejio substation
	Distance (km)	5.9 (3km of which is shared)	7.5	8.9 (2.4km of which is shared)	9.466	6.94 (shared the entire route)
Social Aspect	Number of Buildings in Way Leave (Estimated)	1 (without those in shared way leave)	16	24	20	38
Natural Aspect	Access Road	Some existing roads, including main roads, are present, but construction of access roads may be necessary in some areas.	Some existing roads, including main roads, are present, but construction of access roads may be necessary in some areas.	Some existing roads, including main roads, are present, but construction of access roads may be necessary in some areas.	Some existing roads, including main roads, are present, but construction of access roads may be necessary in some areas.	Some existing roads, including main roads, are present, but construction of access roads may be necessary in some areas.
	Land Use	Farmlands, some residential areas	Farmlands, some residential areas	Farmlands, some residential areas	Farmlands, some residential areas	Farmlands, Vegetation, monument (Arigbajo Shrine) and some

					residential areas
Impacts on Natural Environment	Not much vegetation in this area. No difference from the other route.	Not much vegetation in this area. No difference from the other route.	Not much vegetation in this area. No difference from the other route.	Not much vegetation in this area. No difference from the other route.	Not much vegetation in this area.

	JICA OPTIONS			CONSULTANT OPTIONS	
	Route 1	**Route 2**	**Route 3**	**Route 1**	**Route 2**
Geographical Conditions (Topography, ground stability, etc.)	None in particular	None in particular	None in particular	None in particular	None in particular
Natural Disaster Risk	None	None	None	None	None
Technical Aspect	No difference from the other alternative(s)	No difference from the other alternative(s)	No difference from the other alternative(s)	No difference from the other alternative(s)	No difference from the other alternative(s)
Cost	●	●	●	●	●
Recommended Route					●

Cost Legend

● = Most Expensive
● = Second most expensive
● = Moderate
● =Second least expensive
● = Least Expensive

Reasons for the Recommended Route

For the JICA recommended option, the line length is shorter but did not consider the line route entry into the Ejio substation, therefore this option cannot be used. Consultant route 2 surely has a reduced number of angle points compared to consultant route 1. The advantage of this is that the cost for procuring tower members is reduced if this option is used.Option 2 is also more accessible than all other option when we compare in terms of length of access roads to the line route and obstruction on the route.Further, consultant route 2 was also amended in order to further optimise the right of way by accommodating the line from Ejio – New Agbara on multicircuit towers. Route 2 also create room for corridor for future expansion of Ejio substation because there will be corridor for future incoming line which will not be too possible if route 1 is being used. Therefore, after critical analyses of the content of the route matrix based on the economic, social, technical and environmental consideration as outlined in table above, route 2is recommended.

The variation of this line route from the JICA proposed option are;

- The JICA's Option ran through an estate(Lafarge Estate) while our proposed route maneuver through AP5, AP6 & AP7 (fig 2.4)
- JICA's option is ran through a built up area at the beginning and towards the end (24-2 & 32-2/3-2) while our proposed route was able to avoid some densely built up areas (AP1-AP2-AP4, AP4 & AP5). No connection to any line route entry at Ejio but we are able to structure our angle points to emanate from an arranged Ejio Substation Scheme.

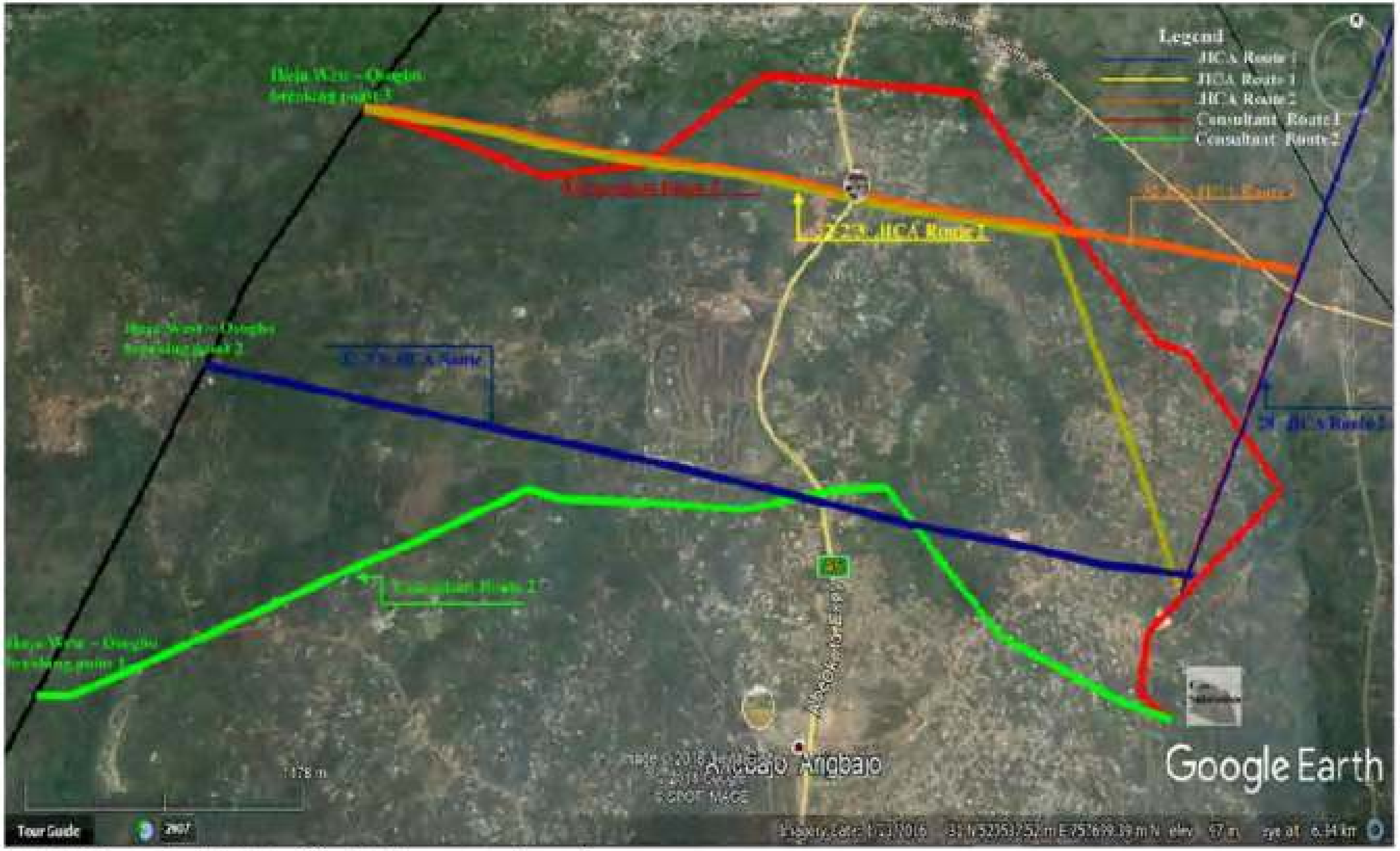


Fig 2.4: Ejio to Ikeja West – Osogbo line route alternatives

CHAPTER THREE

3.0 PROJECT DESCRIPTION

3.1 Introduction

The proposed Lagos and Ogun States Transmission Project is aimed at strengthening the national grid around the country for a more reliable electricity supply. The project is divided into three lots, and this description cover only lot 1 components. This consist of 35.38km 132kV DC transmission line from the proposed Ejio 330/132/33kV substation to the New Abeokuta 132/33kV substation, 12.5km 330kV DC transmission line from Olorunsogo Substation to the proposed Ejio substation and, the turning in-and-out of Ikeja West to Osogbo 330kV SC transmission line through the proposed Ejio substation at a distance of 6.94km.

3.2 Project Phases and Activities

It is anticipated that construction of the transmission line will commence in late 2019 and take approximately 36 months to complete. This does not however show the interdependencies of the activities.

- Phase I: Pre-construction
- Feasibility studies
- Line-route studies
- Environmental and Social Impact Assessment (ESIA)
- Resettlement and Compensation
- Front End Engineering Design
- EPC contract award
- Mobilization
- Check survey of EPC contractor
- Impact Mitigation Monitoring
- Transmission line detail design
- Material production (transformers and accessories, tower members, conductors, insulators, line hardware)
- Material testing
- Material shipment
- Phase II: Construction Phase
- Clear and grub site along transmission lines corridor
- Impact Mitigation Monitoring
- Foundations for tower installation
- Tower erection
- Conductor stringing
- Impact Mitigation Monitoring
- Commissioning and testing
- Reinstating and clean up
- Demobilization
- Impact Mitigation Monitoring
- Ready for handing over

- Phase III: Operations and Maintenance Phase
- Power Transmission
- Maintenance of TL

Compliance Monitoring

- Period Environmental Audit
- Periodic Systems Audit
- Phase IV: Decommissioning/Closure
- Decommissioning Audit
- Dismantling and removal of Structures
- Site restoration

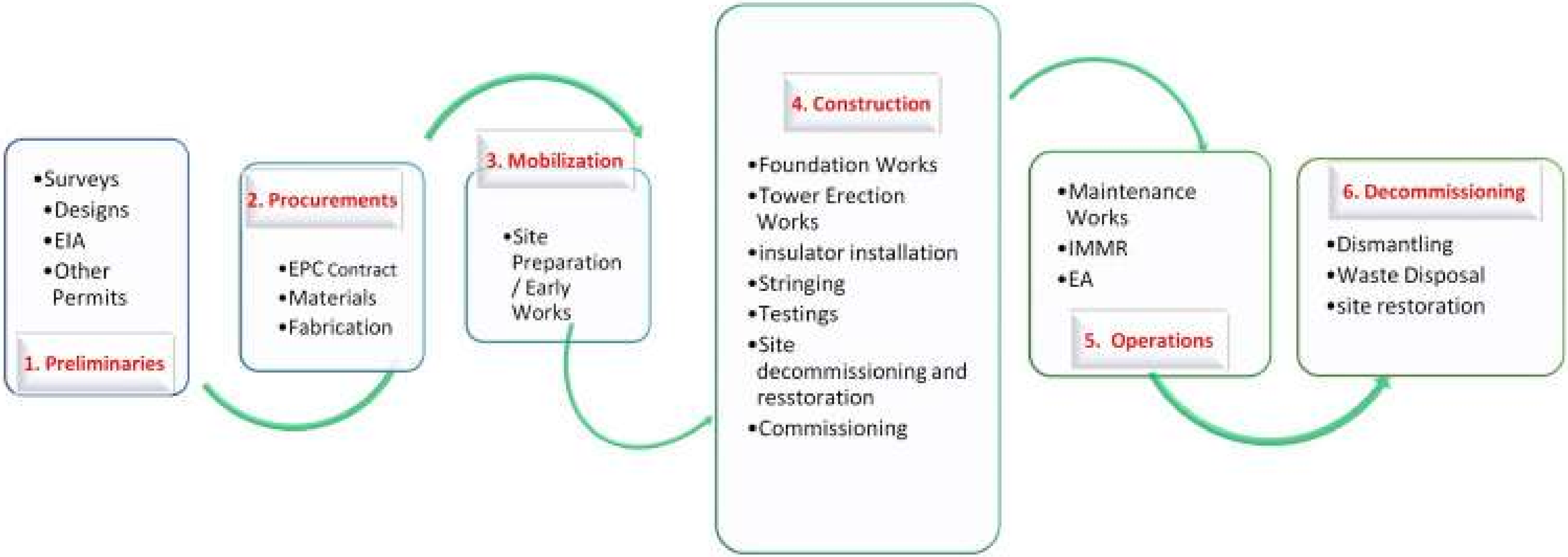


Figure 3.1 Proposed Work Flow Chart

3.3 Pre-Construction Engineering Studies and ROW Acquisition Programme

During Feasibility studies, several site studies have been performed to be used as indicators and basis for engineering works. These studies are considered as preliminary studies and no claim on completeness of these documents can be raised. For detailed engineering, information given herein and described in the reports will be considered during detail design and construction works.

- FEED
- Topographic Survey
- Crossing Study
- Conceptual Design of Transmission Line

3.3.1 Centre - Line and Topographical Survey

Topographical survey has been performed on site. The site is generally flat, with gentle slope/elevation along the line route (see fig 3.3.). According to the results of the topographic survey the TL route and ROW are determined. Road crossings, TL crossing and determination of structures in the TL have been performed according to topographic survey results. All topographical survey works included the establishment of any survey control, needed in addition to the existing survey control.

The complete topographic information for the survey areas use a maximum point interval / grid spacing of 25 m to describe the current local conditions in acceptable accuracy. The locations and elevations of the following minimum scope of data have been determined:

- All topographic surface information and features (high / low points, break lines, streams, river banks, swamps, vegetation, etc.);
- All man-made, civil structures (roads, tracks, buildings, foundations, walls, fences, etc.);
- All existing third party facilities (piping, cabling, process installations, telecom, power lines, utility markers etc.);
- All geotechnical points to be set out / surveyed;
- Temporary access roads, camp sites, fabrication-/storage yards, as required.

A routing team consisting of environmental, a geotechnical engineer, and ROW experts has explored the area of the presently foreseen route. Upon their identification of the area's suitability, navigational positioning marked a preliminary route.

Referring to the evaluation results, the final route has been confirmed on site during a second routing campaign. The centre-line got marked. However, in sections, where the centre-line approximates any constraints, the required minimum clearances have been assured. The route maps have been updated, now showing the confirmed route and being reference for the subsequent route clearance from vegetation.

Upon confirmation of the final TL route the following were performed:

- Clearance of the route from vegetation over a corridor width of 1.5m to 3.0m;
- Establish required survey control along the TL route;
- Set-out and permanently mark the centre-line at an accuracy specified for the TL;

- Survey a longitudinal profile of the centre-line, with specific focus on high / low points, start / end of swamps, road, and water crossings;
- Survey all special points not limited to structures, buildings and obstacles 30m (for 132kV) and 50m (for 330kV) either side of centre-line to meet NESIS/TCN standards for horizontal clearances;
- Capture additional topographic data at tower locations (15m x 15m), dedicated for towers (and definition of leg extensions);
- Update and finalize the route maps by adding all the above survey data.

3.3.2 Width of ROW

TCN typically use 30m as ROW width for 132Kv lines and 50m for 330kV overhead transmission linesas specified by NESIS. Factors considered include space to accommodate the lattice tower (wire zone) and safety buffer zone to provide safe limits for electromagnetic radiation as well as tower collapse.

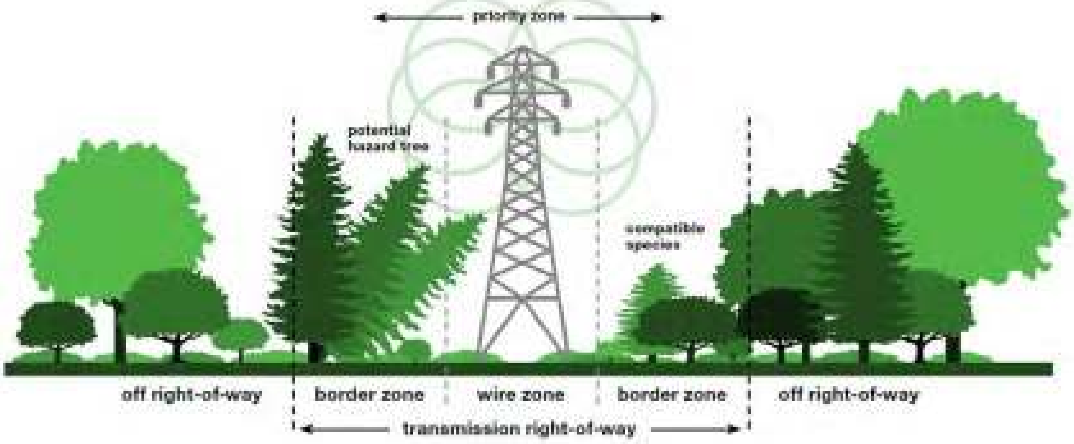


Figure 3.2: Transmission Right of Way

3.4 Construction Activities

The construction program will have several discrete activities and these are described below. The specific pattern of construction activities will generally follow this sequence although some activities may be carried on concurrently.

3.4.1 Campsites / Logistics Bases

Campsites / logistics bases will be located at and adjacent to the substation locations at Ejio, Olorunsogo and New Abeokuta. Material storage during the construction of the lines will be restricted within the acquired ROW. The campsites / logistics bases at these locations will be required only for storage and fabrication, while workers shall be accommodated in existing hotels around the area.

3.4.2 Access Track Repair / Upgrade / Construction

Access to each structure location will be required for a crane, elevated platform, trucks transporting the materials and construction equipment, materials, and vehicles. Access will also be required to temporary sites needed for storing conductor drums, winching and braking equipment during the overhead earth wire stringing.

Apart from the existing community tracks (where they exist) which none in current condition will accommodate larger equipment necessary for the construction activities, several access tracks for the construction work will be require repair and existing ones upgraded. There are several specific locations where tracks and swamp crossings will require upgrading or access re-evaluated. These upgrades will be identified during detailed design and form part of the construction contractor's responsibility. Recommendations have been made where significant or important vegetation communities exist will be re-grown. These recommendations form part of the development project, as described in the ESMP.

The entire line route corridor has adequate existing roads and tracks that can be used to access it. Hence, new tracks will be constructed only where necessary. Any new access road to be constructed upgraded will be limited to 5m, while tracks to be constructed under the line is limited to 3m. These will be used during construction and maintained for maintenance purpose. However, final route of access road will be determined in consultation with the landowner, giving consideration to environmental impacts. Where new tracks are required, road plant may be used to construct the track and for final trimming and construction of drains. Fig 3.3 shows the existing access roads and marshy areas along the transmission line.

Some tracks will need to be constructed in soft or swampy ground and additional foundations may be required to accommodate the expected vehicle movements. This is required particularly for the lines approaching Ikeja West to Osogbo line and New Abeokuta line. Fig 3.3 shows the major crosses of the transmission line. In fig 3.4, the line routes survey plan of all the three transmission lines understudy are shown with the longitude and latitude of the Angle Points (AP's) of the line routes. In fig 3.5 to 3.7, the satellite imagery of the line route are displayed.

There is no specific need for continuous access along the entire route of the transmission line, although continuous access generally provides the simplest and least extensive method of access to individual structures and the proposed easement area. Access tracks will be upgraded progressively as construction works progress.

Erosion and Sediment Control measures for all works will be implemented, in accordance with the respective regulatory standards. EPC contractors shall prepare an Erosion and Sediment Control Plan (ESCP) in accordance with regulatory standards and submit to FMEnv. for approval prior to the commencement of works and maintain same during works. Measures may include installation of silt fences, straw bales, and drains. It is TCN's policy that the tracks be maintained in a condition suitable for the construction work until the completion of the works. The tracks are then maintained to ensure maintenance and inspection works can be undertaken during operation of the transmission line.

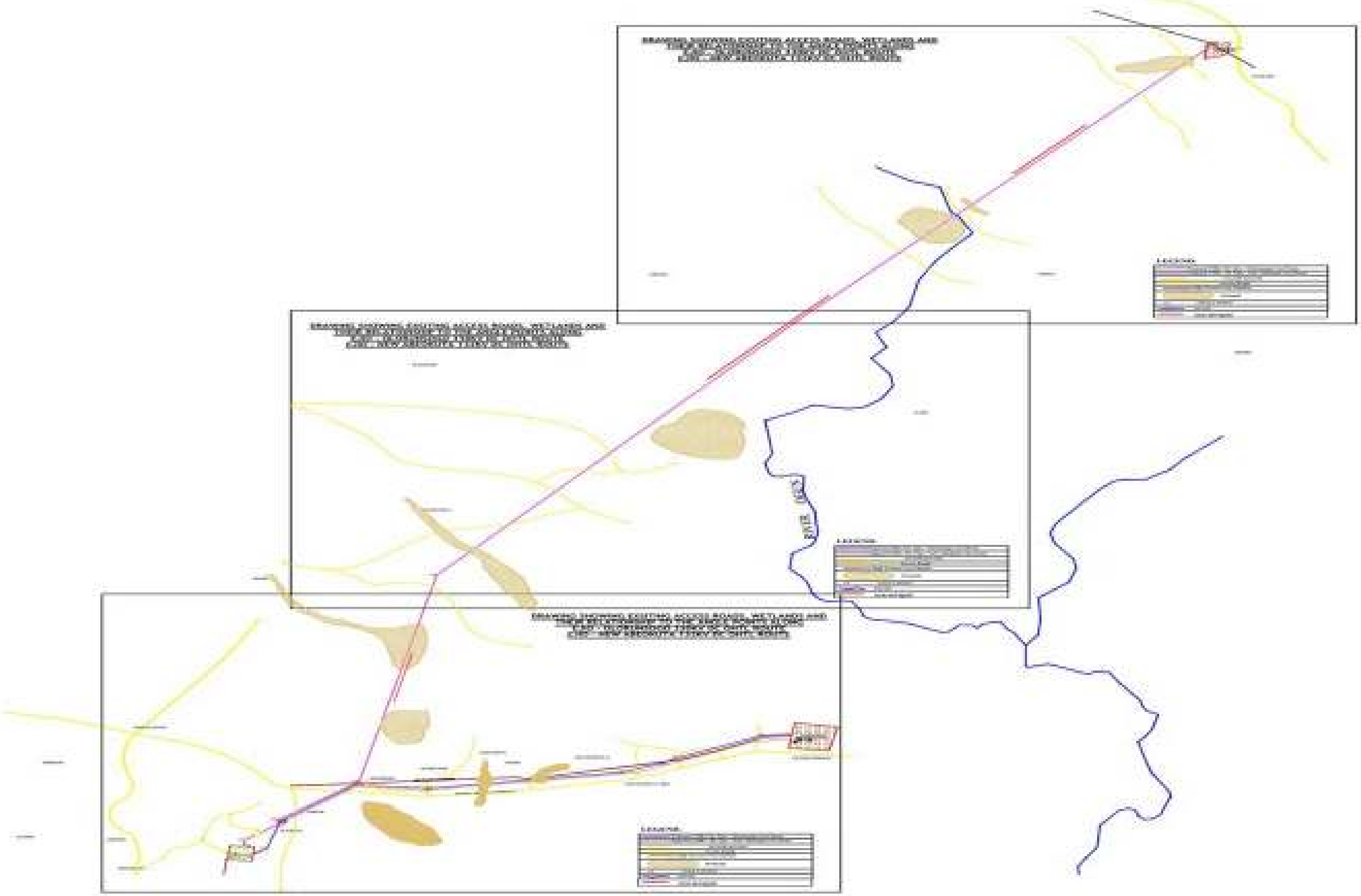
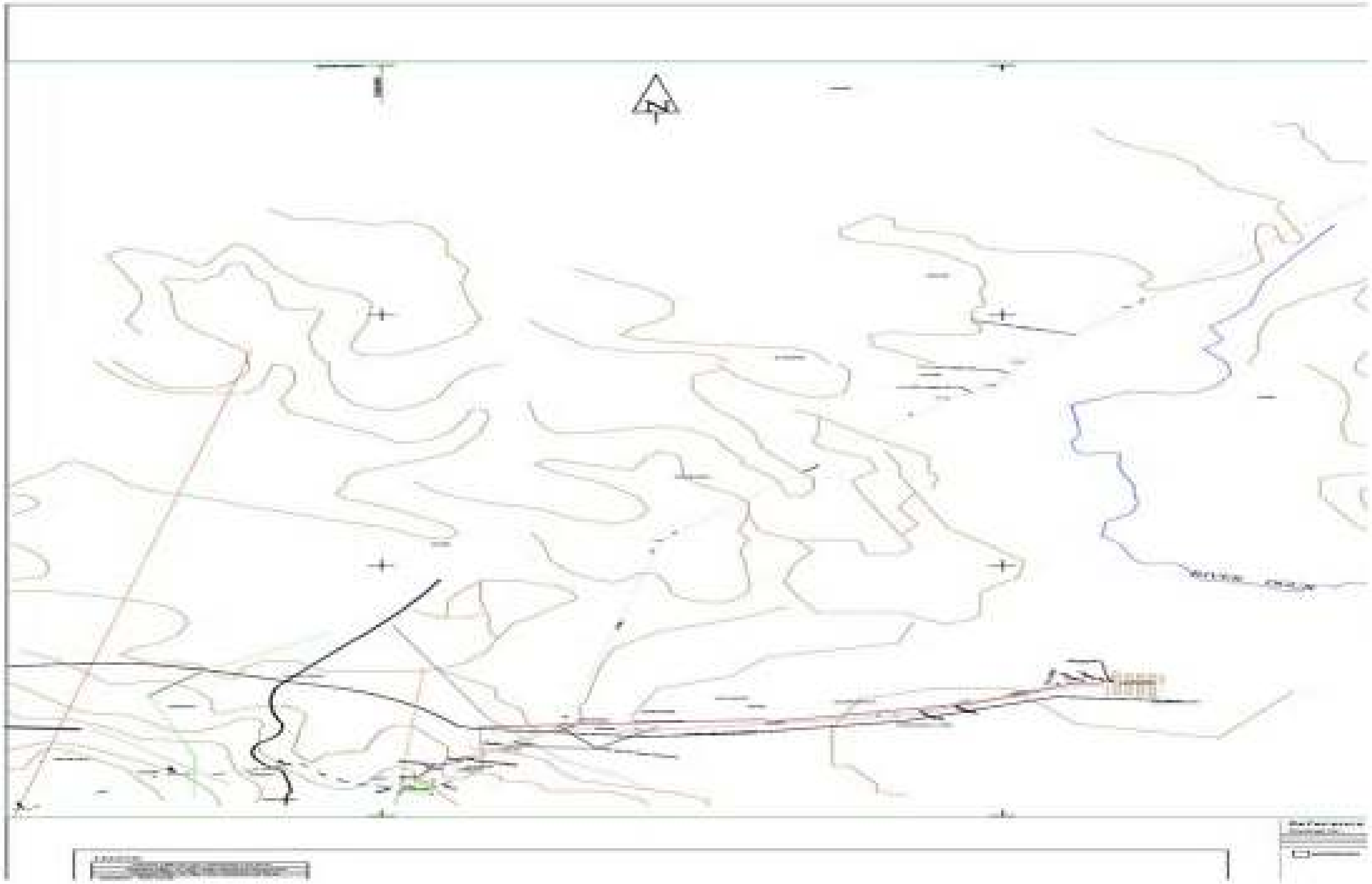


Figure 3.3: Drawing showing access roads and new access roads recommended for construction



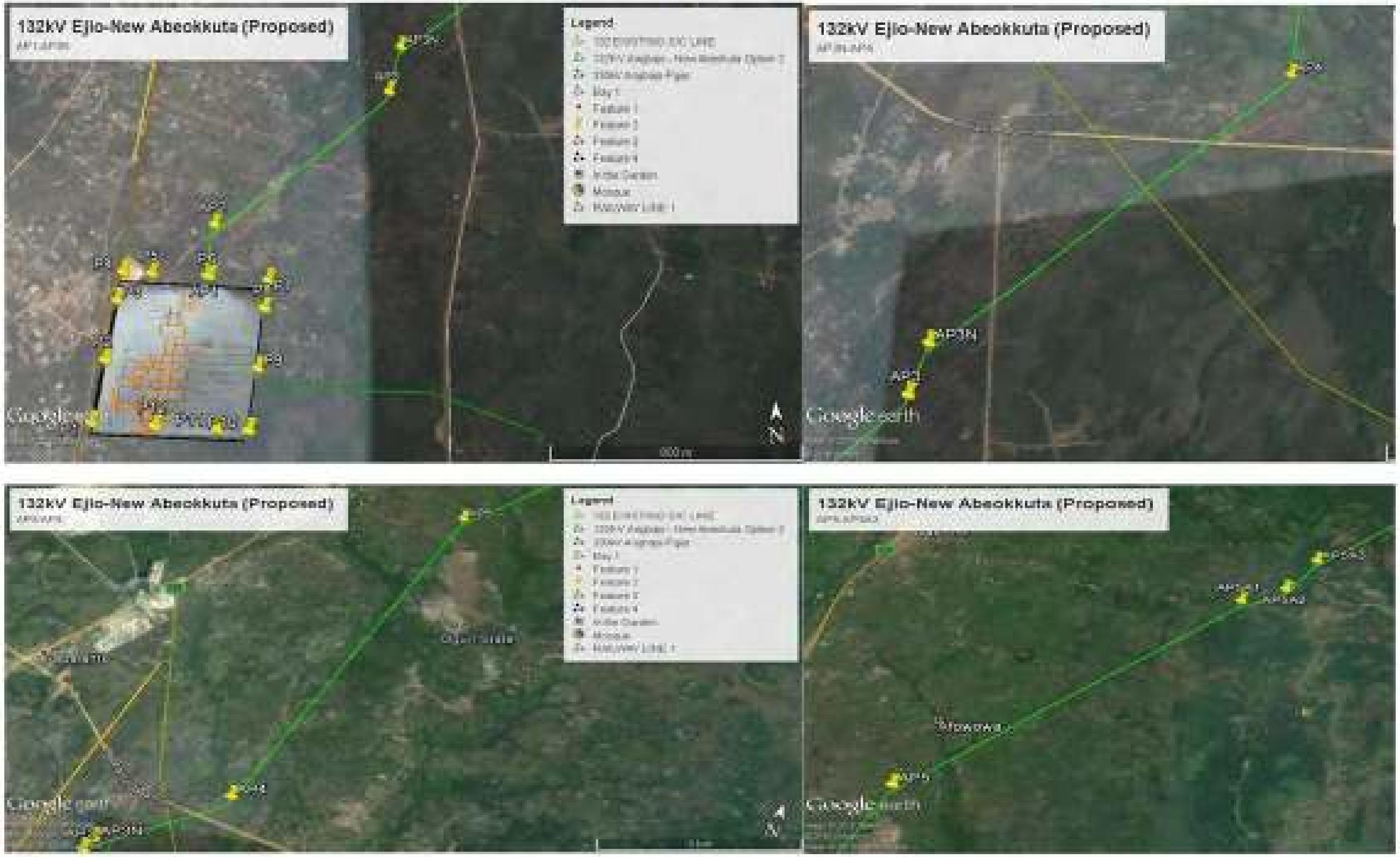

330kV Ejio-Olorunsogo Line route Option 2-proposed
Legend
Google earth


330kV Ejio - Olorunsogo (Proposed)
Google earth


330kV Ejio - Olorunsogo (Proposed)
Legend
Google earth


PROPOSED 330KV EJIO - OLORUNSOGO LINE ROUTE ENTRY
Google earth


330kV Ejio - Olorunsogo (Proposed)
Elevation profile


132kV Ejio-New Abeokkuta (Proposed)
Legend
132kV Ejio-New Abeokkuta (Proposed)
AP3N
AP3
Google earth
132kV Ejio-New Abeokkuta (Proposed)
Legend
132kV Ejio-New Abeokkuta (Proposed)
AP5
Google earth

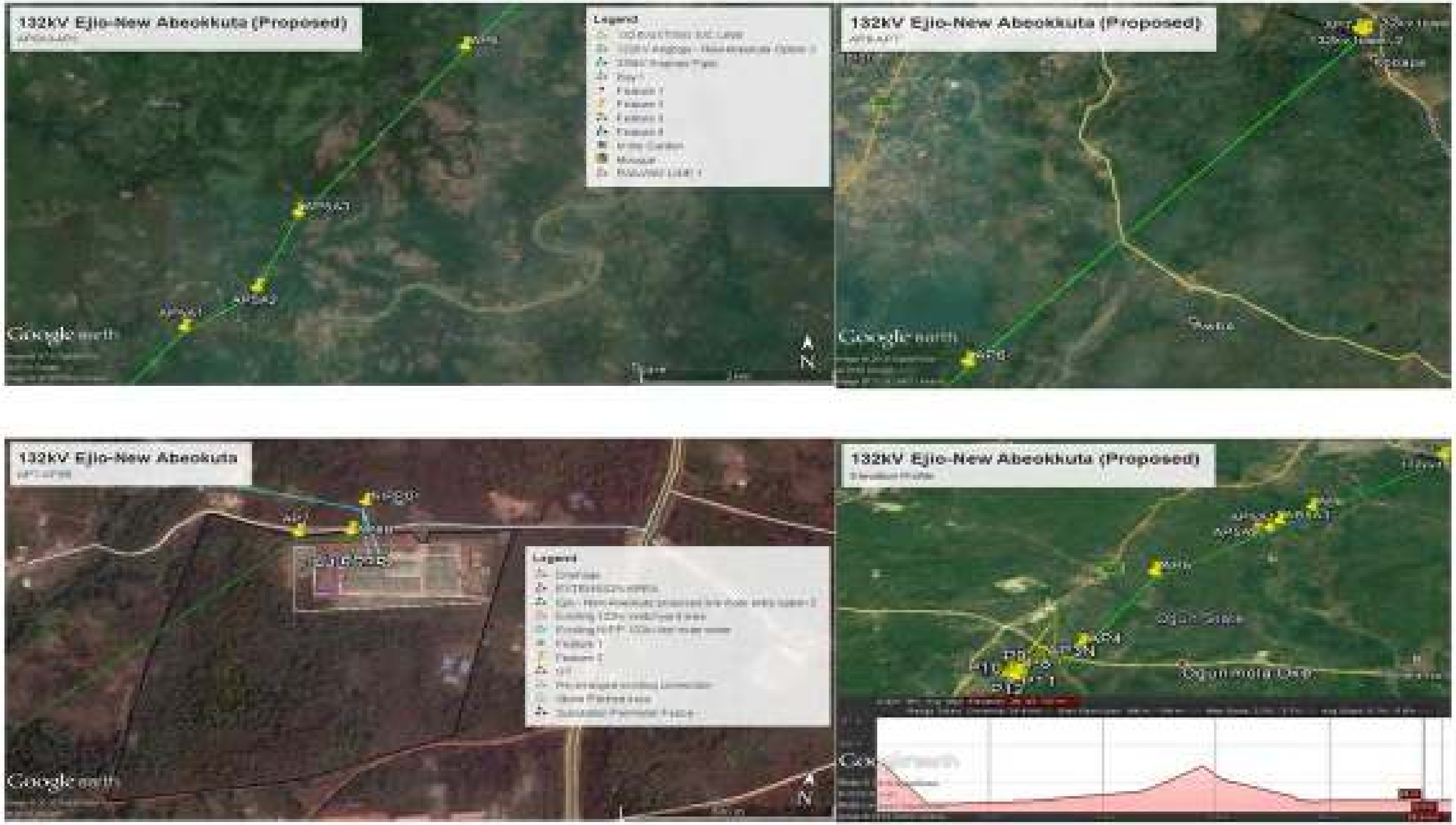


Fig 3.6: 132kV Ejio to New Abeokuta DC line route images and elevations

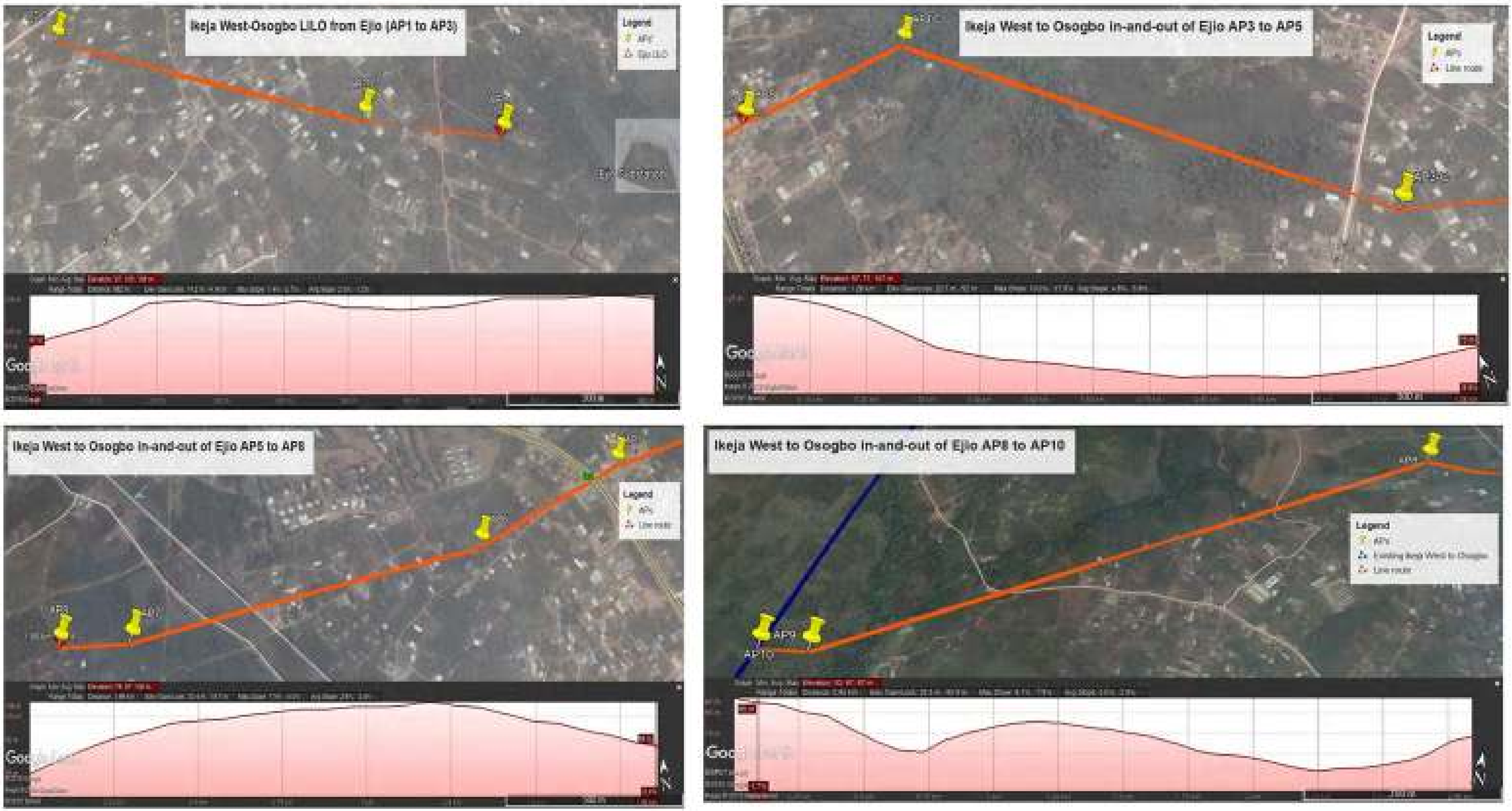


Fig 3.7: Ikeja West to Osogbo turning in-and-out of Ejio Substation line route

3.4.3 Foundation Construction and Erection

The construction of structure foundations generally involves boring or excavating a hole for each leg or pole, installing steel reinforcing and the stub leg, and then pouring concrete. All surplus soils from excavations and boring would be used in filling low lying areas of the access roads, provided that this soil is not polluted. Where the soils are contaminated, this should be reported to Ogun State Ministry of Environment and/or Ogun State Environmental Protection Agency (OGEPA) for guidance on the most appropriate disposal depending on the nature and extent of contamination.

In poor ground conditions and for the heavier tension towers, more substantial foundations are required involving open excavation, the installation of formwork, pouring of concrete, and subsequent backfilling of the excavation. These foundations take longer to install and will cause more disturbance than the construction of bored tower foundations. In steeper terrain, it may be necessary to create a level bench at some tower sites to provide a working area for construction crew and equipment.

The construction of tower and pole foundations will require a workforce of approximately eight (8) persons, an auger type borer or backhoe excavator and arrangements for supply of premixed concrete, by truck. The construction of foundations for a typical tower or pole might take up to three days, although the time could be a week or more where difficult foundation conditions are encountered. Foundations will be under construction at several sites at any one time.

At each new tower sites, the crane and drill rig will require a flat platform to work on. Although the new tower sites are generally flat, there may be a need for the construction of a level pad. The pad will need to be cut into the slope close to the foundation site and access for concrete trucks will be necessary along the access tracks to each structure.

Erosion and sediment control measures will be implemented, and the level area will be retained and vegetation cover rehabilitated following completion of construction works.

3.4.4 Tower Construction

For this project the lattice tower type shall be used. The conductors are vertically arranged, and the earthing conductors are above conductors. Towers of overhead power lines consist of tower body, earth wire peaks and cross-arms. The transmission voltage, the number of circuits, the height of the towers and other aspects determine the tower design and material, whereby galvanized steel is used. The towers dominate the aesthetic impact of an overhead line, govern the operational reliability. They need to withstand reliably the conductor forces and external loads.

3.4.5 Conductor and Earth Wire Stringing

Following erection of the new structures at either end of the line, stringing of the conductors and earth wires will occur. A process known as "tension stringing" is normally used. This ensures that the conductors remain above ground at all locations in each stringing section.

This requires specialized truck mounted equipment. This process will be undertaken gradually along the line as construction progresses.

The process of stringing starts with a light wire, called the draw wire, being fed through "sheaves", or pulleys, supported from the ends of the insulators. Where possible, the draw wire will be run along the ground between structures and through the sheave attached to each structure. The draw wire is then tightened and pulled into the air. Where it is not possible to run the draw wire along the ground, because of terrain difficulties, water bodies, roads or disturbance to vegetation, a nylon draw wire will be fed between two structures using a hurdle and catch cradle arrangement to support the draw wire above ground. The nylon rope will be held at tension above the ground and is "pulled through" the sheaves to draw the normal steel draw wire into the sheaves.

The draw wire will be attached to the end of the conductor and the conductor will be pulled through the sheaves. The conductors will be drawn from the drums and a braking machine applies tension to the conductor as it is pulled out. The tension keeps the conductor from touching the ground, or trees and other obstacles.

At the completion of the "pull", the tension in the conductors will be adjusted to ensure that correct ground clearance is obtained. The conductor will then be fixed in position at each structure and the sheaves recovered and moved along the line to be used again. Stringing requires specialized truck mounted equipment, known as the "winch" and the "brake", to pull out the conductor and to maintain and adjust the tension in the conductors. These two pieces of plant are normally positioned to allow up to 7 km of the transmission line to be strung in a single "pull". For this project the pull distance will be less due to shorter distances between tension structures and the need to minimize outage length. The conductor and earth wire are stored on reels, called "drums", approximately 2 m in diameter. Each drum holds about 3.5 km of conductor so several drums will be stored at each brake site. Plant required at each site includes the winch and/or brake equipment, trucks for delivery of conductor drums, and concrete anchor blocks. Winch and brake sites are normally located adjacent to tensions towers but can also be in the centre of a span. Sites that are relatively level and flat will be required to allow the drums to be maneuvered easily and safely.

The stringing operations will involve approximately 15 to 20 persons, spread over the section being strung. It is expected that each section of line will take several months to string with the actual "pulling out" of the conductors taking only two days. The rest of the time will be spent on preparation and final tensioning in between outage periods.

The stringing and tensioning equipment is normally truck mounted and does not require any specific earthworks or establishment activities. However, the stringing and tensioning activities will involve truck and vehicle access along the section being strung which may result in some surface disturbance. No specific erosion or sedimentation controls will be required however any incidental soil disturbance will be rehabilitated on completion of the construction program.

3.4.6 Substation Construction

Construction activities for the substations will involve the following:

- Construction of the substation access road to the substations, in the case of Ejio the existing untarred road will be upgraded and Olorunsogo substation may not need construction of access road because the substation is along Papalanto-Sagamu road (however, the road is in a bad shape due to the frequent movement of tracks along that road), while the existing road to New Abeokuta substation will be utilized.
- Removal of vegetation within substation footprint.
- Terracing and leveling of the sites.
- Installation of foundations for infrastructure such as transformers, control room and radio tower: - The project area is made up of different types of soils and varying geological conditions which will require geotechnical studies. Excavations will be conducted to create holes for erecting or installing the pylons. After excavation, foundations will be constructed for supporting the pylons. The excavation and construction of the foundations shall involve the use of hand tools like crow bars, mixers, vibrators, trappers, etc. But in case of rocky areas compressors and drills will be used. The equipment to be used in project construction will require various forms of energy which will include manpower, charged battery or fossil fuel. The manual equipment to be used in the development project include crow bars, spanners and ropes. About 75% of materials for the substation construction is expected to come from offshore locations while 25% will be sourced locally.

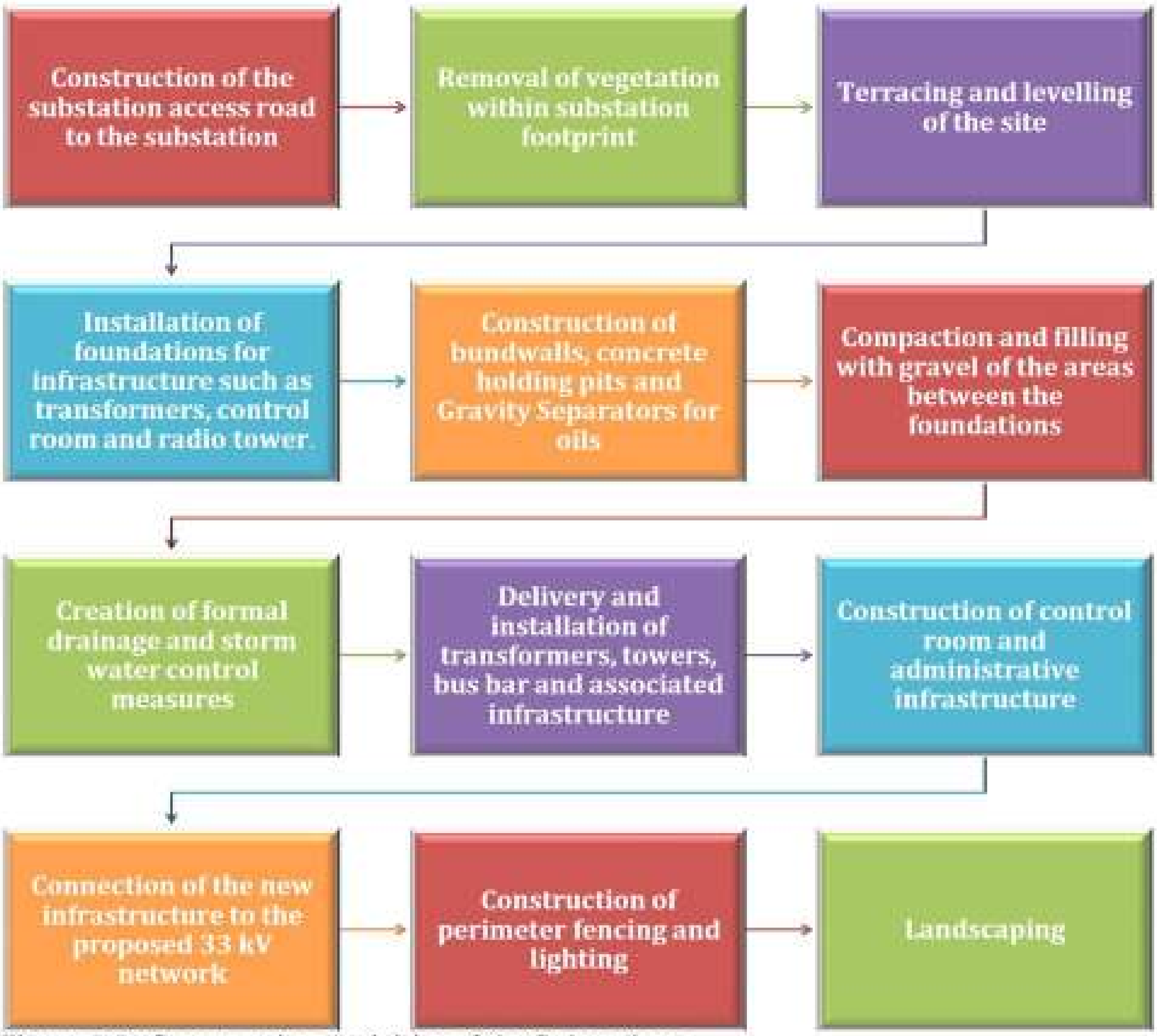


Figure 3.8: Construction Activities of the Substations

Fuel based equipment to be used will include mixer, vibrators, compressors, and drills. The construction of the foundations will involve masonry work and related activities. General masonry and related activities to be undertaken will include concrete mixing, construction of foundations, erection of steel tower and curing of fresh concrete surfaces. These activities shall utilize labour from the neighborhood to supplement some machinery works such as that by the concrete mixers. Thus, creating employment for the local population.

- Construction of bunds and oil holding dams (for emergency holding of transformer oil in the event of a spill) and wall safety walls
- Compaction and filling with gravel of the areas between the foundations
- Creation of formal drainage and storm water control measures
- Delivery and installation of transformers, towers, bus bar and associated infrastructure
- Construction of control room and administrative infrastructure
- Connection of the new infrastructure to the proposed 33 kV network
- Construction of perimeter fencing and lighting

- Landscaping: - After successful completion of the project construction work, the project contractor will rehabilitate the project sites that had been subjected to clearing by planting indigenous plant species.

3.4.7 Transportation

Transportation requirements during the construction period will vary per the work required at each tower site. For new structures, the vehicles likely to be used are as follows:

- articulated truck for steel sections and transformers delivery from Lagos (Tin Can or Apapa port where these offshore components of the required materials will be shipped through;
- non-articulated flatbed truck;
- concrete truck;
- track or 4WD mounted drill rig;
- crane;
- bulldozer/grader/excavator/backhoe;
- 4WD vehicles;
- elevated work platform; and
- brake and winch truck

The nomination above for the main earthmoving equipment will vary between the structure sites and will likely be transported to several sites at different times. For example, some foundation sites will require an excavator for the foundation work while others will only need a backhoe. It is not anticipated that earthworks requiring the use of a dozer would be required.

Each site would require an elevated platform or similar for connection of the conductor pulleys. For the stringing operations, two heavier brake and winch trucks and one truck delivering conductor wire, earth wire, and temporary anchor blocks will need access to specific sites along the route.

The EPC contractor shall prepare a Traffic Management Plan (TMP), as a part of the Construction Environmental Management Plan (CEMP). TMP is to focus on the construction phase of the project and in addition, must also include (but not be limited to including):

- The management of the delivery of equipment;
- Access to and from structure sites;
- Work methodologies for restringing across roadways;
- Arrangements for temporary road closures;
- Parking; and
- Any security access arrangements.

3.4.8 Workforce and Hours of Operation

3.4.8.1 Workforce

The workforce engaged on the project will vary during the construction program and will be dependent on the specific activities underway. Labour requirements will generally be a maximum of 32, comprising approximately 10 on access track and foundation work, 10 on structure erection and 12 on stringing work, with several others engaged on miscellaneous other activities. As outlined above, it is anticipated that most activities will be undertaken gradually in accordance with the requirement to keep the existing line in service during peak demand periods.

3.4.8.2 Hours of Operation

Given the need to undertake most of the work in planned system outages, the construction program will include work outside normal construction hours and will include night time and weekend periods as required. No noisy construction related activities eg transportation of materials along residential areas and other sensitive receptors, piling, use of jackhammer etc will be carried out in the night.

3.4.8.3 Regulatory Requirements

The contractors shall ensure compliance with the following laws and regulations

- The Factories Act, 1987
- Wages Board and Industrial Council Act, 1974
- Workers' Compensation Act, 1987
- IFC Performance Standard 2: Labor and Working Conditions
- International Labour Organizations (ILO) requirements

These are elaborated in Section 1.4

3.4.8.4 Clean-Up and Final Inspection

The following steps will be taken to clean up the construction sites and conduct final inspection, preparatory to commissioning:

- On completion of works, the concrete shall be thoroughly cleaned.
- All packing and surplus materials from site and all rubbish and waste shall be removed as well as trees from transmission line right of way and access roads.
- Required burning permits shall be obtained, to comply with government regulations.
- There shall be no disposal of rubbish, waste or any debris in rivers and do not pile such materials in stream beds, river terraces, or any unauthorized place.
- Any irrigation ditches/pipe born water line (if any) which had been temporarily blocked to facilitate the line construction shall be cleared, cleaned and be restored to the condition existing before arrival on site
- Natural drainage in areas where temporary facilities have been made for construction purposes shall be restored.
- Access roads shall be restored to their original conditions.

Towers shall be inspected to ensure proper installation of all items including signs and accessories, hardware, dampers and spacer dampers, insulators and to ensure that bolts are tightened, no members and bolts are missing, conductors and overhead shield wires are properly sagged with specified clearances maintained, ground leads are removed and towers and foundations are installed within the specified tolerance. Inspection shall be carried out along the transmission line to ensure that rubbish and waste are disposed, fences are mended, holes and over-excavations are filled, drainage is restored, damages to property are made good and the transmission line right-of-way is reinstated.

3.5 Operation and Maintenance of the Transmission Line

The proposed PTL maintenance will be the responsibility of TCN. The maintenance is described in the following sections.

3.5.1 Structure and Conductor Maintenance

Once the transmission line construction is completed, maintenance patrols will make periodic inspections of the structures, the easement and the conductor and line hardware, taking note of clearance conditions, damage to components or evidence of vandalism.

3.5.2 Easement Maintenance

As outlined in NESISEasement and Access Track Maintenance Policy maintenance of the transmission line easement is necessary to ensure that the safe electrical clearances are not infringed due to growth of vegetation.

Generally, the easement will be inspected in conjunction with the inspections of the structures. If necessary, vegetation control activities will be carried out. Two basic types of control will be employed:

Hand clearing: In sensitive areas or in areas too steep for mechanical control, hand clearing of re-growth is used. Only a portion of the re-growth is removed to keep the disturbance to a minimum. A team of up to 4 people could be used on this work; and

Mechanical control: Tractor driven brush cutting equipment capable of clearing small trees are commonly used to maintain access tracks and where heavy re-growth is occurring within the easement. A work team of up to 3 persons could be involved.

In any section of the transmission line the easement does not contain any vegetation, but buildings and other infrastructure instead, it will be important to govern or restrict further development that impinges on the safe electrical clearances required for the 132/330 kV easements.

Nigeria Security and Civil Defence Corps (NSCDC) has the legal responsibility for safeguarding national assets such as power lines, railway lines, pipelines and other public utilities. Therefore, it is NSCDC's responsibility to prevent encroachment on transmission lines. However, TCN being the owner of these lines, shall facilitate and provide logistics support.

3.5.3 Rehabilitation Program

Disturbed areas (e.g., construction pads, winch sites and tracks) that are not required for future use or access will be shaped and seeded in consultation with each landowner. Rehabilitation of work sites will be carried out as work proceeds and as soon as possible after the completion of work on each site. A rehabilitation plan shall be included in the project's ESMP.

Erosion control measures, in accordance with the Blue Book will be implemented at each work site during the work period and following the completion of work at the site, measures to restore the pre-existing ground condition will be implemented, and are further discussed in Chapter 5.

Re-vegetation techniques such as loosening of ground compacted by construction equipment, improving soil quality of excavated material spread around structure sites, spreading of fertilizer and grass seeding will be implemented as required.

Special re-vegetation techniques will be necessary if acid sulphate soils are encountered. These areas may also require follow up maintenance to ensure that vegetation cover is successful.

In some areas, specialized rehabilitation works will be required or otherwise agreed with the landowners. As such, the ESMP that will need to be developed on a site-by-site basis to reflect the prevailing conditions and the level of rehabilitation required. Farmlands for example may prefer to leave the disturbed area tilled but not sown as they will be returned to vegetable production. Other areas, which may involve tree clearing, will require replanting of trees in areas located outside the easement and the agreement of respective land owners.

These trees will be replaced at a ratio of four to one and planted within the riparian corridor outside the easement. This work will be undertaken in consultation with all affected Local Government Councils.

3.5.4 Project Decommissioning/ Closure

This is the last phase of this project. Decommissioning of the substations and TLs will be effected when the active life of the substation has expired. The project will involve removing the substation apparatus and reclaiming the land where necessary. Equipment to be removed include:-

- The transformers;
- Associated substation equipment; and,
- The substation fence.

The aim is to return the disturbed site to equivalent land capability following the substation decommissioning. The guidelines outlined under FMEnv and NESREA's Environmental Protection Guidelines for Transmission Lines for the reclamation of decommissioned substation sites will be applied in for the SS. These include: \

- Assessing soil conditions;
- Protecting the environment during the decommissioning activities; and,
- Ensuring the site is reclaimed to the pre-disturbance land capability and is compatible with current adjacent land use.

Generally, if a decision is made to decommission the lines and SS, the following steps will be taken towards the process in the two study areas:

- Dismantling of the towers and condition
- Dismantling of tower foundations
- Removal of all material from transmission line

- Dismantling and all material and equipment within the substations.
- Restoration of land to its original situation as much as possible

3.6 Project Wastes

A lot of wastes of different kinds are expected and generated during construction, decommissioning/dismantling, operation, and maintenance. Table 3.1 shows estimated quantity, sources, disposal method, place of disposal and the responsible party.

3.6.1 Waste Generation

Below is a list of envisaged project wastes and their potential sources:

Leaves, branches, trunks, grasses from the clearing of the vegetation along ROW and Substation spaces.

Kitchen wastes from human feeding and activities involving many workforces.
Scrap metals – from cuttings, fittings, pylon member, nuts, bolts, and welding etc.
Concrete waste – from foundations and plinths, including housing complex and control room construction.
Nylons/Plastics – from human activities wrappings, water sachet, food etc.
Oil spills from heavy duty machinery and equipment, transformers, breakers, and vehicle engines, either during normal runs of old machines or maintenance work.
Human wastes – from activities of personnel involved in the work or secondary business group.
Operational activities – nylons, paper materials/office, human waste etc.
PCB is a toxic substance contained in certain transformer oil, which shall not be used in this project. Nevertheless, to control an accidental spill, provision shall be included in the project design for an API gravity oil separator as well as a bundwall or underground chamber as an integral part of transformer foundation is required to control PCB spillage.
SF6 is an inert gas which possesses very high insulation resistance to high voltage and also acts as a very good medium for high voltage arc quenching. It is therefore deployed in high voltage switchgear operations.

3.6.2 Waste Disposal

Waste disposal methods will include:

Composting of biodegradable
Selling metal, wood, and plastic scraps to buyers
Reuse of materials e.g., packages, concrete, etc

Dumping of remaining wastes at approved sites
Sewage from site camps will be vacuum-sucked into septic tanked trucks and taken to any closest approved treatment facilities. The EPC contractor shall contact these agency during mobilization stage to arrange the modalities.

Spent oils generated during transformer fillings, retrofitting and maintenance work will bestored in oil trench and oil sump at the substations and in line with requirements of the Basel Convention.It is recommend to use mobile toilets at construction sites and soak-a-way pits at campsites.

Table 3.1 Proposed Transmission Project Waste Estimates and Disposal Plan

Project Phase	Type of waste	Form of Waste	Source of Waste	Estimated Quantity	Colour	Disposal company	Disposal method/use	Disposal location
Site preparation/ clearing	Degradable	Vegetation, kitchen waste	Camp, TLROW	3200 m^3	Green	Community members	Timber, fuel wood, compost	-
Construction	Degradable	Kitchen waste	Camp, TLROW	30 m^3	Green	OGEPA allotted but OGSMEnv. registered Waste Contractor	Compost	OGEPA approved site
	Mixed	Metal scrap, wood, Nylon/plastics, spilled concrete	Camp, TLROW	180 tons	Brown /black	OGEPA approved Waste Contractor	Reuse, recycle	Scrap buyers/ reuse location
	Sewage	Camp sites	Personnel		black	OGEPA allotted but OGSMEnv. registered Waste Contractor	Vacuum-sucked into septic tanked trucks	Any approved sewage treatment facility close to the project facility
Maintenance	Degradable	Vegetation	TLROW	360 m^3 per year	Green	Community members	Fuel wood, compost	-
Decommissioning & Dismantling	Mixed	Demolished concrete	TLROW	200m^3	Brown/black	OGEPA allotted but OGSMEnv. registered Waste Contractor	Backfill	OGEPA approved site
	Mixed	Pylon members, strings, insulators	TLROW	1000 tons	Brown/black	TCN for reusable PTL members	Reuse, recycle	Scrap buyers/ reuse location

Source: EEMS Survey, 2017

- Note: OGEPA shall be contacted for disposal facility nearest to sites, since works will not be located on a fixed site.
- Spilled liquid/oils generated during site preparation, construction and maintenance period be treated in line with requirements of the Basel Convention.

3.7 Project Schedule

TCN is strongly committed to the completion of the proposed PTLs, which have estimated life span of 50 years, and every effort is geared towards actualizing this goal. The proposed project execution schedule is presented in Tables 3.3 and indicates construction commencement in Q1 2019 and commissioning scheduled for Q1, 2022.

The implementation schedule for the construction of the transmission lines would follow the under-listed duration. It should be noted that some of the phases and activities will run concurrently to save time.

Table 3.2:Implementation schedule for construction of Transmission lines

Transmission Lines		
Phase I	Phase II	Phase III
Pre-construction		
Line Route Studies ESIA RAP	Engineering Procurement and Construction (EPC) Final Acceptance Test (FAT)	Commissioning Project closure
12 months	24 months	3 months

Invariably, some percentage variation is allowed in the duration for contingencies. In that case, the average total duration for the entire project execution is put at 36 months. Construction works shall be scheduled at time crops have been harvested.

Table 3.3 Proposed Project Implementation Schedule

	Implementation Schedule (TCN proposal)																																																											
Bidding Schedule																																																												
	2019														2020																	2021														2022		2023												
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Selection of Consultant (12 Months)																																																												
Shortlisting Process for Consultant																																																												
JICA Concurrence on Shortlisting																																																												
Pledge																																																												
Signing of Loan Agreement																																																												
Selection of Consultant																																																												
Advertisement																																																												
Tech Evaluation																																																												
JICA Concurrence																																																												
Financial Evaluation																																																												
JICA Concurrence																																																												
Negotiation & Award																																																												
Selection of Contractor (21 Months)																																																												
PQ Process																																																												
Preparation of prequalification document																																																												
JICA Concurrence on PQ																																																												
Tender PQ																																																												

Prequalification (Evaluation)
JICA Concurrence on PQ Results and Document
Preparation of Bidding documents
JICA concurrence on Tender
Tender Process
Prequalified Applicants Tendering
Tender Technical Evaluation
JICA Concurrence on Tender Technical Evaluation
Tender Price Evaluation
JICA Concurrence on Tender Price Evaluation
Negotiation
Contract including JICA Concurrence
Issuing L/C and L/Com
Construction (Lot 1 - 3) (24/36 Months)

Note: (1) Consultant requires only for supervision as owner Engineer. TCN Project team has the expertise to implement the procurement process for the selection of both Consultant and the Contractors for the project. This is similar to arrangement for other Donors funding projects undertaking by TCN.

(2) Shortlist process for Consultant begins after the signing of the loan and continue with the selection process later after signing. However, PQ process for the selection of contractor expected to starts January 2019 (6 months before the pledge while the actual tender process continue after the signing of the loan.

-2

3.8 Descriptions of the Transmission Lines

The description of the coordinates used in this report is based on the UTM MINNA-NIGERIA DATUM ZONE31. Furthermore, angle points and turning points are described in number of degrees it turns away from its rectilinear direction.

3.8.1 330kv DC line: Ikeja West to Osogbo Line Turning In-and-Out of Ejio Substation

This section of the line is the shortest part and is designed to Loop-In-and-Loop-Out (LILO) of the proposed Ejio substation. The total distance of this transmission line is 6.94km with ten (10) angle points. This transmission line will proceed to the breaking point (Existing Ikeja West-Osogbo SC line) from the western side of Ejio substation. The major crossing by this transmission line are the existing 132kV DC NIPP line from Otta to Papalanto, Lagos-Abeokuta Expressway and a railway line which is out of operation. The communities affected by this transmission line are Ejio, Arigbajo, Apomu, Ayepe and Sojuolu Communities.

The transmission line commences from the Ejio substation at point (523223.522 mE, 756723.323 mN) and move towards the East along a bearing of 285.5^{O} for about one kilometre, where it took a right turn of 30.62^{O} from its rectilinear direction, in order to avoid the densely populated Arigbajo Town. Furthermore, to void a Shrine in the Arigbajo Forest, an angle point of 15.34^{O} to the left was introduced at point AP-002. About 700 m from this point another angle point of 65^{O} to the left, to avoid crossing over a Mobil Petrol Station and the Lafarge Housing Estate. This transmission line crosses the Lagos-Abeokuta Expressway (Trunk A5) at 6.853224^{O}N, 3.192264^{O}E between AP4 and AP5, after about 2.3km from the Ejio substation. This transmission line crossed the existing 132kV DC NIPP line from Otta to Papalanto and a railway line between AP6 and AP7. From AP7 which is 214m away from AP8, the transmission line turned right at a bearing 275 degree to avoid the built up areas in Sojuolu/Apomu community before heading to AP9.

The existing single circuit transmission line from Ikeja West to Osogbo is to be cut at at AP 10. The Osogbo-Ikeja West line will be looped in and out of the Ejio substation. The transmission line from Ejio SS to the crossing point is four circuit; double circuit x 2 (consist of two circuit going to Ajegunle, two circuits from Osogbo-Ikeja West going in and out of Ejio). The cutting point is located at Latitude 6.838162° N, Longitude 3.154384° E and about 6.94km from the Ejio substation.

The altitude of Ejio S/S site is approximately 80m and the altitude of the distance of 5km westward is approximately 110m, transmission line is gradually upslope from Ejio S/S to the Westward. The route map is shown in Figure 3.9.

Figure 3.9: Ejio to Ikeja West-Osogbo line showing the breaking point

3.8.2 330kV DC line:Ejio toOlorunsogo Substation

This transmission line runs majorly along Papalanto – Sagamu road. The total distance of this transmission line is 12.5km. It is worthy to note that this road is in a very poor state, this makes the movement on this axis to be very slow. The vegetation of the line route is relatively light bush with a lot of cassava, corn and Sugarcane farmland with some few dense forest with Bamboo and some forest trees. The right of way along this line route is almost totally free of any obstruction except with few low medium structure in few places. The lists of villages affected by this line route are: Ejio, Iludun, Abese, Soderu, Sowunmi, Ajitadun, Mose, Olowofela, Oreke, Ajegunle, Lerin, Elegbata, Aberemeta, Ogunmola, Ikereku, Ita-Alhaji and Olorunsogo. This transmission line route is divided into eleven (11) Angle Points (AP).The line starts from AP1(523849.750mE, 756688.905mN) with a bearing of 61 degrees to AP2, turning left at AP2 towards AP3.The communities between AP1 and AP3 are Ejio, Iludun and Abese communities (lightly populated) in Ewekoro Local Government Area, Ogun state. The major Agricultural activities in the communities are cassava, sugar cane and plantain plantation. At about 213m from AP2, there exist a marshy area in Iludun community which spanned about 200m along the line.

At AP3, this line is running parallel with the existing 330kV Ejio – Olorunsogo line route and the proposed 132kV DC Ejio – New Abeokuta line route. This three lines run parallel from AP3 towards AP4. Between AP3 and AP4, the line has three major crosses. It crosses the High pressure pipeline, a railway track and Papalanto – Sagamu road. The High pressure pipeline is the pipeline that supplies gas to the Olorunsogo Power Plant while the railway line is coming from the back of Ewekoro cement factory and heading towards Osoosun Railway Station. After the railway crossing, the line crosses a major road (Papalanto – Sagamu road) before having a right turn at AP4. The community covered by this AP3 and AP4 are Abese and Soderu communities. There is a sugarcane plantation at about 513m from AP3 in Abese community, this farm spanned for about 500m along the line route. A river is located at about 400m from AP4 (525570mE, 758698mN) in Soderu. From AP4, the line heads 94 degrees to AP5. This line now run parallel with the existing 330kV transmission line turning in-and-out of Olorunsogo Substation by the Right. There is a seasonal stream at about 395m from AP4 (526163mE, 759036mN) in Sowunmi community and a swampy area which spanned for 180m under the line and started from about 182m from AP4. After AP5, there is a pond with coordinates 528016mE,759043mN which is about 690m from AP5. There also exist a swampy area between AP5 and AP6 which started at (528157mE, 759065mN) and ended at (528485mE, 759110mN). The access road for the existing transmission line along this route would be used. However, for areas where the existing access road may not serve, new access roads will be constructed by means of driving over the vegetation where possible to avoid permanent removal of the existing vegetation.

The line made a 66 degree turn from the North Pole at AP6 heading to AP7.At AP8, the line made 65 degree turn to AP9. From AP9, the bearing about 85 degrees to AP10 (534599.8mE, 760856.9mN). From AP10 to AP11 (534595mE, 961033mN)terminal tower before entering Olorunsogo power station switchyard.

Figure 3.10: Ejio to Olorunsogo Line showing line route

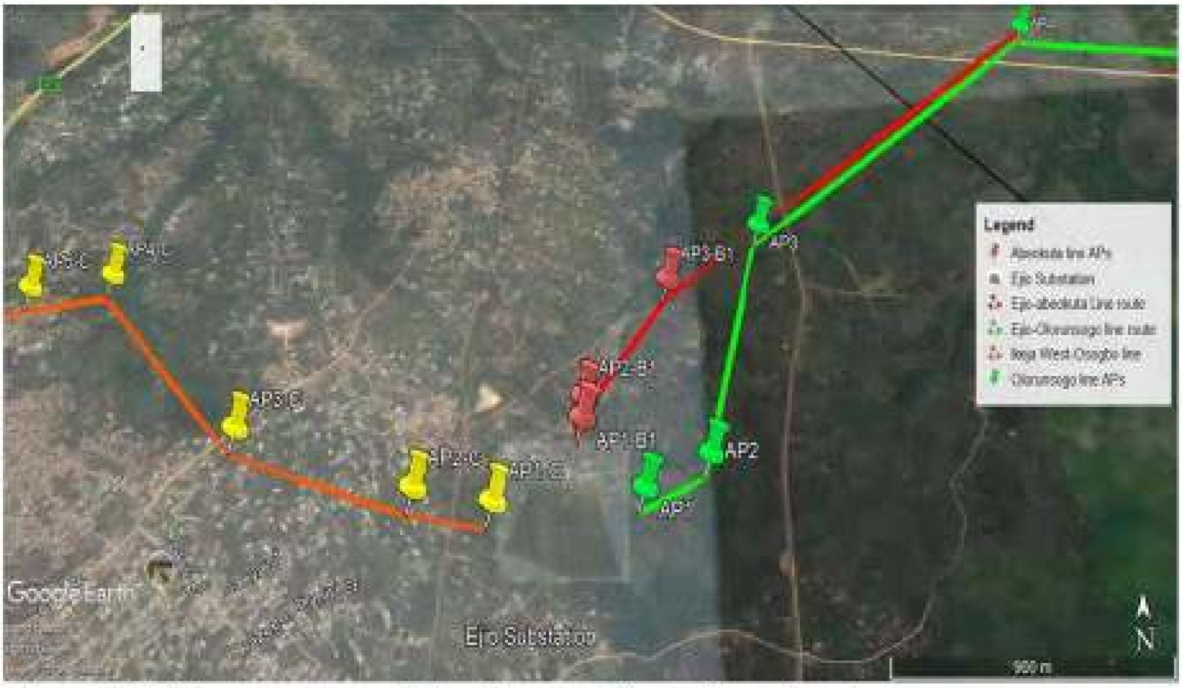


Figure 3.11: The three transmission line route from Ejio substation

3.8.3 330kV DC line: Ejio – New Abeokuta DC 132kv Transmission Line

This is the only 132kV line in this project and the route corridor is 15m by 15m from the center of the transmission line. This transmission line starts at Ejio substation and terminates at New Abeokuta Substation. The total distance of this transmission line is 35.38km. There are seven (7) Angle Points (AP's) along this transmission. The communities affected by this transmission line are Ejio, Iludun, Soderu, Abese ,Soderu, OlukeOrile, AfowowaEleyele, Pankere, Ajade, Obolonti, Ototo communities etc. This transmission line will cross gas pipelines, railways, major roads and several communities as descried as follows.

This line is proposed to start from the proposed Ejio substation at AP1 (523825.030mE, 756758.566mN) with an angle of 3.5 degrees from the north proceeding to AP2 which is 84.2m away. Between AP3 and AP4, This line route is running parallel with the proposed 330kv double circuit line going to Olorunsogo. This line has also three major crosses between AP3 and AP4. It crosses the High pressure gas pipeline, a railway line and Papalanto – Sagamu road as shown in figure 3.11 below. There is a river with coordinates (525570mE, 758698mN) under the line before AP4 in Soderu. At about 140m from AP4, the proposed 330kV line going to Olorunsogo substation parted way by turning right with a bearing of 95 degree from the north.At AP4, this line continue its course by turning slightly by 12 degrees moving towards the worst section of the line in terms of vegetation in this area between AP4 and AP5.This section has some swampy and mangrove vegetation in it. The coordinates of the marshy areas in this section are (start: 526061mE, 759727mN) and (end: 526111mE, 759958mN). A stream in Soderu (525983mE, 759372mN) is at about 150m from AP4. Some of the existing roads within the communities in this section will be used as access roads to the transmission line corridor, however, some areas requires construction of access roads.

AP5 Upwards is a relatively good terrain of lots of farm land with a long stretched slope between AP5 and AP6 heading 38 degree North-East towards AP6. At about 4.5km from AP6 is the crossing spot for River Ogun and Oba road. The coordinates of Ogun river are (start: 537864mE, 779126mN) and (end: 537968mE, 779249mN) under the line. There is a marshy/forest area in AfowowaEleyele community with coordinates (start: 528085mE, 767185mN) and (end: 528259mE, 767407mN) under the line route, this started at about 920m from AP5. At about 2.5km before AP6, there is a river called Odoipa along the line route. There are also marshy areas and mangrove forest in Ajade, Pankere, Opanigangan and ototo villages traversing the line route. This line also transverse another river after AP6 at (535613mE, 776472mN).Transmission line terminated at AP8 in New Abeokuta substation switchyard.

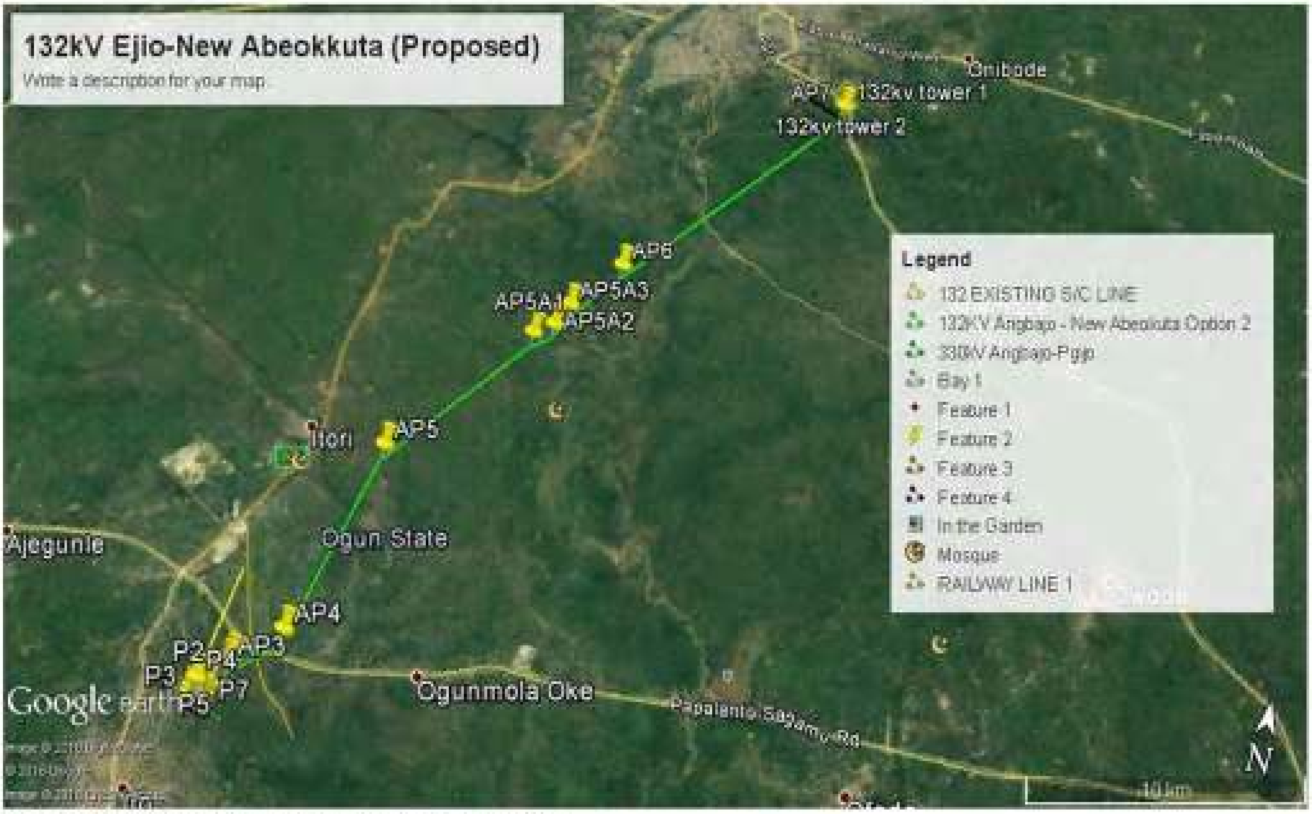


Fig 3.12: Ejio to New Abeokuta line route.

3.8.4 PTL Engineering Characteristics

i Terminologies

In the process of implementation of the project, the following terminologies shall be used:

a. Structure: It shall be taken to be synonymous with the words "tower", "transmission structure" or "transmission tower".

b. Span Length: It shall be taken to mean the horizontal distance between the centre-lines of adjacent towers.

c. Standard Span Length: It shall be the span length assuming level ground, which is considered to be the most economic average span.

d. Standard Tower Height: It shall be the tower height required to provide minimum ground clearance over open land, based on level ground, standard span length and the final unloaded conductor sag at 75^0 C.

e. Wind Span; It shall be on half (1/2) the sum of the lengths of the immediately adjoining spans.

f. Weight Span: It shall be the horizontal distance measured between the lowest points of the sags in the spans immediately adjacent to the structure. This distance is to be the most critical measured at any conductor or ground wire temperature during initial or final sag.

g. Tower Height: It shall be the height of the lowest conductor at the tower above the natural ground at the centre of the structure.

h. Right-of-way width: The distance from the centre-line of the transmission lines to the edge of the right-to-way shall be 15 meters. For a single or double circuit transmission line on its own right-of-way, the total width of the right-of-way shall be 30 meters for the 132kV and 50 meters 330kV.

Tower centreline to tower centreline clearance for parallel transmission lines

The distance between the transmission line centre lines of any voltage to be the larger of Y1 or Y2. Y1 = 50 meters

Where:
Y1 = Distance from centre line of transmission line (A) to Line (B) and
Y2 = (X + 1) + F + G
Where:
Y2 = Distance from centre line of transmission line A to centre line of transmission line B, based on the criteria that transmission tower of line A falls towards line B or tower of line B falls towards A, whichever is critical.

X = Distance from centre line of line A (or line B) to the end of its lower cross arm (m).

F = Total height of maximum height tower of line B (or line A) where maximum height tower is defined as required tower height for a level span length of 1.2 times the design suspension tower wind span (m) or for existing lines, the actual total highest structure.

G = One-half the ground line spread of the maximum height tower of line B (or Line A) (m).

3.8.5 Line Design Inputs

Network Requirements

The network requirements quoted in Table 3.4 underpin the designs recommended for the proposed power transmission lines.

Table 3.4 Network Requirements

Factor	Value	Source
Network nominal voltages	330/132 kV	TCN Criteria
Normal operating range	±10%	
Equipment highest voltage	362 kV	
Minimum required lightning/surge impulse withstand	1175 kVp	
Short time withstand: • OPGW	 56kA for 270 ms	

• Overhead earth wires • Phase conductors	56kA for 200 ms 56kA for 270 ms	

Physical Environment

Line designs have been based on the following physical environmental conditions as presented in Table 3.5.

Table 3.5: Rated Physical Environment

Factor	Value	Source
Conductor rating: Maximum ambient temperature	40^0C	TCN
Solar radiation	$18.2 - 20.0Wm^{-2}day^{-1}$	Nimet
Wind speed	(4.1 – 6.74) knots	Nimet
Keraunic level (Ave. annul thunder days)	11	Nimet
Everyday temperature	$(28 - 32)\,^0C$	Nimet

Maintenance Provisions

The transmission lines are high security lines. As such, future planned outages for maintenance or new load/generator cut-ins will be very difficult to obtain.

Aligned with standard industry practice, TCN allows live line maintenance for 330kV transmission lines. The maintenance policy is to use the live bare hand methodology, with a minimum safe approach distance of 2,030mm (for the live line maintenance clearance requirements).

Design Life and Reliability Requirement

TCN is adopting the industry standard design working life of 50 years for transmission lines and their components. Reliability level 3 (LR=3) is selected which is applicable to the 330/132kv transmission lines. These factors correspond to wind return period of 200 years.

Applicable Codes and Standards

All known and agreed internationally accepted code and system regulations have been reflected in the codes and standards deployed in the manufacture and installation of 330/132kV DC transmission lines network components.All equipment and material to be used in this project shall conform with Nigerian Electricity Supply and Installation Standards (NESIS). A typical code and standard include.

System Parameters for the transmission line:

Electrical:

- 50m (for 330Kv) and 30m (for 132kv) ROW
- 400m - 450m (for 330Kv) and 325 – 350m (for 132kv) span between line towers
- 42m -57m (for 330Kv) and 28m - 32m (for 132kv) height for 330kV DC suspension tower (see Figs 3.7 and 3.8)
- 4.5 tonnes (for 330Kv) and 2.8 tonnes (for 132kv) weight suspension towers.
- Normal Voltage 330kVrms (for 330Kv) and 132kVrms (for 132kv)
- Bison Twin 350mm^2 for 330kV line conductor and Bear 250mm^2 for 132kV line conductor
- Highest Voltage – 362kVrms
- Frequency – 50Hz
- System grounding effectively earthed system
- Basic insulation level 1135Vp switching impulse level 950kVp
- Power frequency withstand voltage (wet) 450kVrms
- Short circuit level for 1sec31.5kA
- Corona extinction voltage 230kVrms
- RIV at 230Vrms (uv at 1MHz) 1000

3.8.6 Structure Plotting

A plot of the proposed locations shall be on the plan and profiles such that the following criteria are satisfied:

The wind span and weight spans shall both be within the design limits for the tower for both the conductor and overhead ground wire. The ratio of weight span to wind span for the conductor at maximum temperature unloaded, initial condition shall not be less than 0.5 for suspension structures. The ratio of ruling spans on each side of strain towers shall be within design limits of the tower.

For strain towers, the maximum weight span on any side of a tower shall not exceed the span used to calculate the design vertical load on that side of the tower. The weight to wind span ratio on suspension structures shall be such that insulator strings do not swing beyond their design limits. Counterweights may be used to limit side swing. The conductor overhead ground wire and OPGW shall not be tensioned beyond the limits specified in sections 10, 12 and 14. Maintain the minimum clearances. When plotting, add not less than 0.5m to the minimum ground clearances to account for minor errors in profile, etc.

Leg extensions shall be used as required to compensate for sloping ground at the structure site. The final span to the substation line entry structures shall be “slack spans”. When crossing over communication lines, distribution lines, or pin insulated power lines, maintain the specified clearances assuming the top wire(s) of the line being crossed over is a straight line extending from support to support. When crossing over major highways, dual carriage ways and railways, adjacent suspension type structures with square cross arms and a complete suspension insulator assembly shall be provided at each corner of the cross arm. Structure spotting using AutoCAD software shall be done using the optimization routine in order to achieve the lowest total cost taking into account towers and foundation.

Minimum Clearances in metres at 75^{0}C (conductor temperature) 330kV.

Vertical Distance: Normal ground 8.0 6.7, road crossings 9.0 8.3, buildings, pole structures, walls and cradle guards 5.2, 5.0, limited access motorways and dual carriageways 10.0, 10.0, navigable waterways (at high water level) 15.0 15.0, pipelines (oil, gas, water) 10.0 10.0 communication and power line wires 4.6 3.6 and cradle guard to top of railway track 9.0 8.3.

Horizontal Distances: Nearest steel of transmission tower, to edge of navigable waterways, pipelines, bridges, highway pavement, railway (nearest rail), buildings on right-of-way and at crossings, to structure of line being crossed 50.0, 50.0.

Route Selection: The routes shown on the Route Plan represents the preferred routes, taking into account such aspects as soil conditions, access, right-of-way acquisition costs, and avoidance of built-up areas. Distances between paralleling transmission lines shall be as determined herein.

Right-of-way Clearing and Access Roads: Clearing transmission line right-of-way shall mean cutting, removing and disposing of all trees, brush, fallen timber and debris from the transmission line right-of-way.

Work Involved: The work of this section consists of the clearing of the right-of-way for transmission lines and shall include all measures and materials to clear the right-of-way as specified. Work also includes the preparation of the permanent access roads.

Anger Trees: This shall mean any tree outside the right-of-way which, when falling towards the line will pass within 1.5 metres from either the tower steel or the conductor at its vertical position. At the maximum or minimum sag, access road and access to the line right-of-way from existing roads/tracks shall also be shown.

Tower Foundations: Tower foundation shall mean the tower footing and footing and the supporting soil, which together resist the applied tower loads. Tower footings are the structural element (piles, grillages, pad and chimneys, etc.) that transmit the load to the soil. The soil types and soil engineering parameters shall be adequate and properly taken into account.

For this project, the determination of type and size of a tower foundation, soil details from geotechnical investigations shall be used and complemented with additional investigations where required. All foundations shall make adequate provision for horizontal shear forces at the ground line. The foundation types chosen for the proposed TL project shall be constructed using concrete and reinforcement as major materials. Due to the possibility of the corrosion of foundation materials by underground water, surface water and soil, the following shall be used: The foundation protection thickness shall be enlarged to over 50mm while the top of the foundation shall be minimum 500mm above ground level.

High strength concrete shall be used.
Antiseptic such as bitumen shall be applied on the area that shall have direct contact with the soil.
Specific high-grade cement shall be used in the concrete mixture.

Standard Foundations

Standard foundations for towers shall be concrete pad and chimney. The height of the chimney shall be determined according to expected buoyancy (e.g. floods, tidal water level changes). The use of displacement method for calculating bearing pressure in pad and chimney foundation, reducing the unit weight of concrete in account of excavated earth overburden shall not be accepted.

Special Foundations

In areas of low soil bearing capacity, special foundations will be required for the set-up of TL towers. Special foundations comprise but are not restricted to:

- Pad and chimney with enlarged pad (soil bearing capacity!)
- Raft foundations (soil bearing capacity!)
- Pile foundations,
- Combined pile and raft foundations

For design of these foundations, special considerations shall be made concerning water levels, buoyancy, concrete quality, etc.

Transmission Lines Design for Actual Conditions:

The design and foundation selection shall be done based on the actual ground conditions at each site, taking into account the differences in design methods applicable to granular and cohesive soils and considering the maximum and minimum ground water elevation at each site, whichever is critical, in the determination of the foundation and protective requirements. Initial identification of the soil type has been based on visual examination of the soils present throughout the length of the ROW. Soils have been identified as either granular or cohesive on the basis of the field identification procedures.
Loading on Foundation: The foundations are designed from the loads worked out from the tower design at the base of the tower and these loads are increased by 10% in case of suspension tower

and 20% in case of tension tower. These loads are considered as working loads for the design of the foundation.

3.8.7 Fabrication and Manufacture

a. Reinforcing Steel

The EPC Contractor shall make bends in reinforcement to shapes shown on the drawings and bar schedules; make bends around mandrels to achieve the specified bending radii; discard bars with cracks or splits; and for concrete filled pile caissons, ensure that the reinforcing steel extends the full length of the pile element.

b. Structural Steel

All structural steel shall be fabricated in accordance with the tower supply specification applicable to this project.

c. Installation

Ground levels existing prior to the construction of foundation shall be considered in determining tower heights and individual single leg extensions. The material shall be disposed and the movement of equipment so regulated that disturbance of the original grade is kept to a minimum.

d. Protective Measures

Foundations shall be provided in seasonally dry riverbeds, or drainage channels, with appropriate erosion protection measures. Foundations shall be provided for steeply sloping ground or erosion sensitive sites with adequate support to prevent loss of backfill.

e. Excavation

The base of the foundations shall be set within the specified allowable tolerances, to the specified depth. Any over-excavations shall be filled with compacted suitable materials to bring the excavation to the required elevation.

f. Backfill

Backfill shall be excavated materials. It shall be clean from organic or other deleterious substance. Backfill from any other source shall be subject to the agreement of the engineer.

Compact backfill will be done by tamping in 150mm layers, before compaction, for the first 1000mm above the bottom surface of the excavation. The remainder of the backfill tamp in layers shall not be more than 200mm. After compaction, backfill shall have at least the minimum density used for uplift design of the foundation. Backfill in every location shall be built up to a minimum of 300mm above the surrounding ground surface to allow for settlement. Backfill shall be placed only in dry excavated holes or in holes kept dry by pumping out any water in the hole using a surface pump. Under no circumstances shall backfill be placed in an excavation where water is present.

g. Concrete
Concrete work shall conform to all requirements of the latest editions of ACI 301. Specifications for structural concrete building, except as modified by the supplemental requirements below:

The use of earth cuts for forms will be permitted, provided adequate cover is maintained for reinforcement. A 40mm x 40mm chamfer shall be provided on external corners and edges of concrete exposed to view. Testing will be carried out as specified in Field Quality Control.

Formwork shall not be disturbed until concrete has hardened adequately. Reference may be made to ACI 347 for recommended times of removal of forms. Welding of reinforcement will not be permitted. For concrete filed pile caissons, reinforcing steel shall extend the full length of the pile element. Placement of concrete underwater will not be permitted. Finishing of exposed formed surfaces shall be as specified in ACI 301 Chapter 10 for the following:

- Rough form finish;
- Smooth form finish;
- Finishes of exposed slabs shall be as specified in ACI 301 Chapter II for the following:
- Broom or belt finish;
- Trowel led finish.

The top of all concrete foundations shall extend at least 500mm above the ground.

The slope of the top of the foundations shall be away from the tower legs.

h. Steel Work
Bases of grillages will be set firmly on and in complete contact with undisturbed soil or backfill used to fill over excavations. Grillages shall not be set on organic material.

i. Piling
Piles shall be driven in such a sequence as to minimize the detrimental effects of vertical and lateral displacement of the ground. When a pile has risen as a result of adjacent piles having been driven, the defect shall be corrected. Driving shall not be carried out close to recently cast concrete which has not attained sufficient strength to withstand the vibration.

j. Casing of Piles
The inside surfaces of the casing to receive concrete shall be cleaned prior to placement of concrete.

k. Towers
EPC shall ensure that all concrete foundations or rock anchor grouting have cured for the minimum period specified (at least 21 days) and that all backfill is compacted to its approved level before placing or erecting tower steel on the foundations.

Tower height specified is the height of the bottom conductor above the natural ground at the centre of the structure. Towers shall be assembled in accordance with the approved NESIS/TCN guidelines.

l. Tower Erection/Accessories

Towers shall be erected at approved distances and all accessories shall be attached such as anti-climbing devices; cattle, birds and cradle guards; circuit plates (2 nos. for D/C towers), phase plates, danger plates, number plates aerial identification signs, step bolts and ladders, etc. Tower painting shall be ensured as prescribed. Specific requirements for painting, if required for the project, shall be provided by TCN. Stub templates above the base shall be provided as necessary to ensure correct position of the stubs during setting and concreting of foundations.

m. Tower Configuration/Extensions

The towers shall be self-supporting, latticed double circuit vertical configuration structures with one overhead ground wire and one OFGW for the lines. The 4-circuit towers shall be provided with 2nos OFGW instead of one OFGW and one ground wire. Opposite faces of the towers shall be identical but adjacent faces may be dissimilar. Each tower type is designed so that the tower height is compatible with and connect directly to the bottom of the common body. Individual leg extensions shall be interchangeable in any combinations and shall be compatible with and directly connected to any leg position of the common body or body extension of a particular tower type. The body extension shall be in the steps of 3m, 6m and 9m and leg extensions in the steps of 1.0m and 2m.

3.8.8 Line Insulation and Fittings

a. Insulators Type Analysis

The following three types of insulators are considered:

- Porcelain discs
- Porcelain Longrod
- Polymeric Longrod

b. Comparative Costs

Polymeric longrod has not had the same service history as porcelains and therefore its longevity has not been as well established as that of the latter type.

Manufacturers and users of polymeric insulators have indicated that the industry assessment, at this point in time, points to a lifetime of about 25 years.

Porcelain ceramic insulators, on the other hand, have a service history of over 50years.

It is evident from the cost analysis that although the porcelain disc insulator presents higher capital cost, porcelain disc insulators are the most economical insulators.

c. Line Fittings

The line fittings design will be in accordance with standard fittings assembly. The design will include armour grip suspension units, spacers and dampers. The tension insulators assemblies will include grading rings to reduce the effects of corona.

3.8.9 Structure Suite Selection

a. Functional Requirements

The objective of this section is to determine the most economical suite of structures that can cover all possible functional requirements of the PTL.

The high-level inputs to this process are as follows:

- wind strength and special wind conditions
- environmental and community engagement inputs
- line route and terrain
- visual impact issues
- special clearance requirements

b. The process of structure suite selection consisted of:

Determining the possible combinations of tower types and functional requirements.

Refining the tower suite to obtain the most optimal use of towers, i.e. taking into consideration cost of developing each different tower type and utilizing towers for multiple applications.

Determining the actual angles for which the towers will be designed that optimizes their usage over the various angle requirements of the line route.

c. Structure Type Optimization

In determining a suite of structures for the transmission lines, the following tower types must be included:

Suspension structures (designed for 0 or less than 5-degree deviation)

Heavy suspension structures (to cater for 5 or more degree deviations). This option may be used where there are many small angles in the line route.

In line strain structures (applicable only for line constructability on long transmission lines)

Strain structures (designed for major line angle /deviations)

Terminal structures (for terminating the transmission lines prior to entering the substation).

Table 3.6 displays all the initial tower type combinations available for the proposed TCN PTL route.

Table 3.6: Structure Types Selection for the proposed PTL project

Region Tower Types	Light Suspension	Heavy Suspension	In-line Tower	Strain Tower	Terminal Tower
Low – Medium Wind Area	•	•	•	•	•
Strong Wind loads Area	X	X	X	N/A	N/A
Low Profile Tower Area	•	N/A	N/A	N/A	N/A

Source: TCN

d. Lost Angle Optimization of Tower Types

The suite of towers identified above comprises a combination of suspension and angle tower types. To determine the angles for which towers should be designed that will be cost effective; a lost angle analysis was carried out. The lost angle analysis reviewed the nominated tower angle and compared its suitability against the actual deviation on the line route.

The difference in angle between the nominated tower angle and the deviation is considered a "lost angle". The average of this "lost angle" is compared with the total cost of the angle towers and the cost to develop and test a new tower.

The analysis considered various angle tower combinations and it shows that the most economical option is to design 4 angle towers that can be used to cover the following range of deviation angles:

- 0-0.4 degrees (0 deg suspension)
- 0.4-5 degrees (5 deg suspension also 0 deg in inline strain)
- 5-15 degrees (heavy suspension based on 45deg angle strain body)
- 15-45 degrees (strain)

e. Section Length Requirement

The structures are designed with longitudinal strength similar to the transversal direction and are fully capable of dissipating a shock load within the next two or three spans and to prevent the cascade failures. This eliminates any need for stop structures.

3.8.10 Tower Geometry

a. Phase Conductor Cross Arm Separation and Length

The line is designed for live line maintenance. As such, the power frequency and impulses do not only determine the geometry withstand clearances required, but also by live line maintenance approach and working distances. A minimum safe approach distance of 2,030mm for live bare hand work is required for 330/132kV line.

For low wind periods, the wind pressure used in calculating the swing angles is 0.1 kPa. For high wind periods, the wind pressure was calculated for a 200-year wind return period and converting the 3 second gust to a 5 minute gust. The 5-minute guest wind will provide a satisfactory operational performance with a probability of exceeding the calculated swing angle of 1%.

b. Lightning Protection and Earthing

The earth-wire cross-arm length is calculated to provide adequate shielding to prevent a shielding failure occurring in an area with a keraunic level of 10 as indicated in NiMET map of thunder days.

The earth-wire is placed above each top phase conductor at the same vertical distance of the vertical phase to phase separation of the line designed for de-energized maintenance as opposed to the live line design. This is due to the increase in length in phase to phase separation for a live line design. Industry practice has shown that de-energized maintenance distance for earth-wire to phase is adequate to avoid flashover.

3.8.11 Structure and Foundation Requirements

Basis of Design: The structures have been designed to withstand minimum loading requirements.

Structural Reliability: As mentioned earlier, the design life of the proposed PTL is 50 years with a reliability level of 3, which correspond to 200 - year wind return period.

- Design Actions
- Wind Loading

The site-specific wind parameters are based on the fact that the majority of the line is orientated west to east and passes through open terrain.

A detailed examination of topographical maps indicated that most the line did not have any issue with increased wind pressure due to local topographical features such as funneling or expansion in valleys, hills, and escarpments.

In addition, the design considers the seasonal change in wind strength.

The structures are designed to withstand the wind combinations as follows:

- Transversal wind;
- Oblique wind 22.5° inclination to transverse axis;
- Oblique wind 45.0° inclination to transverse axis;

Failure Containment Load

The structures are designed to withstand unbalanced longitudinal conductor tension due to failure of adjacent structure by considering the equivalent longitudinal loads resulting from not less than any one third of all phase conductors on the structure being broken with a nominal coincident wind velocity of 0.25 times the ultimate wind pressure.

Maintenance and Construction Loads

To minimize the structural loads on tower and provide suitable stringing methodology the maintenance loads are considered for each complete phase or overhead earth-wire being worked on in turn.

The conditions are based on the worst weather conditions under which maintenance will be carried out. The limiting wind velocity for maintenance work was taken as 10m/s (industry work practice).

3.8.12 Detailed Tower Design

The PLS-CADD method for detailed tower designs is performed to the extent required to extract the tower properties necessary for line optimization analysis such as tower geometry, member sizes, and tower weight and tower models for PLS-CADD optimum spotting and performance verification checks.

The tower models are designed using PLS-Tower software package and inserted in the PLS-CADD line profile for optimal spotting (level 2 modeling). The structural and electrical performance verification was carried out by using level 4 models and finite element analysis (FEA). The FEA method calculates interactions between the tower members and attached conductor loads by including structure flexibility matrices and hence produces more realistic and more economical results compared with the traditional non-interactive model approach.

3.8.13 Material Selection

Towers shall be of steel material using hot rolled angle (90^0) sections and plates. In general the following grades of steel shall be applicable:
Mild steel shall be Grade 250 (for plates) and Grade 300 (for angles)

The recommended high tensile steel shall be Grade 350L0.

Since the responsibility of costly and time consuming production of steel fabrication drawings are with the contractor and can only start after the steel standard is approved, any change of steel standard is expected to have a limited influence on the project.

3.8.14 Tower Acceptance Testing

All tower types will be required to be full scale prototyped and then load tested prior to full production to demonstrate that the developed designs meet the quality requirements of TCN/NESIS technical specification.

The load tests are required to verify the force distribution in the tower members and assess the efficiency of secondary bracing elements for each tower design.

All load tests will be in accordance with IEC 60652 with agreed test procedures to simulate design conditions as closely as practicable.

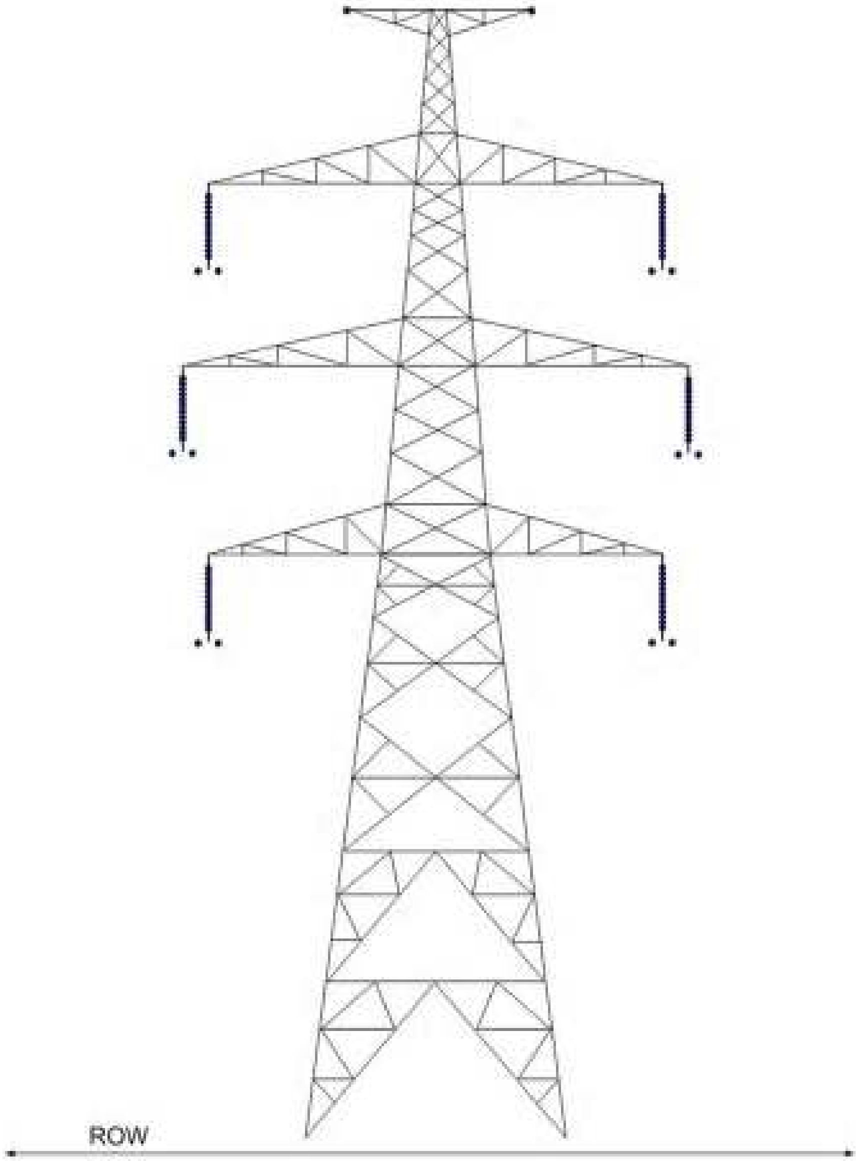


Figure 3.13: Typical Double Circuit Lattice Tower

3.8.15 Foundation Selection and Optimization

The following foundation types are considered on the basis of soil types encountered:

- Bored undercut foundation which is formed by augering a hole into soil and extending its base by forming a "bell".
- Type "A" is for dry stable soil
- Type "D" is for wet stable soil.
- Bored socketed foundation, formed by augering a hole into rock; Type "B"

- Mass concrete or spread footings formed by excavation of square holes in soil or rock. The base may be straight sided or undercut depending on soil conditions and construction methods.
- Type "C" is for dry stable soil,
- Type "C1" for dry unstable soil,
- Type "E" is for wet stable soil,
- Type "E1" is for wet unstable soil.
- Type "F" is mass concrete foundation in rock.
- Piled, consisting of driven steel piles; Type "G".

Further geotechnical investigations shall be carried out at a reduced intervals of 2km along the PTL length in order to achieve the required accuracy of soil parameters.

The cost of the foundations represents a significant part of the overall line cost. Three options are explored to reduce these costs without compromising the safety margin.

Minimum common parameters.

This option is based on less extensive geotechnical investigation and adopts more conservative design parameters. The safety level is high. However, it will result in a higher foundation cost.

Full geotechnical testing at each tower location.

This option will provide very accurate soil parameters at each tower location and prediction of foundation type distribution. However, in order to reduce construction cost the foundation design would be standardized and based on general optimized parameters that cover a reasonable amount of footings (target 90%). Therefore, the option 2 cannot realize the full benefit from the extensive geotechnical investigations.

Reasonably frequent geotechnical testing and design based on engineering soil parameters.

The geotechnical investigation will produce values and reasonably accurate distribution of soil parameters that will allow the determination of engineered soil parameters that cover the majority of foundations (target 90%). The engineering parameters will be used for foundation design. Construction personnel will be made aware of the assumed parameters and guidelines will be issued to allow recognition of soils not conforming to the adopted design parameters. The foundation in non-conforming soils will require special design however this is expected to be a small percentage resulting in this option producing the greatest cost/benefit.

The design of each type of footing is based on the following measures, to ensure that the soil conditions meet the assumed design criteria during construction:

Foundation type testing;

A geotechnical consultant will review the contractor's foundation installation procedures;

The geotechnical consultant will provide steel pile driving acceptance criteria charts (based on testing records); and

The geotechnical consultant will train the Contractor's construction personnel to assess soil parameters. In addition, the geotechnical consultant will provide construction oversight of foundation installation to ensure correct selection by construction personnel.

Material Balance

Material balance recommended for the proposed project.

- Concrete volume
- $0.3^{2}\ \pi.0.2$ $=0.056m^3$
- $0.3^2\ \pi.2.15$ $=0.607m^3$
- $\underline{0.7^2\ \pi.}\ (1.0^2+0.3^2+1.0x0.3)$ $=1.018m^3$
- $1.0^2\ \pi.\ 0.05$ $\underline{0.\ 157m^3.}$
- $=1.838m^3$
- Concrete weight
- 1.838.2240= 4117kg = 4.117t
- Each volume
- b =2.2.85 x tan20^0 + 2.0=4.07m^3
- 2.85. π (2.035^2+1.0^2+2.035 x 1.0) =21.40m^3
-
- -(0.607 + 1.018) $\underline{=-1.625m^3}$
- $=19.775\ m^3$

Earth weight

19.775 x 1600 31.640t

Total weight resisting uplift $\underline{31.640t}$

$\underline{+\ 35.757t}$

3.8.16 Earthing and Protection Systems

Transmission line system protection has both electrical and mechanical aspects. For mechanical protection, Buchholz, high temperature, oil level relays including no-load time changer protection and all will be incorporated. The electrical main protection scheme of the power transformer shall consist of numerical low impedance differential protection, high impedance restricted earth fault for each star connected transformer winding.

On the line, distance protection relays will be incorporated. Other protection devices will include:

- Over current and earth fault protection.
- Surge Arresters protection scheme.
- Reverse Power protection scheme.
- Differential protection scheme.
- Shunt reactor protection.
- Bus bar and breaker failureprotection (numerical bus bar protection)
- General earth mat and earthing system.
- Safety and security.
- Fire hydrant system for the transformers.
- Under and over voltage relay system.
- High and under frequency relay's operation.
- The towers and ground wire are major component of the line earthing, as they are electrically clamped to the towers.
-
- Lightening protection systems are installed as required to protect the lines and the towers.
- Isolators should be in place and used to knock-off supply finally during maintenance activities.
- All relays are in the relay room close to the control room for resetting when flagged, and recording the fault accordingly.
- The control panel in the substation houses the switches, voltage meters, ammeters, indication lamps, alarm horns, metering system, fault signal equipment, synchroscope and the rest.

3.9 Communication/Control System

For effective system operations, radio communication between the technical crew in the Substation with the other Substations in the Transmission network, or between the control room officer and other field officers is imperative.

From inception frequency modulated (FM) radios was in vogue, in addition to use of walky-talky within an environment, but recent developments ushered in optical fibre ground wire (OPGW) and SCADA system. This also includes the use of computer and software application for even operational purposes, handsets and all inclusive. All known methods applicable will be employed in the project. There is normally a communication wire at the top of the Transmission line tower linkage to the radio room. Operational control panel showing various feeder areas, taking hourly meter readings, phase voltages and monitoring fault situations and load levels will be employed.

3.10 The Substations

A substation is part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform as a buffer to provide continuous power to the consumers even if there is a shortfall of power from the source. Electric power may flow through several substations between generating plant and consumer, and its voltage may change in several steps. A substation may include transformers to change voltage levels between high transmission voltages and lower distribution voltages, or at the interconnection of two different transmission voltages.

Substations are normally outdoors and are enclosed by a wire fence. However, in residential or high density areas, the substation may be indoors and even housed inside a building to restrict the humming noise of the large transformers. The elements of a substation are shown in **Fig 3.14**.

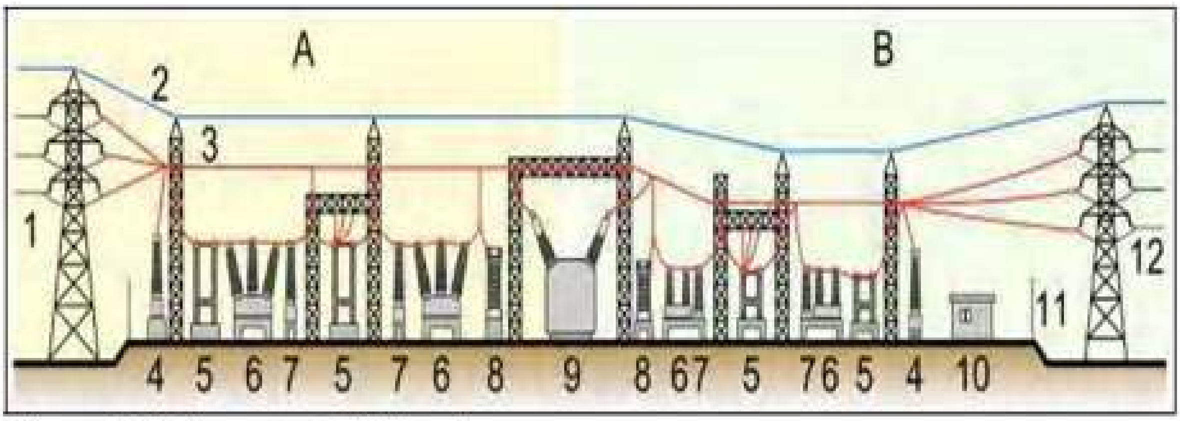


Figure 3.14: Elements of a Substation

A: Primary power lines' side B: Secondary power lines' side

1. Primary power lines 2. Shield wire 3. Overhead lines 4. Transformer for measurement of electric voltage 5. Disconnect switch 6. Circuit breaker 7. Current transformer 8. Lightning arrester 9. Main transformer 10. Control building 11. Security fence 12. Secondary power lines

For this project, all the substations will use Air Insulated Substation (AIS).

The AIS uses air as the primary dielectric from phase to phase, and phase to ground insulation. They have been in use for years before the introduction of Gas Insulated Substation (GIS). Most substations across all regions are AIS, which are in extensive use in areas where space, weather conditions, seismic occurrences, and environmental concerns are not an issue such as rural areas, and favourable offsite terrain. The indoor AIS version is only used in highly polluted areas, and saline conditions, as the air quality is compromised.

Plate 3.15: A Typical AIS Substation (with transformers zoomed in)

The following are some points to explain the features of AIS:

- The primary choice for areas with extensive space
- With quality design, the system is viable due to the low construction costs and cost of switchgear
- Less construction time, thereby more suited for expedited installations
- Easy maintenance as all the equipment is within view.
- It is easy to notice and attend to faults.

3.10.1 Configuration of the Substations

The scope of this ESIA lot 1 does not cover the construction or expansion of any substation, however, the three substation covered by lot 1 transmission lines are Ejio, Olorunsogo and New Abeokuta substations. Olorunsogo and New Abeokuta substations are brownfield (Existing) while Ejio substation is greenfield (Non-existing).

Since the layout of Ejio substation was not provided by JICA or TCN, we developed the preliminary design of Ejio substation considering all the outgoing and incoming transmission lines. This is the basis to determine the line terminations and to determine the direction of the line route alignment. To arrive to this configuration we need to have detailed design of substation in layout to be sure we can accommodate all the lines in the correct positions by considering future and extension for the Ejio substation. Based on the proposed lines emanating from the Ejio substation and to minimise the impact of the encumbrances on the proposed line corridors the orientation was designed as shown in fig 3.15. The configuration of each of the substations as well as coordinates of location is in Table 3.7.All the other substations (New Abeokuta and Olurunsogo) are already existing and therefore the line terminations are planned on the availability of the space within the switchyard fig 3.16 and 3.17.

i. Table 3.7: Location and Configuration of Substations

Substation Name	LGA/State	Location (UTM Zone: 31N)	Size of land (ha)	Voltage class	Incoming bay / Outgoing bay for transmission line
Ejio Substation	Ewekoro LGA/ Ogun State	523203.709mE 756989.301mN	25.3	330/ 132/ 33kV	Incoming bay from Olorunsogo PS : 330kV-double circuit line Incoming bay from Osogbo S/S : 330kV-single circuit line Incoming bay from Ikeja West S/S : 330kV-single circuit line Outgoing to Ogijo S/S : 330kV-double circuit line Outgoing to New Agbara S/S : 330kV-double circuit line Outgoing to New Abeokuta S/S : 132kV-double circuit line
New Abeojuka-Existing	Abeokuta, Ogun State	(542950.860mE, 777314.022mN	25.1	132/ 33kV	Incoming bay from Abeokuta S/S : 132kV-double circuit line
olorunsogo S/S -Existing	olorunsogo, Ogun State	534599.8mE, 760856.9mN	28.5	330kV	Incoming bay from Ikeja West S/S: 330kV-single circuit line Outgoing to Ayede S/S : 330kV-single circuit line

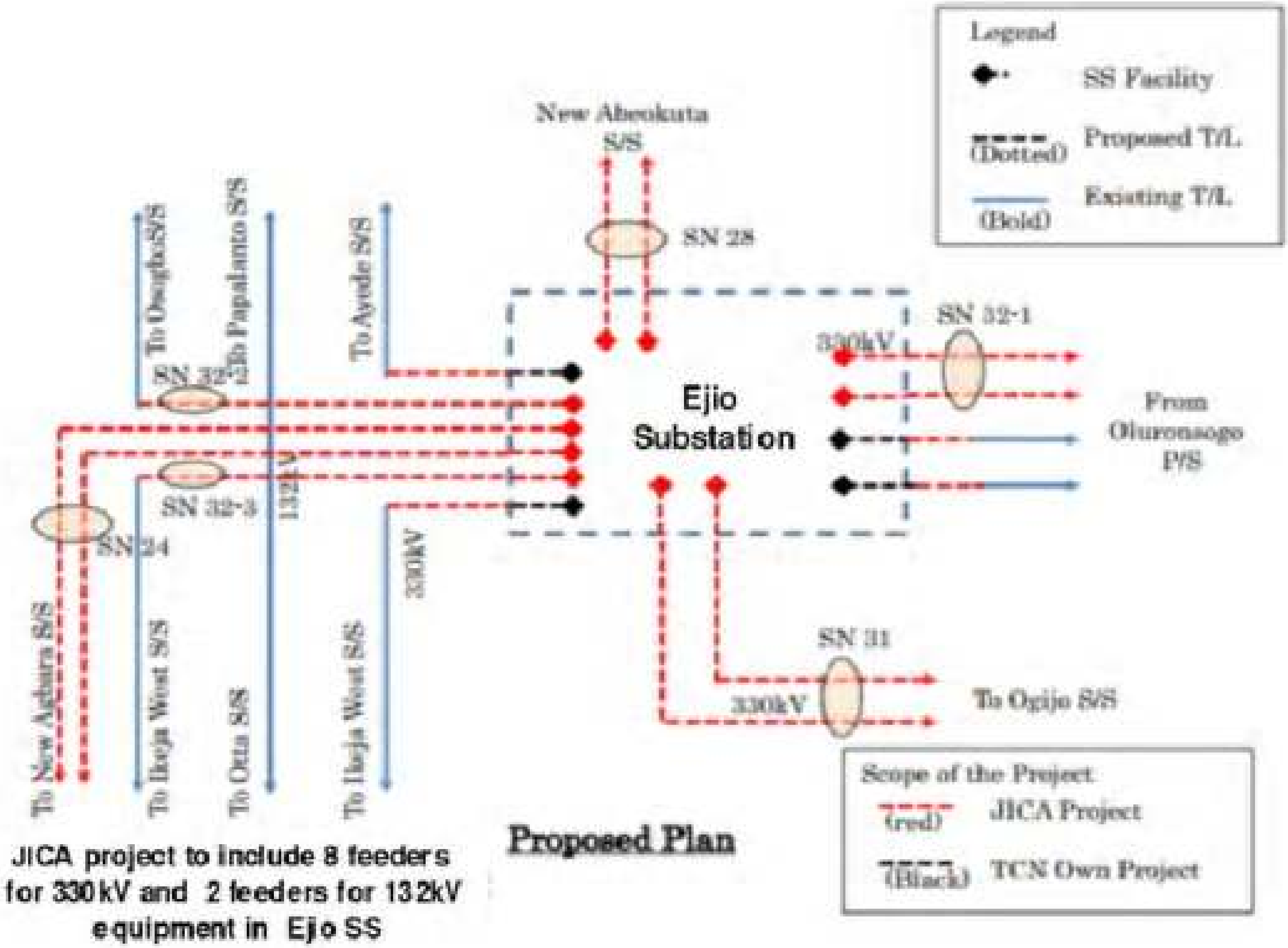


Fig 3.16: Ejio Substation design

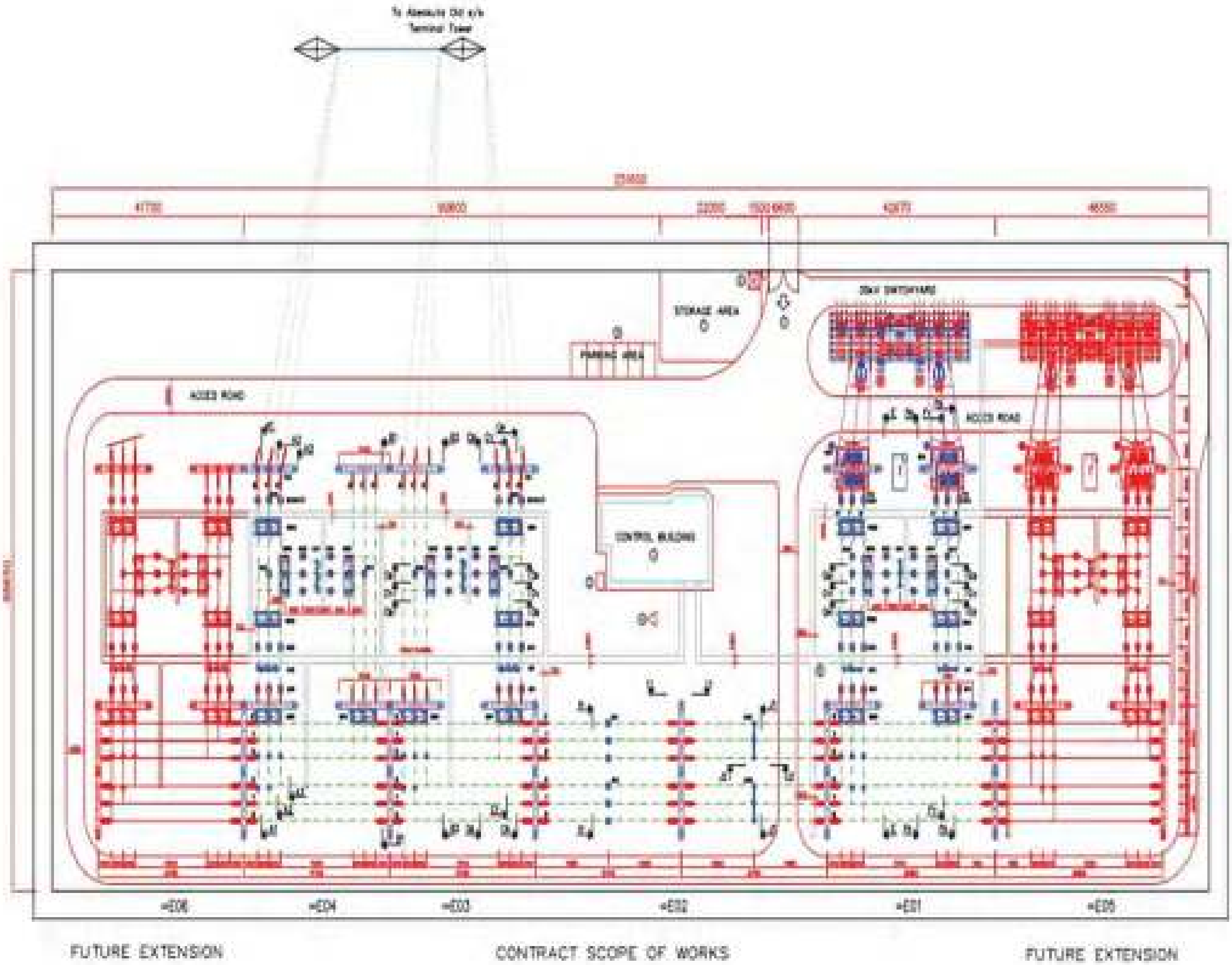


Fig 3.17: New Abeokuta SS single line diagram

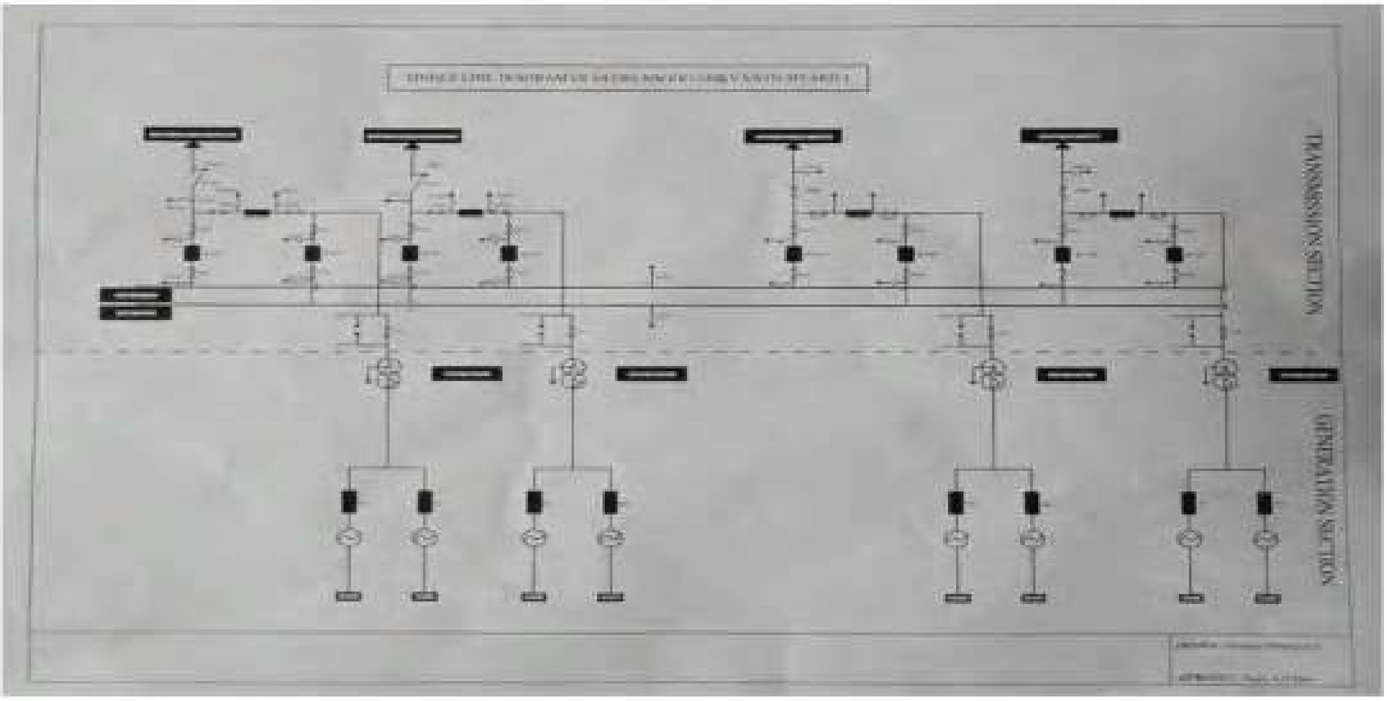


Fig 3.18: Olorunsogo substation single line diagram

3.10.2 Functions of the Substations

The proposed substations are designed to function as follows:

- As voltage control mechanism through the transformers to step-up or step-down the system voltage as case might be, thereby lowering transmission losses.
- Correction of power factor in the circuits when the reactive loads are there to protect the generating plants and increase efficiency.
- For load shedding purposes on the distribution network there maintaining system balance.
- For the purposes of safety by switching and isolating the network during maintenance work, using circuit breakers and isolators including load demand sharing.
- Bus bar splitting for power distribution arrangement.

3.10.3 Substation Facilities

The spaces are meant to accommodate the following, in the minimum:

- All transformers of the following sizes and ratings.
- All breakers and isolators.
- All auxiliary transformers – Voltage, current, reactor, instrument etc.
- Line Bays as required.
- Cable trenches, oil sumps and drainage channels.
- Control room for system operations with offices, battery rooms, communication section, conveniences, clock rooms, parking slots, cable/junk yard etc.

The substations are highly earthed to take care of excessive current at fault condition. A robust environmental management system has been put in place to meet international standard and local environmental regulations.

In addition, the substations are to be gravelled even after laying a nylon cover on the ground as a modern method to:

- Keep the weeds away from growth.
- Allow easy water run-off to drain channels.
- Improve the earthing system.
- Keep the environment clean and clear.

CHAPTER FOUR

4.0 DESCRIPTION OF NATURAL AND SOCIAL ENVIRONMENT

4.1. General

The prevailing ecological conditions of the environment within which the proposed project will be sited, as well as the socio-economic and health profiles of the affected settlements are presented in this chapter. Components described include the physico-chemical environment (meteorology, geology, sediment/soil type and distribution, surface/groundwater characteristics), biological environment (location and distribution of benthos, plankton, fisheries, flora and fauna characteristics), as well as socio-economic and health conditions describing the demographic structure, culture, heritage sites, social and health status of the people and their environment, including outcomes of consultations held.

The summary of baseline conditions is based on information sourced from literatures (see relevant sections) as well as findings from a one season (dry) field sampling program supplemented by secondary data from approved report, laboratory analyses of samples obtained and socio-economic and health surveys specific to this ESIA. The data acquired will be used in further environmental management decisions and future monitoring of changes, if any, in the environmental components.

4.2. Scope of Study

Field studies and data collection for characterization of the baseline conditions of the proposed project environment covered, in line with the approved TOR by the FMEnv.

- Climate and meteorology
- Air quality, EMF and noise levels
- Geology/hydrogeology
- Surface and ground water
- Soil and sediment
- vegetation and fauna wildlife
- Hydrobiology, fisheries and
- Socio economics/health impact, demography and community characteristics

4.2.1. Spatial Boundary and Size

A 700 m wide spatial boundary on each side of the transmission Right of Way (RoW) was taken. For the sub stations, a $3km^2$ boundary was adopted.

4.2.2. Baseline Data Acquisition Methods

The acquisition of data basically involved field data gathering, measurements and the collection of representative samples used to establish the environmental conditions of the study area. This exercise involved a multi-disciplinary approach and was executed within the framework of a QHSE management system approach. This approach assured that the required data and samples were collected in accordance with agreed requirements (scientific and regulatory) using the best available equipment, materials and personnel. Elements of this approach include:

- review of existing reports that contain environmental information on the study area;
- designing and development of field sampling strategies to meet work scope and regulatory requirements;
- pre-mobilization activities (assembling of field team, sampling equipment/materials calibrations/checks, review of work plan and schedule with team, and job hazard analysis);

- mobilization to field; fieldwork implementation - sample collection (including positioning and field observations), handling, documentation and storage protocols and procedures; and
- demobilization from field; transfer of sample custody to the laboratory for analyses.

The following sections present the field data gathering methodology/procedures and the descriptions of the environmental baseline conditions of the study area. The detailed documentation of the fieldwork execution including descriptions of the laboratory analytical methods and procedures, the detection limits for the various parameters analyzed as well as an overview of the general QHSE plan adopted for field data gathering and laboratory analysis is presented.

4.2.3. Desktop Studies

Desktop studies involved the acquisition of relevant background information on the environment of the study area. Materials that were consulted included approved reports on previous environmental surveys in the area, publications, textbooks, articles, maps, etc. on the area and similar environments. The list of materials consulted is specified in relevant sections.

4.2.4. Field Sampling/Measurement

In order to effectively characterize the ecology and meteorology of study area, a one season field data gathering exercise was performed between 18th and 23rd December, 2017. The specific objectives of the ecological field sampling were to determine:

- ambient air quality and noise level of the study area;
- physico-chemical and microbiological characteristics of the soil within the study area;
- physico-chemical and biological characterization of water and sediment samples within the study area;
- hydrobiology and fisheries resources of the study area;
- wildlife abundance and diversity of the study area and environs;
- vegetation characteristics of the area; and
- establish the socio-economic and health status of the host and impacted communities.

Ecological samples and data (water, soil, air, sediment, hydrobiology, meteorology etc.) were collected as appropriate and the exercise involved in situ measurement of unstable parameters where possible or they were preserved for laboratory analysis.

a. Field Study and Sampling Design

Field data gathering is designed to representatively cover the TLROW of the transmission line route. Soil sample stations were established to ensure the major soil types that characterise the area are adequately covered. Also, surface water and sediment sampling as well as hydro-biological studies were carried out along the surface water stations while air quality/noise stations is distributed to ensure the entire area is representatively covered. On the whole, the following sample requirements were established:-

- Sampling obtained from Thirteen (13) soil stations;
- Surface water/sediment sampling in Eight (8) stations;
- Air quality measurement in Fortteen (14) stations;
- Noise level measurement in Fourteen (14) stations; and
- Ground water sampling in Eight (8) stations
- Vegetation and wildlife in (11) stations

Sampling locations were decided as waypoints in Geographic Position System (GPS) and later plotted in a sampling map used during the field studies. Locations for biophysical sampling considered ecological types around the project areas, vulnerable environmental attributes with regards to the potential and associated impacts of the environment and control or buffer zones. Socio economic and health impact studies on the other hand, considered human habitations, infrastructures, cultural heritage sites and prevailing health conditions of people within the sphere of influence to the project area. Table 4.1 presents an inventory of the biophysical and socioeconomics/health details collected during field studies.

Table 4.1 Inventory of Biophysical and Socio Samples

S/N	Environmental Component	Parameter	No of samples requested by FMEnv	Actual no of samples collected	Remark
1	Surface water & Sediments	Physico chemical & microbial, Benthos &Plankton	Three (3) at each stream/river (at 200m upstream, Transmission Line crossing point and 200m downstream)	20	Some points were not accessible due to swampy nature
2	Ground water	Physico chemical & microbial	8	8	--
3	Soil	Physico chemical & microbial	One Sample at every 5km along the Transmission Line route	26	Top and Sub surface
4	Ambient air quality	Criteria pollutants	At every 5km (in-situ @ different elevations)	14	-
5	Noise	Sound/pressure level	At every 5km (in-situ @ different elevations)	14	-
6	EMF	Electromotive force	At the edge of the RoW/regular intervals and around substations	14	-
7	Meteorology	Temperature, Relative Humidity,	At every 5km (in-situ @ different elevations)	14	-
8	Biodiversity	Taxa	-	11 transects	-
9	Socio economics	Human and infrastructures	-	All 65 communities	-

Source: Godirra Chemical Survey, 2017

b. Analytical Methods

Samples collected from the field were analysed in Caran Technologies Ltd laboratory using various methods.

The methods of analysis used in this study were those approved by Federal Ministry of Environment. Other international analytical procedures were also adopted, for instance, the APHA analytical procedures for water quality. To ensure the reliability and integrity of some unstable physico-chemical parameters, in-situ measurement of pH, turbidity, conductivity, TDS, and temperature were carried out in the field. All field instruments were regularly cleaned and recalibrated after each use.

The Quality Assurance/Control for laboratory analyses is in accordance with FMEnv recommended method and include blank analyses to establish analyte level, duplicate analyses to establish analytical precision, spiked and blank sample analyses to determine analytical accuracy.

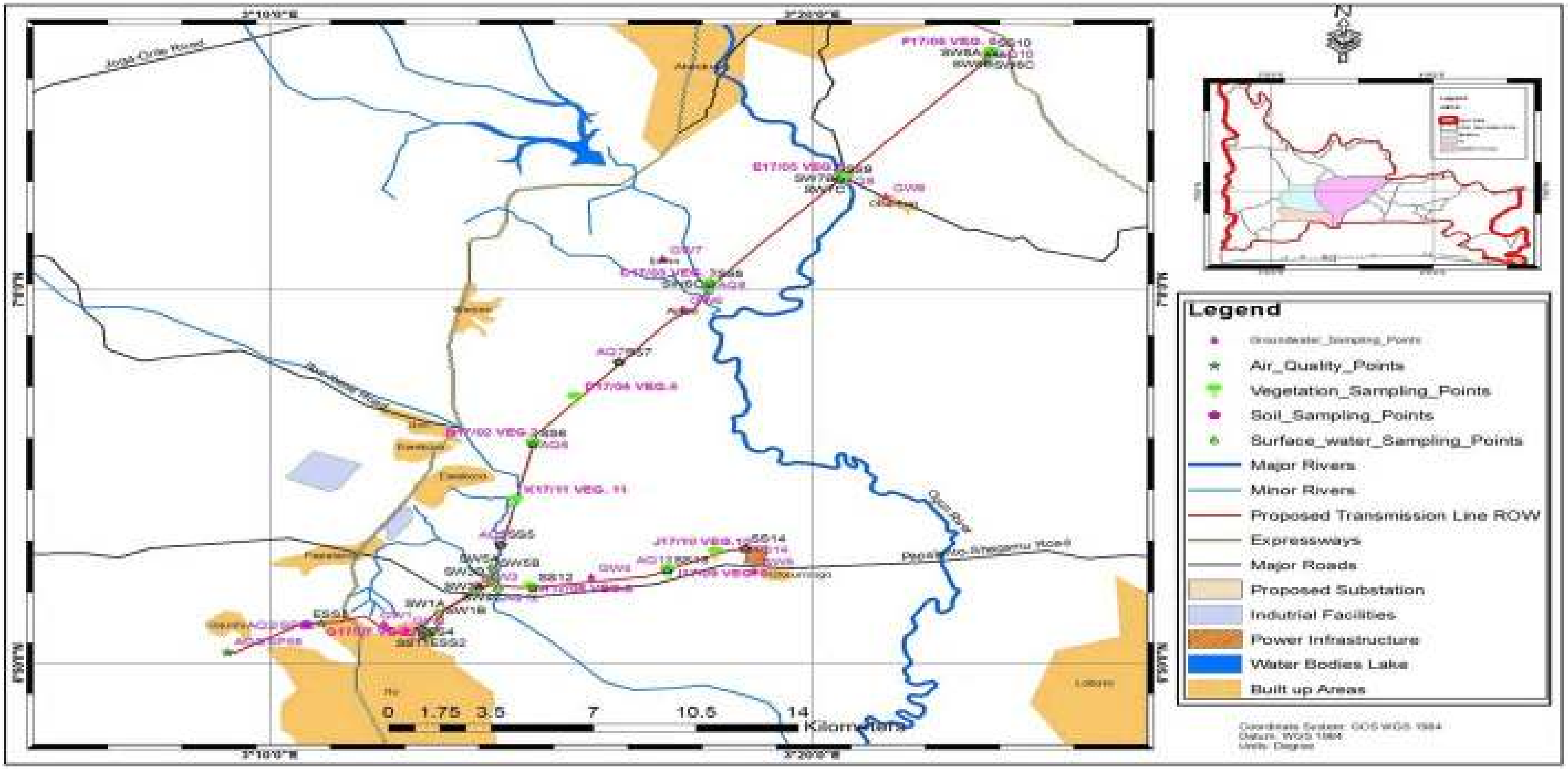


Figure 4.1: Generalized Sampling Map for all the Environmental Components.

4.3. Climate and Meteorology.

Climate and Meteorology encompasses the statistics of temperature, humidity, atmospheric pressure, wind, rainfall, atmospheric particle count and other meteorological elements in a given region over long period (30-35 years) of time. The climate of a location is affected by its latitude, terrain, altitude, as well as nearby water body and their currents. Climates can be classified according to the average and typical ranges of different variables, most commonly temperature and rainfall. The climate of Nigeria is characterized by two regimes-the dry season and the wet season. These are dependent on two prevailing air-masses blowing over the country at different times of the year: the north-easterly air mass of Sahara origin (the tropical continental air mass) and the humid maritime air-mass blowing from the Atlantic (the tropical maritime air mass). The two air masses blowing from nearly opposite directions meet along a slanting surface (the Inter-Tropical Front). The area about this front, where the air masses to some extent mix, is called the Inter-Tropical Discontinuity (ITD) or the Inter-Tropical Convergence Zone (ITCZ). The Data presented are for a period of thirty -one (31) years; from 1986 to 2016.

The entire project study area (Lagos and Ogun States) which is in the Western region of Nigeria, is situated in the tropics and experiences a fluctuating climate which is characterised by two distinct conditions of wet and dry seasons. The wet season occurs between April and October with a brief break in August, while the dry season occurs between November and March.

4.3.1. Rainfall

The rainfall within the study area for the period measure, ranged from 24mm to 461mm with an annual mean of 185.8mm in Ogun state and 25mm to 460mm with an annual mean of 185.5mm in Lagos state. Rainfall distribution was observed to be highest in the month of July and Sept and lowest in January and December for both Ogun and Lagos state respectively (Figure 4.2).

Figure 4.2 Average Rainfall for Lagos and Ogun state (NIMET, 1986-2016)
Source: Nigerian Meteorological Agency (NIMET), 2017

4.3.2. Temperature

The maximum and minimum temperatures recorded for Lagos and Ogun state by the Nigerian Meteorological Agency (NIMET) over same climatic period is shown in Figure 4.3(a-b). From the data obtained the maximum temperature was highest in the month of March for both Lagos and Ogun state and lowest in July. Minimum temperature for Lagos and Ogun sate was highest in March, while the least temperature was also recorded in the month of July.

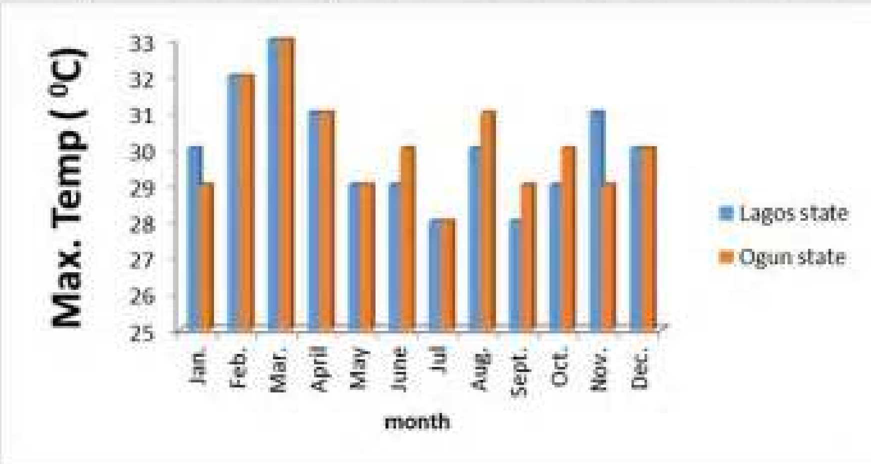


Figure 4.3a Mean Monthly Maximum Temperatures for Lagos and Ogun state (1986 - 2016)
Source: Nigerian Meteorological Agency (NIMET), 2017

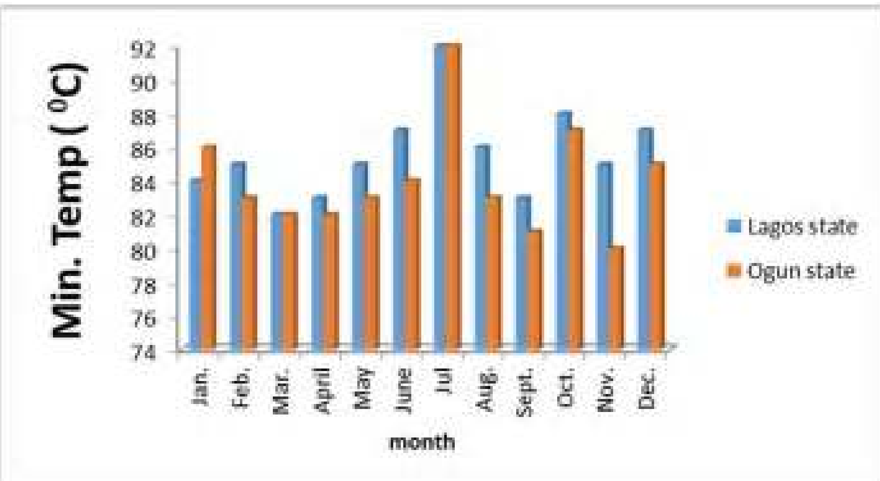


Figure 4.3b Mean Monthly Minimum Temperatures for Lagos and Ogun state (1986 - 2016)
Source: Nigerian Meteorological Agency (NIMET), 2017

4.3.3. Sunlight

Data obtained from NIMET indicates that the proposed project area is most intense between the month of Nov and Feb for both Lagos and Ogun state. Lowest isolation was recorded between the month of July and Aug for Lagos state and Jun and August for Ogun state. Average sunlight hours for both states, ranged between 3 and 7 hours with an annual average of 5 hours (Figure 4.4).

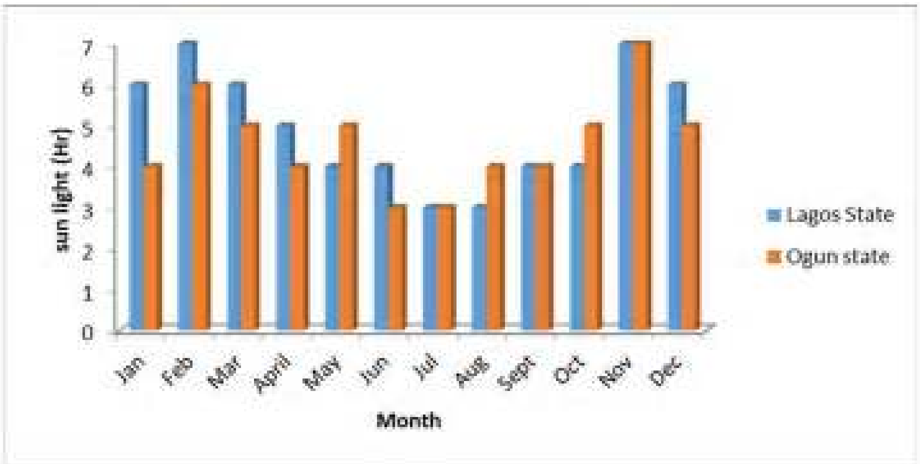


Figure 4.4 Mean Monthly sunlight for Lagos and Ogun state (1986 - 2016)
Source: Nigerian Meteorological Agency (NIMET), 2017

4.3.4. Wind speed

Wind speed for the proposed study area was observed to be highest in month of August for both Lagos and Ogun state respectively. The lowest speed was observed in November for Lagos state and in December for Ogun state (Figure 4.5).

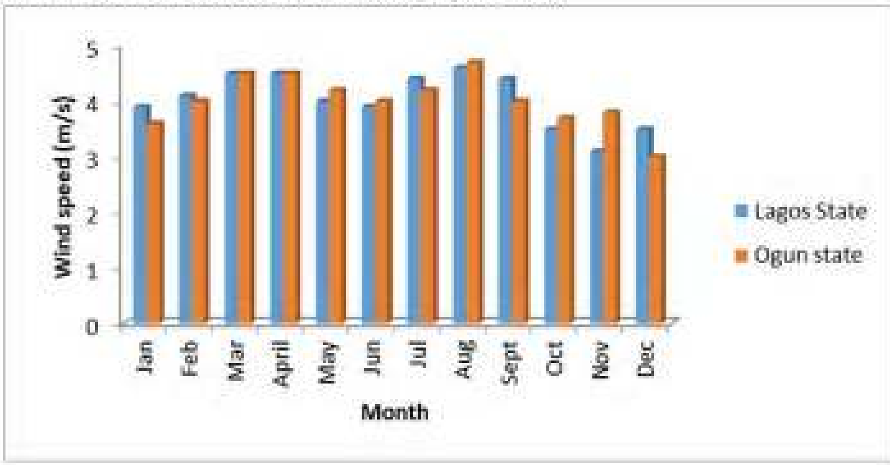


Figure 4.5 Mean Monthly wind speed for Lagos and Ogun state (1986 - 2016)
Source: Nigerian Meteorological Agency (NIMET), 2017

4.3.5. Wind Direction

Data obtained from NIMET revealed that south westerly wind direction is prevalent in the study area throughout the year (NIMET, 1986-2016). However, during dry season, winds are distributed in all directions, but predominantly South-Southwest direction during the raining season in both Lagos and Ogun State respectively.

4.3.6. Relative Humidity

Relative humidity is the ratio of the amount of water vapour in the air at a specific temperature to the maximum amount that the air could hold at that temperature, expressed as a percentage. For example, a reading of 100 percent relative humidity means that the air is totally saturated with water vapour and cannot hold any more, creating the possibility of rain. Relative humidity is usually higher in the wet season than the dry season because of rainfall caused by precipitation of vapour in the atmosphere. Relative humidity was highest in the month of July for Lagos and Ogun state. It was however, least in November for Ogun state and in September for Lagos state (Figure 4.6).

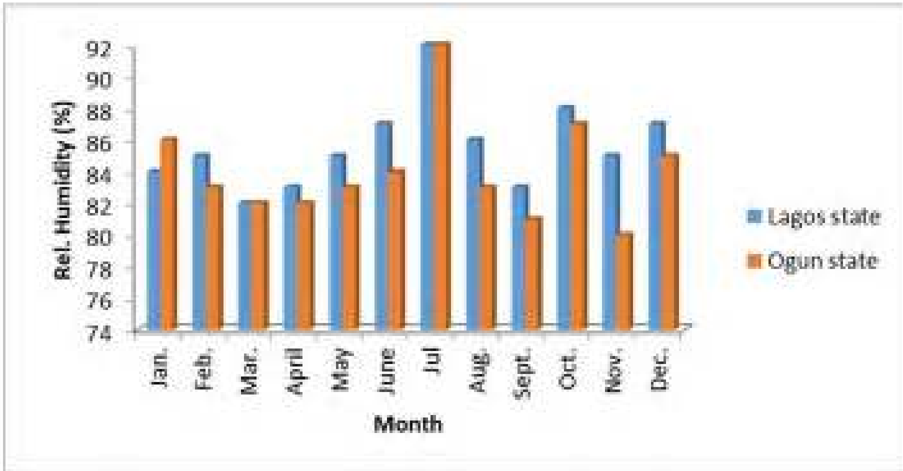


Figure 4.6 Annual Relative Humidity for Lagos and Ogun state (1986-2016)

Source: Nigerian Meteorological Agency, 2017

4.3.7. Cloud

Solar radiation, temperature and humidity have direct relationship with cloud development and thus precipitation. Cloud formation is preceded by upward movement of humid air, which leads to its expansion (against the diminishing resistance of the lowering pressure of the surrounding atmosphere), and cooling. This cooling will lead to immediate condensation in saturated air or to eventual condensation if the cooling is sufficiently prolonged. As the rainy season approaches, there is a trend towards increased cloudiness. Decline in sunshine hours (and radiation) becomes more intense as the rainy season progresses.

4.4. Ambient Air Quality

4.4.1. Methodology

Ambient air and noise quality measurements were carried out on site using *in situ* digital meters (Table 4.2) at sampling locations along the three line routes.

Table 4.2: List of Air and Noise Quality Equipment used in the study

Parameter	Equipment
Particulate Matter: $PM_{2.5}$, PM_{10} and TSP	Aerocet -531S Particle Counter/Dust Monitor
Carbon monoxide	ToxiRAE Model PGM-1150
Sulphur oxides	ToxiRAE Model PGM-1130
Ammonia	ToxiRAE Model PGM-1191
Nitric Oxide	Toxi RAE II PGM -1140
Nitrogen iv oxide	ToxiRAE Model PGM-1110
Total Volatile Organic Compounds (TVOCs)	ToxiRAE PRO with PID
Noise Level	EXTEC HD600 Datalogging Sound Level Meter
Meteorology	Kestrel Weather tracker
Electric Field Strength	B& K Model 2640 Handheld Field Strength Meter
Magnetic Flux Density	Tenmars TM-191 EMF Meter

Source: GCNL Field Work, 2017.

All these methods are as recommended by the Federal Ministry of Environment (FEPA, 1991). Plates 4.1 and 4.2 are the sampling set-ups at two out of the fourteen sampling locations where measurements were taken during the field campaign.

Plate 4.1: Air Quality Sampling during the field survey

Sampling took place between December 18 and 23, 2017 at fourteen sampling locations (average of 5 km apart) (Table 4.3) strategically located in the three line routes (Figure 4.7).

Table 4.3: Sampling Locations for Meteorology, Air Quality and Noise

S/No	Station on Map	Coordinates		Nearest town/Designation
1	AQ1 (common corridor with EEMS)	6.8491	3.2023466	Ejio
2	AQ2 (common corridor with EEMS)	6.8514411	3.1823444	Ayepe
3	AQ3 (common corridor with EEMS)	6.8384879	3.1535053	Sojuolu
4	AQ4	6.84887	3.21305	Soderu
5	AQ5	6.88643	3.23764	Adubi-Aro
6	AQ6	6.93145	3.24742	Oluke -Orile
7	AQ7	6.96769	3.27383	Fallow Land
8	AQ8	7.00249	3.30202	Ijumo-Ologboni
9	AQ9	7.04896	3.34141	Opanigangan (Ogun River Bank)
10	AQ10	7.10539	3.38824	Ototo (Close to New Abeokuta substation)
11	AQ11	6.84681	3.21501	Habited Area (Ejio)
12	AQ12	6.86741	3.24728	Sowunmi
13	AQ13	6.87506	3.28868	Akilagun
14	AQ14	6.88468	3.31266	Olorunsogo Thermal Plant Fenceline

Source: GCNL Field Work, 2017

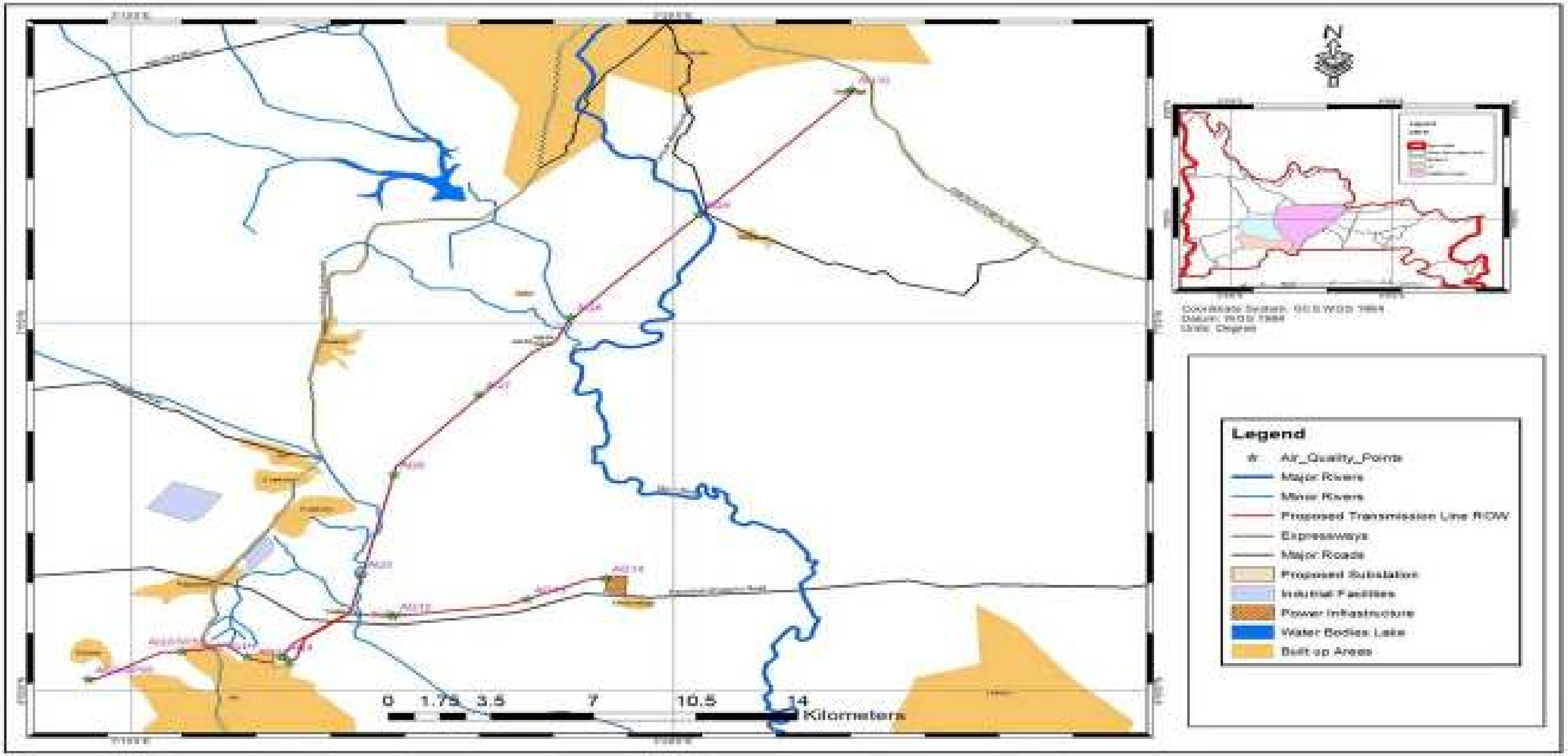


Figure 4.7: Ambient Air Quality sampling for the proposed three transmission lines routes for Lot 1

4.4.2. Air Quality

Suspended Particulates

Particulates are tiny solid or liquid particles in the air. These particles are seen as smoke or haze. Other pollutants as gas or vapour are not visible except in the case of nitrogen dioxide which is a brownish gas. Particles may carry any or all of the other pollutants dissolved in or adhering to their surfaces (Bernard 1990). Particles raging from aggregate of a few molecules to pieces of dust, readily visible to the naked eye are commonly found in the atmosphere. High concentrations of suspended particulate matter (SPM) are known to irritate the mucous membranes and may initiate a variety of respiratory diseases. Fine particulates may cause cancer and aggravate morbidity and mortality from respiratory dysfunctions.

Particulates were detected in all the sampling locations. Table 4.4 summarizes the obtained 1 – hour measured particulate concentration levels in the ambient environment of the Proposed Line Routes sampling locations. The measured concentrations were 33.60 – 75.90 $\mu g/m^3$ with an average and SD of 47.77±11.7 $\mu g/m^3$; 126.10– 429.00 $\mu g/m^3$ with an average and SD of 224.71±91.4 $\mu g/m^3$; and 143.80 – 842.90 $\mu g/m^3$ with an average and SD of 334.68±185.0 $\mu g/m^3$, respectively for $PM_{2.5}$, PM_{10} and TSP.

On extrapolation for 8-hourly average levels (Table 4.5), were 18.77 – 42.40 $\mu g/m^3$ with an average and SD of 26.69±6.6 $\mu g/m^3$; 70.44– 239.64 $\mu g/m^3$ with an average and SD of 125.53±51.1 $\mu g/m^3$; and 80.33 – 470.84 $\mu g/m^3$ with an average and SD of 186.95±103.4 $\mu g/m^3$, respectively for $PM_{2.5}$, PM_{10} and TSP.

The 24 hour extrapolated values (Table 4.6) were 13.80 – 31.17 $\mu g/m^3$ with an average and SD of 19.62±4.8 $\mu g/m^3$; 51.79– 176.19 $\mu g/m^3$ with an average and SD of 92.29±37.5 $\mu g/m^3$; and 59.06 – 346.18 $\mu g/m^3$ with an average and SD of 137.45±76.0 $\mu g/m^3$, respectively for $PM_{2.5}$, PM_{10} and TSP. Daily averaging concentration levels of TSP were within the FMEnV limit of 250 $\mu g/m^3$, but exceeded in AQ14.

The extrapolated annual averaged concentrations of particulates (Table 4.7) were 0.61 – 1.37 $\mu g/m^3$ with an average and SD of 0.86±0.21 $\mu g/m^3$; 2.27– 7.73 $\mu g/m^3$ with an average and SD of 4.05±1.60 $\mu g/m^3$; and 2.59 – 15.18 $\mu g/m^3$ with an average and SD of 6.03±3.30 $\mu g/m^3$, respectively for $PM_{2.5}$, PM_{10} and TSP. Percentage elemental composition of ambient Particulates are presented in **Appendix 3**.

Table 4.4: 1-Hourly Measured Particulate Concentrations in the Study Locations

Sampling Location	Concentrations ($\mu g/m^3$)		
	$PM_{2.5}$	PM_{10}	TSP
AQ1	39.5	206.1	308.1
AQ2	33.6	243.4	363.3
AQ3	39	136.7	162.8
AQ4	50.3	184.6	224.8
AQ5	40.2	144.1	186.3
AQ6	49.4	250.6	349.9
AQ7	44.5	240.9	350.5
AQ8	45.4	213.6	391.1
AQ9	39	126.1	183.3

AQ10	42.8	127.1	143.8
AQ11	48.5	176.7	213.3
AQ12	51.6	288.8	477.8
AQ13	75.9	378.3	487.6
AQ14	69.1	429	842.9

Source: GCNL Field Work, 2017

Table 4.5: 8-Hour Extrapolated Particulate Concentrations in the Study Locations

Sampling Location	Concentrations (µg/m³)		
	$PM_{2.5}$	PM_{10}	TSP
AQ1	22.06	115.13	172.10
AQ2	18.77	135.96	202.94
AQ3	21.79	76.36	90.94
AQ4	28.10	103.12	125.57
AQ5	22.46	80.49	104.07
AQ6	27.59	139.99	195.45
AQ7	24.86	134.57	195.79
AQ8	25.36	119.32	218.47
AQ9	21.79	70.44	102.39
AQ10	23.91	71.00	80.33
AQ11	27.09	98.70	119.15
AQ12	28.82	161.32	266.90
AQ13	42.40	211.32	272.37
AQ14	38.60	239.64	470.84

Source: GCNL Field Work, 2017

Table 4.6: 24-Hour Extrapolated Particulate Concentrations in the Study Locations

Sampling Location	Concentrations (µg/m³)		
	$PM_{2.5}$	PM_{10}	TSP
AQ1	16.22	84.65	126.54
AQ2	13.80	99.96	149.21
AQ3	16.02	56.14	66.86
AQ4	20.66	75.82	92.33
AQ5	16.51	59.18	76.51
AQ6	20.29	102.92	143.70
AQ7	18.28	98.94	143.95
AQ8	18.65	87.73	160.62
AQ9	16.02	51.79	75.28
AQ10	17.58	52.20	59.06
AQ11	19.92	72.57	87.60
AQ12	21.19	118.61	196.23

AQ13	31.17	155.37	200.26
AQ14	28.38	176.19	346.18
FMEnV Limit			250

Source: GCNL Field Work, 2017

Table 4.7: Annual Extrapolated Particulate Concentrations in the Study Locations

Sampling Location	Concentrations ($\mu g/m^3$)		
	$PM_{2.5}$	PM_{10}	TSP
AQ1	0.71	3.71	5.55
AQ2	0.61	4.38	6.54
AQ3	0.70	2.46	2.93
AQ4	0.91	3.32	4.05
AQ5	0.72	2.60	3.36
AQ6	0.89	4.51	6.30
AQ7	0.80	4.34	6.31
AQ8	0.82	3.85	7.04
AQ9	0.70	2.27	3.30
AQ10	0.77	2.29	2.59
AQ11	0.87	3.18	3.84
AQ12	0.93	5.20	8.61
AQ13	1.37	6.81	8.78
AQ14	1.24	7.73	15.18

Source: GCNL Field Work, 2017

Sulphur Oxide

It is also produce from the combustion of sulphur-containing fuels, smelting, and manufacture of sulphuric acid, incineration of refuse as well as production of elemental sulphur. The gas is known to be a harsh irritant, and is capable of aggravating asthma, bronchitis and emphysema. It can also cause coughing and promote impaired functions in the human system.

Also sulphuric acid aerosols (formed from dissolved sulphur dioxide) will readily attack the insulators to be installed on the towers, especially those containing carbonates such as marble, limestone, and mortar. This might pose a problem to the proper functioning of the transmission line in areas with high concentrations. SO_2 was below the lower detection limit of the sampling instruments. In all these sampling locations, the measured SO_2 concentrations were below the 1-hour limit of 0.1 ppm recommended by the Federal Ministry of Environment. Neither Nigeria nor the World Bank has 1-hour recommended limit for all other measured gaseous pollutants.

Nitrogen Oxides

Nitrogen oxides are a family of highly reactive gases called nitrogen oxides or oxides of nitrogen, which are formed during combustion processes. Nitrogen oxides (NO_x) are produced from natural sources, motor vehicles and other fuel combustion processes in the air to produce photochemical smog.

NO_2 results when fuel is combusted at high temperatures and occurs mainly from motor exhaust and stationary sources such as electric utilities and industrial boilers (SIEP, 1995).

It is the only oxide of nitrogen that has been shown to have significant human health effects, with exposure to concentrations higher than 0.5ppm ($1mg/m^3$) triggering changes in pulmonary function in human health (SIEP, 1995). While NO was detected in only one location (AQ 14- Close to Olorunsogo Power pLant fenceline), NO_2 was detected in three sampling locations (AQ1, AQ3 and AQ14).

Ammonia

Ammonia is a colourless, pungent gas that is highly soluble in water. It is an important byproduct of the manufacture and combustion of fuel gases. Ammonia is found in trace quantities in the atmosphere, being produced from the putrefaction (decay process) of nitrogenous animal and vegetable matter.

Ammonia is used to scrub SO_2 from the burning of fossil fuels, and the resulting product is converted to ammonium sulphate for use as fertilizer. Ammonia neutralizes the nitrogen oxides (NO_x) pollutants emitted by diesel engines. NH_3 was detected in ten out of the fourteen locations with concentrations between 1 and 3 ppm.

Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless and tasteless gas produced by the incomplete combustion of carbonaceous materials or fossil fuels - gas, oil, coal and wood. Adverse health effect has been observed with carbon monoxide concentrations of 12 - 17ppm for 8 hours (Canter and Hill, 1977) while prolonged (45 minutes to 3 hours) exposure to concentrations of CO between 200ppm and 800ppm often results in severe headache, dizziness, nausea and convulsions (CCDI, 2001). CO was obtained in five locations with concentration level ranging from 1 and 5 ppm.

Hydrocarbons

Hydrocarbons (C_xH_y) are organic compound consisting entirely of carbon and hydrogen, they can be straight-chain, branched chain, or cyclic molecules. They are mainly grouped into aliphatic and aromatic organic compounds. The majority of hydrocarbons found naturally occur in crude oil, where decomposed organic matter (fossil) provides an abundance of carbon and hydrogen which when bonded can catenate to form limitless chains.

Hydrocarbon vapour in the atmosphere arises from fugitive emissions, vents organic chemical production, and distribution of natural gas, transportation and processing of crude oil. Others are incomplete combustion of fuels, particularly where fuel to air ratios are too high. Most members of this group are significantly toxic and exposure to high concentrations in the atmosphere (about 100ppm or more) could result in interference with oxygen intake (Canter, 1977) and acute leukaemia (SIEP, 1995). Volatile Organic Compounds (VOCs) was detected in three locations (AQ6, AQ10 and AQ14) with respective concentrations of 1, 1, and 2 ppm.

Table 4.8 summarizes the 1-hour measured concentrations of the gaseous pollutants in the ambient environment of sampling locations in the study area as obtained during the field study. Highest concentration of CO, NO, NO_2 and VOCs obtained were measured at AQ14- the sampling point close to the Olorunsogo Power Plant.

Table 4.8: 1-Hour Measured Gaseous Concentrations in the Study Area

Sampling Location	Mean Concentration (ppm)					
	NO	NO_2	CO	SO_2	NH_3	VOCs
AQ1	<0.1	0.3	2	<0.1	1	<1
AQ2	<0.1	<0.1	<1	<0.1	<1	<1
AQ3	<0.1	0.8	2	<0.1	1	<1
AQ4	<0.1	<0.1	<1	<0.1	1	<1
AQ5	<0.1	<0.1	1	<0.1	2	<1
AQ6	<0.1	<0.1	1	<0.1	1	1
AQ7	<0.1	<0.1	<1	<0.1	<1	<1
AQ8	<0.1	<0.1	<1	<0.1	1	<1
AQ9	<0.1	<0.1	<1	<0.1	1	<1
AQ10	<0.1	<0.1	<1	<0.1	<1	<1
AQ11	<0.1	<0.1	<1	<0.1	2	1
AQ12	<0.1	<0.1	<1	<0.1	1	<1
AQ13	<0.1	<0.1	<1	<0.1	3	<1
AQ14	0.1	1.1	5	<0.1	<1	2
FMEnv. Limit	0.04 – 0.06		10	0.1	0.28	-

Source: GCNL Field Work, 2017

On extrapolation, the 24-hour concentrations of NO_2 were 0.12, 0.33 and 0.25 ppm, respectively for sampling points AQ1, AQ3 and AQ14 while CO concentration levels became 0.82, 0.82, 0.41, 1.00 and 2.05 ppm for sampling points AQ1, AQ3, AQ5, AQ6 and AQ14, respectively (Table 4.9). The 24-hour NH_3 concentration levels ranged between 0.00 and 1.23 ppm. The obtained concentrations levels are typical of farmlands. The use of fertilizers and other organic manures contribute to NH_3 concentration levels in the atmosphere. VOCs 24 hour concentration values were 0.41, 0.41 and 0.82 ppm for sampling locations AQ6, AQ11 and AQ14. All the measured parameters with 24-hour averaging period concentrations of 0.0 ppm can be considered to be within the recommended limit of the Federal Ministry of Environment for these parameters. The 24-hour equivalents of measured NO_2, and NH_3 were above their recommended limits and below their recommended limits for CO. The spatial distribution of 24 hrs averaging Concentration levels of the measured pollutants are presented in **Appendix 3**.

Table 4.9: Extrapolated 24-Hour Gaseous Concentrations in the Study Area

Sampling Location	Mean Concentration (ppm)					
	NO	NO_2	CO	SO_2	NH_3	VOCs
AQ1	0.00	0.12	0.82	0.00	0.41	0.00
AQ2	0.00	0.00	0.00	0.00	0.00	0.00
AQ3	0.00	0.33	0.82	0.00	0.41	0.00

AQ4	0.00	0.00	0.00	0.00	0.41	0.00
AQ5	0.00	0.00	0.41	0.00	0.82	0.00
AQ6	0.00	0.00	1.00	0.00	0.41	0.41
AQ7	0.00	0.00	0.00	0.00	0.00	0.00
AQ8	0.00	0.00	0.00	0.00	0.41	0.00
AQ9	0.00	0.00	0.00	0.00	0.41	0.00
AQ10	0.00	0.00	0.00	0.00	0.00	0.00
AQ11	0.00	0.00	0.00	0.00	0.82	0.41
AQ12	0.00	0.00	0.00	0.00	0.41	0.00
AQ13	0.00	0.00	0.00	0.00	1.23	0.00
AQ14	0.00	0.45	2.05	0.00	0.00	0.82
FMENV Limit[a]	0.04 - 0.06		10	0.1	0.28	-
World Bank Limit[b]	0.08		26	0.01		

Source: GCNL Field Work, 2017; [a]Source: FEPA (1991); [b]Source: World Bank (1998)

4.5. Noise Quality and EMF (Electromagnetic Fields)

Ambient noise quality measurements were carried out on site using *in situ* digital meters (Table 4.2) at sampling locations along the three line routes.

All these methods are as recommended by the Federal Ministry of Environment (FEPA, 1991). Plates 4.2 are the sampling set-ups at two out of the fourteen sampling locations where measurements were taken during the field campaign.

Plate 4.2: EMF (a) and Noise Sampling (b) during the field survey

Sampling took place between December 18 and 23, 2017 at fourteen sampling locations (average of 5 km apart) (Table 4.3 in section 4.4) strategically located in the three line routes (Figure 4.7).

4.5.1. Noise Quality Measurement

Noise is a periodic fluctuation of air pressure causing unwanted sound. Apart from causing disturbance to the affairs of man, long term exposure to excessive noise can damage health and have psychological effects (SIEP, 1995). The effects of noise on residents generally relate to the annoyance/nuisance caused by the short and long term high noise levels. Also, disturbance to wildlife is significant especially during breeding seasons and/or when rare species are present. The rate at which these fluctuations of air pressure occur is the frequency, expressed in hertz (cycles per second). The range of sound pressures encountered is very large and to keep numbers in manageable proportions, noise levels are measured in decibels (dB), which have a logarithmic scale. Most legislations and measurements refer to the 'A' frequency weighting, dB(A) which covers the range audible to the human ear. A 10dB (A) typically represents a doubling of loudness.

Sound pressure or acoustic pressure is the local pressure deviation from the ambient (average, or equilibrium) atmospheric pressure caused by a sound wave. Sound pressure in air can be measured using a microphone, and in water using a hydrophone. The SI unit for sound pressure *p* is the Pascal (symbol: Pa). Sound pressure level (SPL) or sound level is a logarithmic measure of the effective sound pressure of a sound relative to a reference value. It is measured in decibels (dB) above a standard reference level. The commonly used "zero" reference sound pressure in air is 20µPa RMS, which is usually considered the threshold of human hearing (at 1 kHz). Noise levels are usually altered during installation and servicing of the transmission line. The regulatory limit for noise provided by the National Environmental Standards and Regulations Enforcement Agency Nigeria is specific to the workplace (85dB (A). However, noise due to construction and installation of the transmission line and associated facilities are expected to rise. The IFC, WHO and NESREA limits shall be used to benchmark the ambient noise levels measured in the project area. Table 4.10 presents the WHO guidelines for community noise.

Table 4.10: WHO Guidelines for Community Noise

Specific Environment	Critical Health Effect(s)	LAeq(dB)	Time base (hours)	LAmax, fast (dB)
Outdoor living area	Serious annoyance, daytime and evening.	55	16	-
	Moderate annoyance, daytime and evening.	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance at daytime and evening.	35	16	
Inside bedrooms	Sleep disturbance at night.	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values).	45	8	60
School classrooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication.	35	During class	-
Pre-schools	Sleep disturbance	30	Sleeping	45

bedrooms, indoors			time	
School, playground outdoors	Annoyance (external source)	55	During play	-
Hospitals, wardrooms, indoors	Sleep disturbance at nighttime Sleep disturbance at daytime and evenings.	30 30	8 16	40
Hospitals, treatment rooms, indoors.	Interference with rest and recovery.	#1	-	-
Industrial, commercial shopping and traffic areas, indoors and outdoors.	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events.	Hearing impairment (patrons:<5 times/year)	100	4	110
Public address, indoors and outdoors	Hearing impairment	85	1	110
Music through headphones/earphones	Hearing impairment (free-field value)	85#4	1	110
Impulse sounds from toys, fireworks and firearms.	Hearing impairment (adults) Hearing impairment (children)	-	-	140#2 120#2
Outdoors in parkland and conservation areas	Disruption of tranquillity	#3		

Table 4.11: IFC Noise Level Guidelines

Noise Level Guidelines		
	One Hour LAeq (dBA)	
Receptors	**Daytime (07:00 – 22:00)**	**Night time (22:00 – 7:00)**
Residential, Institutional, Educational	55	45
Industrial, Commercial	70	70

Source: IFC General Guidelines.

#1: as low as possible; #2: peak sound pressure (not LAmax, fast), measured 100mm from the ear; #3: existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background so should be kept low; and #4: under headphones, adapted to free-field values.

The summary results of the 10-minute measurements are shown in Figure 4.8. The rectangular boxes indicate the interquartile range (first and third quartiles); median values are indicated by the centerline within each box; outliers are indicated by asterisks. At locations AQ1 – A14 are as shown in Figure 4.9 with the minimum noise levels being 21.6 – 48.2 dB(A) and the maximum levels were of the range 46.6 – 81.2 dB(A). These minimum measured noise levels during the study were below both the sleep disturbance limit (Berglund et al, 1999) of 45 dB(A) and the WHO's limit of 55 dB(A) for ambient environment except for sampling point AQ14. The measured noise level in the location are attributable to heavy cement haulage trailers movement and the presence of Olorunsogo Power Plants Phase I and II.

The sleep disturbance limit was breached by the maximum levels in all the sampling locations while the WHO's limit was breached in only 71% of the locations. However, both the measured minimum and maximum noise levels in the fourteen sampling locations were within the 8-hour shop floor limit (Table D6 in Appendix 2) of the . In general, the measured noise levels are representative of typical rural areas. The major observed primary sources of noise during the study include distant voices, river, birds, goats, and crickets. Elevated levels were as a result of heavy sand and cement trucks movement in some locations of the study area. The spatial distribution of minimum and maximum noise levels are presented in Appendix 3.

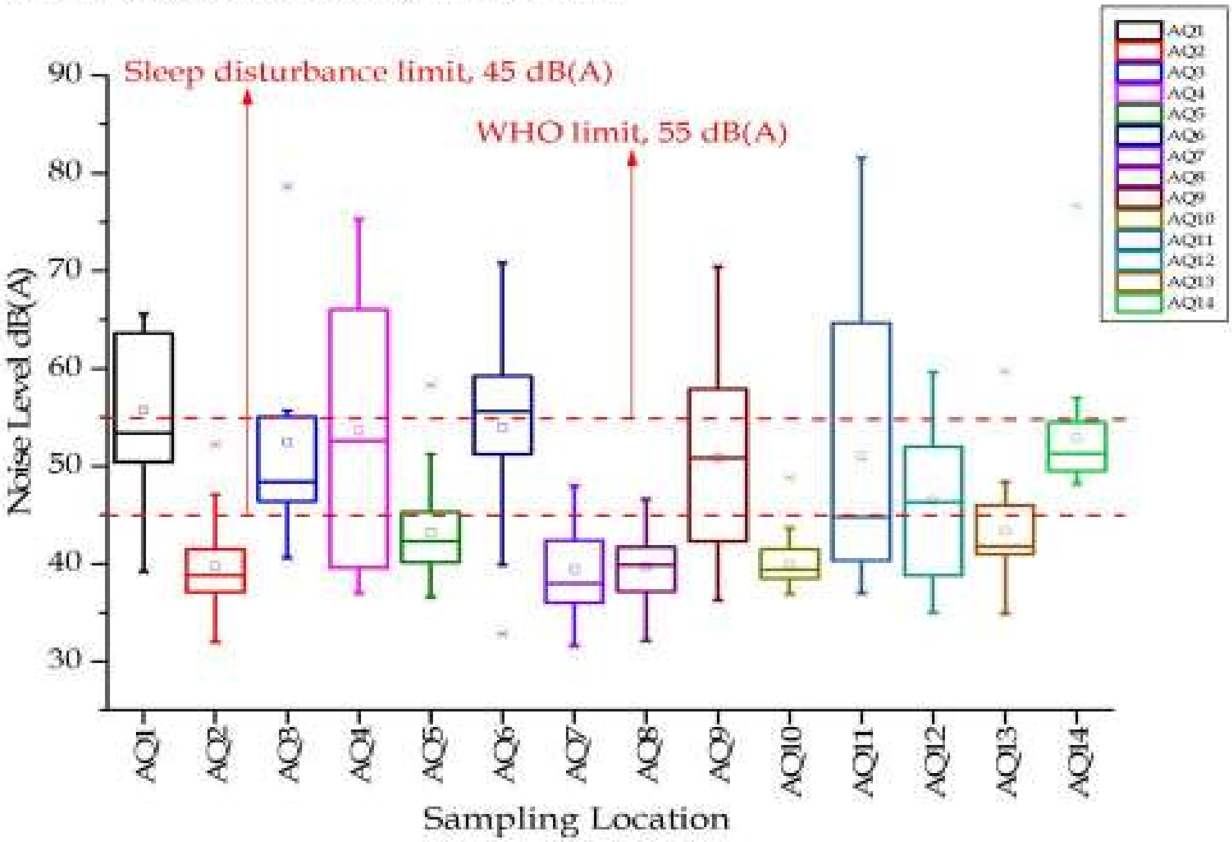


Figure 4.8: Measured Noise Levels in the Study Area

4.5.2. Electromagnetic Field Strength

Electric field and magnetic flux densities measured in the study area are presented in Tables 4.11 – 4-12. Electric field strength varied between 0.00 and 2.33 kV/m while magnetic flux density varied between 0.00 and 4.07 μT. Electromagnetic field strength were detected in about 64% of the sampling locations along the line routes. As expected, the obtained highest values were measured at AQ14 being the sampling point closer to a power generation station fenceline. The obtained values were far below the ICNIRP guidelines for both occupational and general public exposure (Appendix 2; table D9). Electric and magnetic fields are produced by any wiring or equipment carrying electric current. This includes overhead and underground power lines carrying electricity, wiring in buildings, and electrical appliances. The strengths of the fields decrease rapidly with increasing distance from the source. Electric and magnetic fields are fundamentally different, in their physical nature and in the way they interact with the body, from true electromagnetic radiation such as radio waves and microwaves.

Most research efforts have concentrated on finding out whether the magnetic fields can cause cancer or could assist the development of a cancerous condition. Other effects investigated include miscarriages, Alzheimer's disease and depression. In spite of all the studies that have been carried out over the past thirty years there is still no persuasive evidence that the fields pose any health risks. The results obtained show that if there are any risks, they must be very small.

Mains electricity in Nigeria, and in almost all power lines, is an *alternating current* (AC). An alternating current does not flow steadily in one direction, but oscillates backwards and forwards, making 50 complete cycles every second. Therefore, the magnetic field produced by such a current also oscillates at the same rate. This frequency is commonly expressed as 50 Hertz (Hz), and falls into a range referred to as *extremely low frequency* (ELF). The magnetic fields can be referred to as *ELF magnetic fields*. The voltage on a current-carrying wire or electrically charged surface produces an electric field around it. Like the current, the voltage on a cable or appliance carrying mains electricity is not constant but alternates 50 times every second. Therefore, the electric field also alternates and can be referred to as an *ELF electric field*.

Table 4.11: Measured Electric Field Strength in the Study Area

Code	Latitude	Longtitude	Electric Field Strength (kV/m)					
			0 m	10 m	20 m	30 m	40 m	50 m
EMF1	6.84602	3.2102972	0.00	0.00	0.00	0.00	0.00	0.00
EMF2	6.85097	3.17835	0.00	0.00	0.00	0.00	0.00	0.00
EMF3	6.83829	3.1543528	0.03	0.02	0.00	0.00	0.00	0.00
EMF4	6.84887	3.2130528	0.10	0.09	0.05	0.04	0.03	0.01
EMF5	6.88643	3.2376444	0.27	0.16	0.11	0.09	0.06	0.02
EMF6	6.93138	3.2475222	0.00	0.00	0.00	0.00	0.00	0.00
EMF7	6.97359	3.2795778	0.00	0.00	0.00	0.00	0.00	0.00
EMF8	7.00249	3.3020222	0.00	0.00	0.00	0.00	0.00	0.00
EMF9	7.04953	3.3438611	0.01	0.00	0.00	0.00	0.00	0.00
EMF10	7.10547	3.3882444	0.42	0.29	0.21	0.19	0.10	0.10
EMF11	6.84663	3.2151111	0.11	0.11	0.09	0.07	0.03	0.03
EMF12	6.86708	3.246675	0.34	0.29	0.25	0.23	0.23	0.18
EMF13	6.87499	3.288975	0.25	0.18	0.13	0.12	0.08	0.04
EMF14	6.88433	3.3125722	2.33	2.33	2.27	2.27	2.11	2.08

Table 4.12: Measured Magnetic Flux Density in the Study Area

Code	Latitude	Longitude	Magnetic Flux Density (μT)					
			0 m	10 m	20 m	30 m	40 m	50 m
EMF1	6.84602	3.2102972	0.00	0.00	0.00	0.00	0.00	0.00
EMF2	6.85097	3.17835	0.00	0.00	0.00	0.00	0.00	0.00
EMF3	6.83829	3.1543528	0.02	0.01	0.00	0.00	0.00	0.00

EMF4	6.84887	3.2130528	0.09	0.08	0.06	0.03	0.00	0.00
EMF5	6.88643	3.2376444	0.13	0.11	0.11	0.11	0.10	0.09
EMF6	6.93138	3.2475222	0.00	0.00	0.00	0.00	0.00	0.00
EMF7	6.97359	3.2795778	0.00	0.00	0.00	0.00	0.00	0.00
EMF8	7.00249	3.3020222	0.00	0.00	0.00	0.00	0.00	0.00
EMF9	7.04953	3.3438611	0.01	0.00	0.00	0.00	0.00	0.00
EMF10	7.10547	3.3882444	0.23	0.19	0.18	0.18	0.17	0.10
EMF11	6.84663	3.2151111	0.10	0.09	0.08	0.05	0.01	0.00
EMF12	6.86708	3.246675	0.33	0.27	0.22	0.19	0.18	0.11
EMF13	6.87499	3.288975	0.00	0.00	0.00	0.00	0.00	0.00
EMF14	6.88433	3.3125722	4.07	3.99	3.98	3.82	3.67	2.43

When a person is in an ELF electric field, an alternating electric current flows in the body. Even in fields of 50 kV/m (well above the highest fields present under AC transmission lines), the induced currents are so small they cannot be felt.

In fields of several kV/m, sensitive individuals might feel minute vibrations of skin, hair or clothing. Some people may experience small shocks when touching large ungrounded objects (eg, a large bus) in these fields. These effects are harmless but can be irritating, especially if experienced persistently. However, they can be avoided by simple means such as earthing and screening, and normally people do not feel any sensation, even under even the highest voltage lines.

ELF magnetic fields also induce very small electric currents in the body. The minute currents produced by fields near transmission and distribution lines and domestic appliances are far too weak to be felt, and are much lower than currents which occur naturally in the body. Most laboratory studies have found that exposure to ELF magnetic fields has no effect on a wide range of biological processes. However, a few effects have been reported, such as changes in the flow of calcium in and out of cells, changes in hormone production and cell growth. The spatial variation of measured electric field strength and magnetic flux density in the study area are presented in Appendix 3.

4.6. Geology

4.6.1. Regional Geology

The study area lies within Ogun State. Ogun state comprises both sedimentary and basement formations as well as transitional zones.

The basement complex according to Jones and Hockey (1964) is made up of magmatite - gneiss complex, the schist belt and the older granites which are 800 to 500 million years in age (Hurley et al., 1967) as shown in Fig. 4.9. These rocks are well displayed in Odeda, Abeokuta, Igbo - Ora, and Ijebu Igbo, etc

Figure 4.9: Geological Map of Nigeria identifying Ogun as the Study Area (Obaje 2009)

The continent of Africa is made up of a vast stable crystalline basement of very old rocks, mainly of Precambrian age. Superimposed on this basement are later, largely flat-lying cover successions. Along the East, North, and West coasts there are sediments of Mesozoic and Tertiary age, deposited in marginal marine basins. The Precambrian Basement of Africa can be divided into three large masses or cratons; these are the Kalahari, Congo, and West African cratons. They are separated from each other by a number of mobile belts active in Late Precambrian and early Palaeozoic times (Akintola et al., 2012). The general geology of Nigeria has been studied by various workers which include Rahaman (1988), Oyawoye (1965, 1972), Cooray (1972), Dada and Rahaman., (1995) and Ajibade (1976).

Nigerian rocks can be grouped into crystalline and sedimentary rocks. Half of crystalline rocks in Nigeria are buried beneath the Cretaceous and Younger sediments while the other half outcrop largely in the North Central, Southwestern and in three regions from the North to the South along the Cameroon line, that is Mandara highland, Adamawa Plateau and Oban massif. According to Dada et al, 1993, the crystalline rocks can further be divided into three main groups;

- Basement Complex
- Younger Granite
- The Tertiary-Recent Volcanics

The evolution of the Basement Complex is associated with the general evolution of the African continent. The complex comprises of gneisses and migmatite with supra-crustal relicts which have yielded Archean between (C. 2700 Ma) and Proterozoic (C. 2000 Ma) according to Dada et al., 1998. The basement complex outcrops are distributed in three areas.

- A triangular area in southwestern Nigeria, where the rocks continue westwards into the neighboring Benin Republic.
- A roughly circular area in North-central Nigeria.
- A rectangular area broken up into three zones by sedimentary rocks on the eastern border of Nigeria with Cameroon Republic.

The Basement Complex was differentiated into four (4) different groups of by Oyawoye (1964). These are the: the ancient meta-sediments, the gneisses-migmatite and older granites, the newer meta-sediments, and the pegmatite as awell as dolerite dikes which are considered as a special minor group.
Isotopic age distribution has demonstrated the polycyclic nature of the migmatite-gneiss complex. The age of the schist belt and their possible role in the evolution of the Nigeria Basement Complex during the Pan African event has become controversial. McCurry (1971), Ogezi (1977) and Ajibade (1980) noted that apart from the Older Granite, no other rock group can confidently be assigned to the Pan African. They were of the opinion that the nature of the Pan African events in Nigeria has therefore become obscured. They also suggested that to understand the evolution of the Nigeria basement, it must be considered in the context of Pan African belt as a whole.

The Dahomey basin extends from southeastern Ghana through Togo and the Republic of Benin to southwestern Nigeria. It is separated from the Niger Delta by a subsurface basement high referred to as the Okitipupa Ridge. According to Jones and Hockey (1964), the geology of southwestern Nigeria reveals a sedimentary basin, which is classified under five major formations. According to their geological formation age, the five formations include the Littoral and the Lagoon deposits, Coastal Plain sands, the Ilaro formation, the Ewekoro formation and the Abeokuta formation overlying the crystalline basement complex with their ages ranging from Recent to Cretaceous. Four of these formations, excluding Ilaro, constitute aquifers in the Dahomey Basin, from which the geological section of Lagos was drawn. The most recent detailed stratigraphy is that of Omatsola and Adegoke (1981) that proposed three new easily recognized lithostatigraphic unit of formation ranks which are the Ise formation, Afowo formation and the Araromi formation, all made up of the Abeokuta group; others are Ewekoro Formation, Oshosun formation and Ilaro formation (Fig 4.10) and (Fig 4.11).

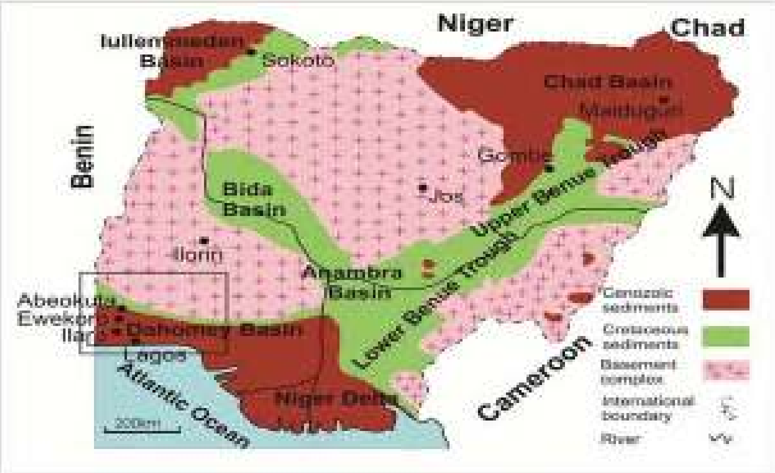


Figure 4.10: Location of Dahomey Basin in Nigeria (modified from Bankole et al., 2007)

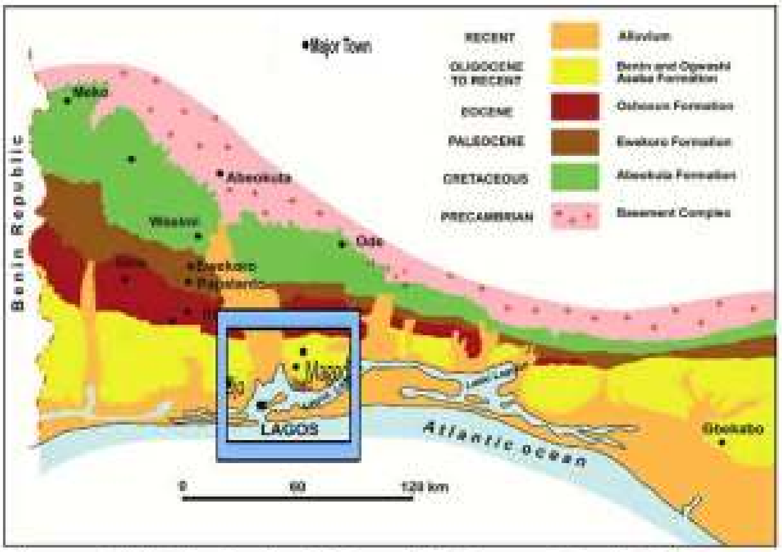


Figure 4.11: Geological Map of Dahomey Basin (Billman, 1992).

The basin is bounded on the west by faults and other tectonic structures associated with landwards extension of romancer fracture zone (Adegoke et al., 1981) with its eastern limit similarly marked by the Benin hinge line. It is a major flat structure marking the western limit of Niger delta basin (Omatsola and Adegoke, 1981). The sedimentary formation of the Dahomey basin outcrop in an actuate belt is roughly parallel to the ancient coastline with sediments in the basin exceeding a thickness of 2.2km at the coast of western Nigeria. The oldest dated sediments onshore consist of lower cretaceous grits and sandstones with interbedded mudstone (Omatsola and Adegoke, 1981).

The stratigraphy of the eastern Dahomey basin has been discussed by various workers and several classification schemes have been proposed. These notably include those of Jones and Hockey (1964) (Table 4.13); Ogbe (1972); Omatsola and Adegoke (1980) (Table 4.13); Coker et al (1983); Billman (1992), Nton (2001); Elueze and Nton (2004); Nton et al., (2006) among others. Inspite of all these classification schemes, there are still controversies on age assignments and nomenclatures of the different lithological units within the basin.

Table 4.13: Different Classification Schemes of the Dahomey Basin

ERA	Jones & Hockey (1964)		Omatsola and Adegoke (1980)	
	Age	Formation	Age	Formation
Quaternary	Recent	Alluvium		
Tertiary	Pleistocene-Oligocene	Coastal Plain Sands	Pleistocene-Oligocene	Coastal Plain Sands
	Eocene	Ilaro	Eocene	Ilaro Ososhun
	Paleocene	Ewekoro	Paleocene	Akinbo Ewekoro
Late Cretaceous	Late Senonian	Abeokuta	Maastrichtian Neocomian	Araromi Afowo Ise
PRE – CAMBRIAN CRYSTALLINE BASEMENT				

4.6.2. Hydrogeology

Despite the undulating productivity of the underlying aquifer units, the hydrogeology was also considered to be particularly sensitive due to the bedrock aquifers being dominated by fracture and weathered formations. Fracture/weathered formations dominated aquifers are more susceptible to pollution as they offer very little attenuation of pollutants. Sequel to the identification and assessment of the sensitivity of the hydrogeology, a comprehensive suite of mitigation measures has to be incorporated into the design of the proposed Transmission Lines, to address the protection of the groundwater from pollution.

4.6.3. Geophysical Survey

The specific objectives of the study are to:

- Undertake geophysical investigation via the application of Vertical Electrical Sounding (VES) and 2-D Electrical Resistivity Techniques for the purpose of evaluating the lithological unit, stratigraphy, structures, groundwater flow direction and aquifer level.
- Interpret the result of above in qualitative and quantitative terms to establish the geo-electric/geologic layers.
- Recommend any high risk and disaster prone areas to be avoided from the result.

Electrical resistivity method, deployed in the vertical probe mode, using Schlumberger array was used to expand the extent and fill the gaps in borehole data sets. A total of eleven (11) Vertical Electrical Sounding (VES) and five (5) 2-D resistivity data were acquired and distributed across the entire area. The Schlumberger and Wenner array configurations were deployed respectively. PASI Earth Resistivity Meter was used for the data acquisition. Other equipment employed include: metal electrodes, hammers, meter rule, four reels of wire and GPS.

4.6.3.1. Discussion of Results

The 2-D Constant Separation Traversing (CST) and Vertical Electrical Sounding (VES) interpreted resistivity results are presented as 2-D resistivity pseudo-section and 1-D resistivity curves. Quantitative interpretation of the VES data involves partial curve matching using two layer

Schlumberger master curves and the auxiliary K, Q, A and H curves. The qualitative interpretation reveals K, Q, A, H, HKH, HA and QH curve types.

a. Ifo – Ejio (Sub-Station)

The 2-D resistivity structure and VES resistivity results around Ifo - Ejio villages (sub-station) are presented in Figs. 4.12 and 4.13. Both the Constant Separation Traversing (CST) and Vertical Electrical Sounding (VES) resistivity techniques were integrated to delineate the subsurface layer lithology.

b. Along Line 1

The first geo-electric layer represents the topsoil with resistivity values that ranges from 142 - 721 Ωm from the surface to depth of about 0.9 - 2.0 m (Table 4.14). The second geo-electric layer has resistivity values that range from 721 - 873 Ωm within the depth range of 0.9 - 10.0 m. This layer is composed of sand which corresponds to sandstone lithology of Oshosun Formation that overlies the Akinbo Formation (Okosun, 1998). The third geo-electric layer is composed of sand with resistivity values that ranges between 1184 - 1690 Ωm and extends from depth range of about 6.4 - 50 m. This sand layer also corresponds to sandstone lithology of Oshosun Formation.

Table: 4.14: Summary of Resistivity, Thickness and Lithology of the VES 1 and 2

VES No	Layers	Resistivity (Ωm)	Thickness(m)	Depth (m)	Lithological Unit
VES 1	1	142	0.9	0.9	Topsoil
	2	873	5.5	6.4	Sand
	3	1690	--	--	Sand
VES 2	1	126	1.0	1.0	Topsoil
	2	97	3.7	4.7	Sand
	3	26	--	--	Clay

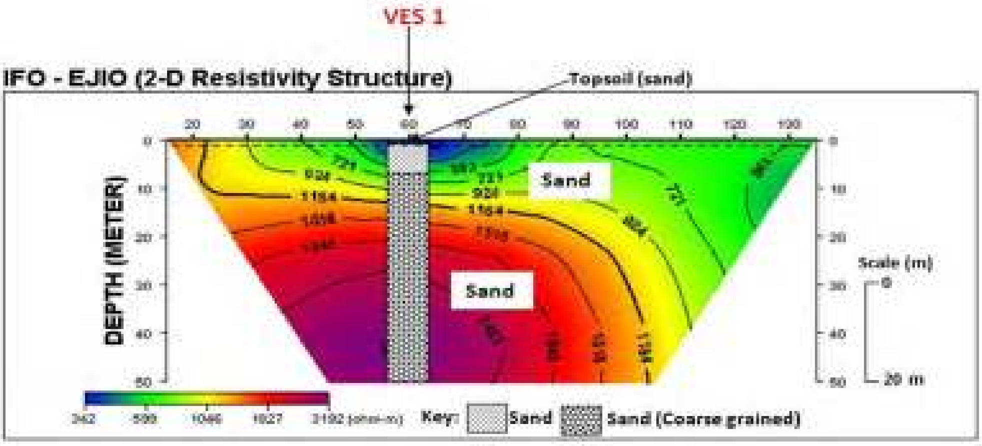


Fig. 4.12: 2D Resistivity Imaging and VES along Ifo - Ejio (Line 1)

c. Discussion of Results along Profile 2

The first geo-electric layer represents the topsoil with resistivity values that ranges from 22 - 264 Ωm from the surface to depth of about 1.0 - 3.0 m (Table 4.14). The second geo-electric layer has resistivity values that range from 22 - 97 Ωm within the depth range of 1.0 - 8.0 m (Fig. 4.13).

This layer is composed of clay and inter-bedded sand of the Oshosun Formation. The third geo-electric layer is composed of thick clay with resistivity values that ranges between 6 - 26 Ωm and extends from depth range of about 4.7 - 50 m. This clay layer belongs to the laminated and glauconitic thick clay of the Oshosun Formation Okosun (1998).

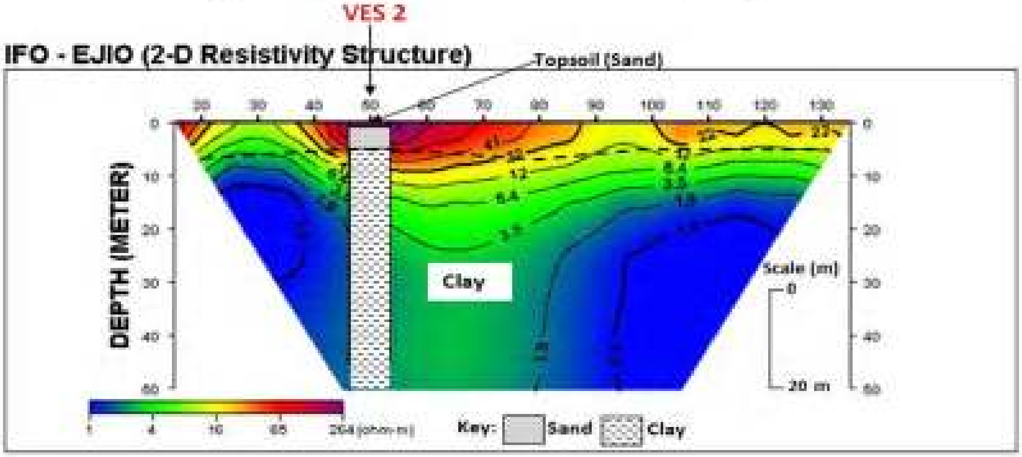


Fig. 4.13: 2D Resistivity Imaging and VES along IFO - EJIO (Line 2)

d. Discussion of Results along EJIO – SOJUOLU SECTION AND WASIMI

e. Discussion of Results along Sojuolu and Wasimi (Line 3)

The first geo-electric layer represents the topsoil with resistivity values that ranges from 113 - 199 Ωm from the surface to depth of about 0.8 - 2.0 m (Table 4.15). The second geo-electric layer has resistivity values that range from 48 - 62 Ωm and thickness values that range from 7.6 – 9.3 m within the depth range of 8.8 – 10.1 m (Figs. 4.14 and 4.15). This layer is composed of clay, sandy clay and sand. The topsoil and the second geo-electric layers composed of clay, sandy clay and sand correspond to the sandstone and shale of the Araromi Formation (Omatsola and Adegoke, 1981). The third geo-electric layer is composed of clay with resistivity values that ranges between 1.4 - 14 Ωm and extends from depth range of about 8.8 - 50 m. The layer composed of clay. This clay layer correspond to the lower part of the Afowo Formation which has transitional with mixed brackish to marginal horizons that alternate with well sorted sand (Billman, 1992).

Table: 4.15: Summary of Resistivity, Stratigraphy and Inferred Lithology of the VES 3 and 4

VES No	Layers	Resistivity (Ωm)	Thickness(m)	Depth (m)	Inferred Lithology
3	1	135	0.8	0.8	Topsoil
	2	62	9.3	10.1	Sand Clay
	3	14	15.3	25.4	Clay
	4	462	--	--	Sand
4	1	113	1.3	1.3	Topsoil
	2	48	7.6	8.8	Sand Clay
	3	10	--	--	Clay

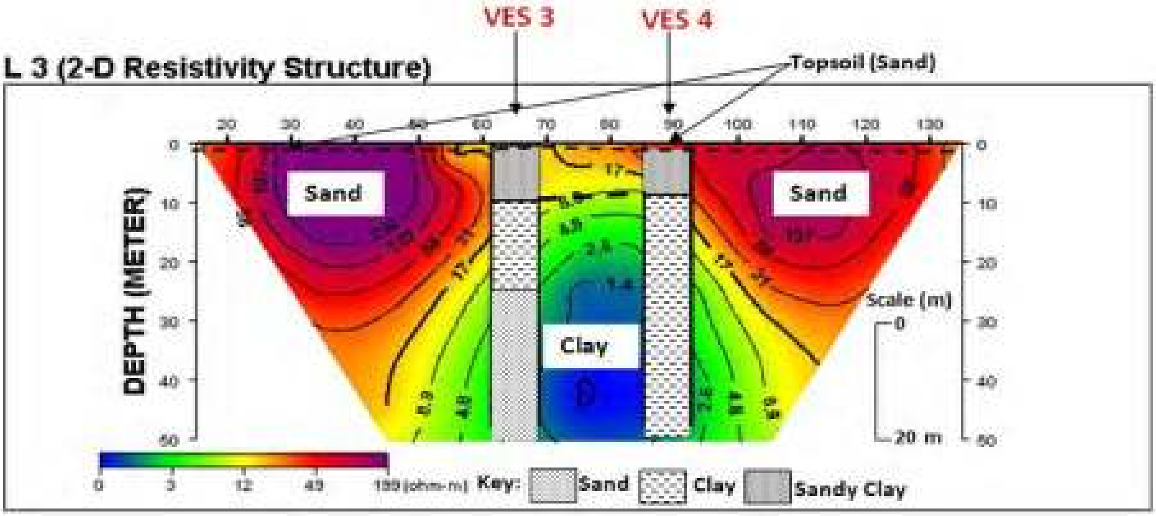


Fig. 4.14: 2D Resistivity Imaging and VES along Sojuolu and Wasimi Railway

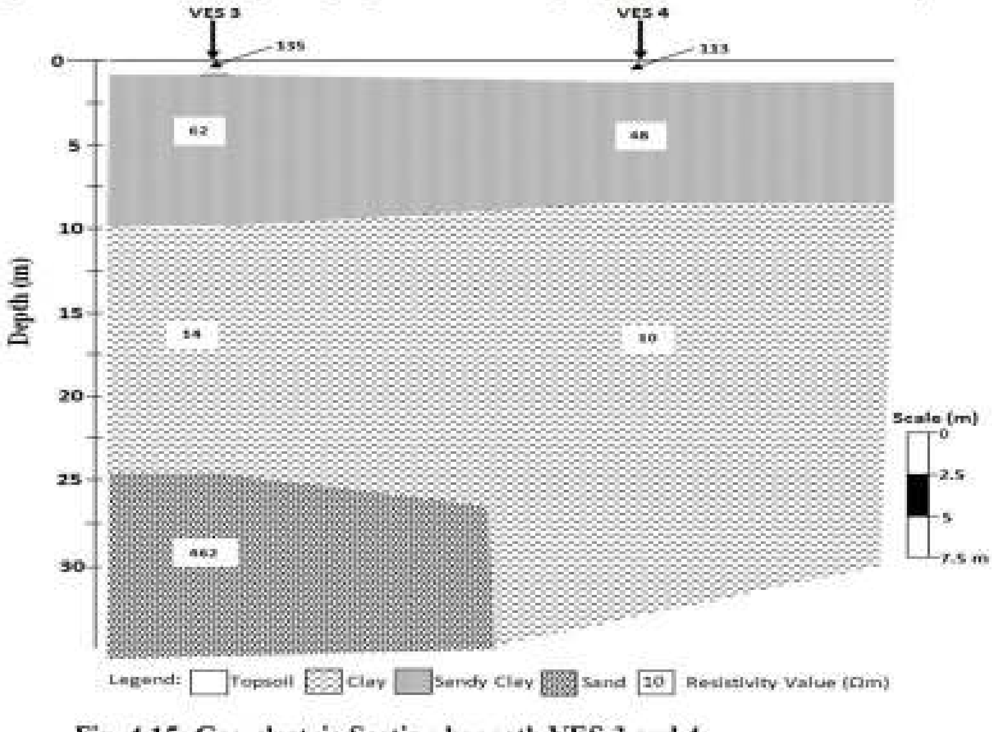


Fig. 4.15: Geo-electric Section beneath VES 3 and 4

f. Discussion of Results along Line 4

The first geo-electric layer represents the topsoil with resistivity values that ranges from 69 - 3261 Ωm from the surface to depth of about 0.9 - 2.0 m. The second geo-electric layer has resistivity values that range from 710 - 3261 Ωm and thickness values that range from 2.5 - 2.8 m within the depth range of 3.6 - 3.8 m. The topsoil and the second geo-electric layers are composed of sand and limestone. The limestone layer correspond to the extensive limestone body of the Ewekoro Formation and extends down to the third geo-electric layer.

The third geo-electric layer is composed of sand and limestone with resistivity values that ranges between 857 - 3261 Ωm and thickness values that range from 12.5 - 18.8 within the depth range of 16.0 - 22.6 m. The fourth geo-electric layer is composed of saturated sand with resistivity values that ranges between 40 - 748 Ωm.

Table 4.16: Summary of Resistivity, Stratigraphy and Inferred Lithology of the VES 5 and 6

VES No	Layers	Resistivity (Ωm)	Thickness(m)	Depth (m)	Inferred Lithology
5	1	98	1.1	1.1	Topsoil
	2	992	2.5	3.6	Sand
	3	1739	12.5	16.0	Limestone
	4	40	--	--	Saturated Sand
6	1	70	1.0	1.0	Topsoil
	2	710	2.8	3.8	Sand
	3	857	18.8	22.6	Limestone
	4	65	--	--	Saturated Sand

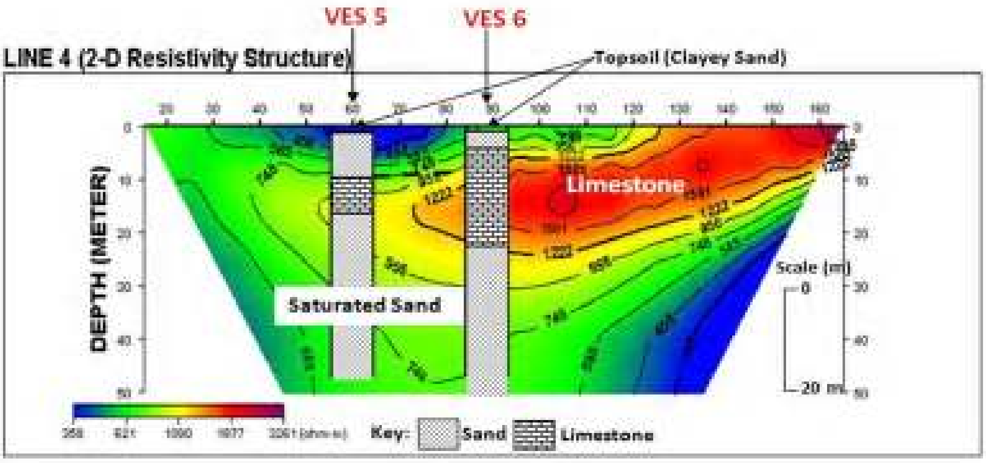


Fig. 4.16: 2D Resistivity Imaging and VES around Sowunmi and Sojuolu (Line 4)

g. Discussion of Results along VES 7

The first geo-electric layer represents the topsoil with resistivity value of 34 Ωm and thickness value of 1.0 m (Fig 4.17). The second geo-electric layer has resistivity value 5 Ωm and thickness value of 1.9 m within the depth of 2.9 m. This layer is composed of clay. The third geo-electric layer is composed of clay with resistivity value of 22 Ωm and thickness value of 13.4 m within the depth of 16.4 m. The fourth geo-electric layer is composed of sand with resistivity value of 137 Ωm (Table 4.17).

Table 4.17: Summary of Resistivity, Stratigraphy and Inferred Lithology of VES 7

VES No	Layers	Resistivity (Ωm)	Thickness(m)	Depth (m)	Inferred Lithology
7	1	34	1.0	1.0	Topsoil
	2	5	1.9	2.9	Clay
	3	22	13.4	16.4	Clay
	4	137	--	--	Sand

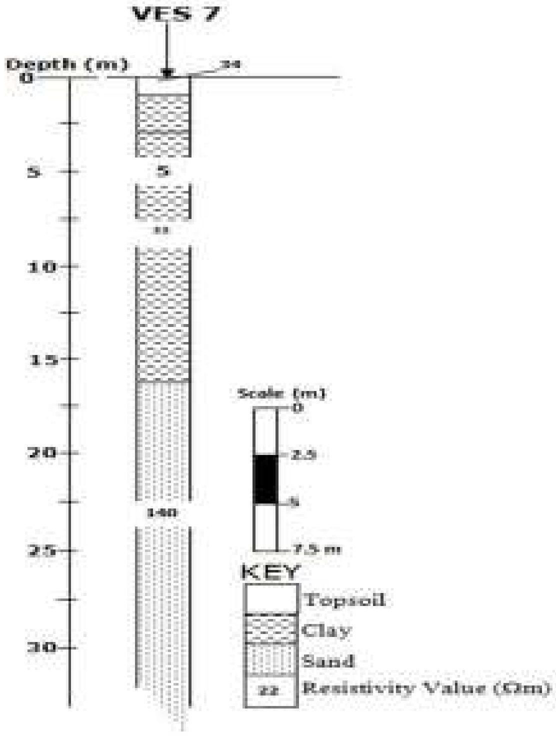


Fig. 4.17: Geo-electric Section beneath VES 7

h. Discussion of Results along Abeokuta Axis

i. Discussion of Results along VES 8 and 9

The first geo-electric layer represents the topsoil with resistivity values that ranges from 257 - 774 Ωm from the surface to depth of about 0.8 - 1.1 m. The second geo-electric layer has resistivity and thickness values that range from 76 - 309 Ωm within the depth range of 1.9 - 7.4 m. This layer is composed of weathered basement that belong to the Ise Formation which unconformably overlies the basement complex of Abeokuta. The third geo-electric layer is composed of partly weathered basement with resistivity values that ranges between 645 - 764 Ωm. This layer has thickness value of 7.5 m and depth of 10.6 m beneath VES 8 (Table 4.18). This partly weathered layer also belongs to the Ise Formation which overlies the basement complex of Abeokuta. The fourth geo-electric layer is composed of weathered basement with resistivity value of 276 Ωm. This layer has thickness value of 53.3 m and depth value of 53.3 m. The fifth geo-electric layer represent fresh basement and has resistivity value of 1374 Ωm. This layer corresponds to the Nigerian Precambrian Basement complex that underlies the Ise Formation.

Table 4.18: Summary of Resistivity, Stratigraphy and Inferred Lithology of VES 8 and 9

VES No	Layers	Resistivity (Ωm)	Thickness(m)	Depth (m)	Inferred Lithology
8	1	774	1.1	1.1	Topsoil
	2	309	1.9	3.1	Weathered Basement
	3	764	7.5	10.6	Partly Weathered Basement
	4	276	53.3	63.8	Weathered Basement
	5	1374	--	--	Fresh Basement
9	1	257	0.8	0.8	Topsoil
	2	76	7.4	8.3	Weathered Basement
	3	645	--	--	Partly Weathered Basement

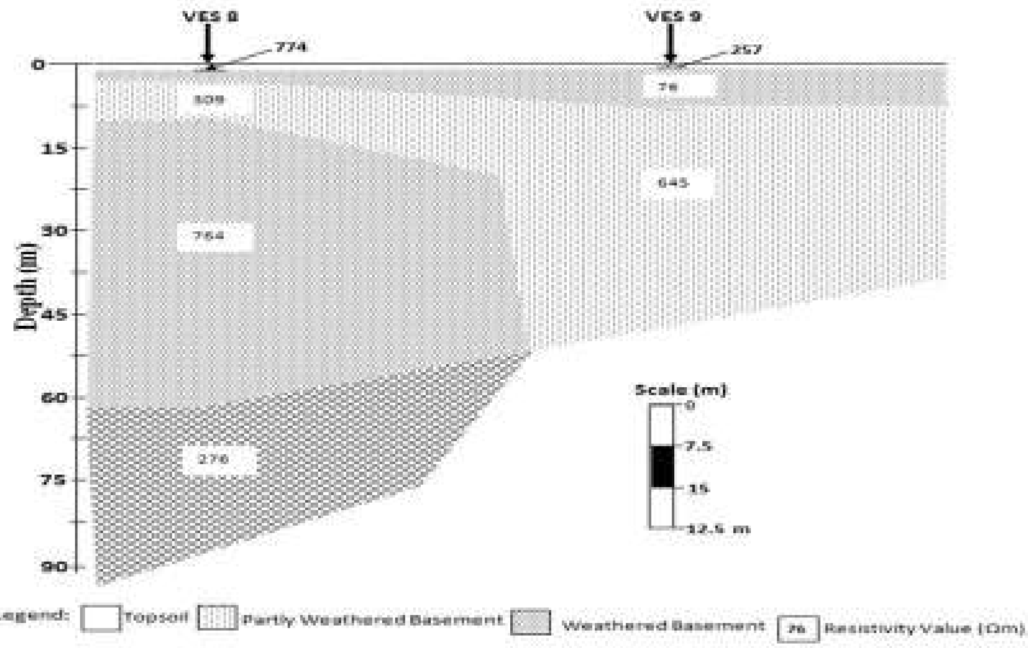


Fig. 4.18: Geo-electric Section beneath VES 8 and 9

j. Discussion of Results along 2D Line 5 and VES 10 and 11

The first geo-electric layer represents the topsoil with resistivity values that ranges from 335 - 361 Ωm from the surface to depth of about 1.0 - 1.1 m (Fig. 4.19 and 4.20). The second geo-electric layer has resistivity and thickness values that range from 425 - 426 Ωm within the depth range of 11.3 - 11.4 m (Table 4.19). This layer is composed of partly weathered basement that belong to the Ise Formation which unconformably overlies the basement complex at Abeokuta. The third geo-electric layer is composed weathered basement with resistivity values that ranges between 149 - 153 Ωm. This weathered layer also belongs to the Ise Formation which overlies the basement complex at Abeokuta.

Table 4.19: Summary of Resistivity, thickness and Lithology of VES 10 and 11

VES No	Layers	Resistivity (Ωm)	Thickness(m)	Depth (m)	Inferred Lithology
10	1	361	1.1	1.1	Topsoil
	2	425	10.3	11.4	Partly Weathered Basement
	3	153	--	--	Weathered Layer
11	1	335	1.0	1.0	Topsoil
	2	426	10.4	11.3	Partly Weathered Basement
	3	149	--	--	Weathered Layer

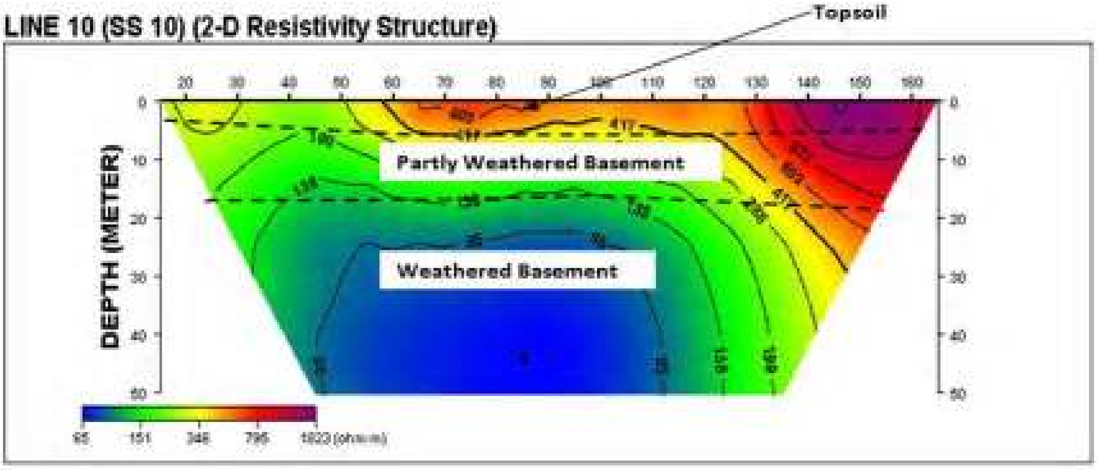


Fig. 4.19: 2D Resistivity Imaging and VES along Abeokuta Axis (Line 6)

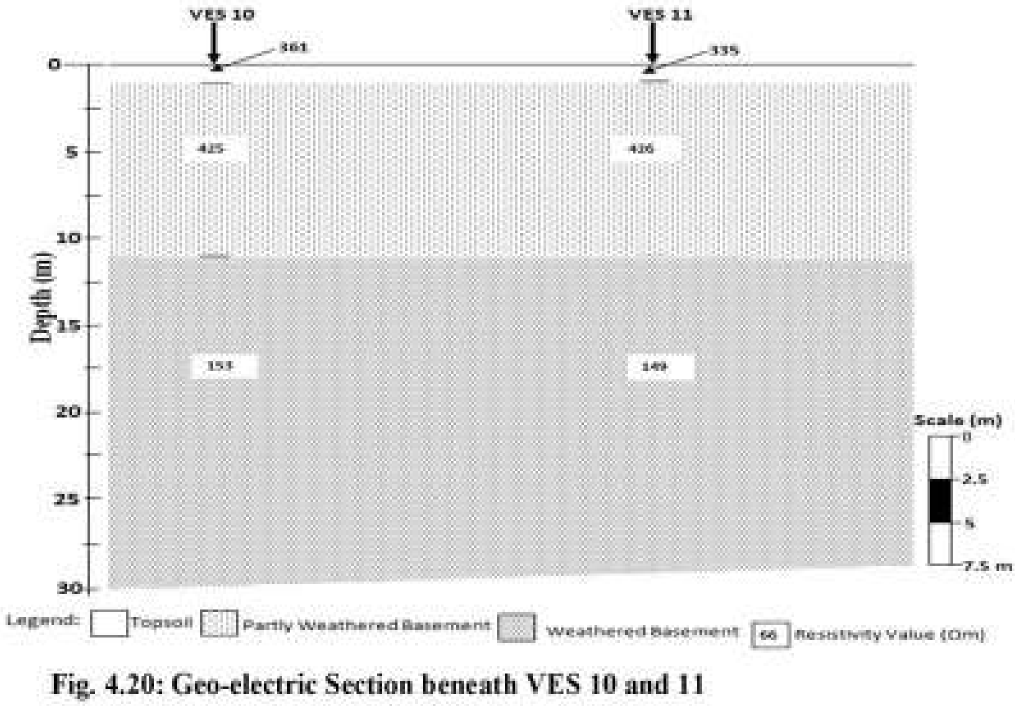


Fig. 4.20: Geo-electric Section beneath VES 10 and 11

The geophysical investigation has showed that the subsurface lithological layer mapped has no specific hazard, therefore caution should be exercise during transmission lines installation. However, caution should be exercise in areas (Sowumi and Sojuolu) where limestone was identified during transmission line installation.

The assessment has revealed that there are no designated sites of geological importance within or adjacent to the site boundary. The proposed transmission lines will result in permanent alterations to the geology of the locations. However, the overall impact is considered to be negligible. The utilization of borrow pits and excavation of foundations could have adverse effects on the Local geological resource but the magnitude of this impact is considered to be negligible.

Based on this study, the proposed areas are suitable for transmission lines and associated substation installation.However, caution should be exercised during transmission line and associated substation installation so as to prevent hazards.

Plate 4.3: Field Data Acquisition by Godirra Team

4.7. Water Source

4.7.1. Hydro-chemistry of Ground Water

Groundwater chemistry is mainly controlled by natural as well as anthropogenic factors. Chemical composition of geologic formations affects the hydrochemical characteristics of groundwater during their circulation in the subsurface (Elango et al. 2003). This underground passage through the pore spaces and weathered zones may alter the natural composition of the groundwater by the action of various hydrochemical processes (Rajmohan and Elango 2004). In other words, composition of water can reveal the various processes in groundwater. Groundwater chemistry can be modified by a variety of anthropogenic sources. These include point sources, such as waste disposal facilities, industrial pollution

4.7.2. Groundwater Vulnerability

The vulnerability classification can be attributed to the transmission of rainfall and runoff from the surface to groundwater and the subsequent ease of movement of pollutants through the fracture and weathered formation. This assessment is based on the generic consideration of soil and rock types and does not indicate that the risks to individual sources are high.

4.7.3. Sampling Methodology

Ground water sample were typically collected from the discharge line of the borehole. Effort was made to reduce the agitation by adjusting the flow. Water was allowed to run to waste for at least 2-3 minutes before collecting the water into the sample containers. Groundwater is never chemically pure; it is a solution of substances taking place during the course of percolation through the rocks. Ground water were collected from six (6No) existing boreholes and two (2No) hand dug wells located within the communities affected by the transmission line route. The water observed in the boreholes and hand dug wells in the area of investigation were found to be colourless. Groundwater sampling location is provided in table 4.20 and figure 4.21.

Plate 4.4: shows the ground water sampling and insitu measurement.

Table 4.20: Groundwater Sampling locations

S/N	Water Sample Points	Name of Location	Latitude	Longitude	Sampling Requirements
1	GW1	Ejio	6.85106	3.20166	Ground Water
2	GW2	Ejio	6.84857	3.20851	Ground Water
3	GW3	Soderu	6.868056	3.230722	Ground Water
4	GW4	Mose	6.872	3.265444	Ground Water
5	GW5	Olorunsogo	6.877111	3.316528	Ground Water
6	GW6	Ajade	6.991225	3.293722	Ground Water
7	GW7	Ijumo	7.013636	3.287452	Ground Water
8	GW8	Oba-Eerin	7.041194	3.355944	Ground Water

4.7.4 Groundwater Quality

The result of groundwater analysis is presented in table 4.21

Table 4.21: Ground Water Physico-Chemical Characteristics

Line Route section	**Ejio to Sojuolu**		**Olorunsogo to Ejio**			**Ejio to New Abeokuta**			**EMP BL Data (2016)**	**ICCL baseline data (201**
Parameters	**GW1**	**GW2**	**GW3**	**GW4**	**GW5**	**GW6**	**GW7**	**GW8**		
Well Depth	3.27	**NA**	**NA**	**NA**	**2.95**	**NA**	**NA**	**NA**	**1.8 – 10.5**	**ND***
pH	6.96	6.52	7.04	7.25	7.12	6.96	7.54	6.93	**6.29 – 7.86**	5.46 - 5.8
Temperature (^{0}C)	27.2	26.0	30.1	29.0	29.0	28.2	27.4	29.1	**29.3 – 31.2**	26.50-27.
Colour	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	**ND***	**ND***
Conductivity	55.3	54.3	474	420	1094	498	350	374	**332 -1028**	41.5-126.
TDS	27.0	27.0	235	208	547	249	175	184	**220 - 684**	**ND***
TSS	33.1	28.2	0.02	0.20	0.29	0.68	0.20	0.54	**ND***	**ND***
Chloride	ND*	ND*	96.09	79.25	59.30	50.28	63.20	40.25	**23.70 – 71.60**	**ND***
Total Hardness	14.2	13.6	14.86	15.32	10.10	19.38	15.20	12.39	**68.57-111.05**	**ND***
TSS	33.1	28.2	0.02	1.22	0.40	0.20	0.65	0.50	**-**	**ND***
Turbidity	6.95	1.35	1.74	4.06	5.00	4.06	4.06	4.06	**1.53 – 10.72**	1.46-9.51
DO	10.90	9.62	5.80	5.40	3.44	4.50	3.40	5.52	**4.8 – 5.6**	**ND***
COD	10.2	9.8	6.40	7.70	9.20	6.45	5.70	6.73	**9.23 – 23.08**	**ND***
BOD	1.48	1.23	1.50	0.60	0.95	0.62	1.60	0.30	**2.0 – 4.6**	**ND***
Nitrate	0.21	0.10	0.57	0.44	0.58	1.05	0.84	1.49	**0 - 0.64**	<0.1-0.21
Phosphate	0.55	0.68	3.98	4.33	3.36	4.98	2.31	4.53	**0.010 – 0.424**	0.22-1.14
Sulphate	<1.0	<0.1	0.51	0.52	0.59	0.42	0.25	0.34	**0.85 -23.71**	<1.0
PAH	ND*	ND*	ND	ND	ND	ND	ND	ND	**ND***	**ND***
BTEX	ND*	ND*	ND	ND	ND	ND	ND	ND	**ND***	**ND***

Line Route section	Ejio to Sojuolu		Olorunsogo to Ejio			Ejio to New Abeokuta			EMP Baseline Data, 2016
Parameter	**GWI**	**GW2**	**GW3**	**GW4**	**GW5**	**GW6**	**GW7**	**GW8**	
Phenols	**ND***	ND*	ND	ND	ND	ND	ND	ND	**ND***
THC	**ND***	ND*	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**ND***
TPH	**ND***	ND*	ND	ND	ND	ND	ND	ND	**ND***
PCB	**ND***	ND*	ND	ND	ND	ND	ND	ND	**ND***
Oil and Grease	**ND***	ND*	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**ND***
Potassium	0.39	0.30	2.64	2.92	1.95	2.02	1.12	0.42	**1.52 – 56.42**
Sodium	ND*	ND*	5.00	4.30	2.30	3.30	3.10	3.80	**22.35 – 100.53**
Calcium	ND*	ND*	3.96	3.76	3.55	2.79	3.16	7.75	**17.16 – 30.45**
Magnesium	ND*	ND*	1.19	1.42	1.57	1.02	2.45	3.62	**1.76 – 11.08**
Copper	0.12	0.01	<0.001	0.02	0.01	0.01	0.02	0.01	**0.280 – 0.296**
Iron	0.15	0.22	2.58	3.11	2.21	1.91	0.25	1.10	**21.60 – 22.20**
Nickel	**ND***	**ND***	0.03	0.01	0.01	0.01	0.01	0.01	**0.011 – 0.158**
Chromium	**ND***	**ND***	0.79	1.27	0.50	0.20	0.14	0.22	**0.079 – 0.144**
Cadmium	**ND***	**ND***	0.02	0.04	0.01	0.02	0.01	0.01	**0.015 – 10.01**
Zinc	**ND***	**ND***	<0.001	0.01	0.02	0.01	0.01	0.01	**ND***
Barium	**ND***	**ND***	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**ND***
Lead	ND*	ND*	<0.001	0.01	<0.001	<0.001	<0.001	<0.001	**0.010 – 0.122**
Mercury	ND*	**ND***	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**ND***

ND*- Not Determined, NS- Not Stated, ND Not Detected, NA- Not Applicable.

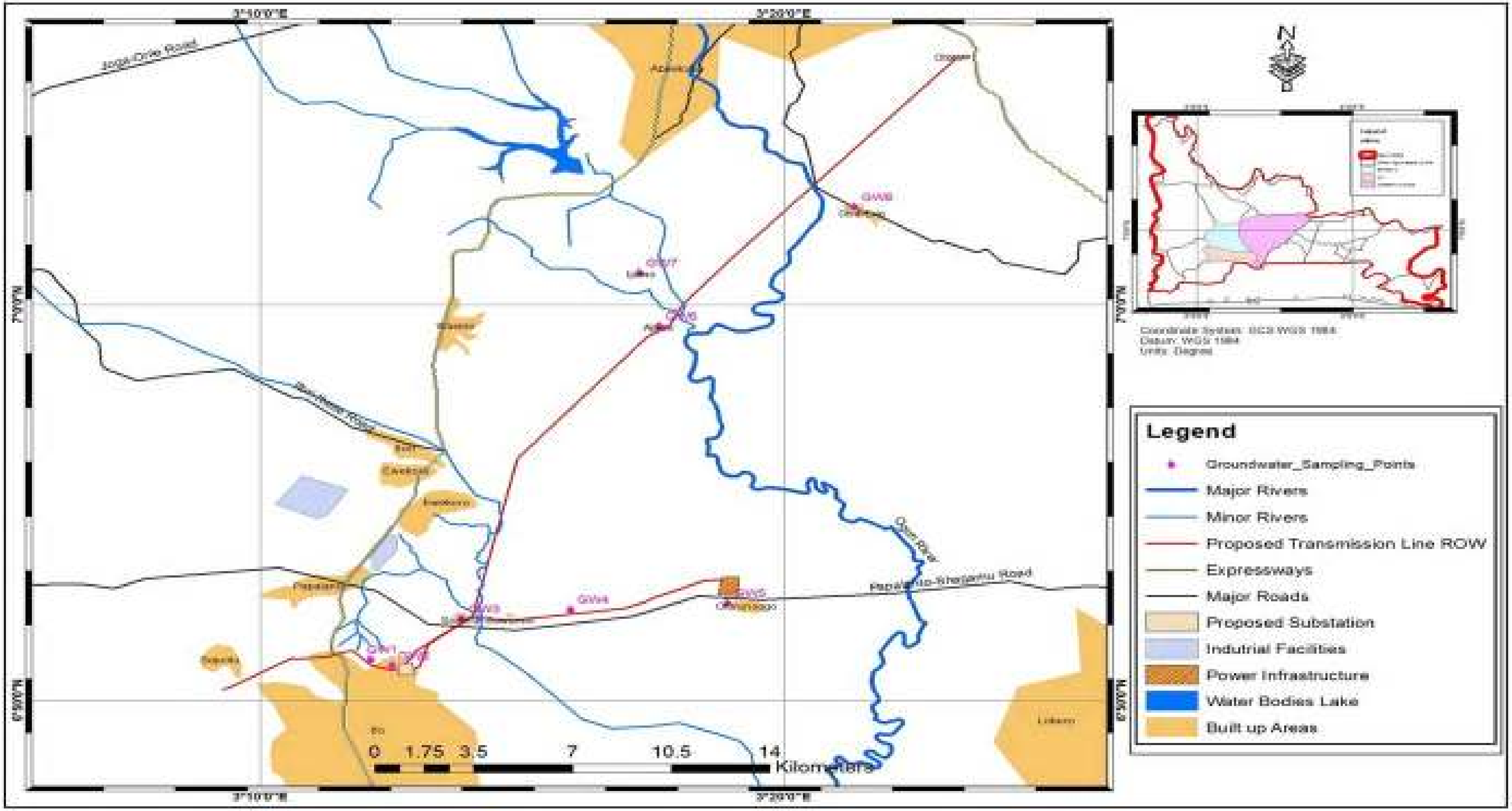


Figure 4.21: Groundwater sampling location map

4.7.4. Physico-chemical Characteristics of Ground water

a. Colour

Colour in drinking water can be caused by the presence of dissolved and suspended organic materials and compounds of calcium and iron. WHO therefore recommends that any water suitable for drinking must be colourless.

Results of all the samples indicated colourless water implying conformity to WHO standard for this parameter.

b. BOD and COD

BOD indicates the amount of putrescible organic matter present in water. Therefore a low BOD is an indicator of good water quality (Shelton, 1991) while a high BOD indicates polluted water. Reduction in the availability of dissolved oxygen present in a water body represents the BOD while a measure of the oxygen equivalent of the organic matter content that represents potential consumption of oxygen within the receiving water body is COD. Both parameters are inversely linked to dissolved oxygen.

The concentrations of BOD and COD ranged from 0.30 – 1.48mg/L and 9.8 – 10.2mg/L respectively. The BOD and COD concentrations range were in line with previous studies around the project area (EMP BL Data, 2016) and below WHO limit of 10mg/L.

c. DO

Dissolved Oxygen (DO) is a measure of the amount of gaseous oxygen dissolved in the water sample. It is an indicator of biological activity in a water body and is essentially for aerobic respiration.The level of dissolved oxygen in water is used as an indication of pollution and its portability. DO concentration ranged from 3.40 -10.90mg/L.

d. Total Hardness

It is the resistance of water in forming lather with soap. Hard water thus requires a considerable amount of soap to produce lather. The principal cause of hardness in groundwater is the presence of calcium and magnesium ions which however, indicates the level of groundwater pollution (Olumuyiwa *et al.*, 2012).

According to WHO, groundwater with concentration ranging from 0 to 60 mg/L is classified as soft; 61 to 120 mg/L as moderately hard; 121 to 180 mg/L as hard; and >180 mg/L as very hard. The Total hardness concentrations ranged from 10.10 – 19.38mg/L. The concentrations range is below the concetrations of previous studies around the project area (EMP BL Data, 2016) and below NSDW limit of 50mg/L. With reference to WHO classification of hardness of ground water the ground water in the study area is soft.

e. Total suspended Solids (TSS)

These are minerals and organic materials present in water. It enters groundwater through runoff from industrial, urban or agricultural areas. Elevated TSS causes rise in groundwater temperature which in turn supports growth of some microbial organisms. The TSS concentrations ranged from 0.02 – 33.1mg/L. The concentrations range is below the WHO limit.

f. pH

pH of water determines the solubility of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals. pH is therefore an index of groundwater pollution . Although pH has no direct health implication on humans, high pH encrusts water pipes and water-using appliances with deposits; and depresses the effectiveness of groundwater disinfectants.

pH <6.5 or >9.2 would markedly impair the potability of drinking water (WHO 2011).

The pH concentrations ranged from 6.52 – 7.54. The concentrations range is in line with concetrations of previous studies around the project area (EMP BL Data, 2016) and also within NSDW limit and WHO limit.

g. Temperature

The rate of chemical reactions generally increases as temperature increases. Groundwater with higher temperatures tend to dissolves more minerals from the rocks in the aquifer and therefore have a higher electrical conductivity (EC). High temperature negatively impact water quality by enhancing the growth of micro-organisms which may increase taste, odour, colour and corrosion problems. Temperature above ambient level is therefore an index of groundwater pollution. The temperature ranged from 26 -30.1^{0}C.

Result of the study which is within the temperature range of previous studies around the area (EMP BL Data, 2016, (ICCL Baseline Data, 2015) and within WHO permissible limits for drinking and for other domestic uses.

h. Electrical Conductivity (EC)

Electrical conductivity gives an indication of the amount of total dissolved substitution in water. Pure water containing less or no organic salt is an excellent insulator which cannot conduct electricity, hence any water with EC concentration above WHO/FMEnv limits is said to be polluted (IFC EHS 2007). The Eletrical Conductivity ranged from 53.93 -1094μScm$^{-1.}$

Results of this study were within WHO limits except at GW5 that recorded EC higher than WHO limit, NSDW limit and previous studies done around the project area.

i. Total Dissolved Solids (TDS)

TDS values depend on climate, the host rock, and the residence time of the groundwater in the geological matrix. The TDS concentration ranged from 27 – 547mg/L is in line with previous studies aroun the project area (EMP BL Data, 2016). The TDS was found to be in an acceptable range.

j. Turbidity

Turbidity or cloudiness is caused by the presence of clay, silt, suspended matter, colloidal particles and other microorganisms. These particles of turbidity provide "shelter" for microbes by reducing their exposure to attack by disinfectants. High turbidity promotes re-growth of pathogens in the distribution system, leading to waterborne disease outbreaks, which have caused significant cases of gastroenteritis throughout the world.

Turbidity also affects other water quality parameters such as colour, when it is imparted by colloidal particles as well as rise in temperature. Turbidity concentrations ranged from 1.74 – 6.95mg/Lwhich is in line with previous study around the project area. (EMP BL Data, 2017 and ICCL Baseline Data, 2015). The Turbidity values were found to be in acceptable limit except at GW1 that recorded 6.95mg/L which is higher than NSDW and WHO limit of 5mg/L. There is currently little information regarding turbidity in groundwater and the cause is not fully understood. The common assumption is that turbidity in groundwater indicates a fast transport pathway connecting potentially contaminated surface water with the aquifer.

k. Nutrients (Nitrate, Sulphate and Phosphate)

Nutrients are essential for the growth of micro-organisms in groundwater. Excessive concentrations of nutrients in drinking water, however, promote bacterial growth, as well as imparting bitter taste (WHO 2011). High level of nutrients in groundwater is attributed to failing septic systems, excessive use of agriculture fertilizers, leachable from refuse dumps and industrial discharges.

Nutrients level above the maximum permissible limits in drinking water, indicates pollution, and thus poses some health challenges (WHO 2011). Nitrate, Sulphate and Phosphate recorded concentration ranging from 0.10 – 1.49mg/L, <0.1 – 0.59mg/L and 0.55 – 4.53mg/L respectively.
Results of all samples revealed concentration within WHO limits although, phosphate recorded higher concentrations than established concentrations from previous studies around the project area.

l. Chloride (Cl⁻)

The concentration of chloride is the indicator of sewage pollution and also imparts laxative effect. Atmospheric sources or sea water contamination is reason for bulk of the chloride concentration in groundwater which may exceed due to base-exchange phenomena, high temperature, domestic effluents, septic tanks and low rainfall. Porosity of soil and permeability also plays a key role in building up the chlorides concentration (Istifanus, 2013). According to WHO recommendation (1993), the permissible value is 250 mg/l. As shown in Table 4.21 the current analysis result reveals that all the samples of ground water in the project area have values of chloride ranging from 40.25 to 96.09 mg/L which is in the permissible range for drinking and in line with previous studies around the project area. (EMP BL Data, 2015).

m. Potassium (K)

Potassium is an essential element in humans and it is hardly found in groundwater at levels that could be a concern for healthy humans. It occurs widely in the environment, including all natural waters. It can also occur in drinking water as a consequence of the use of potassium permanganate as an oxidant in water treatment.
Although concentrations of potassium normally found in drinking water are generally low and do not pose health concerns, high solubility of potassium chloride and its use in treatment devices such as water softeners can lead to significantly increased exposure. Potassium concentration ranged from 0.30 – 2.92mg/L.
Result of this study therefore indicates that K level in all the samples were within WHO permissible limits and in line with previous study close to the project area. (EMP BL Data, 2016)

n. Lead (Pb)

Lead is a cumulative poison; toxic in small concentrations. Pb level in groundwater above WHO/FMEnv limits can cause lethargy, loss of appetite, constipation, anaemia, abdominal pain, gradual paralysis in the muscles, and death. Lead concentration ranged from 0.001 – 0.01mg/L. All the ground water samples had concentration within WHO and NSDW permissible limits. Pb concentrations were also in line with previous studies done close to the project area. (EMP BL Data, 2016 and ICCL Baseline data, 2015).

o. Copper (Cu)

Copper is both an essential nutrient and a drinking-water contaminant. Cu concentrations in groundwater vary widely as a result of variations in water characteristics, such as pH, hardness and copper availability in the distribution system. Copper is an essential nutrient, but at high doses it has been shown to cause stomach and intestinal distress, liver, kidney damage and anemia (WHO, 2006). Copper concentration ranged from 0.001- 0.12mg/L. Result of all samples showed concentration within WHO/NSDW permissible limits.

p. Iron

Iron is the second most abundant metal in earth's crust. It is an essential element in human nutrition. The minimum daily requirement of iron ranged from about 10 to 50 mg/day (FAO/WHO 1988). Iron can be a troublesome chemical in water supplies. Making up at least 5 percent of the earth's crust, iron is one of the earth's most plentiful resources. Rainwater as it infiltrates the soil and underlying geologic formations dissolves iron, causing it to seep into aquifers that serve as sources of groundwater for wells. Although present in drinking water, iron is seldom found at concentrations greater than 10 milligrams per liter (mg/L) or 10 parts per million. However, as little as 0.3 mg/l can cause water to turn a reddish brown color. High concentration can also promote growth of certain kinds of bacteria that clog pipes and well openings of boreholes. Fe concentration ranged from 0.15 – 3.11mg/L. Concentrations higher than WHO and NSDW limits were recorded at GW3, GW4, GW5, GW6 and GW8.

q. Barium

Barium gets into groundwater through discharge of drilling wastes, from metal refineries; and erosion of natural deposits (Flaten, 1991). At concentrations above WHO/FMENv limits, barium causes vasoconstriction by its direct stimulation of arterial muscle, peristalsis as a result of the violent stimulation of smooth muscles and convulsions and paralysis following stimulation of the central nervous system (Flaten, 1991).
Result of all samples revealed low concentration and hence were within WHO/NSDW limits.

r. Zinc

Zinc levels in groundwater normally do not exceed 0.05 mg/l. Zinc is found naturally at low concentrations in my rocks and soils principally as sulphide ores and to a lesser degree as carbonates. Most zinc is introduced into water by artificial pathways such as byproducts of steel production or coal –fired power station or from burning of waste materials, from fertilizer that may leach into groundwater. Zinc is considered an essential trace metal which functions as a catalyst for enzymatic activity in human bodies. Drinking water contains this trace metal in very small quantities which may reduce the possibility of its deficiency in the diet. However, its accumulation in the human body causes harmful effects such as stomach cramps, nausea, vomiting, decrease good cholesterol and acceleration of anemic conditions (Reda, 2016). Zinc concentrations in the ground water ranged from <0.001 – 0.02mg/L. The maximum permissible limit for Zn in drinking water is 3.0 mg/L as recommended by NSDW, 2007.

s. Hydrocarbons

The summary of results of oil and grease, Total Petroleum Hydrocarbon (TPH), Polycyclic Aromatic Hydrocarbons (PAHs) and BTEX concentrations measured in the ground water samples across the project zone of influence and are presented in Table 4.21
The oil and grease content of the ground water recorded <0.001mg/L. Benzene, toluene, ethylbenzene and xylenes (BTEX) concentrations measured were below instrument detection limit. BTEX, which constitutes the volatile organic compounds (VOCs) primarily originate from petroleum products and solvents. The analysis of BTEX is widely used as an indicator of contamination with light petroleum products, e.g., petrol and kerosene (Margesin and Schinner, 2005). Thus, the observed values of these chemical substances in the ground water reflect an unpolluted environment. Also, the total petroleum hydrocarbon were not detected in this study.

4.7.5. Ground Water Microbiology

More than 95 percent of the world's available fresh water (excluding ice caps and glaciers) is groundwater. This ground water is valuable as a source of drinking water for most communities in the world, especially small ones. The groundwater in a drinking-water well may contain a wide variety of microbes without presenting a public health risk. However, groundwater in some areas becomes contaminated by the faecal material of humans and other animals.

This is a cause for concern because faecal material may contain pathogenic (disease-causing) microbes that can infect the intestinal tract of humans. Faecal pathogens may be bacterial, viral, or protozoan. Water containing faecal material may seep into the groundwater from the land surface or from underground sources of contamination. Major surface sources include, wastewater and bio solids from sewage treatment facilities that have been applied to land as a soil conditioner; seepage from shallow artificial ponds (lagoons) used for processing sewage; seepage from contaminated lakes and other surface-water bodies; urban runoff; faeces from cattle and other livestock operations; and improperly constructed sanitary landfills where trash and garbage are disposed. Faecal contamination also can reach the groundwater from underground sources, such as improperly functioning septic tank systems, underground reservoirs for liquid household sewage (cesspools), or leaking underground sewer lines.

Plate 4.5: In- situ Test for Bateria Species using Watersafe Rapid Bacteria Test Kit

In-situ Detection of Bacteria Species:

Watersafe Rapid Bacteria Test was used for in-situ bacteria detection in the field. Watersafe Rapid Bacteria Test is an antibody-based test kit for detecting the presence of bacteria in water, including *Escherichia coli, Pseudomonas aeruginosa*, species of Shigelia, Enterobacter etc.

The samples were collected into test vial and gently swirled. The test vial was left standing for five minutes. The vial was swirled again and returned to a flat surface. The test strip was then placed into sample vial and observed for ten minutes. The strip or vial was not disturbed during this time. Reddish lines appeared on strip. The test is negative if only red control line appeared, but positive if red test line and red control line appears.This was used as quality assurance procedure to results expected from the laboratory.

Table 4.22: Microbiological Characteristics of Ground Water in the Study Area

Parameter / Sample Stations	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Ultilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi	Count (cfu/ml)
Ejio to Sojuolu Section						
GW1	*Pseudomonas sp Proteus sp Bacillus sp*	5.0×10^2	*Bacillus sp Pseudomonas sp*	3.0×10^2	*Rhizopus sp*	4.0×10^2
GW2	*Proteus sp Pseudomonas sp*	5.3×10^2	*Pseudomonas sp*	4.5×10^2	*Trichodenma Rhizopus*	5.2×10^2
Ejio to Olorunsogo Section						
GW3	*Proteus sp Bacillus sp*	2.3×10^3	*Pseudomonas sp Bacillus sp*	3.8×10^2	*Aspergillus Cladosprium sp*	2.0×10^3
GW4	*Pseudomonas sp Proteus sp*	6.2×10^2	*Pseudomonas sp*	4.4×10^2	*Candida sp Aspergillus sp*	8.0×10^2
GW5	*Pseudomonas sp Enterobacter sp Escherichia coli*	8.0×10^3	*Pseudomonas sp*	3.0×10^2	*Penicillium sp Aspergilus sp Rhizopus sp*	7.3×10^2
Ejio- New Abeokuta Section						
GW6	*Pseudomonas sp Actinomyce sp*	1.3×10^3	*Pseudomonas*	3.2×10^2	*Penicillium Candida sp Mucor sp*	4.8×10^2
GW7	*Bacillus sp Proteus sp*	7.4×10^2	*Bacillus sp*	3.0×10^2	*Aspergillus sp Rhizopus sp, Penicillium sp*	3.9×10^2
GW8	*Proteus sp Klebsiella sp*	5.0×10^2	-	-	*Aspergillus sp Rhizopus sp*	3.0×10^2

a. Total Heterotrophic Bacteria (THB)

The most predominant bacterial genera found in the ground water samples is *Pseudomonas* which was present in 75% of the sampled ground water. Other bacteria genera found are Proteus, *Enterobacter*, *Actinomyces* and *Klebsiella*. THB counts ranged between $5.0x10^2$cfu/ml and $8.0x10^3$cfu/ml

b. Hydrocarbon Utilizing Bacteria (HUB)

The hydrocarbon utilizing bacteria (HUB) counts ranged between $3.0x10^2$cfu/ml and $4.5x10^2$cfu/ml. The predominant HUB species found in the ground water samples is *Bacillus sp and Pseudomonas sp*. Their counts were low indicating no hydrocarbon contamination.

c. Total Heterotrophic Fungi (THF)

The total heterotrophic fungi (THF) counts ranged between $3.0x10^2$cfu/ml and $2.0x10^3$cfu/ml. The predominant fungus found in the ground water samples are *Penicillium sp* and *Cladosporium sp*.

d. Hydrocarbon utilizing Fungi (HUF)

The various hydrocarbon utilizing fungi found in the ground water samples of the study area include *Candida sp, Mucor sp* and *Rhizopus sp*, HUF count ranged between $3.0x10^2$cfu/ml and 8.0 $x10^2$cfu/ml. Their counts were low which indicates that the ground water is not polluted with hydrocarbons.

e. Faecal Coliforms

If Faecal coliform or *Escherichia coli is* detected along with other coliforms in water, there is strong evidence that sewage is present in the water; therefore, a greater potential for pathogenic organisms exists (Minnesota Department of Health, 2005).

Escherichia coli a pollution indicator was detected in GW5. The presence of *Escherichia coli* in GW5 could be attributed to the shallow water table and lack of cover over the hand dug well which must have exposed the water.

4.7.6. Surface Water Analysis

In the course of this study, a total of twenty (20 No) surface water samples were collected from identified eight (8No) streams/rivers along the transmission line. These include Osun Stream at Iludun, Osun stream at Abese, River Wagunu at Soderu, River Wagunu at Adubiaro, Sowunmi Stream, River Odoipa, Ogun River and Ototo Stream. Plates 4.6 - 4.8 shows pictures of some of the surface water sampled along the TLROW used to determine the physicochemical factors, trace metal contents, microbiological status and productivity of the rivers.

The people depend on them for various activities ranging from drinking, cooking, washing and bathing. In view of the pivotal role the river plays in the day to day lives of the people coupled with the expected roles they will assume on the commencement of the project life cycle, the baseline physical, chemical and biological characteristics was conducted. Some of the parameters analysed insitu were pH, temperature, conductivity and total dissolved solids. Others analysed in the laboratory were turbidity, nitrate, sulphate, chloride, phenols, BOD_5, COD, Phenols PAH, BTEX, TPH, THC, Oil and Grease and various heavy metals etc.

The surface water bodies ranges in depth from few meters to tens of meters (observation and personal communication).

The rationale for surface water studies is to acquire baseline concentrations for the physico-chemical and microbial contents for which future evaluation and monitoring could be based. Several activities of the project may impact negatively on the surface water within the proposed project RoW. Such activities include: waste water disposal from maintenance and servicing of the base stations, sewage disposal on surface water by camp workers and migrant food seller thus polluting the water bodies in the proposed project area. Although, the water bodies in the proposed project area are generally small they serve the residents as major sources of water. Pollution of these water bodies, shall impact negatively on the health and socioeconomic status of the residents. However, the mitigation measures of these impacts are presented in chapter six of this report.

The surface water sampling location is shown in table 4.23 and figure 4.22

Plate 4.6 River Odoipa (7^0 00'00.4"N, 3^0 18' 07.8"E)

Plate 4.7 Ogun River (7^0 02'59.9"N, 3^0 20' 37.0"E)

Plate 4.8: River Wagunu (6°52'9.47"N, 3°14'13.67"E)

Table 4.23: Watersurface Smapling Location

S/N	Water Sample Points	Name of River/stream	points	Latitude	Longitude	Sampling Requirements
1	SW1A	Osun stream @ Iludun-Ejio	Up stream	6.856214	3.218069	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
2	SW1B	Osun stream @Iludun-Ejio	Mid stream	6.853344	3.218633	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
3	SW2B	Osun stream @ Abese	Mid stream	6.865411	3.229073	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
4	SW2C	Osun stream @ Abese	Down stream	6.865097	3.230619	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
5	SW3A	Wagunnu River@ Soderu	Upstream	6.871644	3.233017	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
6	WS3B	Wagunnu River@ Soderu	midstream	6.870361	3.234411	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
7	SW3C	Wagunnu River@ Soderu	Downstream	6.869039	3.235658	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
8	SW4B	Sowunmi stream	Midstream	6.867981	3.237125	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
9	SW4C	Sowunmi stream	Midstream	6.86665	3.236636	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
10	SW5A	Wagunnu River @	upstream	6.876358	3.234697	Surface water, Sediment, Benthos,

		Adubi aro				Zooplankton and Phytoplankton
11	SW5B	Wagunnu River @ Adubi aro	midstream	6.874389	3.235236	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
12	SW5C	Wagunnu River @ Adubi aro	downstream	6.872969	3.236006	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
13	SW6B	Odoipa stream	Midstream	7.001128	3.300558	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
14	SW6C	Odoipa stream	Downstream	6.999833	3.301781	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
15	SW7A	Ogun River @ Opanigangan	Upstream	7.052586	3.341354	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
16	SW7B	Ogun River @ Opanigangan	Midstream	7.050886	3.342122	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
17	SW7C	Ogun River @ Opanigangan	Downstream	7.048251	3.343675	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
18	SW8A	Ototo stream	Upstream	7.106083	3.387217	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
19	SW8B	Ototo stream	Midstream	7.104347	3.387406	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton
20	SW8C	Ototo stream	Downstream	7.102872	3.386906	Surface water, Sediment, Benthos, Zooplankton and Phytoplankton

SW A –upstream point of line crossing

SW B – Line route crossing point
SW C---downstream of line route crossing

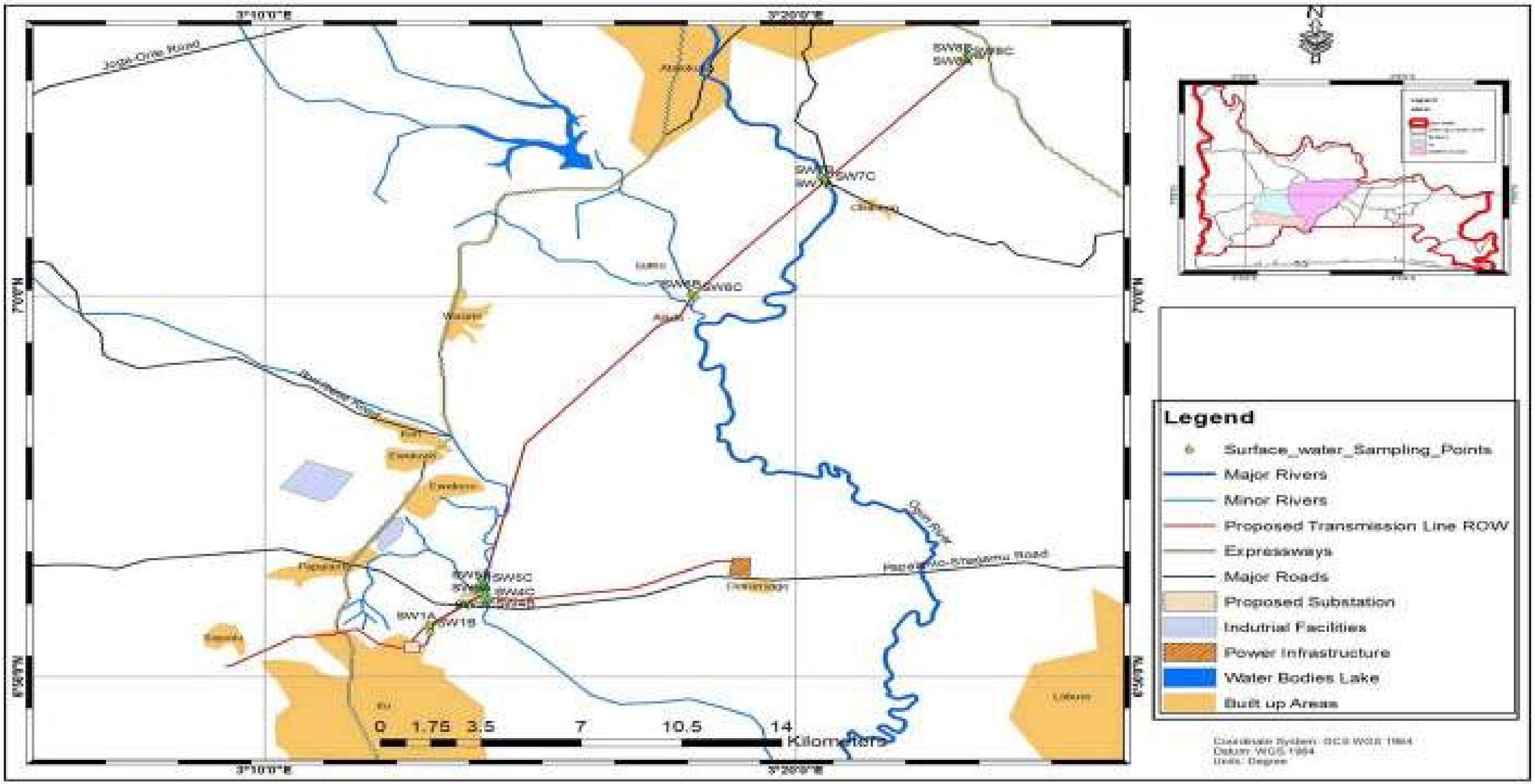


Figure 4.22 Surfacewater sampling location Map

4.7.6.1. Sampling Methodology

At each sampling point, composite water samples were taken using an Automatic Global Water WS750 Water Sampler. See plate 4.9.

Plate 4.9: Sampling at Iludun Stream using Automatic Global Water WS750 Water Sampler

Samples for physico chemical analysis were stored in an ice-packed Dometic cooler and transported to laboratory were they are transferred into the fridge and preserved at 4^0C before the analysis.
Samples for Heavy metal analysis were preserved using 1:1 nitric acid while those for oil and grease were preserved by acidifying to pH 2 using 1:1 sulphuric acid.

Plate 4.10: Preservation of Surface Water Sample with high grade analytical Preservatives

In situ measurement of Temperature, pH, Conductivity, and Total dissolved solid were carried out at all sample locations. Plate 4.11; shows surface water *in situ* measurement.
Samples for microbiology were collected and preserved in a sterilized McCartney bottles and stored in an ice packed Dometic cooler and transported to the laboratory for identification and counting.
Samples for BOD were collected using the BOD bottles. The bottles were filled to brim and cover with the stopper to ensure that no air bubble was trapped in the bottles. The samples were then kept away from sunlight.

Plate 4.11: Insitu measurement of unstable parameter using Hanna Combo Water Tester HI 98130

4.7.6.2. *Surface water Physico-Chemical Result*

The physico-chemical characteristics of the surface water bodies within the proposed project areas are summarized in Table 4.24a-d (see Appendix 4 for detailed result).

Table 4.24a: Results of physical and chemical surface water quality parameters in the study area.

	EJIO - OLORUNSOGO AXIS												Secondary Data (ICCL 2015)	Secondary Data (EMP Baseline 2017)	FMEnv Limit	WHO (2011) limits for Sustenance of Aquatic lives
	ODO-OSUN @ ILUDUN-EJIO (SWI)			OSUN STREAM (SW2)			WAGUNNU RIVER (SW3)			SOWUNMI STREAM (SW4)						
PARAMETER	min	max	mean	min	max	mean	min	max	mean	min	max	mean				
Chloride	4.39	14.24	9.315	96.09	120.17	108.13	144.26	168.34	156.30	96.09	120.17	108.12	NA	7.54 – 41.07	600	
Total Hardness	8.39	8.54	8.465	11.87	12.26	12.065	24.70	37.71	30.28	15.23	17.6	16.42	NA	79.35 – 93.61	NS	
TSS	0	0	0	0.01	0.01	0.01	0.01	0.03	0.02	0.02	0.02	0.02	9 -74		30	
Turbidity	0.01	0.21	0.11	2.43	2.55	2.49	1.10	2.68	1.79	2.05	2.30	2.18	1 - 45	1.53 – 7.59	NS	≤25
DO	4.8	5.1	4.95	5.6	5.8	5.7	6.00	6.20	6.13	4.70	5.60	5.15	2.66 - 45	7.2 -10.6	>2	>4 <9
Temperature	27.7	28.9	28.1	26.7	27.0	26.9	28.30	28.70	28.50	26.9	26.9	26.9	24.4 – 28.1	29.7 – 33.3	<40	40
pH	7.02	7.1	7.06	7.06	7.2	7.11	6.99	7.15	7.08	6.85	6.80	6.83	7.20 -7.56	8.49 – 9.61	6 - 9	4.8 – 9.2
EC	45	45	42.7	85	86	85.3	371	371	371.0	68	67	67.5	45.1 - 287	314 - 418	NS	
TDS	19	20	45.7	43	43	43	184	186	185.0	33	34	33.5	29.- 43.2	213 - 276	2000	
Depth	0.5	0.15	0.33	0.3	0.4	0.35	0.95	0.97	0.96	0.15	0.19	0.17	NA		NA	
Width	1.9	3	2.3	2.1	2.9	2.33	2.50	3.10	2.71	1.50	1.58	1.54	NA		NA	
Transparency	clear	clear	clear	0.3	0.3	0.3	0.13	0.15	0.14	0.20	0.20	0.20	NA	0.15 – 0.9	NA	
Flow Rate	0.21	0.25	0.23	0.12	0.21	0.2	0.22	0.21	0.22	0.10	0.10	0.10	NA		NA	
COD	16.79	31.5	24.145	26.6	31.5	29.05	21.70	26.60	23.33	36.40	41.30	77.7	20.6 – 51.3	11.54 – 23.08	40	20
BOD	0.6	1.3	0.95	1.3	1.7	1.5	0.80	0.90	0.83	1.00	2.00	1.50	8 – 15.6	2.6 – 6.0	30	≤5
Nitrate	0.46	0.59	0.525	0.46	0.54	0.5	0.44	0.49	0.46	0.47	0.48	0.475	NA	0 – 0.9	20	
Phosphate	2.43	3.22	2.825	3.11	4.08	3.595	3.98	4.71	4.27	3.81	4.15	3.98	NA	0.002 – 0.01	5	
Sulphate	0.53	0.54	0.535	0.64	0.67	0.655	0.66	0.67	0.67	0.52	0.74	0.63	NA	19.14 – 41.99	500	
PAH	0.00	0.02	0.01	0	0.01	0.005	0.000	0.010	0.003	0.02	0.03	0.015	NA			
BTEX	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA			

Phenols	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA			
THC	<0.001	0.12	0.12	0.11	0.21	0.16	0.02	0.12	0.06	0.03	0.14	0.085	NA		NS	
TPH	0.00	0.12	0.06	0.1	0.21	0.155	0.10	0.02	0.05	0.03	0.13	0.08	NA			

Table 4.24b: Results of physical and chemical surface water quality parameters in the study area Cont'd.

PARAMETER	EJIO – OLORUNSOGO AXIS												Secondary Data (ICCL 2015)	Secondary Data (EMP Baseline 2017	FMEnv. Limit	WHO (2011) limits for Sustenance of Aquatic lives
	ILUDUN (SWI)			OSUN STREAM (SW2)			WAGUNU RIVER (SW3)			SOWUNMI STREAM (SW4)						
	min	max	mean	min	max	mean	min	max	mean	min	max	mean				
Sodium	2.60	6.50	4.55	6.10	6.90	6.50	10.00	11.00	10.50	7.30	13.00	10.15	NA	4.21 – 9.85	NS	
Oil & grease	<0.001	<0.001	<0.001	<0.001	0.01	<0.01	<0.001	0.02	<0.01	<0.001	0.01	<0.01	1 - 4		10	
Calcium	1.14	1.4	1.27	2.28	2.37	2.325	7.48	12.40	9.81	3.89	4.54	4.23	NA	21.59-31.87	200	
Magnesium	1.21	1.33	1.27	1.48	1.52	1.5	1.09	1.61	1.38	1.32	1.51	1.42	NA	3.39 – 6.42	200	
Copper	0.01	0.02	0.015	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01 – 1.3	0.233 – 0.296	<1	1500
Iron	0.64	1.24	0.94	1.58	2.4	1.99	1.23	2.6	1.94	1.11	2.71	1.91	2 - 6	18.9 – 24.5	20	300
Nickel	0.03	0.28	0.155	0.1	0.04	0.07	<0.001	<0.001	<0.001	0.01	0.01	0.01	0.00 – 0.12	0.019 – 0.288	<1	88
Chromium	0.1	0.3	0.2	0.2	0.5	0.35	0.4	0.07	0.36	0.40	1.20	0.8	NA	0.031 – 0.08	<1	0.1
Cadmium	<0.001	0.01	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	0.01 – 0.03	<1	0.03
Zinc	<0.001	0.01	0.01	<0.001	<0.001	<0.001	0.02	<0.001	0.015	<0.001	<0.001	<0.001	3 - 11		<1	5000
Barium	<0.001	0.02	0.02	<0.001	0.01	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA			
Lead	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	<0.01	2 - 16	0.033 – 0.348	<1	25
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA	ND	0.05	

Table 4.24c: Results of physical and chemical water quality parameters in the study area.

PARAMETER	EJIO – NEW ABEOKUTA AXIS												Secondary Data (ICCL 2015)	Secondary Data (EMP Baseline 2017)	FMEnv. Limit	WHO (2011) limits for Sustenance of Aquatic lives
	RIVER WAGUNU (SW5)			ODOIPA (SW6)			OGUN RIVER (SW7)			OTOTO STREAM (SW8)						
	min	max	mean	min	max	mean	min	max	mean	min	max	mean				
Chloride	72.01	100.91	86.46	93.68	132.21	112.9	127.40	153.89	140.6	129.81	158.70	144.3	NA	7.54 – 41.07	600	
Total Hardness	10.08	16.74	13.41	11.05	16.13	13.59	10.68	15.57	13.12	11.80	17.77	14.78	NA	79.35 – 93.61	NS	
TSS	0.01	0.08	0.045	0.00	0.07	0.07	0.03	0.08	0.05	0.01	0.07	0.04	9 -74		30	
Turbidity	0.28	1.50	0.89	0.31	1.23	0.77	1.32	2.50	1.91	0.30	0.60	0.45	1 - 45	1.53 – 7.59	NS	≤25
DO	5.10	5.50	5.30	4.90	5.60	5.25	4.80	5.00	4.90	4.90	5.90	5.40	2.66 - 45	7.2 -10.6	>2	>4 <9
Temperature	28.8	29.0	28.9	27.0	27.2	27.1	30.6	31.5	31.05	29.2	29.8	29.5	24.4 – 28.1	29.7 – 33.3	<40	40
pH	6.35	6.38	6.37	7.15	7.18	7.16	7.10	7.40	7.25	8.70	8.72	8.71	7.20 -7.56	8.49 – 9.61	6 - 9	4.8 – 9.2
EC	375	378	376.5	75.0	75.0	75.0	165	165	165	92.0	92.0	92.0	45.1 - 287	314 - 418	NS	
TDS	186	189	187.5	36.0	36.0	36.0	82	82	82	46.0	46.0	46.0	29.- 43.2	213 - 276	2000	
Depth	0.55	0.67	0.61	1.50	1.56	1.53	6.51	6.70	13.21	0.32	0.35	0.34	NA		NA	
Width	4.2	4.7	4.45	14.3	15.0	14.65	62.5	70.0	66.3	2.92	2.93	2.93	NA		NA	
Transparency	2.14	2.16	2.15	1.10	1.14	1.12	2.60	2.65	2.63	0.24	0.28	0.26	NA	0.15 – 0.9	NA	
Flow Rate	0.20	0.22	0.21	0.80	0.83	0.82	1.22	1.24	1.23	2.80	2.88	2.84	NA		NA	
COD	16.79	21.70	19.25	16.79	31.50	24.14	31.50	36.40	33.95	11.50	16.60	14.05	20.6 – 51.3	11.54 – 23.08	40	20
BOD	0.30	1.10	0.70	0.40	1.90	0.93	0.50	1.50	1.00	0.70	1.40	1.05	8 – 15.6	2.6 – 6.0	30	≤5
Nitrate	0.76	0.94	0.85	0.77	1.10	0.93	0.51	0.90	0.71	0.50	0.71	0.61	NA	0 – 0.9	20	
Poshphate	4.23	5.10	4.66	4.50	4.86	4.68	3.45	4.76	4.11	2.36	3.11	2.74	NA	0.002 – 0.01	5	
Sulphate	0.53	1.11		0.45	1.20	0.82	0.48	0.67	0.57	0.69	0.81	0.75	NA	19.14 – 41.99	500	
PAH	0.00	0.20	0.20	0.03	0.03	0.03	0.01	0.03	0.02	0.00	0.01	0.01	NA			
BTEX	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	NA			
Phenols	0.00	0.01	0.01	0.00	0.02	0.02	0.00	0.01	0.01	0.00	0.00	0.00	NA			
THC	0.05	0.23	0.14	0.14	0.15	0.145	0.03	0.14	0.08	0.02	0.04	0.03	NA		NS	
TPH	0.04	0.21	0.125	0.13	0.14	0.135	0.02	0.13	0.07	0.01	0.01	0.01	NA			

Table 4.24d: Results of physical and chemical surface water quality parameters in the study area Cont'd.

PARAMETER	EJIO – NEW ABEOKUTA AXIS												Secondary Data (ICCL 2015)	Secondary Data (EMP Baseline 2017	FMEnv. Limit	WHO (2011) limits for Sustenance of Aquatic lives
	WAGUNU RIVER (SW5)			ODOIPA RIVER (SW6)			OGUN RIVER (SW7)			OTOTO STREAM (SW8)						
	min	max	mean	min	max	mean	min	max	mean	min	max	mean				
Sodium	6.23	8.00	7.12	4.56	6.12	5.34	4.30	8.70	6.50	6.20	7.99	7.09	**NA**	4.21 – 9.85	**NS**	
Oil & Grease	<0.001	0.01	<0.01	0.01	0.02	0.015	<0.001	0.01	<0.01	<0.001	0.02	<0.02	**1 - 4**		**10**	
Calcium	2.20	3.93	3.06	2.42	3.45	2.93	1.67	3.56	2.61	1.87	3.11	2.49	**NA**	21.59-31.87	**200**	
Magnesium	1.09	1.66	1.37	1.20	1.80	1.50	1.43	1.60	1.51	1.71	2.41	2.06	**NA**	3.39 – 6.42	**200**	
Copper	<0.001	0.03	<0.01	<0.001	0.02	<0.02	<0.001	<0.001	<0.001	0.01	0.20	0.105	**0.01 – 1.3**	0.233 – 0.296	**<1**	**1500**
Iron	1.20	2.99	2.09	1.44	2.10	1.77	0.20	2.01	1.10	0.30	2.56	1.43	**2 - 6**	18.9 – 24.5	**20**	**300**
Nickel	0.01	0.02	0.015	<0.001	0.02	<0.02	<0.001	0.02	<0.02	<0.001	0.02	<0.02	**0.00 – 0.12**	0.019 – 0.288	**<1**	**88**
Chromium	0.01	0.45	0.23	0.01	0.20	0.11	0.02	0.10	0.06	0.003	0.40	0.201	**NA**	0.031 – 0.08	**<1**	**0.1**
Cadmium	<0.001	0.10	<0.10	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	<0.01	**0.01**	0.01 – 0.03	**<1**	**0.03**
Zinc	<0.001	0.01	<0.01	<0.001	0.02	<0.02	<0.001	0.01	<0.01	<0.001	0.10	<0.05	**3 - 11**		**<1**	**5000**
Barium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**			
Lead	<0.001	0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**2 - 16**	0.033 – 0.348	**<1**	**25**
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**NA**	ND	**0.05**	

Godirra Chemicals Nig Ltd Field Survey, 2017

4.7.6.3. Physico-chemical Characteristics of Surface Water

a. pH

The acidic or basic nature of a solution is expressed as pH, which is determined by the hydrogen ion (H^+) concentration in a solution. In natural waters, this is usually dependent on the carbonic acid equilibrium. A pH range of 6.0 to 9.0 is normal for aquatic life (KWW, 2001).

The pH of an aquatic ecosystem is important because it is closely related to biological productivity (UNEP/GEMS, 2008). The recorded mean pH values in surface water samples from the study area ranged from 6.37 – 8.71 indicatng slight acidic to alkaline status. These values are within established pH range for surface waters by FMEnv. and compared well with previous baseline studies around the study area. This water quality parameter is likely to be affected especially during site construction in the rainy season as the run-off will be discharged into the surface waters.

b. Temperature

It was observed that temperature of the water bodies vary from one water body to the other with mean value of 26.9 – 31.05 which fall within FMEnv limit of <40) ^{0}C and in line with previous studies around the project area (EMP Baseline, 2017 and ICCL, 2015). However, the variation was within the range of 15 - 32°C and 21 - 32°C recommended by WHO (2011) for drinking water and ICAR (2006) for aquatic life in the tropical environment respectively. Water temperature is one of the major factors that the presence, survival and abundance of biotic organisms in aquatic ecological systems and fluctuates both daily and seasonally (Odulate *et al*., 2016). The proposed project is not expected to impact negatively on the temperature of the water bodies except thermal waste water is discharged into them. Temperature affects the speed of chemical reactions, the rate at which algae and aquatic plants photosynthesize, the metabolic rate of other organisms. Besides, it influence how pollutants, parasites and other pathogens interact with aquatic residents (UNEP/GEMS, 2008). Water temperature affects the behaviour, reproduction, growth, migration, feeding, mortality and distribution of fishes in the aquatic environment. The time of sampling might be responsible for the high temperature recorded at some points.

c. Electrical Conductivity (EC)

Electrical conductivity (E.C) also referred to as the specific conductance, is a measure of the ability of a water sample to convey an electric current. This is related to the concentration of ionized substances in the water samples.

Conductivity mean values of the water bodies were within the natural limits and consistent with reported values from previous studies around the project area (EMP Baseline, 2017 and ICCL, 2015). The mean values recorded ranged from 42.7 -376.5μscm^{-1}.This water parameter is not likely to be impaired except there is a discharge of ionisable and corrosive elements into the water bodies during site construction. Intensive bathing activities by children in Wagunu river (Plate 4.8) and Ogun river might cause the high value of electrical conductivity experienced in the rivers. This will invariable affect the total dissolved solids, transparency, turbidity and total suspended solids.

d. Transparency

Most of the waters were clear to the bottom except for Wagunu River and Ogun River. Water transparency is usually affected by suspended particles such as planktonic materials and suspended soil particles. The transparency of the surface water bodies in the proposed project areas are expected to in reduce as a result of the constructions especially during rainy season

e. Total dissolved solids (TDS)

The mean concentration of total dissolved solids ranged from 19.5 – 187.5 mg/L within the safe limit (<500 mg/L) recommended by WHO for drinking and within range when compared with (EMP Baseline, 2017 and ICCL, 2015). It implies that there is need for regular monitoring of the water quality to ensure its safety for drinking. Dissolved salts and minerals in natural water bodies are essential components of good quality water in that they help to sustain the vitality and health of its inhabitants. The observed variations might be as a result of different geological formations in the study area and differences in mineral solubilities.

f. Nitrate

Natural waters in their unpolluted state contain minute concentration of nitrate. Increased nitrate level is an indication of anthropogenic influence and may also be due to fresh water inflow, litter fall decomposition and terrestrial run-off during rainy months (Odulate *et al.*, 2011). Nitrate mean concentrations in the water bodies ranged from 0.46 – 0.93mg/L and were below 50mg/l recommended by WHO (2011) in drinking water and FMEnv Limit of 20mg/L. These mean values fall in line with previous studies around the project area

g. Phosphate

Phosphate is essential for the growth of organisms and a nutrient that limits the primary productivity of the water body. Phosphate and nitrate were reported to be limiting nutrients in aquatic ecosystems and are primary drivers of eutrophication of aquatic systems (Soulsby *et al.*, 2001; UNEPGEMS/Water Programme, 2006). Phytoplankton production in aquatic systems, which serves as link in the food chain, is dependent on the amount and bioavailability of phosphate and nitrate. Intrusion of phosphorus into aquatic ecosystems, among other sources includes detergents, soil run-off, septic effluents, industrial discharges and fertilizers from agricultural lands (Odulate *et al.*, 2016). The mean concentration of phosphate ranged between 2.74mg/L and 4.68mg/L in line with previous studies done around the project area (EMP Baseline, 2017 and ICCL, 2015) and below FMEnv limit of 5mg/L.

h. Dissolved oxygen

Dissolved oxygen is a very important water quality parameter as it serves as an indicator of the physical, chemical and biological activities of the water body. The amount of dissolved oxygen in water is greatly influenced by water temperature with inverse relationship. The primary source of dissolved oxygen in aquatic ecosystem is through photosynthesis of green aquatic flora especially phytoplankton and it is a key factor for aquatic life. Concentration of dissolved oxygen obtained during the study were within the range recommended by WHO for aquatic lives. However, this healthy situation may be hampered if dumping of waste into the water bodies during execution of the project is encouraged. Dissolved oxygen averaged between 3.84 mg/L and 6.13mg/L. These values compared well with natural limits expected for fresh water bodies and were consistent with reported baseline values for the area as well above FMEnv limit of >2mg/L.

i. Turbidity

The Turbidity is an indication of the extent to which light passing through the water is reduced by floating suspended solids and colloidal materials. High turbidity lowers the light penetration through the water, which results to lower primary productivity in the water. It also reduces the aesthetic values.

The mean values of Turbidity of the water bodies ranged from 8.0 – 60mg/L which are in line with previous studies around the area.

j. Total Suspended Solids

The total suspended solid (TSS) comprises colloidal suspension components such as clay, silt, sand, finely divided organic and inorganic matter, plankton and other microorganisms in water. High concentration of suspended solid affects water clarity and light penetration, which will affect photosynthetic processes and consequently primary production. A positive effect of the presence of suspended solids in water is that toxic chemicals (pesticides and metals) tend to adsorb to them or from complexes with them, thus making the toxics less available to be absorbed by living organisms (Kentucky water watch, 2001).The mean concetrations of TSS in water bodies from the study area recorded mean values ranging from 0.00 – 50.00 mg/L which is in line with previous studies done around the project area. It is however above FMEnv limit of 30mg/L

k. Total Hardness:

Total concentration of Calcium and Magnesium expressed as their $CaCO_3$ equivalent denotes the Total Hardness of water. Carbonate hardness can be regarded as temporary hardness since they can be easily removed from water by boiling. The metal carbonate reacts with soap or detergents leading to formation of scum. The Total Hardness mean concentration ranged between 8.465mg/L and 30.28mg/L. These values were far below those of previous studies around the area.

l. Biochemical Oxygen Demand (BOD)

BOD is an indirect measure of the amount of biologically degradable organic materials in water and is an indicator of the amount of dissolved oxygen that will be depleted from water during natural biological assimilation of organic pollutants. Excess BOD in water therefore could adversely affect aquatic organisms and by extension humans. BOD mean concetration in surface water samples from the study area ranged from 0.70-10mg/L. Values from other stations were however within natural limits and compliant to limits set by the WHO and FMEnv. These values were also consistent with previous baseline data and are as required for proper functioning of natural water habitats

m. Chemical Oxygen Demand (COD)

Chemical oxygen demand is a rapid (2 H) test which measure the oxygen required for the oxidation of all the substance present in water, included those are not biologically decomposable. COD is a reliable parameter for judging the extent of pollution in water.The COD of water increases with increasing concentration of organic matter. Chemical Oxygen Demand mean values ranged from 14.05 – 59.4mg/L. COD of 59.4 mg/L is above FMEnv limit of 40mg/L and also above values of prevous studies. The concentration above FMEnv regulatory limit was recorded at SW9 sampled point.

n. Sulphate

Sulphate is naturally present in surface waters as SO_4^{2-}. It rises from atmospheric deposition of oceanic aerosols and the leaching of sulphur compounds, either sulphate minerals such as gypsum or sulphide mineral such as pyrite, from sedimentary rocks. It is the stable, oxidized form of sulphur and is readily soluble in water (with the exception of lead, barium and strontium sulphates which precipitate). Industrial discharges and atmospheric precipitation can also add significant amounts of sulphate to surface waters. Sulphate can be used as an oxygen source by bacteria which convert it to hydrogen sulphide (H_2S, HS^-) under anaerobic conditions. Sulphate concentration in surface water samples ranged from 0.53 -0.82mg/L with mean of 2.31mg/L in the wet season. These values are within report values for natural waters around and within the study area and below FMEnv limit. However the mean concentrations were lower that values of previous studies around the project area (EMP Baseline, 2016).

o. Alkali and alkaline earth metals

Sodium (Na), Calcium (Ca) and Magnesium (Mg) are the alkali and alkaline earth metal analysed. These alkali and alkaline earth metals in solution make up the exchangeable cations. Their mean values ranged from 4.55 – 10.50mg/L (Na), 1.27 – 9.80mg/L (Ca) and 1.27 – 32.06mg/L (Mg) respectively. The order of dominance is thus Na>Ca>Mg. These mean values are consistent with previous studies done around the project area except for calcium that recorded mean value low than values of previous studies. Also these mean values were within FMEnv regulatory limits.

p. Heavy Metals

Natural water also contain very small (quantities of many essential metals viz, Zinc (Zn), cadmium (Cd) Copper (Cu), Lead (Pb), Iron (Fe), Manganese (Mn) called trace or heavy metals. They are required by plants and animals in minute quantities. They are toxic if present in relatively high concentrations and are non-biodegradable as well easily assimilated and bio-accumulated in the protoplasm of aquatic organisms.

q. Zinc

Zinc is found in some natural water, most frequently in areas where it is mined. It is not considered health unless it occurs in very high concentrations. It imparts an undesirable taste to drinking water. For this reason, the SMCL of zinc in water was set 5.0 mg/L. In the present study the zinc is found normal SMCL in all samples. The mean concentration value for zinc ranged from <0.001 – 0.02mg/L below FMEnv limit and consistent with previous studies done around the project area.

r. Chromium

The concentration of chromium in the lake water was quite low and fluctuated vary widely. Chromium is a specific pollutant providing evidence of industrial pollution like dye or paint operations. In the present study the mean concentration of Cr is high ranging from <0.001-0.45 mg/L and values below FMEnv limit of <1 mg/L.

The mean concentrations of other Mercury, Lead Cadmium, Nickel, Iron and Barium heavy metals in the surface water samples from all the streams/rivers were generally low with concentrations within FMEnv. and consistent with studies done around the project area.

s. Hydrocarbons

The summary of results of oil and grease, total petroleum hydrocarbon polycyclic aromatic hydrocarbons (PAHs) and BTEX concentrations measured in the surface water samples across the project zone of influence and are presented in Table 4.32a&c.

The oil and grease mean concentration of the surface water ranged from <0.001 – 0.02 mg/L, while total hydrocarbon content mean concentration ranged from 0.03 – 0.16 mg/L. Benzene, toluene, ethylbenzene and xylenes (BTEX) which constitutes the volatile organic compounds (VOCs) primarily originate from petroleum products and solvents. The analysis of BTEX is widely used as an indicator of contamination with light petroleum products, e.g., petrol and kerosene (Margesin and Schinner, 2005). Thus, the observed mean values of these chemical substances in Ogun River and Odoipa River only were 0.01mg/L and 0.01mg/L which thus reflect an unpolluted environment. Also, the total petroleum hydrocarbon values obtained in this study were low ranging from 0.01 - 0.155mg/L.

4.7.6.4. *Surface Water Microbiology*

The microbiological characteristics of the surface water in the study area are presented in table 4.25

Table 4.25: Result of surface water microbiology

Parameter / Sample Stations	Total Heterotrophic Bacteria	Count (cfu/ml)	Hydrocarbon Ultilising Bacteria	Count (cfu/ml)	Total Heterotrophic Fungi
Ejio- Olurunsogo Section					
SW1	*Staphylococcus sp Pseudomonas sp Bacillus sp*	2.0 x 10^2	*Pseudomonas sp Bacillus sp*	3.6 x 10^2	*Rhizopus sp Aspergillus sp Penicillium sp*
SW2	*Bacillus sp Staphylococcus sp Pseudomonas sp*	5.3 x10^4	*Pseudomonas sp Bacillus sp*	3.2 x 10^2	*Rhizopus sp Candida sp*
SW3	*Bacillus sp Pseudomonas sp Micrococcus sp, Enterobacter sp Escherichia coli*	2.3 x 10^4	*Bacillus sp Micrococcus sp Pseudomonas sp*	5.8 x 10^2	*Aspergillus Rhizopus spsp*
SW4	*Bacillus sp Pseudomonas sp Micrococcus sp, Enterobacter sp Escherichia coli*	1.8 x 10^4	*Bacillus sp Micrococcus sp Pseudomonas sp*	4.4 x 10^2	*Candida sp Mucor sp Aspergillus sp*
Ejio- New Abeokuta Section					
SW5	*Bacillus sp Pseudomonas sp Escherichia coli*	2.9 x 10^3	*Bacillus sp Microcuccus sp Pseudomonas sp*	9.0 x 10^2	*Penicillium s Rhizopus s Geotrichum s Mucor sp*
SW6	*Bacillus sp Pseudomonas sp Actinomyce sp, Protues sp, Micrococcus sp*	2.3 x 10^4	*Bacillus sp Micrococcus sp Pseudomonas sp*	9.2 x 10^2	*Penicillium Candida s Aspergillus sp*
SW7	*Bacillius sp Proteaus sp Escherichia coli*	2.3 x 10^3	*Bacillus sp*	4.5 x 10^3	*Aspergillus sp Geotrichum s Rhizopus sp Candid sp, Mucor sp*
SW8	*Bacillus sp Proteus sp Klebsiella sp*	5.1 x 10^2	*Bacillus sp*	3.0 x 10^2	*Aspergillus sp Rhizopus sp*

Source: GCNL Field Work, 2017

a. Total Heterotrophic Bacteria (THB)

The most predominant bacterial genera found in the water samples is Bacillus which was present in all the sample water bodies. Pseudomonas was also predominant. Other bacteria genera found are Proteus, Enterobacter, Staphylococcus and *Escherichia coli* a pollution indicator, *Actinomyces, Proteus* and *Klebsiella*. THB ranged between $2.0x10^3$cfu/100ml and $5.36x10^4$cfu/100ml

b. Hydrocarbon Utilising Bacteria (HUB)

The Hydrocarbon utilizing bacteria (HUB) ranged between $3.0x10^2$cfu/ml to $4.5x10^3$cfu/ml The predominant HUB found in the water bodies is *Bacillus sp and Pseudomonas sp. Micrococcus sp* was also found. Their counts were low indicating no hydrocarbon contamination.

c. Total Heterotrophic Fungi (THF)

The Total Heterotrophic Fungi (THF) ranged between $3.0x10^2$cfu/100ml and $6.9x10^3$cfu/100ml. The predominant fungus found in the water bodies is *Aspergillus sp.*

d. Hydrocarbon utilizing Bacteria (HUF)

The various Hydrocarbon utilizing Fungi found in the surface water of the study area include *Mucor sp* and *Rhizopus sp*, HUF count ranged between $3.0x10^2$cfu/ml and 9.0 $x10^2$cfu/ml. The predominant fungus found in the water bodies is *Aspergillus sp.* Their counts were low which indicates that the water bodies are not polluted with hydrocarbons.

e. Faecal Coliforms

If Faecal coliform or *Escherichia coli* is detected along with other coliforms in water, there is strong evidence that sewage is present in the water; therefore, a greater potential for pathogenic organisms exists (Minnesota Department of Health, 2005).

Escherichia coli a pollution indicator was from Wagunu River and Ogun River only which may be attributed to anthropogenic activities downstream.

The presence of *Escherichia coli* indicates a very recent pollution of human or animal origin like birds, cows etc. Anthropogenic activities were seen at Wagunu River eg children seen bathing in the Wagunu River, also at Ogun River in Opanigangan various anthropogenic activities were observed eg sand mining.

4.8. Soil Resources

Soil provides water, nutrients and anchorage for plants and trees in natural forests and grasslands, annual and perennial crops and planted grassland. It also provides the habitat for decomposer organisms which have an essential role in the cycling of carbon and mineral nutrients. Soil degradation occurs as a result of human activities such as dumping of solid waste, construction (road and building), and industrial activities. Part of the project land is underlain by one predominant soil type derived from sedimentary deposits belonging to the Ewekoro Formation. The soil is classified locally as Alagba series or Oxic Haplustalf using the United States Department of Agriculture (USDA) classification scheme or Eutric Nitosol (Food and Agricultural Organization and United Nations Scientific and Cultural Organization, FAO/UNESCO) which occur in the well drained areas. Transmission line project will affect soil quality negatively.

The activities that are likely to affect the soil quality includes construction of access road, transportation of equipment and other materials needed for construction and indiscriminate dumping of waste by the construction worker. Mitigation measures will be provided for these impacts in chapter six.

4.8.1. Soil Sampling

Soil samples were collected at Fouteen (14) stations. At each station, soil samples were collected at two depths (0-15cm for top soil and 15-30cm for sub soil). This operation was carried out with the aid of stainless steel Dutch auger (Plate 4.13a) and bulked Plate 4.13b


A **B**

Plate 4.12: Soil sampling using Auger (A) Soil sample preservation (B)

Each sample was collected in polyethylene bags, McCartney bottles and foil, labelled appropriately, and stored in a cooler ready for transportation to an FMEnv. accredited laboratory Caran Technologies Limited laboratory, 15 Oritshe Street. Off Awolowo Way, Ikeja. Lagos State. Table 4.26a-b is a summarized physico chemical results for which detailed results is shown in Appendix

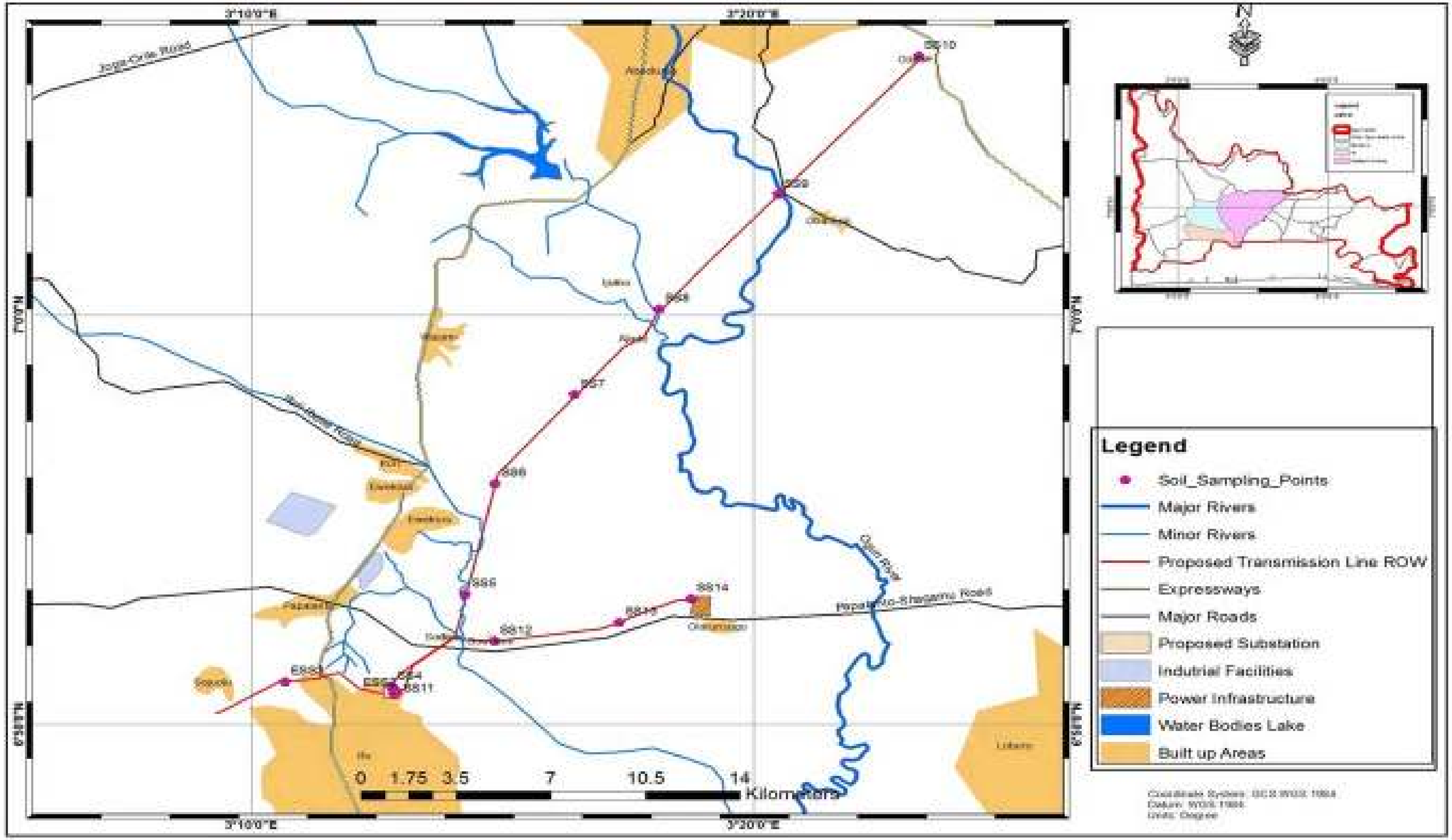


Figure 4.23: The soil sampling locations.

Table 4.26a: Soil physical and chemical properties Result

Parameters	Ejio – Sojuolu						Ejio - Olorunsogo						Ejio - Abeokuta						2° Data (ICCL 2015)	WHO/ FMENV Limits (USDA 2017)
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max		
	Top soil			Sub soil			Top soil			Sub soil			Top soil			Sub soil				
Colour	Gray and Brown						Gray						Gray, Brown and Black							
MC (%)	19.78	10.50	26.30	26.09	25.12	28.30	19.28	18.24	19.80	19.08	16.65	23.95	18.41	13.80	26.10	21.39	19.59	22.76	**7.62 - 18.03**	
pH	7.74	6.65	8.20	7.56	6.42	7.95	7.29	7.08	7.72	7.21	7.01	7.60	7.94	8.01	8.24	7.78	7.20	8.10	**5.01 - 6.85**	**5.0 - 8.0**
Sand (%)	73.82	58.30	79.10	73.98	58.50	79.40	70.50	68.10	71.70	71.07	68.60	72.30	76.85	68.20	88.90	77.23	68.70	89.00	**34 – 86**	
Silt (%)	14.18	11.10	21.70	14.02	11.00	21.50	17.83	13.30	26.90	15.60	12.70	21.40	14.40	6.10	26.80	14.03	6.00	26.30	**1 – 66**	
Clay (%)	12.00	10.00	20.00	12.00	5.00	20.00	11.67	5.00	15.00	13.33	10.00	15.00	8.75	5.00	15.00	8.75	5.00	15.00	**0 - 16**	
Texture	Loamy sand and Sandy loam			Loamy sand and Sandy loam			Sandy loam and Loamy sand			Sandy loam and Loamy sand			Sandy loam and Loamy sand			Sandy loam and Loamy sand				
Bulk density (g/cm^3)	2.09	1.97	2.33	1.98	1.87	2.08	2.05	2.00	2.07	2.00	1.94	2.12	2.02	1.75	2.27	1.95	1.74	2.14		
Porosity (%)	21.74	12.04	25.63	24.93	21.36	29.38	22.79	21.85	24.67	24.62	20.12	26.87	23.81	14.35	33.97	26.52	19.35	34.41		
WHC (%)	22.04	18.66	25.34	22.10	20.05	24.76	23.98	23.45	25.05	23.40	22.71	23.74	20.84	17.90	23.56	21.16	18.02	24.43		
Ext. Sulphate (mg/kg)	6.88	4.60	14.96	6.14	3.90	13.56	4.80	4.51	5.38	4.18	3.88	4.79	9.23	4.74	15.19	8.34	4.30	14.05	**14 - 688**	
Bicarbonate (mg/kg)	32.40	8.00	72.00	30.80	12.00	60.00	61.33	56.00	72.00	53.33	48.00	64.00	31.50	16.00	68.00	33.00	20.00	60.00		
CEC (meq/100 g)	2.6	2.08	3.61	2.50	1.97	3.50	2.26	3.21	3.56	3.24	3.08	3.32	2.28	1.26	3.77	2.23	1.18	3.70		
Nitrate (mg/kg)	161.32	141.50	210.10	148.88	128.90	196.80	107.33	105.40	111.20	100.33	98.30	101.35	121.45	97.80	162.50	108.34	80.10	143.30	**0.01 - 10**	**500**
Chloride (mg/kg)	88.68	79.62	94.20	92.31	84.35	97.35	85.40	83.17	89.86	89.34	87.89	92.23	89.86	87.89	91.83	88.88	86.71	91.83		
TOC (%)	3.46	2.98	3.96	3.01	2.73	3.32	3.96	3.95	3.97	2.65	2.63	2.69	3.18	2.93	3.39	2.96	2.75	3.22		

K(mg/kg)	0.38	0.23	0.73	0.51	0.29	0.98	1.17	1.08	1.21	1.29	1.22	1.32	1.18	0.5	2.04	1
Na (mg/kg)	1.97	1.61	2.23	2.11	1.82	2.44	1.94	1.86	2.10	2.07	1.98	2.24	1.94	1.68	2.24	2
Cu (mg/kg)	0.01	BDL	0.02	0.03	BDL	0.04	BDL	BDL	BDL	BDL	BDL	BDL	0.02	BDL	0.02	0
Fe (mg/kg)	33.87	6.93	44.70	30.36	6.10	39.66	32.23	31.00	34.70	28.59	27.44	30.88	46.45	27.90	59.50	4

BDL = Below Detection Limit of 0.001

Sources: Source: GCNL Field Work, 2017

Table 4.26b: Soil physical and chemical properties Result (Continued)

Parameters	Ejio – Sojuolu						Ejio - Olorunsogo						Ejio - Abeokuta			
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
	Top soil			Sub soil			Top soil			Sub soil			Top soil			Sub s
Zn (mg/kg)	0.10	0.07	0.15	0.05	0.02	0.10	0.09	0.09	0.09	0.03	0.02	0.03	0.10	0.07	0.11	0.03
Ba (mg/kg)	0.02	BDL	0.02	0.03	BDL	0.04	0.13	0.10	0.20	0.05	0.03	0.09	0.02	BDL	0.03	0.01
Ni (mg/kg)	0.36	0.02	0.61	0.26	0.01	0.52	0.18	0.17	0.21	0.04	0.01	0.06	0.28	0.03	0.60	0.24
Cr (mg/kg)	0.05	0.04	0.06	0.03	0.02	0.06	0.06	0.05	0.07	0.04	0.04	0.05	0.07	0.06	0.08	0.06
Cd (mg/kg)	0.04	0.01	0.06	0.05	BDL	0.11	0.04	0.01	0.06	0.13	0.06	0.16	0.07	0.01	0.13	0.02
Pb (mg/kg)	0.01	BDL	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.02	BDL	0.02	0.01
Hg (mg/kg)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
PAH (mg/kg)	4.24	0.55	13.14	3.21	0.06	11.51	0.38	0.02	1.09	0.30	0.04	0.82	0.00	0.00	0.01	0.00
BTEX (mg/kg)	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.01	0.00	0.04	0.00
Phenols (mg/kg)	1.22	0.00	1.32	0.08	0.00	0.30	0.07	0.00	0.11	0.01	0.01	0.02	0.39	0.00	1.53	0.06
TPH (mg/kg)	9.74	2.31	27.21	7.30	1.15	21.74	0.98	0.32	2.29	0.63	0.06	1.76	1.12	0.00	3.78	0.52
THC (mg/kg)	13.20	5.93	30.19	10.32	4.47	24.47	4.94	4.27	6.28	3.28	2.69	4.46	4.31	2.97	7.17	3.48

BDL = Below Detection Limit

Source: GCNL Field Work, 2017

4.8.2. Physico-chemical Characteristics of Soil

a. Colour

Soil colour is influence by moisture. The colour of the soil samples collected were mostly gray, brown and black. Along Ejio – Sojuolu, the colour of the soil samples collected were gray and brown while Ejio – Olorunsogo were gray and Ejio – Abeokuta were gray, brown and black.

Moisture content

Percentage moisture content ranged from 10.50 – 26.30 (topsoil) and 25.12 – 28.30 (subsoil) along Ejio – Sojuolu, 18.24 – 19.80 (topsoil) and 16.65 – 23.95 (subsoil) along Ejio – Olorunsogo and 13.80 – 26.10 (topsoil) and 19.59 – 22.76 (subsoil) along Ejio – Abeokuta. The soil moisture varied across the soil depths. The range of the moisture content was higher than moisture content observed in the soil by ICCL (2015).

b. pH

The soil pH along the three routes were alkaline. The soil pH reduced across the soil depths and within the limits set by WHO 2017 as shown in Table 4.26a. The major issue with alkaline soil is reduced nutrients, especially micronutrient availability, which causes Iron deficiency. The most common symptom of Iron deficiency is *Chlorisis* (yellowing of leaves). The FMEnv standard prescribed the range of pH to be 6.5 - 8.5. If pH value is higher than the permissible limit, this will affect adversely alkalinity of soils, microbial life and corrosion rate.

c. Soil texture

Soil texture is based upon the arbitrary division of the soil into three size fractions: sand, silt and clay. If one of these fractions dominates the grain size composition of a soil, the name of that fraction is included in the name of the soil texture Sand dominated the three line routes and the soil textures were loamy sand and sandy loam.

d. Bulk density

Bulk density is defined as mass of oven-dry soil per unit volume, and depends on the densities of the constituent soil particles (clay, organic matter etc.), and their packing and arrangement into peds. Values of bulk density range from < 1 Mg/m^3 for soils rich in organic matter, to 1.0-1.4 for well aggregated loamy soils, to 1.2 – 1.8 for sands and compacted horizons in clay soils. The bulk density of the soil samples collected ranged from 1.74 – 2.27.g/cm^2 (White, 2006)

e. Porosity

Porosity depends on the water content of the soil, since the volume of pores and total volume of an initially dry soil may change differentially due to swelling as clay surfaces hydrate, or shrinkage as the soil dries. Soil porosity ranged from 14.35 – 33.97%. The soil water content at which the porosity is measured therefore needs to be measured (White, 2006).

f. Water holding capacity

The pores of a soil are partly or wholly occupied by water. Water is vital to life in the soil because of its existence as a liquid at temperature most suited to living organisms. It possesses several unique physical properties, namely the greatest specific heat capacity, latent heat of vaporization, surface tension and dielectric content of any known liquid. The water holding capacity ranged from 17.90 – 25.34%

g. Exchangeable Sulphate

Exchangeable Sulphate was low compared to the results obtained by ICCL (2015).

h. Cation Exchange Capacity

The mineral and organic colloid of soils exhibits a negative charge which attracts and holds cations in such a way as to be exchangeable with other cations. The extent of this negative charge present in a soil is called the Cation Exchange Capacity of the soil and is usually expressed in milliequivalents per 100 g of oven-dry soil. The Cation Exchange Capacity of a soil, however, is not a unique value, for it is dependent, to some extent, on the cation species and on the pH of the saturating solution used in its determination. The CEC of tropical soils is due primarily to the organic matter, since tropical soils contain negligible amounts of vermiculite (125 – 175 meq/100 g) and montmorillonite (75 – 125 meq/100 g). For humus and kaolinite, the CEC ranged between 150 – 400 meq/100 g and 2 – 5 meq/100 g respectively.

i. Nitrate

All sample points recorded high level of Nitrate concentration above the FMEnv limit. The influencing factors for the occurrence of Nitrate in the soil may be attributed to the intensification of agricultural activities such as use of fertilizers and land- use practices.

j. Total Organic Carbon (TOC)

The organic carbon content of the soil samples ranged from 2.63 to 3.97 % across the soil depth. The low organic carbon can be attributed to many factors such as continuous cropping activities This means that the soils have low stable soil organic matter, thus the benefits of a stable soil organic matter such as enhancing aggregate stability, improving water holding capacity and reduces the stickiness of clay soils making them easier to till.

k. Sodium (Na) and Potassium (K)

The sodium and potassium content of the soil samples ranged from 1.61 – 2.44 mg/kg and 0.23 – 2.68 mg/kg respectively as shown in Table 4.26a. The low Na and K can be attributed to nature of the soil samples (low organic matter). However, Cu, Fe, Zn and Ba were also low.

l. Hydrocarbons

The summary of results of oil and grease, total petroleum hydrocarbon, polycyclic aromatic hydrocarbons (PAHs) and BTEX concentrations measured in the soil samples across the project zone of influence are presented in Table 4.26b.

The oil and grease content of the soil ranged from 8.96 mg/kg to 14.76 mg/kg for both soil depths, while total hydrocarbon content ranged from 8.47 mg/kg to 13.10 mg/kg. Values within BTEX, which constitutes the volatile organic compounds (VOCs) in soils primarily originate from petroleum products and solvents. The analysis of BTEX is widely used as an indicator of contamination with light petroleum products, e.g., petrol and kerosene (Margesin and Schinner, 2005).

Thus, the observed values of these chemical substances in the soil reflect an unpolluted environment. Also, the total petroleum hydrocarbon values obtained in this study were lower than 50 mg/kg DPR Target value and more so, it has been widely reported that soils with a hydrocarbon level below 100 mg/kg are considered unpolluted (Concawe, 1975).

m. Heavy metals

The concentrations of the heavy metals such as Ni, Cr, Cd, Pb and Hg analysed were low when compared to corresponding naturally occurring concentrations in unpolluted soils as reported by Alloway (1995) thus there is no evidence of heavy metal accumulation in the soil as at the time of the field investigation.

n. Organic compound content

The organic content analyzed were PAH, BTEX, Phenols, TPH and THC as shown in Table 4.26b. All the organic carbon were low compared to the standard.

Table 4.27: Mirobiology characteristics of Soil

Sample	Depth	Total Heterotrophic Bacteria (THB)	Counts (cfu/g)	Hydrocarbon utilizing Bacteria (HUB)	Counts (cfu/g)	Total Heterotrophic Fungi (THF)	
SS1	0 – 15cm	*Pseudomonas Bacillus Enterobacter*	9.8 x 10^4	*Bacillus Pseudomonas*	2.0 x 10^3	*Aspergillus Penicillium*	7.0
	15 – 30cm	*Pseudomonas Serratia Enterobacter*	2.2 x 10^3	*Pseudomonas*	5.6 x 10^2	*Geotricum Penicillium Mucor Rhizopus*	5.4
SS2	0 – 15cm	*Alcaligene Pseudomonas Enterobacter Proteus*	5.0 x10^5	*Pseudomonas Alcaligene*	2.5 x 10^3	*Trichoderma Rhizopus*	3.2
	15 – 30cm	*Pseudomonas Proteus*	3.0 x 10^5	*Pseudomonas*	9.0 x 10^2	*Trichoderma Rhizopus*	2.0
SS3	0 – 15cm	*Pseudomonas Klebsiella Bacillus Enterobacter*	8.7 x 10^5	*Pseudomonas Bacillus*	3.7 x 10^2	*Aspergillus Cladosporium Rhizopus*	9.5
	15 – 30cm	*Proteus Pseudomonas Klebsiella Bacillus*	6.1 x 10^4	*Bacillus Pseudomonas*	6.5 x 10^2	*Aspergillus Cladosprium Rhizopus*	2.9
SS4	0 – 15cm	*Proteus Alcaligene Bacillus*	6.5 x 10^5	*Bacillus Acaligene*	3.1 x 10^3	*Aspergillus Penicillium Candida*	4.0
	15 – 30cm	*E.coli, Proteus Bacillus Acaligene*	3.4 x 10^3	*Bacillus Alcaligene*	3.8 x 10^2	*Aspergillus Penicillium Candida*	2.0
SS5	0 – 15cm	*Pseudomonas Micrococus Enterobacter Serratia Proteus*	2.0 x 10^5	*Pseudomonas Micrococcus*	5.0 x 10^2	*Cuvularia Aspergillus Mucor*	5.8
	15 – 30cm	*Pseudomonas Proteus Enterobacter Micrococcus*	5.2 x 10^5	*Pseudomonas Micrococcus*	1.8 x 10^3	*Aspergillus Cuvularia Rhizopus*	3.2
SS6	0 – 15cm	*Pseudomonas Arthrobacter E.coli Proteus Bacillus*	3.0 x 10^5	*Pseudomonas Bacillus*	5.0 x 10^2	*Aspergillus Geotrichum Rhizopus*	6.5
	15 – 30cm	*Pseudomonas Proteus Arthrobacter Bacillus*	3.4 x 10^5	*Pseudomonas Bacillus*	3.5 x 10^2	*Aspergillus Cuvularia Rhizopus*	4.3
SS7	0 – 15cm	*Proteus Bacillus Pseudomonas Enterobacter*	1.5 x 10^5	*Bacillus Pseudomonas*	7.2 x 10^2	*Cuvularia Aspergillus Penicillium Rhizopus*	7.0

	15 – 30cm	*Pseudomonas Erwinia Proteus Enterobacter*	2.2×10^4	*Pseudomonas*	3.0×10^2	*Rhodotorula Rhizopus*	5.2
SS8	0 – 15cm	*Bacillus Erwinia Pseudomonas*	3.0×10^5	*Bacillus Pseudomonas*	2.0×10^3	*Cuvularia Mucor Geotrichum Pencillium*	3.0
	15 – 30cm	*Pseudomonas Micrococcus Erwinia*	4.2×10^4	*Pseudomonas Micrococcus*	1.2×10^3	*Aspergillus Cuvularia Mucor Rhizopus*	1.5
SS9	0 – 15cm	*Alcaligene Pseudomonas Ecoli Streptococcus fecalis Micrococcus*	7.2×10^4	*Alcaligene Pseudomonas Bacillus Micrococcus*	6.0×10^2	*Penicillium Mucor Aspergillus*	7.3
	15 – 30cm	*Ecoli Pseudomonas Proteus*	3.0×10^5	*Pseudomonas*	4.0×10^2	*Penicillium Mucor Aspergillus*	2.0
SS10	0 – 15cm	*Pseudomonas proteus Serratia Enterobacter Bacillus*	3.7×10^5	*Pseudomonas Bacillus*	5.5×10^2	*Penicillium Cuvularia Rhizopus Mucor*	8.0
	15 – 30cm	*Pseudomonas Bacillus Enterobacter Proteus*	2.0×10^4	*Pseudomonas Bacillus*	4.0×10^2	*Penicillium Cuvularia Rhizopus*	3.4
SS11	0 – 15cm	*Bacillius Proteus citrobacter Klebsiella*	2.2×10^5	*Bacillus*	6.0×10^2	*Aspergillus Geotrichum Rhizopus*	9.3
	15 – 30cm	*Proteus Citrobacter Bacillus Klebsiella*	4.9×10^5	*Bacillus*	4.0×10^2	*Aspergillus Rhizopus*	3.9
SS12	0 – 15cm	*Bacillus Proteus Pseudomonas E. coli*	5.1×10^2	*Bacillus Pseudomonas*	9.0×10^2	*Rhizopus*	4.0
	15 – 30cm	*Bacillus Ecoli Proteuss*	3.4×10^5	*Bacillus*	3.0×10^2	*Geotrichum Rhizopus*	3.8
SS13	0 – 15cm	*Alcaligene Pseudomonas Arthrobacter*	5.0×10^4	*Alcaligene Pseudomonas*	2.5×10^3	*Trichodenna Rhizopus Mucor*	6.6
	15 – 30cm	*Pseudomonas Proteus Artrobacter*	3.0×10^5	*Pseudomonas*	9.0×10^2	*Trichoderma Rhizopus*	2.0

Source: GCNL Field Work, 2017

4.8.3. Soil Microbiology

Soil microorganisms are very important as almost every chemical transformation taking place in soil involves active contributions from soil micro-organisms. In particular, they play an active role in soil fertility as a result of their involvement in the cycle of nutrients like carbon and nitrogen, which are required for plant growth. For example, soil micro-organisms are responsible for the decomposition of the organic matter entering the soil (e.g. plant litter) and therefore in the recycling of nutrients in soil.

Soil is generally made up of five major components such as mineral matter, water, air, organic matter and living organisms and the quantity of each of these constituents vary from one locality to another. "The five major groups of micro-organisms present in soil include: Bacteria, *Actinomycetes*, Fungi, Algae and Protozoa and the soil ecosystem include these microbial groups as well as the organic and the inorganic constituents of a given site. For the purpose of the present study, we are interested only in those microbial groups that have the potential to degrade and detoxify complex organic compounds that may be present in the soil and these microbial groups are basically "Bacteria and Fungi".

Naturally, "the bacterial populations in soil are usually higher than those of fungi", however because of their small size in relation to large size and extensive filament of Fungi and other groups. In a well aerated soil, both bacteria and fungi are present, however, if limited oxygen conditions prevail, bacteria accounts for most of the microbial community biomass. Numerically, Fungi are much less than bacteria in soil, but are the major contributor to soil biomass because of their large size.

Table 4.27 shows the microbial counts species diversity of the soil of the study area. The total heterotrophic bacterial count (THB) of these soils ranged from $3.0\text{x}10^3$cfu/100g to]. Lower counts were recorded at sub soil while the higher counts were recorded at top soil as a result of the presence of more organic content, air and moisture at the surface soil require for growth. The Hydrocarbon Utilizing Bacteria (HUB) counts ranged from $3.0\text{x}10^2$cfu/100g to $3.1\text{x}10^3$cfu/100g.

TheTtotal Heterotrophic Fungi (THF) ranged from $2.0\text{x}10^3$cfu/100g to $8.0\text{x}10^3$cfu/100g. The Total Hydrocarbon Utilizing Fungi (HUF) ranged from $3.0\text{x}10^2$cfu/100g to $2.6\text{x}10^3$cfu/100g in both the top soil and sub soil.

The most predominant Heterotrophic bacteria species isolated in the area are the *Pseudomonas sp* and *Bacillus species*. However a wide range of other genera of bacteria were found and these include: *Enterobacter*, *Serratia*, *Alcaligene*, *Micrococcus*, *Arthrobacter*, *Citrobacter*, *Proteus*, *Enterobacter*, *Klebsiella*, *Streptococcus fecalis* and *Escherichia coli*. The presence of *Escherichia coli* indicates the presence of fecal contamination in some of the soil sampled (SS4, SS6 and SS9). *Streptococcus fecalis* was found in Soil sample SS9. Also the most predominant Heterotrophic Fungi genera encountered in the area is *Rhizopus* and *Aspergillus*. Other genera present include *Geotrichum, Candida, Penicillium, Cladosporium, Rhodotorula, Cuvularia, Mucor* and *Trichoderma*.

Majority of the soil samples analyzed especially the surface soil recorded relatively high concentrations of total heterotrophic Bacteria (THB). The corresponding hydrocarbon utilizing bacterial counts (HUB) were however low, same is applicable to hydrocarbon utilizing fungal counts (HUF).

A lower concentration of hydrocarbon utilising bacterial (HUB) species is a clear evidence of insignificant concentrations of hydrocarbons in majority of the soil samples. Also, the load of the hydrocarbon utilizing fungi (HUF) was however low suggesting no hydrocarbon contamination of the study area. The heterotrophic microbial load is suggestive of relatively high amount of biodegradable organic matter in the soil of the study area. The hydrocarbon utilizing bacteria genera isolated in the area *include Bacillus, Pseudomonas, Micrococcus* and *Alcaligene* while the hydrocarbon utilizing fungi genera include *Rhizopus, Mucor* and *Candida*.

4.9. Protected Area

The International Union for the Conservation of Nature (IUCN) defines a protected area as "An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources and managed through legal or other effective means".

Protected areas are special places which are established and designated for the protection of important cultural or natural values, Kuiper (1997). They have always been part of human culture and from the beginning of time people have associatedrtain places with special values and protected them from disturbance or exploitation. These include religious, spiritual and cultural places; in recent years, parks and natural areas have been added.

Table 4.28: Protected Areas in Ogun State

S/N	Name	Location	Total Area	Established Year	Purpose	Remarks
1.	Omo F/R Area J1 & J3 , Area J4, Area J6 & Ak, 16 Enclaves	Ijebu East and Ijebu North Local Government	1305.5 kmsq, 519.3kmsq, 565.8kmsq, 220.4kmsq 65kmsq	1925	Eco- Tourism, Biodiversity conservation .	Productive
2.	Olokemeji Forestry Reserve	Odeda LG (Olokemeji)	58.88kmsq	1916	Set aside for preservation or controlled use	Degraded
3.	Arakanga Forestry Reserve	Odeda LG (Olokemeji)	2.39kmsq	1945	Set aside for Preservation or Controlled use, Protective	Protective
4.	Ilaro Forestry Reserve	Yewa South LG (Ipake)	46.08kmsq	1953	Set aside for preservation or controlled use	Degraded

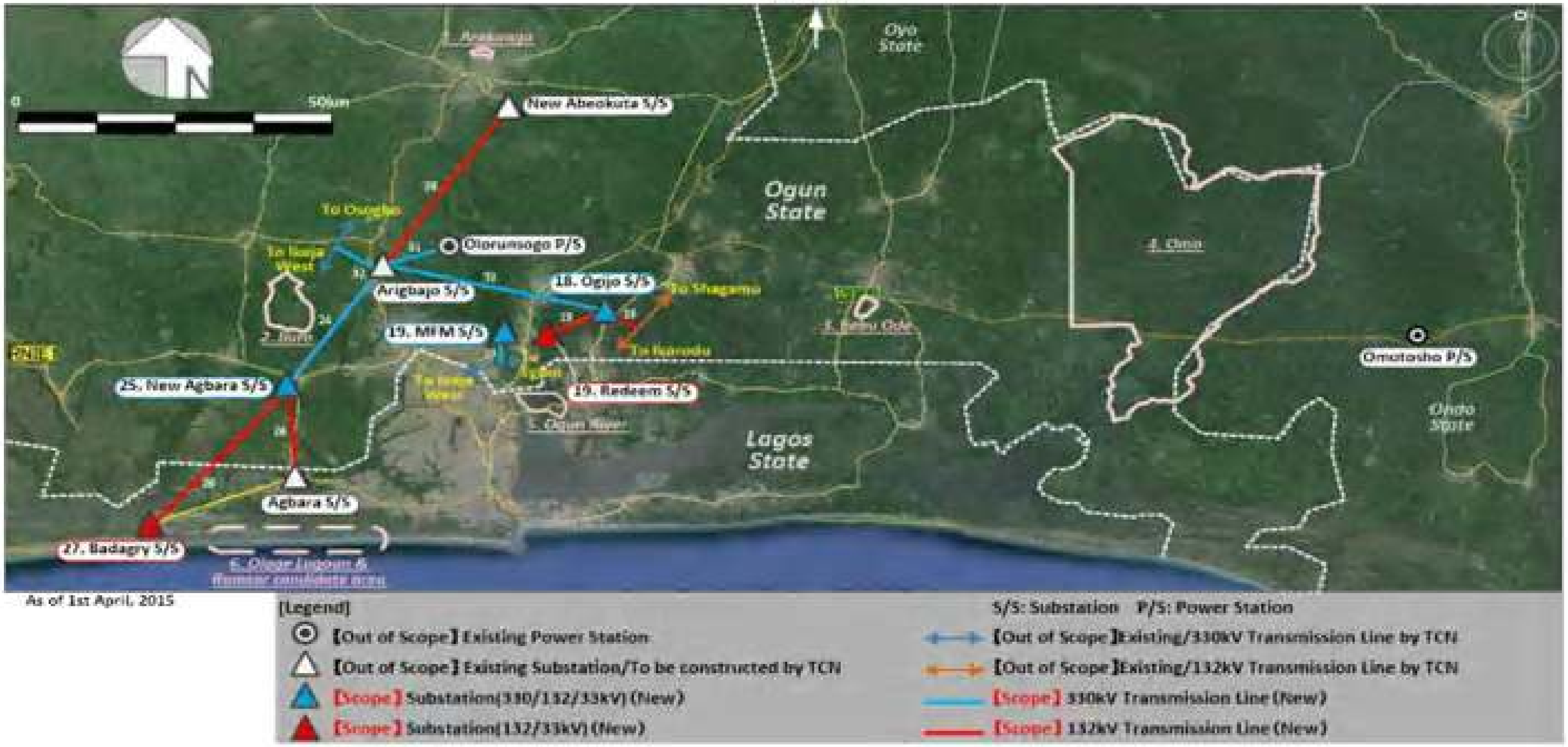
S/N	Name	Location	Total Area	Established Year	Purpose	Remarks
5.	Edun Stram Forestry Reserve	Yewa South LG (Ilaro)	0.97kmsq	1953	Protective because they protect and conserve the water bodies of Ilaro, Ogun river and Edun stream from drying up and also prevent the host communities from natural disasters like flooding".	Protective
6.	Eggua Forestry Reserve	Yewa North LG (Eggua)	41.47kmsq	1937	Set aside for preservation or controlled use	Degraded
7.	Aworo Forestry Reserve	Yewa North LG (Aworo)	212.99kmsq	1936	Set aside for preservation or controlled use	Degraded
8.	Imeko Game Reserve	Imeko-Afon LG	954.88kmsq	1933	Set aside for preservation or controlled use	Degraded
9.	Ohumbe Forestry Reserve	Yewa North LG (Oja Odan)	46.08kmsq	1936	Set aside for preservation or controlled use	Degraded

Degraded forest: a forest which the biological wealth is permanently diminished by some factor or by a combination of factors. "This does not involve a reduction of the forest area, but rather a quality decrease in its condition."The forest is still there, but with less number of trees, or less species of trees, plants or animals, or some of them affected by plagues. This degradation makes the forest less valuable and may lead to deforestation.

Productive forest: An area of forest capable of producing wood for more than a certain predicted amount, e.g. the increment volume is more than 1 m^3/ha/year in the foreseeable future.

Protection forest: a forest whose value lies in the regulating of stream flow and the preventing of erosion and avalanches rather than in its timber.

There are no protected areas within the zone of influence of the proposed project. The protected areas in Ogun State is shown in Figure 4.24. The closest protected area are the Arakanga Nature Reserve (7^0 10'60"N, $3^0$21' 0"E) located in Logbara which is about about 89km from New Abeokuta Substation and Omo forest Reserve ($7^0$0'0"N, $4^0$15'0"E) which is about 185km from the project area.



Location Map of the Project Site

Figure 4.24: Map showing location of protected area close to the project area.

4.10. Biodiversity

Biological diversity or biodiversity simply means the resources upon which individuals, families, communities, nations and future generations depend. It is the link between all organisms on earth, binding each into an interdependent ecosystem in which all species have their role. It is the web of life.

4.10.1. Terrestrial Biodiversity

Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The requirements set out in this Performance Standard have been guided by the Convention on Biological Diversity, which defines biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems." . Biodiversity provides ecosystem services, thus ecosystem services are the benefits that people and the environment, derive from ecosystems. The services are organized into four types: (i) provisioning services, which are the products people obtain from ecosystems (ii) regulating services, which are the benefits people obtain from the regulation of ecosystem processes (iii) cultural services, which are the nonmaterial benefits people obtain from ecosystems; and (iv) support services, which are the natural processes that maintain the other services. Ecosystem services valued by humans are often underpinned by biodiversity. Impacts on biodiversity can therefore often adversely affect the delivery of ecosystem services. This Performance Standard addresses how clients can sustainably manage and mitigate impacts on biodiversity and ecosystem services throughout the project's lifecycle.
The objectives of this biodiversity study are to:

- identify biodiversity resources in the study area,
- identify the benefits from biodiversity,
- Determine the ecosystem services of the biodiversity and ensure sustainable management of the resources through appropriate conservation measures.

Most of the detailed biodiversity inventories in Nigeria are held as propriety rights of multinational oil companies who often conduct such exercises as a pre requisite for their operations. However, private recording is a new and a fascinating trend. This is owed largely to greater awareness, economy liberalization, threat of changing climatic regimes and enforcement of the ESIA act and its various instruments. The availability of biodiversity data in most regions is poor. The few that exist are mainly ESIA reports of telecommunication firms and quarrying operation. And these include *Bridelia ferruginea, Cadaba grandulosa, Cola cordyla, Cordia stuhlmannii, Detarium microcarpum, Diospyros mespilliformis* and *Erythrophleum africanum* plant species, and *Osteolaemus tetraspis, Agama agama, Alligator sinensis, Civettictis civetta, Rattu rattus, Helioscius rufobrachium* and *Potamochoerus porcus* fauna species were constantly mentioned in the reports of the reviewed ESIAs.

4.10.2. Flora study

4.10.2.1. *Methodology*

Vegetation sampling

This involved site selection, samples collection, and data analyses.

Site Description

Location and Area Descriptions

The focal area of interest, termed the Terrestrial Biodiversity Study Area (called 'Study Area') of about ten (10) plots (25m x 25m) was established. Each of the ten plots was considered as a sampling point. Also, three (3) sections were obtained from the plots based on the communities that fall within sections (Table 4.29).

Table 4.29: Sections and Communities within the Study Areas

SN	SECTIONS	COMMUNITIES
1	Ejio-Soju-olu	Soju-olu, Ejio.
2	Ejio-Olorunsogo	Ejio, Akinlagun, Sowunmi, Ogunmola, Ikereku.
3	Ejio- Abeokuta	Adubi-Aro, Ijumo, Opanigangan, Ogun-River Bank, Oluke-Orile, New Abeokuta sub-station.

Source: GCNL Field Work, 2017

Characterization Method

A combination of field surveys and desktop assessments was used to characterize the biodiversity resources present in the Study Area.

Survey Timing

Detailed biodiversity study was conducted from 18th to 22nd December, 2017.

Plate 4.13: Biodiversity sampling activities at the study location.

Sampling site: Ten sampling points were delineated using plant species physiognomic conditions and habitat types. Table 4.30 presents the sampling sites and their coordinates.

Sampling Size: An average of 625m^2 was adopted as sampling size per sampling point. This resulted in a total sampled area of 6250m^2.

Sampling Team: The team comprises plant taxonomist/ecologist and an assistant and an animal ecologist.

Sampling Parameters and Methods (Flora)

Floristic data were collected from randomly selected (10) – 25m x 25m sample plots from Ejio-Soju-olu section, Ejio-Olorunsogo section and Ejio-Abeokuta section. However, the following communities were involved from the three sections viz: Sojuolu, Oluke Orile, Ejio, Akinlagun, Sowunmi, Ogun River bank, Olorunsogo and New Abeokuta station in Ogun State to cover some portions of the area under consideration. However, these plots were further investigated with 1m by 1m plot at specified points under Tropical Biome in Transition (TROBIT) protocol as transects within the plots for a thorough investigation of understorey species.

Data collected comprise all trees and shrubs greater than 5cm diameter at breast height (dbh) and ground flora data. The dbh of the trees were measured and regeneration of the species determined through understorey species composition. Most of the species for this report were identified in the field. Unknown species were collected, pressed and preserved for identification at Forestry Research Institute of Nigeria (FRIN), Ibadan. Furthermore, botanical exploration was carried out for collection and listing of plant species not encountered within the sampled plots. Literature and herbaria were consulted for species already listed for the area.

Table 4.30: Sampling Sites, Locations and their coordinates

Sampling plot ID	Latitude (N)	Longitude (E)	Location	Habitat feature
EA2711Veg.1 (common corridor)	6.85062 – 6.84421	3.20651 – 3.21697	Ejio	Fallow land
EA2811Veg.2 (common corridor)	6.84569-6.82116	3.16911 - 3.14647	Sojuolu	Fallow land
B17/02 VEG.2	6.931361°	3.247639°	Oluke Orile	Abandoned Farmland
C17/03 VEG. 3	6.846583°	3.215250°	Ijumo	Fallow Land
D17/04 VEG.4	6.951631°	3.260431°	Adubi Aro	Farm land
E17/05 VEG.5	6.867056°	3.246667°	Opanigangan	Fallow land @Ogun river bank
F17/06 VEG. 6	6.874972°	3.288972°	New Abeokuta Substation	Abandoned Quarry
G17/07 VEG.7	6.882794°	3.303481°	Iludun Ejio	Fallow land
H17/08 VEG.8	7.002492°	3.302022°	Sowunmi	Grazing land
I17/09 VEG. 9	7.049528°	3.343861°	Ogunmola	Mining (Quarry)
J17/10 VEG.10	7.105472°	3.388244°	Ikereku	Fallowland
K17/11 VEG. 11	6.905811°	3.241953°	Adubiaro	Close to Wagunnu river bank

Source: GCNL Field Work, 2017

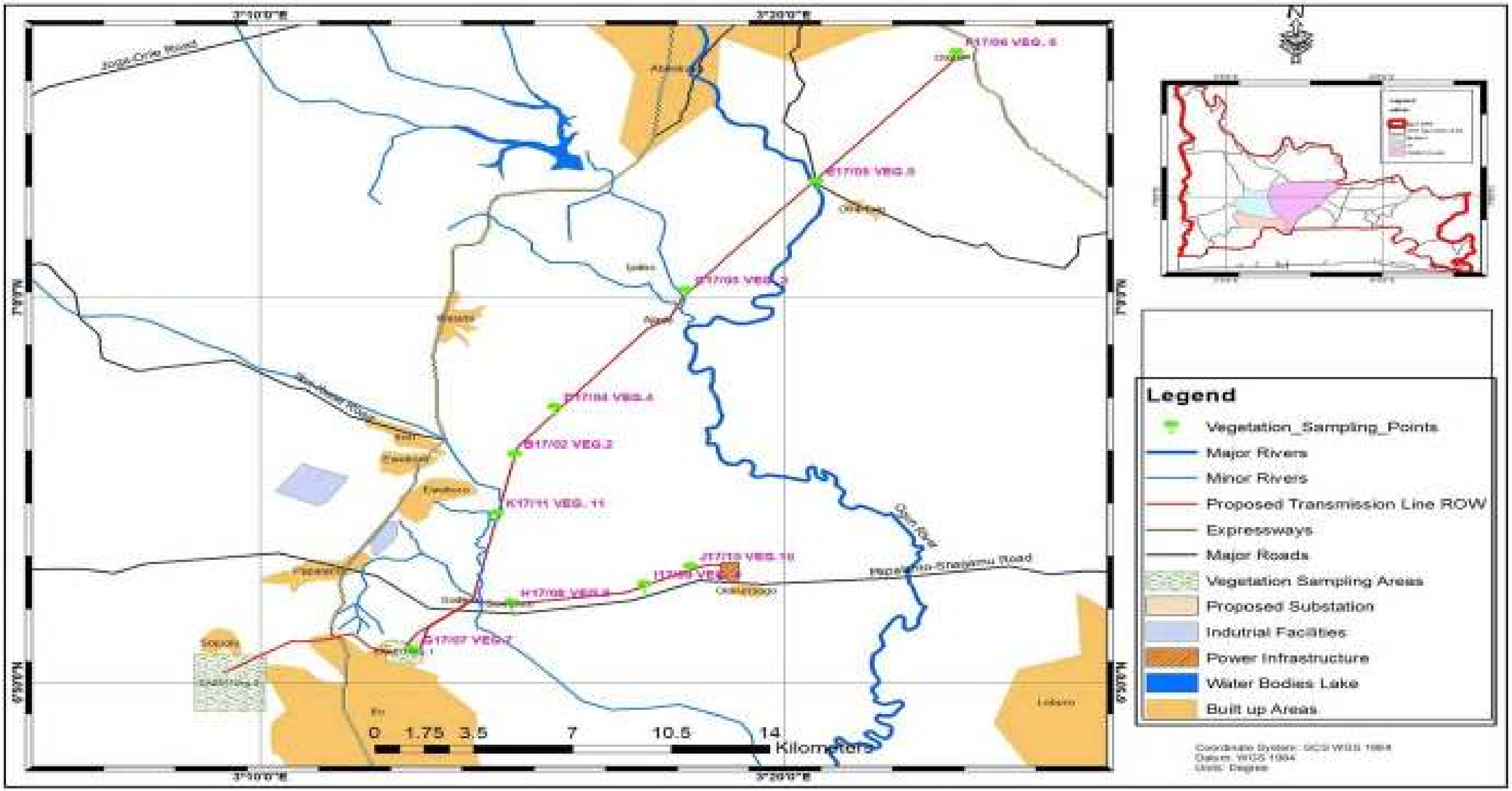


Figure 4.25: Vegetation sampling location map

4.10.2.2. *Habitat Description*

The survey of the site revealed that the area shows partial degradation resulting from human activities. These activities range from housing, firewood collection and farming. Each of these activities conferred different outlook on the ranges where they were carried out. Therefore, closer look of the profiles of the vegetation of the area showed that the site can be stratified into the following:

1. Grassland
2. Degraded forestland
3. Riparian forest
4. Secondary forest regrowth
5. Farmland

Grassland

Human activities have cleared reasonable portion of the land area in Ejio-Olorunsogo section of the sampling points showing significant human influence and forest degradation of the areas. This is suspected to be a deliberate action carried out to improve economic activities and consequently the welfare of the local population in the area. This has attracted population influx into the areas with increasing human activities to degrade the vegetation through infrastructure provision to accommodate man and materials (Akobundu and Agyakwa, 1998). Therefore, the grassland form major expanse of land in Ejio-Olorunsogo section.

Plate 4.14: Grassland with *Imperata cylindrica* (Ejio community)

Plate 4.15: Grasslandwith *Sporobolus pyramidalis* (Abese community)

Major portions of the sampling points with human activities were converted to grassland. Hence large areas were visible to the eyes at a time. The area is dominated by annual and mostly perennial grasses that are renewed annually through human disturbance of land clearing for human use. However, *Albizia zygia* was a dominant understorey tree species in those areas. A checklist of species observed in these location were; *Andropogon gayanus, Centrosema pubescens, Cyperus rotundata, Eleusine indica, Imperata cylindrica, Aspilia Africana*

Plate 4.16: Grassland with *Panicum Maximum* (Soderu community)

Plate 4.17: Vast expanse of grassland of mixed species (Akinlagun community)

Degraded forestland

These are areas where housing and other human activities have pierced forest vegetation. It was noticed that those areas were either covered by patches of shrubs, grasses and creepers that were suspected to have evolved through succession with the intention of returning the vegetation to its climax form. This area was found in sampling points J17/10 veg.10, B17/02 veg.2 and C17/03 veg.3. The profile in this area appears with mostly understorey shrubs and herbs. They include; *Aspilia africana, Calopogonium mucunoides, Centosema pubescenss, Chromolaena odorata, Crotallaria refusa, Sida acuta, Alchornea cordifolia, Newbouldia laevis, Annona senegalensis.* High population of these plants are a reflection of dispersal agents and ability to out compete and suppress weeds. (Rodder et al., 1995, Ikuenobe and Anoliefo, 2003)

Riparian forest

This exists in A17/01 veg.1 in Oluke Orile and D17/04 veg.4 with high water table. The forest exists on river bank and wetland with partial degradation through human activities for example housing and farming but presently a larger percentage of the forest approaches climax vegetation under succession. There were palm species (*Elaeis guineensis*) in the location linking suspicion with human activities. *Mangifera indica of* varying dbh sizes were observed in the location. The riparian forest does not display a clear vegetation structure but with dominant woody species such as *Elaeis guineensis, Raphia hookeri, Alstonia boonei, Lepanodiscus cupanoides, Ceiba pentandra* and *Anthocleista vogelii*, The presence of these tree species in nearly all the locations may indicate their wider range of ecological adaptation (Senbeta, 2005, Oladoye *et. al.*, 2014), with herbs of *Asteraceae, Euphorbiaceae, Malvaceae, Fabaceae* as undergrowth thus the claim that the area may be under succession. This vegetation covers large expanse of land in D17/04 veg.4. This area had undulating land terrain with valley more conspicuous in the area. Furthermore, there were water troughs with aquatic plants such as *Nymphaea lotus, Ludwigia abyssinica* and *Pteridium aquilinum.*

Also, there were colonies of Bamboo in J17/10 veg.10 well pronounced indicating riparian forest as well as few colonies in D17/04 veg.4.

Plate 4.18: Riparian forest with high water table (Oluke-Orile community)

Plate 4.19: Riparian forest with diverse flora (Adubiaro community)

Farmland

Nearly all the locations visited from A17/01 veg.1, B17/02 veg.2 and D17/04 veg.4 and others recorded farmland. Almost 65% of the area around location G17/07 veg.7 was farmed with crops such as cassava, groundnut, cocoyam, pineapple, banana and plantain with relics of riparian forest in a section of the location. In other areas the percentage of land cultivated varies but ranges from 10 - 25%. Locations such as H17/08 veg.8, J17/10 veg.10 and others had been cultivated before and were still under cultivation with visible farms. Such areas harbour economic fruit trees determined by farmers choice or abandoned farmland under succession recovering from slash and burn agriculture. Thus, well noticed agricultural crops on the land were cassava, plantain, cocoyam, groundnut, banana, plantain, garden egg, okra and leafy vegetables with few economic trees – Oil palm trees and Guava (Plate 4.20 and 4.21).

Plate 4.20: Farmland with mixed crops (Iludun Ejio community)

Plate 4.21: Farmland with cassava only (Abese community)

4.10.2.3. Land Use

A summary of land use in the locations is presented in Table 4.31. The land use pattern shows more of secondary forest, cultivated area and fallow land. Cultivated area accounted for 76,233.8 m^2, 169,660.0m^2 and 120,390.0m^2 of land use in Ejio to Sojuolu section, Ejio to Olorunsogo section and Ejio to New Abeokuta section respectively while fallow land accounted for 42,296.1m^2, 168,051.0m^2 and 207,145.0m^2 respectively, secondary forest accounted for 144,356.6m^2, 102,114.4m^2 and 102,114.4m^2 respectively. Ejio to Sojuolu had the highest builtup area 32,717.1m^2 while primary forest was not in any of the section as the forest in the project area are all degraded or secondary forest.

Table 4.31: land use of project area

Land use type	Affected area within ROW (square metre)		
	Ejio-Sojuolu Route	Ejio – Olorunsogo Route	Ejio – New Abeokuta Route
Primary Forest	0.0	0.0	0.0
Secondary Forest	144,356.6	102,114.4	102,114.4
Marshy Area	8,052.6	1,178.7	12,890.7
Riparian Vegetation	2,472.6	1,031.1	14,067.1
Waterbody	0.0	1,143.6	2,607.2
Cultivated Area	76,233.8	169,660.0	120,390.0
Fallow Land	42,296.1	168,051.0	207,145.0
Builtup Area	32,717.1	6,755.9	8,257.9
Plantations	8,625.2	64,419.3	44,802.3
Others	34,831.2	104,462.0	43,676.6

Source: GCNL, 2017

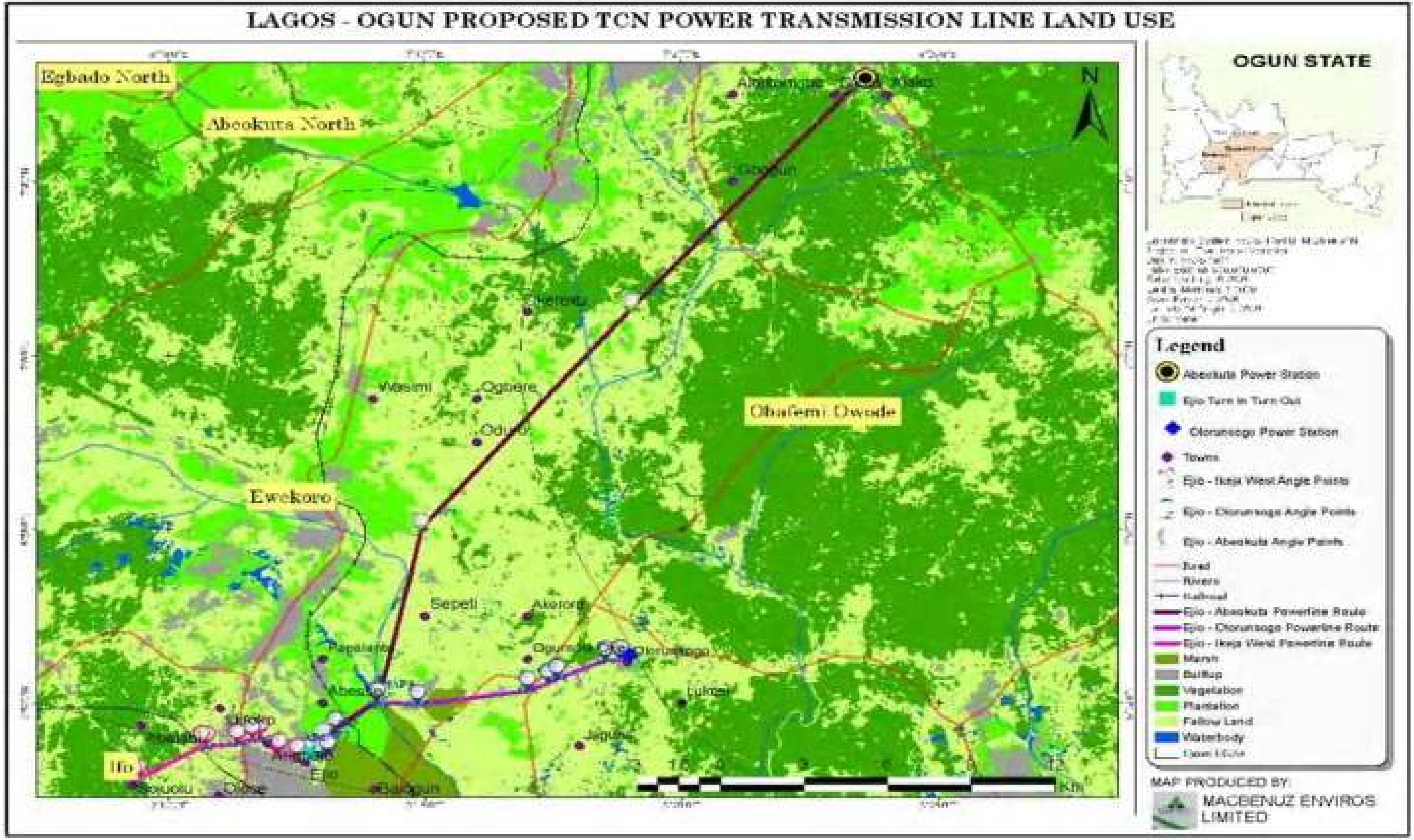


Figure 4.26: Land Use map of project area

4.10.2.4. *Species composition*

A total of twenty-three (23) tree species and eighty-three (83) understorey species belonging to 15 and 43 taxonomic families (Table 4.32) the floristic composition of the locations is similar to findings of Anning *et al*., 2008, Addo-Fordjour *et al*., 2009

Table 4.32: Checklists of flora species in the study locations

SPECIES	Local name	Form	Family
Luffa cylindrica	Kankan-ayaba	Climber	Cucurbitaceae
Centrocema pubscens	Ewa-ahun	Climber	Papilionaceae
Pteridium aquilinum		Grass	Aspidiaceae
Cyperus spp	Imumu	Grass	Cyperaceae
Bambusa vulgaris	Oparun	Grass	Poaceae
Imperata cylindrica	Ekan	Grass	Poaceae
Sporobolus pyramidalis		Grass	Poaceae
Eragrostis tenuifolia	Agbado-esin	Grass	Poaceae
Cynodon plectostachyus		Grass	Poaceae
Panicum maximum	Eesun	Grass	Poaceae
Pennisetum purpurem	Eesu	Grass	Poaceae
Colocasia esculenta	Isu-koko	Herb	Araceae
Tridax procumbens	Igbalode	Herb	Asteraceae
Struchium sparganophora	Ewuro-odo	Herb	Asteraceae
Carica papaya	Ibepe	Herb	Caricaceae
Commelina bengalensis	Gbagodo	Herb	Commelinaceae
Commelina nudiflora		Herb	Commelinaceae
Commelina diffusa	Itopere	Herb	Commelinaceae
Telfaria occidentalis	Aworoko	Herb	Cucurbitaceae
Phyllantus amarus	Eyinolobe	Herb	Euphorbiaceae
Arachis hypogaea	Epa	Herb	Fabaceae
Mimosa pudica	Patanmo	Herb	Fabaceae
Mucuna pruriens	Yerepe	Herb	Fabaceae
Pueraria phaseoloides		Herb	Fabaceae
Desmodium gangeticum	Eemo-agbo	Herb	Fabaceae
Cassia occidentalis	Rere	Herb	Fabaceae
Corchorus olitorius	Ewedu	Herb	Malvaceae
Sida acuta	Isekutu	Herb	Malvaceae
Urena lobata	Okeriri	Herb	Malvaceae
Thaumatococcus daniellii	Ewe-iran	Herb	Marantaceae

Musa paradisiaca	Ogede agbagba	Herb	Musaceae
Musa sapientum	Ogede Omini	Herb	Musaceae
Boerhavia diffusa	Etiponla	Herb	Nyctaginaceae
Nmphaea lotus	Osibata	Herb	Nympheaceae
Parquetina nigrescens	Ogbo	Shrub	Ascelpiadaceae
Chromolaena odorata	Akintola	Shrub	Asteraceae
Cnestis ferruginea	Omu-aja	Shrub	Connaraceae
Ipomea batata	Anamo	Shrub	Convolvulaceae
Ipomea involculata	Ododo-oko	Shrub	Convolvulaceae
Alchornia cordifolia	Ipa	Shrub	Euphorbiaceae
Jathropha curcas	Lapalapa funfun	Shrub	Euphorbiaceae
Manihot esculentum	Gbaguda	Shrub	Euphorbiaceae
Caesalpinia bonduc	Ayo	Shrub	Fabaceae
Lonchocarpus cyanescens	Elekiriti	Shrub	Fabaceae
Sesbania pachycarpa	Senifiran	Shrub	Fabaceae
Walteria indica	Korikodi	Shrub	Malvaceae
Sphenocentrum jollyanum	Akerejupon	Shrub	Menispermaceae
Ficus exaperata	Ipin	Shrub	Moraceae
Phyllanthus reticulatus	Iranje	Shrub	Phyllantaceae
Smilax anceps		Shrub	Smilacaceae
Solanum incanum	Igba	Shrub	Solanaceae
Glypheae brevis	Atori	Shrub	Tiliaceae
Anacardium occidentalis	Kaju	Tree	Anacardiceae
Lannea spp	Ekudan	Tree	Anacardiceae
Annona senegalensis	Abo	Tree	Annonaceae
Uvaria chamae	Eruju	Tree	Annonaceae
Funtumia elastica	Ire	Tree	Apocynaceae
Aspilia africana	Yunriyun	Tree	Asteraceae
Newboldia laevis	Akoko	Tree	Bignoniaceae
Ceiba pentandra	Araba	Tree	Bombacaceae
Anogeissus leiocarpus	Ayin	Tree	Combretaceae
Dracaena mannii	Peregun	Tree	Dracaenaceae
Uapaca togensis	Ipe	Tree	Euphorbiaceae
Acacia spp	Aluki	Tree	Fabaceae
Delonix regia	Sekeseke	Tree	Fabaceae
Senna fistula	Aidan toro	Tree	Fabaceae
Anthocleista vogelii	Apara	Tree	Loganiaceae
Albizia ferruginea	Ayinreta	Tree	Mimosaceae
Albizia zygia	Ayinre-weere	Tree	Mimosaceae
Psidium guajava	Guofa	Tree	Myrtaceae

Olax subscorpioidea	Ifon	Tree	Olacaceae
Elaeis guineensis	Ope	Tree	Palmae
Lecaniodiscus cupanioides	Akika	Tree	Sapindaceae
Sterculia oblongata	Orodo	Tree	Sterculiaceae
Trema orientalis	Afere	Tree	Ulmaceae
Vitex doniana	Oori	Tree	Verbanaceae
Malacantaalnifolia	Akala	Tree	Sterculiaceae
Magnifera indica	Mongoro	Tree	Anacardiaceae
Spondias mombin	Iyeye	Tree	Anacardiaceae
Annona senegalensis	Abo	Tree	Annonaceae
Alstonia boonei	Awin	Tree	Apocynaceae
Ceiba petandra	Araba	Tree	Bombacaceae
Terminalia ivorensis	Afara dudu	Tree	Combretaceae
Diospyros spp	Igi dudu	Tree	Ebanaceae
Alchornia cordifolia	Ipa	Tree	Euphorbiaceae
Upaca togoensis	Ipe	Tree	Euphorbiaceae
Delonix regia	Sekeseke	Tree	Fabaceae
Senna fistula	Aidan toro	Tree	Fabaceae
Anthocleista vogelli	Apa-oro	Tree	Loganiaceae
Albizia ferruginea	Ayinreta	Tree	Mimosaceae
Albizia zygia	Ayinre-weere	Tree	Mimosaceae
Ficus sur	Opoto	Tree	Moraceae
Elaeis guineensis	Ope	Tree	Palmae
Raphia hookeri	Oguro	Tree	Palmae
Nauclea latifolia	Egbesi	Tree	Rubiaceae
Cola gigantea	Oporoporo	Tree	Sterculiaceae
Sterculia oblongata	Orodo	Tree	Sterculiaceae
Sterculia tragacantha	Alawefon	Tree	Sterculiaceae
Holoptelea grandis	Ayoo	Tree	Ulmaceae

Source: GCNL Field Work, 2017

4.10.2.5.*Species Richness*

Species richness in each of the location is presented in Table 4.33. Number of species per study site ranged from 1-11 species for trees and 12-28 species for understorey.

Table 4.33: Species Richness and number of Plants per Location

Sampled Section	Species Richness	Location	UNDERSTOREY		TREE	
			No of Species	NO/PLOT	No of Species	NO/PLOT
Section 1	45	G17/7 veg.7	16	926	1	1
		H17/8 veg.8	14	842	3	19
		I17/9 veg.9	10	685	11	50

		J17/10 veg.10	15	2226	5	12
Section 2	69	A17/1 veg.1	28	1549	2	3
		B17/2 veg.2	19	1175	4	6
		C17/3 veg.3	14	318	4	30
		D17/4 veg.4	10	172	3	10
Section 3	79	E17/5 veg.5	13	373	2	4
		F17/6 veg.6	24	1105	5	12
		K17/11 veg.11	16	267		

4.10.2.6.Species Density

Density is the number of species per given area. Densities of plants per unit area are useful for taking decision in forest management. The result showed that density/ha ranged from 1.6/ha to 60.8/ha and 0.06/ha to 139.16/ha for trees and understorey respectively. The result showed that species density/ha was lower this is a reflection of anthropogenic activities in those area. The estimated number of trees expected to be removed from the TLROW is 39,041

Table 4.34: Checklist of Tree Species in the study locations

Species	Family	DENSITY	RIV
Albizia ferruginea	Mimosaceae	11.2	4.49
Albizia zygia	Mimosaceae	14.4	5.84
Alchornia cordifolia	Euphorbiaceae	1.6	1.08
Alstonia boonei	Apocynaceae	1.6	1.08
Annona senegalensis	Annonaceae	4.8	1.54
Anthocleista vogelli	Loganiaceae	60.8	31.62
Ceiba petandra	Bombacaceae	3.2	1.31
Delonix regia	Fabaceae	20.8	6.02
Diospyros	Ebanaceae	1.6	1.08
Elaeis guineensis	Palmae	6.4	9.51
Ficus sur	Moraceae	43.2	14.95
Cola gigantean	Sterculiaceae	6.4	1.77
Holoptelea grandis	Ulmaceae	1.6	1.08
Magnifera indica	Anacardiaceae	12.8	3.65
Nauclea latifolia	Rubiaceae	4.8	1.54
Raphia hookeri	Palmae	3.2	1.31
Senna fistula	Fabaceae	19.2	3.82
Spondias mombin	Anacardiaceae	1.6	1.08
Sterculia oblongata	Sterculiaceae	1.6	1.08
Sterculia tragacantha	Sterculiaceae	4.8	2.41
Terminalia ivorensis	Combretaceae	6.4	2.63
Upaca togoensis	Euphorbiaceae	1.6	1.08
Total		233.6	100

Source: GCNL Field Work, 2017

Table 4.35: Checklists of understory Species in the study locations

SPECIES	Life Form	Family	TOTAL	DENSITY	RIV
Acacia spp	Tree	Fabaceae	12	0.75	0.34
Albizia ferruginea	Tree	Mimosaceae	3	0.19	0.57
Albizia zygia	Tree	Mimosaceae	13	0.81	0.35
Alchornia cordifolia	Shrub	Euphorbiaceae	728	45.53	4.89
Anacardium occidentalis	Tree	Anacardiceae	3	0.19	0.29
Annona senegalensis	Tree	Annonaceae	25	1.56	0.96
Anogeissus leiocarpus	Tree	Combretaceae	1	0.06	0.28
Anthocleista vogelii	Tree	Loganiaceae	27	1.69	1.53
Arachis hypogaea	Herb	Fabaceae	8	0.50	0.32
Aspilia Africana	Tree	Asteraceae	570	35.65	4.35
Bambusa vulgaris	Grass	Poaceae	405	25.33	2.38
Boerhavia diffusa	Herb	Nyctaginaceae	12	0.75	0.34
Caesalpinia bonduc	Shrub	Fabaceae	2	0.13	0.29
Carica papaya	Herb	Caricaceae	4	0.25	0.30
Ceiba pentandra	Tree	Bombacaceae	2	0.13	0.29
Centrocema pubscens	Climber	Papilionaceae	32	2.00	0.72
Chromolaena odorata	Shrub	Asteraceae	2225	139.16	14.32
Cnestis ferruginea	Shrub	Connaraceae	46	2.88	1.63
Corchorus olitorius	Herb	Malvaceae	4	0.25	0.30
Commelina bengalensis	Herb	Commelinaceae	15	0.94	0.36
Commelina nudiflora	Herb	Commelinaceae	120	7.51	0.90
Delonix regia	Tree	Fabaceae	4	0.25	0.30
Elaeis guineensis	Tree	Palmae	32	2.00	1.83
Ficus exaperata	Shrub	Moraceae	38	2.38	1.03
Imperata cylindrical	Grass	Poaceae	1080	67.55	6.99
Ipomea batata	Shrub	Convolvulaceae	3	0.19	0.29
Ipomea involculata	Shrub	Convolvulaceae	1	0.06	0.28
Jathropha curcas	Shrub	Euphorbiaceae	4	0.25	0.30
Lannea spp	Tree	Anacardiceae	5	0.31	0.30
Lonchocarpus cyanescens	Shrub	Fabaceae	4	0.25	0.30
Malacanta alnifolia	Tree	Sterculiaceae	12	0.75	0.62
Manihot esculentum	Shrub	Euphorbiaceae	600	37.53	4.22
Mimosa pudica	Herb	Fabaceae	10	0.63	0.33
Mucuna pruriens	Herb	Fabaceae	2	0.13	0.29
Musa paradisiaca	Herb	Musaceae	2	0.13	0.29
Musa sapientum	Herb	Musaceae	1	0.06	0.28
Newboldia laevis	Tree	Bignoniaceae	14	0.88	1.46
Nmphaea lotus	Herb	Nympheaceae	65	4.07	0.61

Olax subscorpioidea	Tree	Olacaceae	28	1.75	1.53
Parquetina nigrescens	Shrub	Ascelpiadaceae	4	0.25	0.58
Phyllantus amarus	Herb	Euphorbiaceae	2	0.13	0.29
Psidium guajava	Tree	Myrtaceae	6	0.38	0.59
Pueraria phaseoloides	Herb	Fabaceae	177	11.07	1.75
Cyperus spp	Grass	Cyperaceae	55	3.44	1.12
Senna fistula	Tree	Fabaceae	6	0.38	0.31
Sida acuta	Herb	Malvaceae	438	27.39	4.77
Smilax anceps	Shrub	Smilacaceae	13	0.81	1.46
sphenocentrum jollyanum	Shrub	Menispermaceae	40	2.50	0.49
Sporobolus pyramidalis	Grass	Poaceae	125	7.82	1.48
Sterculia oblongata	Tree	Sterculiaceae	17	1.06	0.92
Telfaria spp	Herb	Cucurbitaceae	3	0.19	0.29
Thaumatococcus danielii	Herb	Marantaceae	150	9.38	1.06
Trema orientalis	Tree	Ulmaceae	4	0.25	0.30
Tridax procumbens	Herb	Asteraceae	410	25.64	2.96
Uapaca togensis	Tree	Euphorbiaceae	1	0.06	0.28
Vitex doniana	Tree	Verbanaceae	14	0.88	0.63
Walteria indica	Shrub	Malvaceae	17	1.06	0.92
Urena lobata	Herb	Malvaceae	56	3.50	1.68
Sesbania pachycarpa	Shrub	Fabaceae	4	0.25	0.30
Colocasia esculenta	Herb	Araceae	24	1.50	0.96
Phyllanthus reticulatus	Shrub	Phyllantaceae	18	1.13	0.93
Desmodium gangeticum	Herb	Fabaceae	25	1.56	0.41
Eragrostis tenuifolia	Grass	Poaceae	15	0.94	0.36
Fern	Grass	Aspidiaceae	756	47.28	4.48
Dracaena mannii	Tree	Dracaenaceae	1	0.06	0.28
Solanum incanum	Shrub	Solanaceae	5	0.31	0.30
Commelina diffusa	Herb	Commelinaceae	100	6.25	0.80
Cassia occidentalis	Herb	Fabaceae	5	0.31	0.30
Cynodon plectostachyus	Grass	Poaceae	150	9.38	1.06
Glypheea brevis	Shrub	Tiliaceae	1	0.06	0.28
Panicum maximum	Grass	Poaceae	260	16.26	1.90
Funtumia elastic	Tree	Apocynaceae	13	0.81	1.18
Uvaria chamae	Tree	Annonaceae	5	0.31	0.30
Luffa cylindrical	Climber	Cucurbitaceae	15	0.94	0.36
Pennisetum purpurem	Grass	Poaceae	500	31.27	2.87
Struchium sparganophora	Herb	Asteraceae	30	1.88	0.43
Lecaniodiscus cupanioides	Tree	Sapindaceae	5	0.31	0.30

4.10.2.7.Species Diversity

Species diversity reveals how diverse in term of species availability of a habitat. Shannon index equitability was computed for each of the location. Result as shown in (Table 4.36) indicated that I17/09 veg.9 recorded highest diversity (1.65) and equitability (0.69) for trees and understorey diversity ranged from 0.99 – 2.20 and equitability ranged from 0.43 – 0.71

Table 4.36: Diversity Indices per sampled Location

Locations	Sampling ID	Understorey		Tree	
Ejio- Soju-olu		Shannon_H	Equitability_J	Shannon_H	Equitability_J
	A17/01 veg.1	2.20	0.66	0.64	0.92
	B17/02 veg.2	1.75	0.60	1.33	0.96
	G17/07 veg.7	1.45	0.52	0.00	0.00
Ejio-Olorunsogo	H17/08 veg.8	1.19	0.45	0.77	0.70
	I17/09 veg.9	0.99	0.43	1.65	0.69
	J17/10 veg.10	1.94	0.72	1.52	0.94
	D17/04 veg.4	1.16	0.44	1.11	0.80
Ejio- Abeokuta	C17/03 veg.3	1.53	0.66	0.90	0.82
	E17/05 veg.5	1.91	0.75	0.56	0.81
	F17/06 veg.6	1.63	0.51	1.47	0.92
	K17/11 veg.11	1.21	0.44		

Source: Godirra Chemical survey, 2017

4.10.2.8. Life form of the Plants in the Area

The results revealed that tree formed the dominant life form in the study area which accounted for 48% followed by Herb (23%), Shrub (18%), Grass and Climbers accounted for 9 % and 2% respectively. Some of the tree species encountered include *Sterculia oblongata, Vitex doniana, Anthocleista vogelli, Albizia zygia, Delonix regia, Alstonia boonei*

Table 4.37: Life form of the Plants in the Location

Life Form	No of Plants	Percentage (%)
Climber	2	2
Grass	9	9
Herb	23	23
Shrub	18	18
Tree	48	48
Total	**100**	**100**

4.10.2.9.IUCN Status of the flora

IUCN Red List is set as precise criteria to evaluate and classify species in terms of high risk of global extinction. The general aim is to provide an explicit and objective framework for conservation of the species to the public and policy makers, as well as help the international community reduce activities leading to species extinction. This is because the Red lists are among the most widely used conservation tools globally.

The IUCN status of the plant resources for the studied area was evaluated using IUCN version 2017 .3 criterion. The results showed that majority of the plant species encountered do not fall to the categorization of IUCN Red lists. However, the following species (Table 4.38) were identified within the IUCN Red list classification.

Table 4.38: IUCN Status of identified plant species

Species	Life form	Family	IUCN Status
Funtumia elastica	Tree	Apocynaceae	This taxon has not yet been assessed for the IUCN Red List, but is in the Catalogue of Life
Albizia ferruginea	Tree	Mimosaceae	Vulnerable
Albizia zygia	Tree	Mimosaceae	This taxon has not yet been assessed for the IUCN Red List, but is in the Catalogue of Life
Sterculia oblongata	Tree	Sterculiaceae	This taxon has not yet been assessed for the IUCN Red List, but is in the Catalogue of Life
Terminalia ivorensis	Tree	Combretaceae	Vulnerable
Diospyros barteri	Tree	Ebanaceae	Vulnerable
Holoptelea grandis	Tree	Ulmaceae	This taxon has not yet been assessed for the IUCN Red List, but is in the Catalogue of Life

4.10.2.10. Alien and Invasive species

Alien species are plant resources that are accidentally introduced into an area while invasive species also known as invasive exotics or simply exotics may or may not be alien except that they may out - compete other species and establish dominance in native habitats. International Union for the Conservation of Nature (IUCN) listed about 24 plant species that are alien to Nigeria while the global invasive database listed the occurrence of 29 invasive flora in Nigeria (Borokini 2011). *Delonix regia*, and *Chromolaena odorata* were the two species censored in this study listed as alien to Nigeria while *Ficus exasperata Chromolaena odorata* and *Mimosa pudica* so listed as invasive to Nigeria was found in this study. As could be observed *Chromolaena odorata* censored in this study was listed as both alien and invasive species to Nigeria.


Plate 4.22: ***Chromoleana odoranta*** **(Invasive and Alien)** **Plate 4.23:** ***Ficus exasperata*** **(Invasive)**


Plate 4.24: ***Mimosa pudica*** **(Invasive species)** **Plate 4.25:** ***Delonix regia*** **(Alien species)**

4.10.3. Fauna Studies

The results of the fauna study are presented for each parameter (Species richness, species diversity, Species abundance, Conservation status and Ecosystem services) across the three Animalia groups of mammals, aves and reptilian.

4.10.3.1.*Sampling method*

Inventory of the site was conducted in plotless sampling points where fauna inventory was carried out. Both direct sighting, observation indices of presence and searching of hunters and farmers bag were adopted to gather information.

4.10.3.2.: *Fauna Composition*

The survey showed a total of 261 wildlife species including the mammals, birds and reptiles.

a. Insects

The result of the survey showed that out of the 8 diurnal insect species listed, the largest number was observed in Hymenoptera Order accounting for 50%. This was followed by Diptera with 37.5% and Lepidoptera with 12.7% (Table 4.26). The observed species of insect include: Spider (*Hysteroccrates laticeps*), ants (*Camponotus pennyslavanis*), Grasshopper (*Zonocerus variegatus*), (Caelifera), Wasps (*Polistes galicus*), termites (*Cryptotermes brevis*) and Butterfly (Lepidoptera).

Plate 4.26: Grasshopper (*Zonocerus variegatus*).

Table 4.39: Diurnal Insects in Study area

S/N	Order	Family	Scientific Name	Common Name
1	Hymenoptera	Apidae	*Apis millifera*	Bee
2	Diptera	Muscidae	*Musca domestica*	Housefly
3	Lepidoptera	Papilimoidae	*Macrosomana spp*	True butterfly
4	Hymenoptera	Formicidae	*Eciton burchelii*	Soldier Ant
5	Hymenoptera	Glossimidae		Ikamodu
6	Diptera	Culicidae	*Anopheles spp*	Mosquito
7	Hymenoptera	Vespidae	*Vespula germanica*	Wasp
8	Hymenoptera	Formicidae	*Solenopsis germinate*	Red Ant

Source: GCNL Field Work, 2017

b. Mammals

Mammals encountered in the project site are listed in Table 4.39. Bush bucks (5), Hare (35), Grass cutter (50), were the most abundant of all the mammals found. Other mammals found include: Mona monkey, Palm squirrel, Fruit bat, Forest Genet, but in low quantity. All the species encountered in the studies are common and are not listed in the IUCN Red list of endangered species.

c. Birds/ Aves

Birds recorded are listed in Table 4.40, they include: wood pecker, Morning dove, Cattle egret, Glossy sterlon, Senegal coucal, Village weavers. Other species include: lizard buzzard, Senegal parrot, Orange checked watbill, Senegal fire find, willow wabler. Most of these species are classified as least concerned and are not threatened by the proposed project directly. Presence of some birds was as a result of large expanse of farmland within the locations

d. Amphibians

The observed species include frog (*Afrixalus nigeriensis)* Toad (*Amitophrnus supercillaris*).

The area at present is a regenerating forest which may account for low population of animals found during the exercise. Farming , Hunting and ravaging activities of cattle and frequent collection of firewood and felling activities in the past are suspected to be major factors for inability of the wild fauna to thrive and triumph abundantly in the area. It is expected that the population of wild fauna population in the area should have increased much more than what is there at present. This is not the case because of various forms of Perturbation and Persecuting activities of people within the community on animals. If hunting had been kept at bay all this while, the area should be flourishing with abundant population of wild vertebrates, but presently, cattle grazing, farming, charcoal processing, fuel wood collection, sand and gravel quarrying, logging have delineated the animal population to the extent that hardly can animal be sighted directly except bird and other ones whose availability can be felt through indices of their presence. It was noticed that the area still harbor representative samples of rodents, small and medium-sized ungulates and carnivores as predators of primates and birds. Extensive survey of insects and other invertebrates were not carried out but biological activities of soil arthropods and worms were visibly observed. Butterfly, crickets, termites, ants and several other insect groups were also observed in the site.

Table 4.40: Fauna species in the study Locations

Common name	Scientific name	Fauna Type	IUCN Status	Frequency	Abundance
Bush Buck	*Tragelahpus scriptus*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	5	1.92
Fruit Bat	*Rousethus smithii*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	7	2.68
Red-necked Cobra	*Naja melanolenca*	Reptile	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	6	2.30
Hare	*Lepus capensis*	Mammal	Least concern	35	13.41

Mona monkey	*Cercopithecus mona*	Mammal	Least concern	4	1.53
Grass Cutter	*Thryonomis swinderianus*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	50	19.16
Palm Squarrel	*Epixerus ebii*	Mammal	Least concern	4	1.53
Forest Genet	*Genetta trigrina*	Mammal	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	4	1.53
Lizard Buzzard	*Kaupifalco monogramicus*	Reptile	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	7	2.68
Woodpecker	*Dendropicos fuscescens*	Ave	Least concern	6	2.30
Senegal coucal	*Centropis senegalensis*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	2	0.77
Morning Dove	*Streptopelia decipens*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	2	0.77
Grey heron	*Ardea cinera*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life	11	4.21
Cattle Egret	*Ardeola ibis*	Ave	Least concern	10	3.83
Francolin	*Francolinus bicalcaratus*	Ave	Least concern	30	11.49
Village Weaver Bird	*Ploceus cucllatus*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	25	9.58
Senegal Parrot	*Poicephalus senegaus*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	5	1.92
Glossy Sterlon	*Lamprotornis nitens*	Ave	Least concern	4	1.53
Willow Warbler	*Phylloscopus trochilus*	Ave	Least concern	6	2.30
Barn Owl	*Tyto alba*	Ave	Least concern	1	0.38
Grey Plantain Eater	*Crinifer piscato*	Ave	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.	4	1.53
Orange Checked Waxbill	*Estrilda melpoda*	Ave	Least concern	12	4.60
Tawny-Flanked	*Prinia subflava*	Ave	Least concern	7	2.68
Senegal Firefinch	*Lagonosticta senegala*	Ave	Least concern	10	3.83
Total				261	100

Source: GCNL Field Work, 2017

4.10.3.3.*Species abundance per community*

Analysis on abundance per communities was conducted across all fauna groups. Results obtained from the analysis are presented in Table 4.41. From the result, H17/08 veg.8, B17/02 veg.2 and J17/10veg.10 had the highest number of individuals while C17/03 veg.3 had the least individuals. This reduction in species individuals in most of the sample communities, habitat and sections indicates the level of disturbance. From the aforementioned fact, it is anticipated that, during the different phases of the proposed project, fauna populations will be impacted.

Table 4.41: Species Abundance per Communities

Fauna	A17/01 veg.1	B17/02 veg.2	C17/03 veg.3	D17/04 veg.4	E17/05 veg.5	F17/06 veg.6	G17/07 veg.7	H17/08 veg.8	I17/09 veg.9	J17/10 veg.10	**Total**
Mammal	8	12	4	11	6	19	10	23	7	14	**114**
Aves	12	22	8	10	21	9	14	18	9	18	**141**
Reptile	3	0	0	0	1	0	0	0	2	0	**6**
Total	**23**	**34**	**12**	**21**	**28**	**28**	**24**	**41**	**18**	**32**	**261**

Source: GCNL Field Work, 2017

4.10.3.4.*Species Diversity Indices*

Shannon weiner and equitability indices were used to evaluate species diversity in the study. This index is used in accessing the degree of richness of any habitat. The diversity indices for the entire study area and sections were conducted across all faunal groups. As presented in Table 4.42, Ejio-Sojuolu section had the highest Shannon index followed by the Ejio-Abeokuta and least was Ejio-Olorunsogo. However, Ejio- Olorunsogo is the most evenly distributed section of them all with the highest equitability index.

Table 4.42: Species richness for each of the study sections

	Ejio-Sojuolu	Ejio-Olorunsogo	Ejio-Abeokuta
Shannon_H	0.8148	0.7238	0.7726
Equitability_J	0.7416	0.6588	0.7033

Source: GCNL Field Work, 2017

4.10.3.5.Diversity indices for each study section

The avian group recorded highest Shannon index across all the three sections. However the avian, mammalian and amphibian group recorded the highest equitability index across the first, second and third sections respectively**.** Table 4.43 presents the result of diversity indices for each section.

Table 4.43: Diversity indices for each section

Fauna	Ejio-Sojuolu	Ejio-Olorunsogo	Ejio-Abeokuta
Mammal	24	35	54
Ave	40	54	45
Reptile	3	1	2
Shannon_H	0.8148	0.7238	0.7726
Equitability_J	0.7416	0.6588	0.7033

Source: Godirra Chemical survey, 2017

4.10.4. : Ecosystem Services

Ecosystem services are the benefits people including businesses derive from plant resources (IFC 2012). Ecosystem services are organized into four types namely provisioning services (food, medicine and raw materials), regulating services (Carbon sequestration and storage, Local climate regulation (air quality), Waste water treatment and detoxification, Regulation of water flow, Biological control, Erosion prevention and maintenance of soil fertility and moderation of extreme events such as storm and shorelines), supporting services (soil conservation and soil improvement) and cultural services (Spiritual and religious values, Knowledge systems and Educational values, Inspiration, Aesthetic Values, Social Relations, Sense of Place, Cultural diversity, Cultural Heritage Values and Recreation and Ecotourism). Impacts on biodiversity often adversely affect the delivery of ecosystem services. The functional ecosystem services played by the censored plant species in the study area was evaluated via desk top review.

4.10.4.1.Provisioning Services

Services that describe the material or energy outputs from ecosystems are termed provisional services. Provisional services offered by the floristic resources of the study area are organized into three groups namely; food/fibre/energy**,** medicinal attributes and raw materials.

All the plant species censored in the study offers provisioning services but at varying degrees. However, among these, fifteen (15) species were recorded to providing food/fibre/energy, Seven (7) as sources of raw materials while forty (40) provides medicinal services. Some of the species include *Albizia ferruginea*, *Albizia zygia*, *Carica papaya*, *Nauclea latifolia*, *Thamoutococcus danielli*, *Annona senegalensis*, *Bambusa vulgaris*, *Ceiba pentandra* and *Elaeis guineensis*. All the genera of the tree species are used for regulatory services in the study area while *Thermacoccus danielli* serve for food. They are applied to addressing carbon sequestration and storage, regulation of water flow, local climate regulation, erosion prevention and maintenance of soil fertility, and biological control.

Plate 4.27: ***Ceiba pentandra***

Plate 4.28: ***Annona senegalensi***

Plate 4.29:***Thamoutococcus danielli***

Plate 4.30: ***Albizia zygia***

Plate 4.31: ***Albizia ferruginea***

Plate 4.32*: Nauclea latifolia*

4.10.4.2. Supporting Services

Appendix 4 showed that *Mangifera indica, Uapaca togoensis and Ceiba pentandra* are used for habitat mediation by the people while all the listed plant species in appendix 4., act as nutrient recycling especially the understorey species through litter fall and decomposition.

4.10.4.3.Cultural Services

These are the non material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences. IFC (2012) grouped this services into Cultural diversity, SpiSritual and religious values, Knowledge systems, Educational values, Inspiration, Aesthetic values, Social relations, Sense of place, Cultural heritage values and Recreation and ecotourism.

As evident in Appendix 4**,** *Raphia hookeri, Blighia sapida, Bambusa vulgaris, Ceiba pentandra* and *Albizia zygia* are five (5) species censored in the project area that serves cultural values. They are applied to addressing spiritual/religious values, and aesthetic values

Plate 4.33: ***Blighia sapida***

Plate 4.34: ***Raphia hookeri***

4.10.5. Ecosystem services of the Fauna species

Analysis on the ecosystem services provided by the fauna species across the fauna group was conducted. The ecosystem services reviewed are provisional services (food and energy, medicine, raw material), regulatory services (biological control, pollination), supportive services and cultural services. Details of the ecosystem services are presented in Appendix 4, while Table 4.44 presents the summary. A total of 21 fauna species were reviewed as offering ecosystem services. A breakdown of the number of species with respect to fauna group revealed that the Avian taxon with 13 species was the group with the highest number of species offering ecosystem services, this was followed by Mammals with 7 species and reptiles with 1 species. However the total may exceed 21 as some species provides two or more ecosystem services

Table 4.44: Ecosystem services of the fauna groups

Ecosystem services	Mammals	Aves	Reptiles
Provisioning	5	4	1
Regulatory	-	2	-
Supportive	-	3	-
Cultural	2	4	-
Total	7	13	1

The flora and fauna species in the study location do not fall within IUCN Red lists categorization. Therefore the location of transmission line project in the study area will create little or no impact on flora and fauna in the vegetation belt of the project.

4.10.6. Hydrobiology

4.10.6.1. *Overview*

Phytoplanktons are the essential and fundamental to the primary production in aquatic ecological systems and are at the base of food chain which serves as food for other higher animals in the system. The composition and diversity of phytoplankton in aquatic ecological system is an index of its healthy status. Diversity is the variety and variability among living organisms and the ecological complexes in which they occur (Pielou, 1994). Diversity index is to obtain a quantitative estimate of biological variability that can be used to compare biological entities, composed of discrete components, in space or time. They exist in all aquatic ecosystems (Lee, 2008). According to Sverdrup *et al.*, (2006), oceanic phytoplankton contributes about half of the atmospheric oxygen present on earth. However, their survival, growth, distribution and diversity in time and space are influenced by water quality parameters in with they inhabit. In some cases, the presence and abundance of some species are used as index of eutrophication and water pollution. The construction of the proposed project is changes in these properties can lead to degradation of ecosystems services and loss of biological diversity. The acquired data will serve as base line information on which the future data can be compared with over time during monitoring to reflect the impact of the project on the aquatic environment. Three hydrobiological parameters, phytoplankton, zooplankton and benthos were considered.

4.10.6.2. *Sampling methods*

a. Zooplankton

Zooplankton samples were collected on each occasion at site with 55µm mesh size standard plankton net towed in the water for 5 - 10 minutes. The net was thoroughly washed after each tow so that any planktonic material adhering to the mesh of the filtering cone is removed into the collecting bottle to prevent contamination from the previous hauls. Thereafter, the net was pulled up, debris and other extraneous materials were removed, and sample transferred into 250 ml well labelled plastic containers with screw cap. Each sample was preserved with 4% buffered formalin prior to laboratory microscopic observations.

b. Phytoplankton

Phytoplankton samples were collected on each occasion at site with a 55µm mesh size standard plankton net towed in the water for 5 - 10 minutes. The net was thoroughly washed after each tow so that any planktonic material adhering to the mesh of the filtering cone is removed into the collecting bottle to prevent contamination from the previous hauls. Thereafter, the net was pulled up, debris and other extraneous materials were removed, and sample transferred into 250 ml well labelled plastic containers with screw cap. Each sample was preserved with 70% ethanol to preserve and prevent shrinkage of the organisms prior to laboratory microscopic observations.

Plate 4.35: Phytoplankton sampling using Plankton net.

4.10.6.3. *Summary Results of hydrobiology*

Table 4.45: Checklist of plankton species.

	Ejio to Olorunsogo		**Ejio to New Abeokuta**	
Parameter	**species**	**count**	**Species**	**count**
Phytoplankton	14	169	24	412
Zooplankton	12	67	17	90

4.10.6.4. *Phytoplankton result*

A total of 38 different species of phytoplankton consisting of 581 individuals were encountered during the study. In Appendix 4 shows percentage composition of phytoplankton in the surface waters in the study area, also the diversity index of phytoplankton. Oscillatoria, Protococcus and Cyclotella were the most abundance phytopklankton species while Stauroneis, Synura, Mougeotia, Tetmomorus, Pinnularia, Prasiola, Spirogyra, Diatom and Cocconeis were least prominent in the study. Highest species taxa was reported in Ejio to New Abeokuta section. Result of Ejio to Olorunsogo section revealed that Oscillatoria and Protococcus were very dominant species hence the high value of dominance index and low evenness. This observation might be due to the shallowness, transparent to the bottom (clear) and frequent human disturbances of the surface waters as they are major sources of water to the surrounding settlements in this section. Most of the surface waters in Ejio to Olorunsogo section are very shallow and transparent to the bottom and these might be responsible for its low species taxa and diversity. However, its diversity is slightly above average.

4.10.6.5. *Zooplankton result*

Zooplankton essential role in the food web and also influence the functioning and productivity of aquatic ecosystems through their impact on the nutrient dynamics. The composition and abundance of zooplankton vary in aquatic environments. This makes their biomass ecologically very important because of its uses for monitoring eutrophication, pollution, global warming and environmental disturbances. Also, their abundance can be altered by spatio-temporal variations in hydrochemical parameters and physical forces in aquatic ecosystems (Bianchi *et al.*, 2003). Molinero *et al.* (2005) reported that zooplankton are important indicators of change in aquatic systems and climate change. Most of the sampled surface waters were poor in zooplankton composition.

4.10.6.6.*Benthic Studies*

Secondary data Aiwerioghene *et al*., (2016) who worked on Ikere Gorge which is situated along the basin of Ogun River, was used in this wise. They reported the presence of *Chironomus spp, Cloeon dipterum, Melanoides tuberculata, Bulinus spp, Bellamya unicolor,* and *Hirudina sp* in the basin. Besides, it was observed that abundance and distribution of *Cloeon dipterum* (Mayfly nymph), *Bellamya unicolor, Bulinus* sp., and *Huridina sp* (Leech) were influenced by changes in pH, dissolved oxygen, biological oxygen demand, conductivity, sulphate, transparency, nitrate, and phosphate. While *Chironomus sp* and *Melanoides tuberculata* were independent of any physico-chemical parameter. None of the benthic macro invertebrates was affected by water total dissolved solids and water temperature. The presence of *Melanoides tuberculata* and *Chironomus* larvae have been reported to be pollution tolerant species and associated with deterioration of water quality.

4.10.7. Fishery Studies

The major aquatic macrofauna were fishes. Discussions with the villagers revealed the presence of *Parachanna obscura, Tilapia spp, Malapterurus electricus, Hepsetus odoe, and Clarias gariepinus* in Wagnnnu stream. Secondary data from the research work Adeosun (2012) and Odulate (unpublished) in Ogun river showed that *Chrysichthys nigrodigitatus, Coptodon zillii, Tilapia mariae, Mormyrus rume, Clarias gariepinus, Distichodus engycephalus* were prominent in catch output of Ogun river (Table 4.46 and Plate 4.36). Fish fry were sighted in Osun stream while freshwater prawn was observed in Ototo stream (Plate 4.37). These are indications that these systems have potentials for fisheries production. The major fish landing sites in Ogun River are Iberekodo, Oniyanrin and Oba. Sand mining from the drainage basin of Ogun River is also a prominent activity in Oba apart from fishing. Fishing gears used in Ogun River included castnet, gillnet and assorted traps. Fish catch in the study area has been observed to be decreasing over the years. This may be due to intense fishing, climate change and use of indiscriminate fishing methods.

Table 4.46: Fish Composition within the study area.

Common Name	Biological Name	Local Name	2017 IUCN Ranking
Bagrid catfish	*Chrysicthys nigrodigitatus*	Obokun	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.
Red belly tilapia	*Coptodon zilli*	Epiya	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.
African mud catfish	*Clarias gariepinus*	Aro	Least Concern

African pike	*Hepsetus odoe*	Ijakere	Least Concern
Elephant fish	*Mormyrus rume*	Ayo lele	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.
Nile tilapia	*Oreochromis niloticus*	Epiya	This taxon has not yet been assessed for the IUCN Red List, and also is not in the Catalogue of Life.
Electric catfish	*Malapterurus electricus*	Ojiji	Least Concern

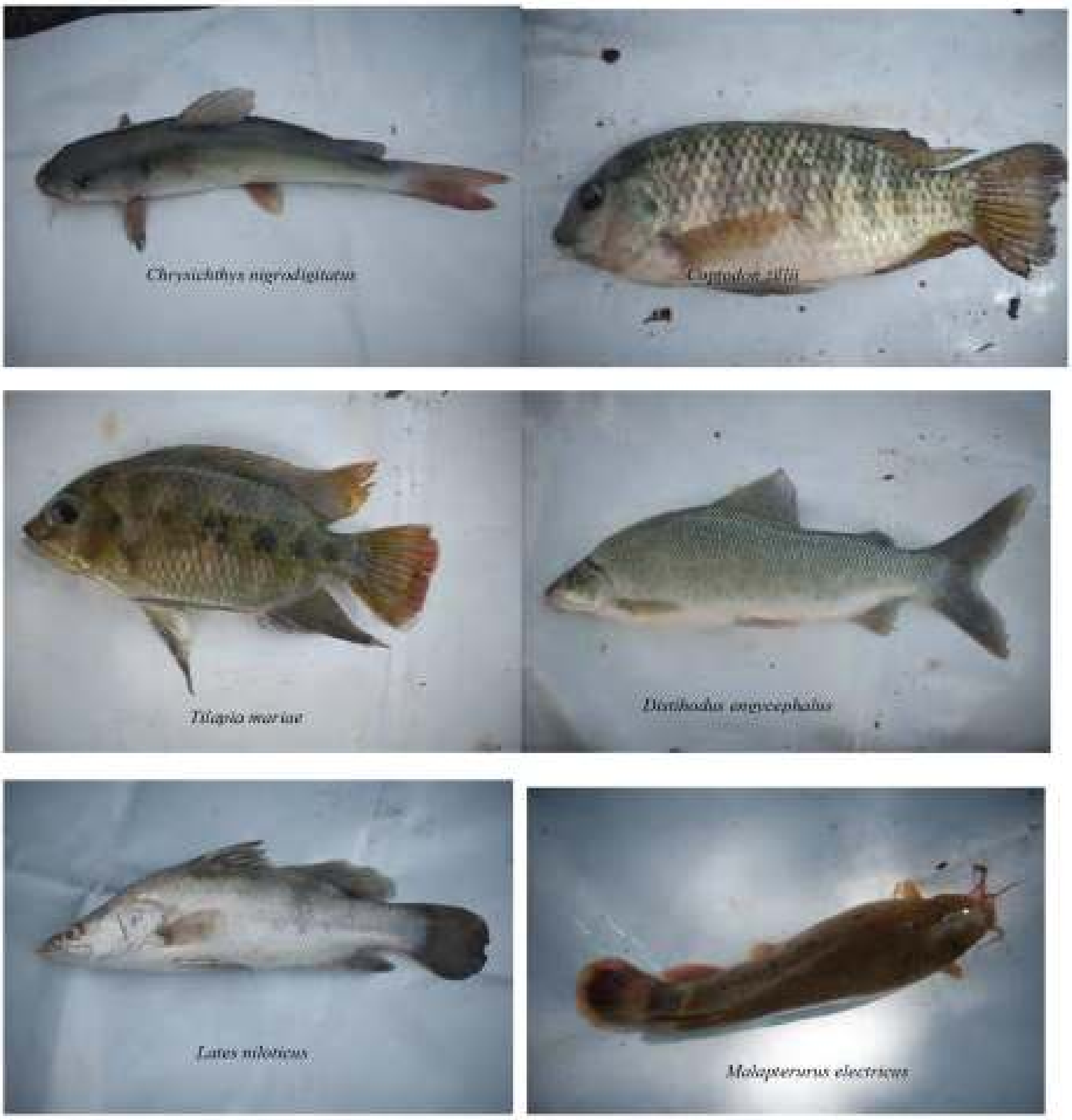


Plate 4.36: Some of the fish species in the aquatic systems in the study area.

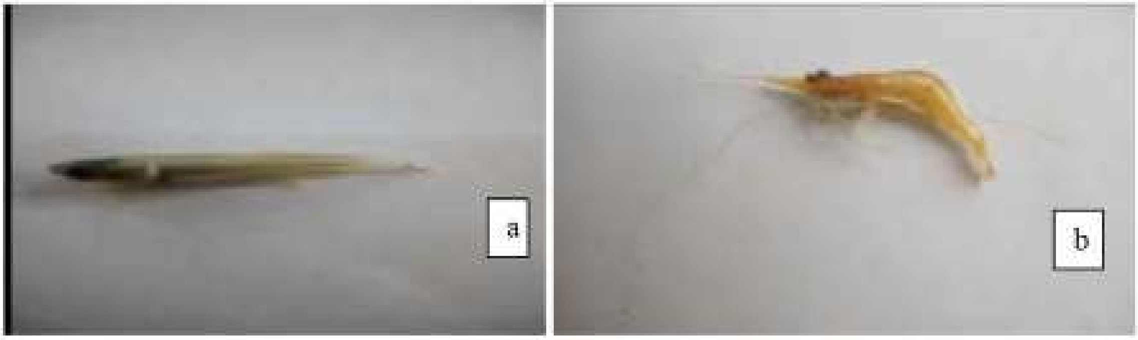


Plate 4.37: (a) fish fry obtained from Osun stream and (b) freshwater prawn from Ototo stream respectively.

4.11. Sediment Study

In an aquatic ecosystem, soil is one of the most important ecological factors. The productivity of water body is related with soil conditions. Soil serves as a more reliable index for productivity than water qualities. The productivity of any river or spring depends largely on the quality of bottom soil that is a "store house of nutrients." The chemical and biological changes continuously takes place resulting in releases of different nutrients in to the over lying water and their absorption by the soil mass and microbial population. The growth and abundance of different aquatic flora and fauna are greatly dependent upon the presence of essential nutrients in water body in adequate and balanced quantities. Therefore, bottom soil could best be described as the "chemical laboratory of pond." The ability of soil to provide various nutrients for biological production are assessed through the analysis of important soil constituents such as pH, specific conductivity, total alkalinity, calcium, magnesium, chloride, nitrate-nitrogen, phosphate-phosphorus, sulphate, sodium and potassium. Most of the dying out component of our environment is being contaminated by human activities like rapidly urbanization, industrialization population explosion, and agricultural waste and anthropogenic activity in and around water bodies.

4.11.1. Sediment Sample Collection

Sediment samples from river/stream bed were collected using an Eckman grab. The grab used was of a stainless steel plates with two jaws that close automatically when it reaches the riverbed. On reaching the bottom of the river/stream, sediments are trapped in the jaws and are gradually pulled back to the surface. For shallow streams, samples were collected without grabs.

Plate 4.38: Collecting Sediment Sample at Ogun River

4.11.2. Sediment Physico-Chemical Analyses

The physico-chemical characteristics of the sediment collected from the surface water bodies within the proposed transmission line project areas are summarized in Tables 4.47(a-b) (see Appendix 4 for detailed result).

Table 4.47a: Results of physical and chemical of sediment parameters in the study area.

	EJIO - OLORUNSOGO AXIS												Secondary data (ICCL 2015)	WHO /FMEnv Limits
	SD1 (Osun Stream @ Illudun-Ejio)			SD2 (Osun stream @ Abesse)			SD3 (Wagunnu River @ Soderu)			SD4 (Sowunmi Stream)				
PARAMETER	min	max	mean	min	max	mean	min	max	mean	min	max	mean		
Colour	Gray	Gray dark	Gray	Gray	Gray	Gray	Gray	Gray	Gray bark	Gray	Gray	Gray		
Chloride (mg/l)	84.74	85.53	85.14	100.89	103.65	102.27	85.53	88.68	87.11	78.80	93.24	86.02		
Ext. Sulphate (mg/kg)	5.74	6.11	5.93	3.015	6.17	4.59	4.96	5.65	5.31	6.51	8.07	7.29	0.12-0.15	
Moisture content (%)	15.67	22.89	19.28	25.30	26.40	25.85	14.40	19.30	16.85	23.10	27.20	25.15		
Bicarbonate (mg/kg)	64.00	70.00	67.00	34.20	52.00	43.10	68.00	72.00	70.00	28.10	43.00	35.55		
CEC (meq/100g)	1.22	1.44	1.33	3.53	3.61	3.57	2.08	2.34	2.21	2.20	3.21	2.70		
Nitrate (mg/l)	21.54	23.5	22.52	17.55	21.33	19.44	24.21	43.60	33.90	15.55	21.33	18.44	0.10-0.18	
pH	6.56	7.35	6.95	7.02	8.05	7.54	7.28	7.43	7.35	7.02	7.23	7.12	5.50-5.80	6.0-9.0
Bulk Density (g/cm³)	1.66	1.81	1.74	1.69	1.76	1.73	1.51	1.62	1.56	1.34	1.46	1.40		
Porosity(%)	31.60	37.54	34.57	33.71	36.08	34.89	38.90	42.94	40.92	30.51	38.30	34.40		
WHC (%)	29.99	42.90	36.45	20.46	25.1	22.78	29.98	33.93	31.95	30.43	35.45	32.94		
TOC (%)	3.20	3.74	3.47	4.17	4.19	4.18	4.02	4.06	4.04	3.12	3.92	5.52		
Potassium (mg/kg)	0.27	0.46	0.36	0.21	0.31	0.26	0.79	0.96	0.87	0.11	0.21	0.16		
Sodium (mg/kg)	2.47	2.63	2.55	2.13	2.35	2.24	2.14	2.55	2.34	2.12	2.65	2.38		
Copper (mg/kg)	<0.001	0.03	<0.02	<0.001	0.01	<0.001	<0.001	0.02	<0.01	<0.001	<0.001	<0.001	2.35-9.35	35.7
Iron (mg/kg)	53.60	98.60	76.1	33.20	41.00	37.1	93.20	218.00	155.6	43.20	72.00	57.60	55.00-95.80	
Nickel (mg/kg)	0.14	0.71	0.43	0.48	0.56	0.52	0.05	0.40	0.23	0.38	0.66	0.52	0.42-0.50	18-61
Chromium (mg/kg)	0.05	0.07	0.06	0.04	0.04	0.04	0.15	0.24	0.19	0.01	0.02	0.015		0.006
Cadmium (mg/kg)	0.03	0.04	0.035	0.01	0.03	0.02	0.02	0.13	0.07	0.00	0.02	0.01		0.025
Zinc (mg/kg)	0.08	0.13	0.11	0.07	0.08	0.07	0.16	0.19	0.17	0.08	0.12	0.10	0.20-1.56	123-540
Barium (mg/kg)	0.01	0.10	0.05	<0.001	0.03	<0.02	<0.001	0.10	<0.05	<0.001	<0.001	<0.001		

Lead (mg/kg)	0.01	0.03	0.02	<0.001	<0.001	<0.001	<0.001	0.01	<0.01	<0.001	<0.001	<0.001	**0.01-0.05**	**35-170**
Mercury (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
PAH (mg/kg)	0.93	1.07	1.00	0.05	0.06	0.05	0.00	0.07	0.035	0.02	0.00	0.01		
BTEX (mg/kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.005	0.00	0.00	0.00		
Phenols (mg/kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
THC (mg/kg)	5.72	6.14	5.93	4.43	4.74	4.58	4.04	4.40	4.22	2.43	3.73	3.08	**0.50-1.40**	
TPH (mg/kg)	2.40	2.52	2.46	0.26	0.55	0.40	0.02	0.36	0.19	0.22	0.57	0.39		

Table 4.47b: Results of physical and chemical sediment parameters in the study area Cont'd.

	EJIO – NEW ABEOKUTA AXIS												**Secondary data (ICCL 2015)**	**WHO /FMEnv Limits**
	SD5 Wagunu River @ Adubi Aro Axis			SD6 (Odo Ipa River)			(SD7) Ogun River @ Opanigangan			SD8 Ototo Stream				
PARAMETER	min	max	mean	min	max	mean	min	max	mean	min	max	mean		
Colour	Gray	Gray	Gray	Brownish yellow	Brownish yellow	Brownish yellow	Gray	Gray	Gray	Brown	Brown	Brown		
Chloride (mg/l)	83.43	90.68	87.05	94.20	100.10	97.15	82.77	86.34	84.55	83.56	93.50	88.53		
Ext. Sulphate (mg/kg)	7.63	9.52	8.57	6.33	7.45	6.89	16.17	18.45	17.31	6.34	13.42	9.68	**0.12-0.15**	
Moisture content (%)	11.25	17.10	14.17	23.40	31.30	27.35	10.69	20.62	15.65	25.70	34.02	29.86		
Bicarbonate (mg/kg)	64.00	82.00	73.00	54.00	98.20	76.1	62.00	78.32	70.16	61.00	79.00	70		
CEC (meq/100g)	1.08	2.04	1.56	2.28	2.78	2.53	2.83	3.68	3.25	5.03	7.10	6.06		
Nitrate (mg/l)	28.11	39.60	33.85	15.11	23.56	19.33	12.5	15.89	14.18	31.40	37.60	34.5	**0.10-0.18**	
pH	7.18	7.36	7.27	6.20	7.43	6.81	7.75	7.89	7.82	7.79	7.86	7.83	**5.50-5.80**	**6.0-9.0**
Bulk Density (g/cm^3)	1.41	1.62	1.52	2.24	2.28	2.26	1.98	2.64	2.31	1.68	2.56	2.12		
Porosity(%)	33.90	44.94	39.42	15.50	18.40	16.95	25.37	34.42	29.89	36.59	38.72	37.65		
WHC (%)	29.82	36.93	33.37	20.34	44.25	32.29	18.18	25.13	21.65	17.75	34.12	25.94		
TOC (%)	3.12	4.56	3.84	4.15	5.67	4.91	3.72	4.46	4.09	3.12	4.37	3.74		
Potassium (mg/kg)	0.59	0.98	0.78	5.27	6.30	5.78	1.04	2.05	1.54	0.2	0.67	0.43		
Sodium (mg/kg)	1.98	2.67	2.33	5.11	5.87	5.49	2.07	3.30	2.68	2.89	4.36	3.63		

Copper (mg/kg)	<0.001	0.01	0.055	0.09	0.10	0.095	0.02	0.06	0.04	<0.001	<0.001	<0.001	**2.35-9.35**	**35.7**
Iron (mg/kg)	100.20	234.00	167.1	286.90	303.50	295.2	54.8	67.23	61.02	57.70	89.67	73.68	**55.00-95.80**	
Nickel (mg/kg)	0.03	0.80	0.41	0.23	0.48	0.35	0.03	0.07	0.05	0.11	0.17	0.14	**0.42-0.50**	**18-61**
Chromium (mg/kg)	0.20	0.29	0.24	0.27	0.32	0.29	0.15	0.51	0.33	0.02	0.04	0.03		**0.006**
Cadmium (mg/kg)	0.01	0.09	0.05	0.01	0.04	0.025	0.06	0.08	0.07	0.01	0.03	0.02		**0.025**
Zinc (mg/kg)	0.20	0.37	0.28	0.28	0.35	0.32	0.14	0.16	0.15	0.1	0.2	0.15	**0.20-1.56**	**123-540**
Barium (mg/kg)	<0.001	0.03	<0.005	<0.001	0.01	<0.01	<0.001	0.01	<0.001	0.02	0.04	0.03		
Lead (mg/kg)	<0.001	<0.001	<0.001	0.00	0.1	0.1	0.01	0.04	0.025	0.02	0.03	0.025	**0.01-0.05**	**35-170**
Mercury (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
PAH (mg/kg)	0.00	0.04	<0.001	0.08	0.09	0.085	1.25	2.20	1.73	0.01	0.05	0.03		
BTEX (mg/kg)	0.00	0.00	0.00	0.00	0.02	0.02	0.01	0.02	0.015	0.01	0.01	0.01		
Phenols (mg/kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
THC (mg/kg)	3.30	5.40	4.35	4.36	5.61	4.98	3.65	4.78	4.22	3.19	3.45	3.32	**0.50-1.40**	
TPH (mg/kg)	0.01	0.06	0.03	0.19	0.24	0.21	7.38	8.34	7.86	0.06	0.09	0.075		

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a. pH

The pH of the sediment obtained from the surface water samples in study area recorded the following mean level; Osun stream at Illudun-Ejio 6.95; Osun stream at Abese 7.54; Wagunnu river at Soderu 7.35; Sowunmi stream 7.12; Wagunnu river at Adubiaro 7.27; Odoipa river 6.81; Ogun river 7.82 and Ototo Stream 7.83. The pH value obtained for the study area indicates a moderate acidic – moderate alkaline riverbed.

b. Hydrocarbon Level

THC

The total hydrocarbon mean concentration in sediment samples from the study area were; Osun stream at Illudun-Ejio 5.93mg/kg, Osun stream at Abese 4.58mg/kg, Wagunnu river at Soderu 4.22mg/kg, Sowunmi stream 3.08mg/kg, Wagunnu river at Adubiaro area 4.35mg/kg, Odo Ipa river 4.98mg/kg, Ogun river 4.22mg/kg and Ototo stream 3.32mg/kg.

PAH, TPH and BTEX

Polycyclic aromatic hydrocarbon (PAH) and Total Petroleum hydrocarbon (TPH) were detected in all the sampled points. BTEX was detected in some of the sampled points. See tables 4.33a.b above.

c. Heavy Metals

The heavy metals analysed for sediment samples from the area were cadmium, chromium, copper, iron, lead, nickel, zinc, barium, and mercury.

The recorded levels of heavy metal concentration across sediment samples within the study area were found to be within reported values (see Tables 4.33) from secondary data and compliant to levels required for optimal functioning of a typical freshwater ecosystem.

d. Sediment Particle Size Distribution

The sediment particle size distribution (PSD) was found to be consistent across the sampling stations with sand and clay dominating, followed by silt. A table 4.48 shows the sediment particle size distribution across the study area.

The particle size distribution suggests that the river bed of streams and surface water systems along the transmission line route are basically sandy-clay.

Table 4.48: Sediment Particle size distribution (PSD)

		EJIO - OLORUNSOGO AXIS							
Sample ID	**1mm**	**0.53mm**	**0.425mm**	**0.106mm**	**<0.106mm**	**%T. Sand**	**%Silt**	**%Clay**	**Texture**
	VCS (%)	**CS (%)**	**MS (%)**	**FS (%)**	**VFS (%)**				
SD1 (Osun Stream @ Illudun-Ejio) (Pts a-b)	3.32	8.53	15.63	42.47	5.05	75.00	5.00	20.00	Sandy Clay Loam
	1.05	2.89	5.11	14.21	1.74	25.00	60.00	15.00	Silt Loam
SD2 (Osun stream @ Abesse) (Pts a-b)	2.70	6.30	10.81	51.86	13.33	85.00	10.00	5.00	Loamy sand
	2.34	6.66	10.44	52.04	13.51	85.00	5.00	10.00	Loamy sand
SD3 (Wagunnu River@	3.57	2.50	2.50	26.61	24.82	60.00	15.00	25.00	Sandy,Clay Loam
	4.09	2.72	3.41	22.99	21.80	55.00	10.00	35.00	Sandy Clay

Soderu) (Pts a-c)	11.79	9.93	10.86	20.66	6.75	60.00	15.00	25.00	Sandy,Clay Loam
SD4 (Sowunmi Stream)	4.02	3.20	4.67	12.89	24.46	65.00	20.00	30.00	Sandy Clay
	10.34	6.45	11.23	19.56	13.80	50.00	15.00	25.00	Sandy Clay
		EJIO – NEW ABEOKUTA AXIS							
SD5 (Wagunu River @ Adubi Aro Axis) Pts a-c	4.57	3.50	2.50	36.61	26.82	65.00	15.00	20.00	Sandy,Clay Loam
	3.09	3.72	3.41	22.99	21.80	60.00	10.00	25.00	Sandy Clay
	8.79	9.93	6.86	20.66	6.75	70.00	15.00	25.00	Sandy,Clay Loam
SD6 (Odo Ipa River)	0.88	0.85	0.88	1.77	0.62	5.00	40.00	55.00	Clay
	0.90	0.87	0.92	1.84	0.68	5.00	40.00	60.00	Clay
SD7 (Ogun River @ Opunigangan)	6.20	8.80	12.72	50.22	10.76	88.70	1.30	10.00	Loamy Sand
	6.50	9.93	10.86	48.34	8.89	79.80	2.00	15.00	Loamy Sand
SD8 (Ototo Stream)	23.87	20.20	13.75	23.06	9.10	90.00	5.00	5.00	Sand
	10.34	6.45	11.23	19.56	13.80	85.00	5.00	5.00	Sandy Clay

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4.12. Human Environment

4.12.1. Introduction

4.12.1.1. *Political context*

Nigeria is a Federal Republic made up of 36 States and a Federal Capital Territory. Nigeria became an independent state in 1960 and a republic in 1963. It started off with three regions namely Eastern, Northern and Western regions until a fourth; the Mid-West region was created in 1963. Nigeria experienced the first military coup in 1966, and a thirty month civil war from 1967 to 1970. The military government created 12 states from the four regions in 1967. Between 1967 and 1996, the 12 states were further divided into 19, then 21 and finally 36 states. Ogun State was created in 1976 out of the then Western State. Lagos state was created on the 27th May 1967 by virtue of the state creation and Transitional Provisions Decree No.14 of 1967.Lagos state is known as the financial hub of Nigeria.

4.12.1.2. *Country Location and Administrative structure*

Nigeria lies between latitudes 4° and 14° north of the equator and longitudes 3° and 15° east of the Greenwich meridian on the west coast of Africa. It covers a total area of 923,766 square kilometres consisting of 910,768 square kilometres of land and 13,000 square kilometres of water with the coast line stretching up to 853 kilometres. The entire country is divided into 36 states and federal capital territory. These are further sub-divided into 770 local government areas which form the third tier of government while the central and state governments form the first and second tier respectively. The third tier consists of the Local Government Areas. The country practices a presidential system of government consisting three arms of government: the executive, the legislature and the judiciary (Nigerian 1999 Constitution). The executive consists of both elected and appointed members, while members of legislature, both at federal and state levels are elected. This pattern is similar to what obtains at the Local Government level, except that there is no third arm (the judiciary) at the LGA level. Another major difference between the central government structure and that of the state is the presence of two legislative chambers at the center (i.e. the Senate and the House of Representatives), while the states have just one.

The LGA administration is run by an elected Executive Chairman and appointees of the Chairman representing the executive arm of local government administration. There is also the legislature made up of ten Counselors elected from the wards in the LGA. The Chairman is the chief security officer of the LGA and the office is important in the operations of the proposed project.

The communities have a well-defined hierarchical political structure with traditional leadership through Kings (Oba) or Baale, chiefs and community Heads. The traditional authority structures are similar in all the communities. This governance structure is graphically represented in Figure 4.3.4

At the community level, the traditional authority structure hardly varies from one community to another with the traditional head (King or Baale) and chiefs jointly administering their political, economic and social affairs. Authority in each community is at two levels. The first is the traditional ruling council composed of the village chiefs and headed by the village head (the "Baale"). The second is the Community Development Association (CDA) comprising of an elected Chairman and some Executive Members. All CDAs operate under the leadership of one Community Development Secretary (CDS) who is coordinates the activities of all CDAs in the area.

The Community Development Association (CDA) mobilizes the different sections and interest groups in the Community for development purposes. The CDA reports to the CDS who takes issues to Council of Elders. There is also a Youth Organization with elected Chairman and members in each community.

Three broad groups are identifiable in each of the communities – male elders, youths and women. The role of male elders is traditional governance of the communities. They dominate the political arena and the decision-making positions, while the youth leaders are usually at the bottom rungs of the ladder of authority. The traditional role of the youths includes constituting a labour force in development projects, security of the community and to enforce law and order. Traditionally, there is a limit to the involvement of women in the political governance of these local settlements. Generally, women play a subdued role in the communities, usually placed at the background. Each of the communities has a patriarchal familial arrangement. There is also the women group led by the women leader (Iya lode) who organizes and co-ordinates the activities and role of women in the community. The children as well as the non-indigenes or visitors are at the base of the governance system. The system rewards good and hardworking people and reprimands troublesome and unprogressive individuals. The communities have very high respect for the Baale who is the overall ruler.

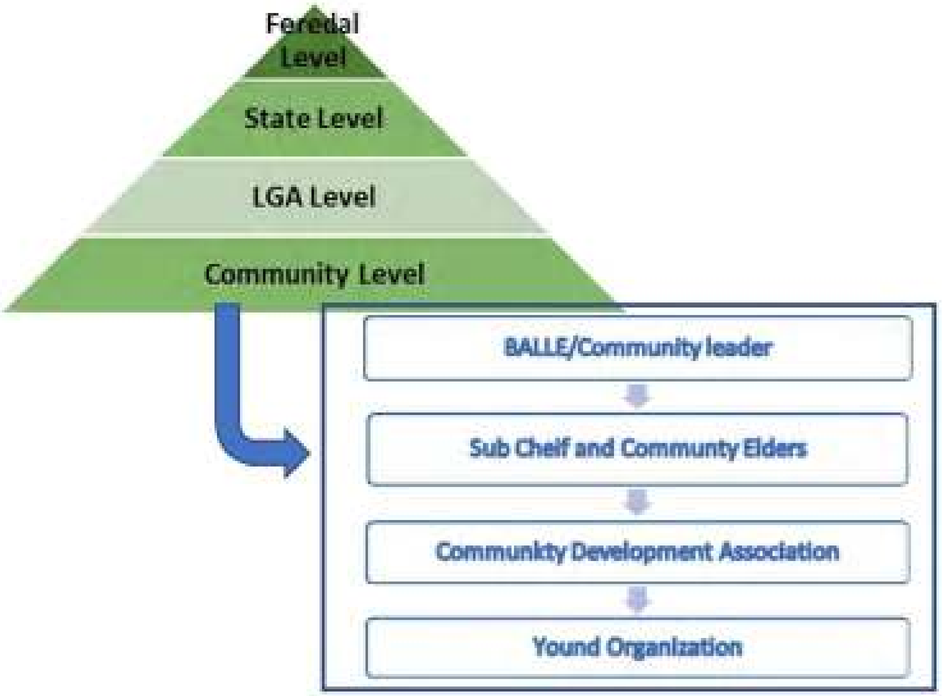

Fig. 4.27: Governance Structure of the Communities in the project Area

4.12.2. Socio Economic Baseline

4.12.2.1.*Methodology*

Data accumulation for the baseline information starts with some reviews and desktop studies of various reports on Nigeria. This provides the context within which the baseline information about Ogun State, the affected Local Government Areas (LGAs) and the immediate settlements around the project site will be appreciated. Finally, mostly data in statistical representation and charts, reflected in this ESIA, were obtained from structured consultations with the traditional rulers, community heads, and officials of the LGAs as well as members of the affected communities.

Human environmental baseline data was gathered using a combination of desktop studies and field surveys. It covers the following social components: demography, land uses, land ownership, administrative and socio-cultural institutions, infrastructures, economics and livelihood, cultural heritage and health.

The baseline socio-economic and health status of the project area was assessed using questionnaires distributed to not less than 30% of the people in the affected communities (because members of the affected communities were quite few). The data was supplemented by interview of selected adults and youths in each community. A total of five hundred (500) community members and health personnel were interviewed between 16th and 23rd of December 2017.

a. Stakeholder Engagement and Consultation

The communities were first visited and the Chiefs, Elders, Youth leaders and women leaders were contacted. Various meetings were held with these groups on the need for the studies. They were then mobilized to co-operate and participate in the survey. The process of consultations with members of the communities continued throughout the study and is even to continue in the course of execution of the transmission power line plant project in the communities.

Olorunsogo, Lerin, Ita-alaji,Akilagun consultation

Abese, Soderu Consultation

Ijumo-Ologboni consultation

Inandan, Opanigangan, Okuri consultation

Women group consultation

Youth group consultation

Plate 4.39: Socioeconomic Consultation with the affected communities

b. Recruitment and Training of Field Assistants

With the approval of the community leaders, educated and literate members of the communities were recruited and trained as field assistants in the administration of questionnaires and to conduct the study team round the communities.

c. Socio-economic data collection

This was done mainly by the use of a well-structured questionnaires which addressed all the socio-economic issues e.g. occupation, income, marital status and marriage practice, educational status, historical data, Natural resources management, social groups, land use and on infrastructures like housing, markets, schools, hospital type of water, electricity, roads and other baseline socio-economic data.

d. Health Data Collection

The administered health questionnaires contained questions addressing the socio-demographic data; housing; infrastructure and physical environment; health and well-being including current prevalent communicable and non-communicable diseases; health seeking behaviours, nutritional status; occupational health, lifestyle and social habits as they affects health. Both adults, children and infants in the surveyed households were physically examined. Some of the parameters assessed were weight, and height (with which the Body Mass Index was calculated) hair quality and colour, the eyes, skin, ear, mouth, breath and heart sounds, breasts and abdominal examinations. The various disease ailments seen were recorded. Other parameters assessed were common adult and childhood diseases, immunization status, physical body assessment and general appearance of the individuals.

e. Assessment of Available Health Care Facilities

The local hospitals/ clinic and other orthodox health establishments where available in the communities were visited and their health data and records were obtained. Some of the parameter obtained are as follows:

- Types and number of health professionals
- Types of available equipments
- Types of health services available for the communities
- In-patient and Out-Patients records
- Types and conditions of health infrastructure
- Administrative structure
- Logistic /accessibility of the health facilities to the communities members
- Utilization of the facilities as well as baseline health parameters.

f. Sampling Technique:

The socio-economic and health questionnaires were administered to the households. A cross sectional stratified random survey method was employed. Questionnaires were administered to 15% of the adult population (i.e. 39% of the total population). A total of 500 questionnaires were randomly administered to adults in the different communities. The study team ensured that the entire communities were covered.

g. Focus Group Discussions (FGD)

These were held separately with male elders, youths and women groups. All socio-economic and health issues and how they have been affected by previous development projects as well as what is to be expected in the current project were discussed. The felt needs of the communities, and possible ways of mitigating against the identified possible negative impacts due to the negative environmental effects that may arise in the transmission line projects in all the neighbouring communities were also discussed.

Plate 4.40: Focus Group discussion with adult men and women

Source: Godirra Chemicals Fieldwork, 2017/2018

h. Study of infrastructures and other environmental Issues

A walk-through the communities was conducted and all infrastructures that can be seen e.g. Electricity, Schools, Roads, Hospitals and markets were located georeferenced using the GPS location of its latitude and longitude and studied. Also observations were made on the environmental living conditions, noting the following: types of housing, environmental sanitation, source and quality of water supply, evidence of erosion and flooding and general environmental degradation.

i. Social and Health hazards:

The social and health hazards identified during the studies and the overall possible impact of the transmission line project on the communities were assessed and rated in accordance with Hazard identification and inventerrization (HAZID) and Hazards and Effects Management process (HEMP) practices in development projects. Recommendations of the possible environmental management to mitigate the observed hazards as well as the negative impact remediation measures were accordingly proffered.

4.12.2.2.*Overview of project area*

Following the 2006 census, the National Population Commission (NPC) published the population of Nigeria as 140,431,790 comprising 71,345,488 males and 69,086,302 females. The NPC estimated annual population growth at 3.2% (NDHS, 2008). The current population, projected at 3.2% annual growth and using the exponential model is 180,735,714, with a density is 198.6 per square kilometer. A higher male population and sex ratio of 103 was recorded for the country. Children (age 0-14) constituted 41.8% of the population while those less than 20 years were 52.3% and those less than 25 years 61.9%. The elderly (65 years and above) were 3.2% of the population. The age dependency ratio was 82.0. Given these proportions, the population of Nigeria is quite young. Average household size in Nigeria is 4.9 (NBS 2012).

According to the 2006 census, Lagos State has a population of 10,694,915 (NBS, 2012), with a projected population of 12,130,986.7 for the year 2015 (NBS, 2012).The population of Ogun State according to the 2006 census is 4,424,096, with a projected population of 5,037,594.173 for the year 2015 (NBS, 2012). The density of Lagos state and Ogun State are 3304.55 and 307.17 square kilometers respectively.

In Lagos State, children aged (0-14 years) constituted 30.3% of the population, those from (15-44 years) constitute 49.3%, (45-64 years) constitute 15.28% while 2.8% of the population are 65 years and above. The age dependency ratio of the population in the state is 70.9%. Similarly, children (age 0-14 years) in Ogun state constituted 38.3%, those within (15-44 years) are 39.9%, those within (45-64years) are 15.3%, while the elderly (65years and above) occupy 3.6% of the population. The age dependency ratio of the population in the state is 88.5%.

Table 4.49: Relevant livelihood indices in the project states

Livelihood Indices	Ogun state		Lagos state	
Population	4,424,096		10,694,915	
Literacy	78.8		80.5	
Youth Literacy in any language	Male	Female	Male	Female
	98.2	88.1	99.4	99.3
Adult literacy in English language	Male	Female	Male	Female
	80.3	77.2	95.8	92.3
Infant Mortality	67		45	
Life expectancy	53years		51years	

Source: NBS (2012)

4.12.2.3.*Host Local Government Areas*

The affected Local Government Areas are Ifo, Ewekoro and Obafemi Owode local Government Areas (LGA) in Ogun state. In Ogun State Government recenetly devided the [Number of LCDA] Local Government Areas into Local Council Development Authorities (LCDAs). However, these LCDAs are not recognized by the Federal Government and most of the indigene are yet to get used to the LCDA as most of them mention them when you ask for their local government areas. In this report, the Local Government Areas will be used rather than the recently created LCDAs.

4.12.2.4.*Host Communities*

It is expected that there would be 65 communities within the spacial boundary of the proposed project (700 m wide each of RoW). The information and location of affected communities is presented in table 4.50 and Figure 4.28b.

Table 4.50 Affected Communities and LGAs

	Sections	LGA/ State	LCDA*	Communities
1	Ejio – Shojuolu	Ewekoro, Ogun State		Ejio
2				Arigbajo
3				Apomu
4				Ayepe
5				Sojuolu
6	Ejio - Olorunsogo	Ifo, Ogun State		Olorunsogo
7				Ita - Alaji
8				Fenopa
9				Lerin
10				Ikereku

11				Obasa
12				Olowofela
13				Mose
14				Ajegunle
15		Ewekoro, Ogun State		Molaja
16				Ajitadun
17				Elegbata
18				Oreke
19				Aberemeta
20				Ogunmola
21				Sowunmi
22				Soderu
23				Abese
24				Iludun
25				Ejio
26	Ejio – New Abeokuta	Ewekoro, Ogun State		Ejio
27				Iludun
28				Abese
29				Soderu
30				Adubi-Aro
31				Ayeye
32				Sepeti
33				Baase
34				Akinbore
35				Ifada
36				Onikoko
37				Oluke - Orile
38				Afowowa Eleyele
39				Ilao
40				Itori - Alase
41				Awado
42				Ake
43				Ogidi
44				Akakun
45				Onibotuje
46				Pankere
47				Agbangban
48				Ajade
49				Obolonti
50				Owode
51				Ijumo
53		Obafemi Owode, Ogun State		Agboke
54				Ikija
55				Otegbola
56				Oluwo

57				Ikija - Olose
58				Odana
59				Okuri
60				Inandan
61				Opanigangan
62				Iregun
63				Aganyan
64				Lukosi - Kenta
65				Ijemo - Efon
66				Ijeun
68				Kerebe
69				Odofin
70				Oya
71				Isota
72				Bamukun
73				Lisa
74				Tolu
75				Ototo

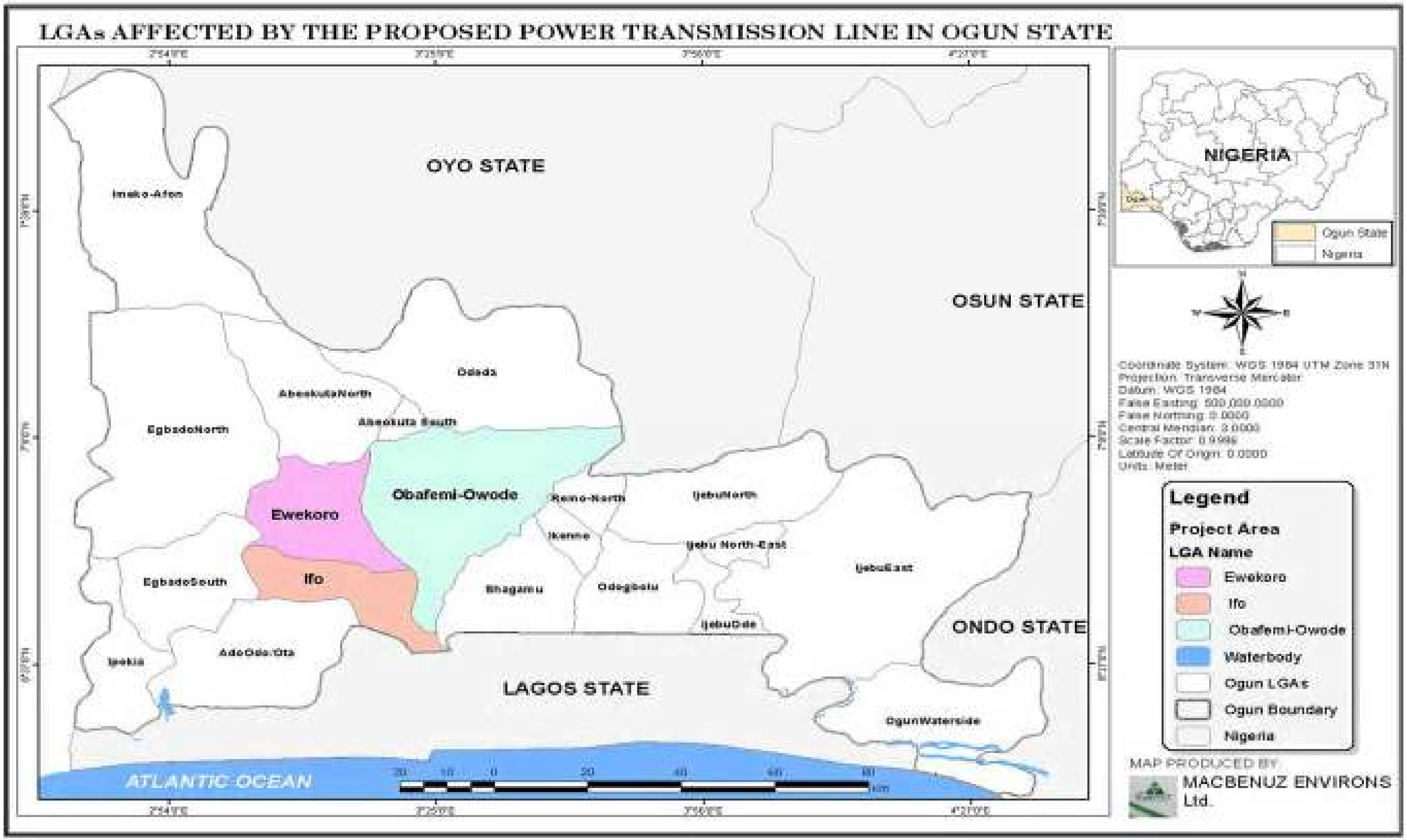

Figure 4.28a: Map of Ogun State Showing the LGAs

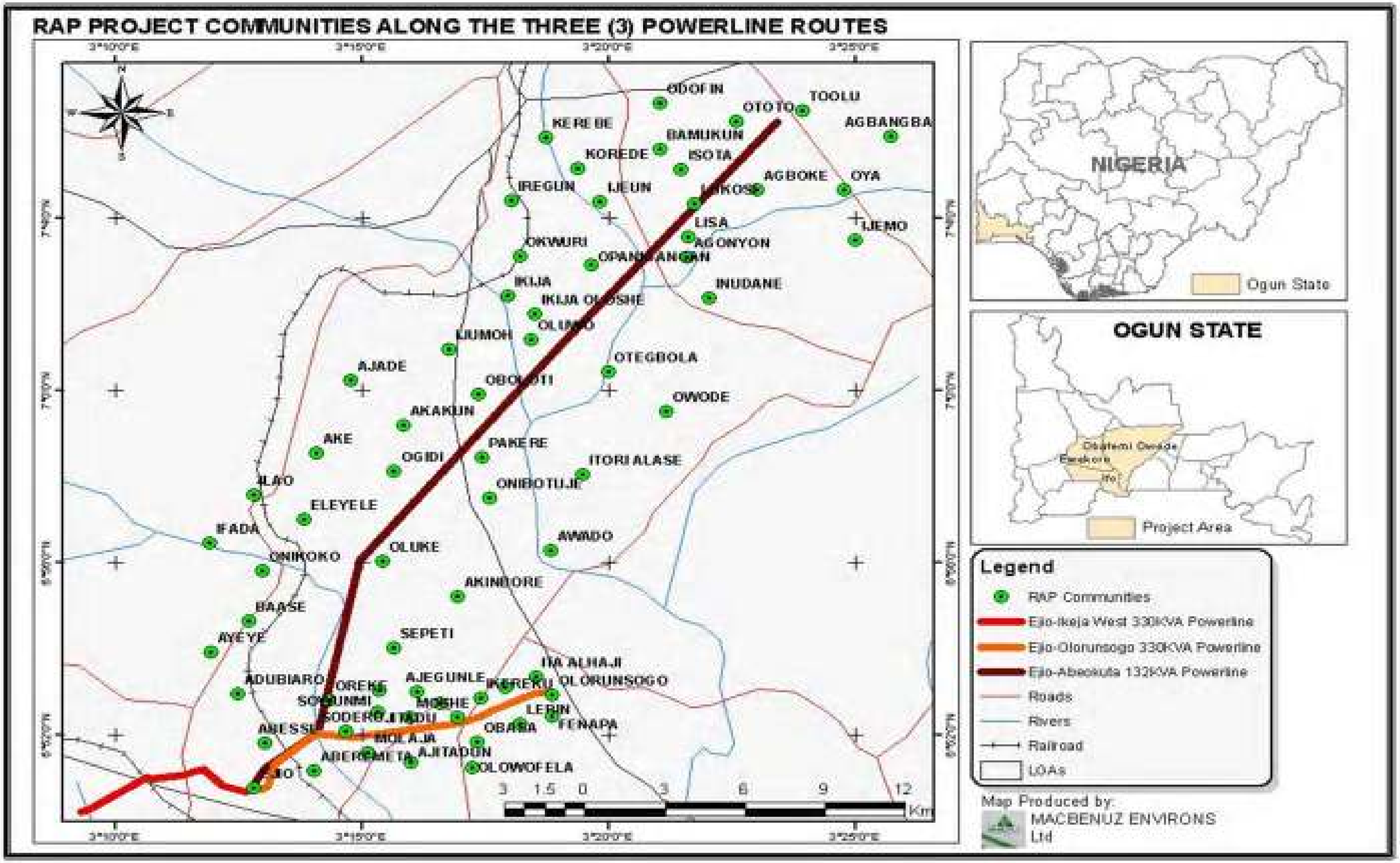

Figure 4.28b: Map showing communities around the Proposed Project

4.12.3. Household Characteristics

A total of 500 copies of questionnaires were administered, 488 retrieved representing a success rate of 98%, and 2% of health personnel from the various health centres.

The 2017 projected population estimates of all the communities from 1991 population figures at 2.83% growth rate was about 12,500 consisting of about 6,150 males and 6350 females. The study population profile comprised 10% infants (between 0 – 4yrs), 25% in the primary school age (5 – 11yrs), 20% in the adolescent group (12 - 21), 36% in the mature adults and elders group (22 – 59yrs), while the least of 3% were in the very elderly group (60yrs and above). The family size is moderate with an average of about 7-8 persons per house

j. Age and Gender Distribution

Based on the interactions with members of the communities, it was observed that majority of the people residing in the communities are between 45 and 65 years (>25%) while those above 65 year of age were the least (<19%) represented in the project area . According to participants in focus group discussions, a significant number of youths have moved to urban area to work in the factories, to school in better education facilities and to look for white collar jobs. However, the proportion of youth in various area is still fairly large which indicates a general likelihood for future growth of the populations in the communities.

The field survey revealed that the household population structure is made up of 46.5% male and 53.5% female. (Table 4.51).

Table 4.51 Age and Gender Distribution

Age Bracket	Ifo		Ewekoro		Obafemi	
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female %)
1-18	10	14	11.4	14.6	10.9	**10.1**
19-39	9	10	16.3	17.7	18.2	21.8
40-65	20	18	10.6	12.4	7.7	11.3
>65	8	11	7.4	9.8	9.9	10.1

Source: GCNL, 2017

k. Martial status of head of household

The total adults sampled consisted of 280 males and 208 females. Among them, 11% were single, 81% were married, 8% widowed. The marriage practice in the community is mainly polygamy (45%) and monogamy (55%) which is only evident mostly among the elderly members of the community. Monogamy is fast becoming more dominant due to increase in the Christian faith and the poor economy making it difficult for a man to care for more than one wife and several children. However members of the communities marry at an early age of about 19years old. The older men claimed that the several wives and children enabled them to maintain their farms and to support their farming and fishing occupations to feed and maintain the family.

Table 4.52 Nature of Marriage in Households

Nature of marriage	Ifo	Ewekoro	Obafemi	TOTAL	PERCENT (%)
Monogamous	47	104	41	192	55%
Polygamous	37	90	32	159	45%
TOTAL	84	194	73	351	100%

Source: GCNL, 2017

Table 4.53 Marital Status of Heads of Household

Martial status	Ifo	Ewekoro	Obafemi Owode	TOTAL	PERCENT (%)
Single	8	16	0	24	11%
Married	42	100	32	174	81%
Widowed	3	8	5	16	8%
Divorced/Separated	0	0	0	0	0%
TOTAL	53	124	37	214	

l. Houshold size

Information on household size of the communities in each of the LGAs is presented in Table 4.54

Table 4.54 Household Size of Project Area

Members of household	Ifo		Ewekoro		Obafemi Owode		TOTAL		Percentage (%)
	Male	Female	Male	Female	Male	Female	Male	Female	
1-2	3	4	9	8	0	0	12	12	2.7
3-5	44	45	83	117	2	1	151	192	38.3
6-10	40	54	128	148	6	7	205	239	49.7
11-15	25	35	10	13	0	0	35	48	9.3
>15	0	0	0	0	0	0	0	0	0
TOTAL	112	138	230	286	8	8	403	491	

Source: Godirra Chemicals Nig Ltd 2017

As could be seen in Table 4.54, the dominant household sizes in the project area are those made up of 6-10 persons, accounting for 49.7% of the households. This was followed by those made up of 3-5 persons (38.3%). About 9.3% and 2.7% households have family sizes of between 11-15 persons and 1-2 persons respectively. Also, the population of females in households of all the LGA was higher than the males.

m. Ethnic Compostion

The 69 communities studied belong to the Yoruba ethnic group and speak the Yoruba language with the Egba dialect. The communities are located in Ifo, Ewekoro and Obafemi Owode local government areas (LGAs) in Ogun state, Nigeria. The inhabitants claimed that they were born in their communities and have hired all their life in the communities. The settlements appear nucleated with houses facing each other along the road which tends to bend round and round enclosing the communities. The houses are also crowded together living very little spaces between them. This kind of settlement afford the people the necessary security making it difficult for thieves, invaders and outsiders to single out a house for an attack. At one call, the whole community can rise almost at once. In almost all cases there are no fences separating one building from another. Whatever affects one household immediately affects the whole community. The communities clearly demonstrate a very good example of communal living.

The communities also have the same culture and tradition of the Yoruba people in general. This is clearly demonstrated in their marriage, burial, traditional religious practices and in their general living habits and conditions. Festivals and ceremonies are marked with eating of pounded yams and rice (called "*Ofada* rice"), drumming and dancing by masquerades or people wearing masks and with tattooed bodies as well as people wearing various apparels. Some of these apparels distinguish the celebrants and their relatives from other people in the ceremony.

Plate 4.41: Ofada rice processing at Opanigangan Community

Plate 4.42: Burying family members in front of their homes at Abese community

Eight ethnic groups were observed to be present within the project area. These ethnic groups and their respondent populations in each affected LGA are presented in Table 4.55.

Table 4.55: Ethnic groups and their respondent populations in each affected LGA

Ethnicity	Local Governments			Average (%)
	Ifo	Ewekoro	Obafemi	
Yoruba	40	75	30	48.3
Egun	40	12	55	35.7
Igede	5	4	2	3.67
Ogoja	3	2	3	2.67
Aja	1	2	1	1.35
Ihori	1	2	2	1.67
Ibo	5	2	5	4.0
Hausa	5	1	2	2.67

n. Religion

The inhabitants in all the communities of study practice three religions namely Christianity, Islam (Muslim religion) and Traditional religion. In some communities Christianity is dominant while in others Islam is dominant. On the average only about 10% are the traditional religion worshippers in all the communities, studied and these traditionalist maintain and still retain the shrines in the communities. Putting all the communities together, the modern day Christianity is the dominant religion with various churches in the communities like Catholic, Anglican, Baptist, Methodist, Assemblies of god and other Pentecostal churches.

Plate 4.43: Four Square church @ Soderu and Redeem church @Sowunmi communities

Those that still adhere to traditional religion have their shrines located in the community. Some of the major shrines are as follow:

- Obatanla
- Oju Osun (eyes of the river god)
- Ogun (god of iron)
- Erinle
- Oro
- Oju Yemoja
- Egungun
- Sango (god of thunder)
- Oya
- Papa
- Iguniko
- Esu (devil)
- Egun (Shokpono and
- god of Masquerade)
- Alale
- Aragbo
- Ogunyemoja
- Uso
- Igbogunko kuso
- Angora
- Ogboni (brotherhood fraternity)

Despite the presence of the three religions, the people have no religion crisis and they live together peacefully. The major forbidden/evil forest in the communities is the Igbo-oro. Women, children and strangers are not allowed into these forests. Others are Igbo fa, Igbo meiro, Igbo Ounuko and Makpere land.

Plate 4.44: Esu (devil's) shrine at Abese community

o. Traditional style

All the communities studied claimed that their ancestors migrated from Abeokuta in Ogun State to settle in their present day communities. They claimed that their forefathers were great farmers and till date farming is still their main occupation. The quest to acquire more expanded land for farming and to acquire more independence and freedom influenced their forefathers' migrations.

The migration thus afforded the people the opportunity to acquire the land on which they settled for agricultural, hunting and development purposes.

Traditionally, the first settler became the head of the community where they settled and in most cases the community is named after him. So most communities bear the name of the founder or first settler.

The major festivals of the communities is the New Yam Festival whereby they celebrate the harvest and the dawn of new farming year. It is marked by eating, drinking and various dances with the traditional ruler chairmaning the occasion. They are also said to make sacrifices to their gods for provision, protection and blessings. The other major festivals are the worshippings of their gods at their various shrines. The days set aside for each of these festivals are usually determined and announced by the traditional rulers (the Baale and the chiefs) and the chief priest of the various shrines. The information is announced to the people by the town crier (information officer).

The communities also observe and celebrate other modern day festivals like the Christmas, New Year, Independence Day and Easter celebrations. The Muslims also celebrate Muslim festivals and holidays (e.g. Eid el kabir, Eid el malud) as it happens in other parts of Nigeria.

Marriage and Burial ceremonies are also marked in their Yoruba traditional ways as has always been the case. These ceremonies are marked with various cultural dances and traditional rites and have not changed since the advent of modern day developments. The culture and tradition of these communities are very rich and admirable.

Generally the people forbid adultery and incest and the eating of sacred animals e.g. the vulture, snakes, alligator, dove, deer and millipedes. Apart from these the people really do not have so many forbidden food (except eating of millets or drinking of palm wine "Emu Okpe") or cultural/ traditional taboos. Strangers therefore find it easy to mix freely with the people.

4.12.4. Economic Environment

4.12.4.1. *Occupation*

The major occupations of the people of the communities are farming (75%), trading (50%), fishing (40%), hunting (20%) labourers (10%) and others e.g. civil servants, skilled workers etc. (10%). Some people, as shown from the prevalence figures of the occupations combined two or more occupations (e.g. fishing and farming, fishing and trading or even farming and civil service job) in order to improve their quality of life which was generally poor. The people engaged in farming, fishing and other labourious work which make them susceptible to injuries and other health hazards associated with these labourous occupations. Among the farmers, common crops grown are cassava, yams, cocoyam plantain/Banana, vegetables maize, ofada rice and beans. The farmers claimed that for more than 20 years now the yields have been poor due to land overuse with no shifting cultivation and the non-use of fertilizers.

Plate 4.45: People ploughing their farmland at Olorunsogo Community

Plate 4.46 : Processing of cassava from the farm produce in Olorunsogo community

Fishing is done in communities that have rivers or streams e.g. Opanigangan, Iregun, Inandan and Okuri communities fish at river Ogun; Illudun-Ejio, Abese uses Osun stream; Soderu, Sepeti, Ayeye and Adubi aro communities use the Wagunnu River; while Ijumo-Ologboni, Ajade community uses the Odo Ipa River. Those that used to fish in the nearby creeks and rivers were said to also have very poor fish yields possibly due to the effects of over fishing. Some of the common fishes caught from the water include mostly, cat fishes, tilapia, momyrups and other freshwater fishes. The people also fish out periwinkles, aquatic snails, oyster and other aquatic animals for local consumption.

Most of the youths (about 85%) complained of unemployment hence they resorted to self-employment jobs of fishing, farming, trading or other labourious jobs. There have been no help from governments or any other organizations in the employment of the youths and no help to even enable them enhance their occupations of farming, trading or other jobs.

4.12.4.2. *Industry*

Olorunsogo Power Plant Phase 1 at Olorunsogo managed by Pacific Energy Company Limited, Olorunsogo Power Plant Phase II at Olorunsogo, Lafarge Cement Company Limited at Papalanto community and Ice block fabrication industry at Abese are the most known industries in the area. However, cassava processing industries, oil palm processing industries, building block industries, pure water industries and bakeries are some other examples. It was revealed that most of them are owned by non-indigenes. Hospitality industries –hotels are also present in the area.

Plate 4:47: Ice Block Machine fabrication @Abese

Plate 4.48: Olorunsogo Power Plant Phase 1

4.12.4.3. *Income*

The average monthly income in the communities was very poor and most people earned below ₦20,000 monthly. The breakdown of the income levels from respondents was as follows: Less than ₦10,000 per month (20%): ₦10,000 to ₦19,999 (50%): ₦20,000 to ₦29,999 (20%), and ₦30,000 and above (10%). The respondents claimed that they do not actually keep records of their incomes but simply spend money as it comes. They claimed to spend their income on feeding, paying rents, clothing, children's education, medical care, transportation and general living expenses.

They do not own many possessions and claimed not to really save any money since the money was not even enough to spend. To live sustainably on the average nowadays, particularly in the modern day when goods and services are very expensive, an individual has to earn sufficiently in the neighbourhood of at least ₦50,000 monthly.

Table 4.56: Average monthly income of communities

Monthly Income Level	% of People
< ₦10,000	20
₦10,000 to ₦19,999	50
₦20,000 to ₦29,999	20
≥ ₦30,000	10

4.12.4.4.*Educational Level*

The Educational status showed that about 70% of respondents have had at least primary education and can speak (i.e. communicate orally) as well as read and write using English Language. However most of the people (about 95%) were very well informed and speak Pigeon English. The educational status in the communities at the time of study was as follows: No formal education (30%), Primary education only (30%) secondary education attained (30%), Tertiary education (University Polytechnic graduates) (8%) Higher Degrees (Master's/Doctorate degrees) (2%). The people were thus very well informed on socio-economic and health issues relating to the overall development of the community.

Table 4.57: Eduational level of communities

Educational Level	**% of People**
No formal education	30
Primary education only	30
Secondary education attained	30
Tertiary education (University and Polytechnic graduates)	8
Higher Degrees (Master's/Doctorate degrees)	2

4.12.5. Existing Infrastructure

a. Educational facility

Most communities do not have schools. A few have only the primary school while the secondary schools are even fewer. Children have to travel long distances on foot on very bad roads to attend school daily. All the schools are however very poorly maintained by government. They do not have educational facilities and no enough teachers. There are no tertiary institutions. For example, There is only one primary school at Olorunsogo for the five communities living in the axis, namely Olorunsogo, Lerin, Akinlagun, Fenopa and Ita Alhaji while for the secondary education the children go far outside the communities to Papalanto or Itori or Abeokuta which are over 10km away. Also at Moshe, Olowofela, Ajegunle, Ijoko and Apena communities, only Moshe has a primary school. The children also have to go far away to Papalanto, Itori and Abeokuta for their secondary education and only a few wealthy ones can afford this.

Plate 4.49: Methodist Nursery and Primary School in Abese Community

Plate 4.50: Primary school donated by the Chinese Organization at Olorunsogo

b. Water

Inhabitants of the impacted community obtain water from rivers, streams and wells (95%) while only about 5% use borehole water provided by some individuals (i.e. private boreholes). There were also some old ring wells and mono-pump boreholes established in the 1970's by Directorate of Food, Road and Rural Infrastructure (DFRRI) but are no longer in use, as the water produced, if at all, were of very poor quality. Almost all the people in the communities use mostly pure water in sachets as their drinking water. These are sold at 10 naira per sachet.

Plate 4.51: Borehole facility @ Sowunmi and Ajade communities respectively

Plate 4.52: Community water well facility in Olorunsogo Community

c. Electricity

Most of the communities (80%) have no electricity supply from the National Grid of Power Holdings Co-operation of Nigeria (PHCN). Only financially capable individuals generate their own power supply by use of petrol powered generators. This is a major problem in the community.

Plate 4.53: Electricity line and Transformer at Soderu Community

d. Health care facility

The communities had only one Primary Health Care Centre each at Olosunsogo and Obaeerin communities. All other communities had no clinic or health centre. For proper medical care the people go to Ifo, Itori, Abeokuta and Shagamu Hospitals which are over 1 hour distance by road for only serious medical cases. There are a few private clinics which were usually too expensive for the masses.

There were also said to be a very few herbalists and Traditional Birth Attendants (TBA) in the communities although their numbers were not officially known or disclosed by the people. Most people were said to simply embark more on self-medication with drugs purchased from the several medicine stores and people only go to the hospital when their cases are serious. Personnel and medical facilities in the Health centres are very poor as the centre has no resident doctor

e. Security facility

The existence of police station was only noticed at Oba Eerin and Ejio Communities out of the 69 communities of the project area. Most communities surveyed practiced local community policing (vigilante groups) or solely rely on tradition medium in tackling crime. According to the respondents, one of such traditional medium is the Esu deity. They claim that the Esu is capable of punishing anyone who does evil in the community, hence, there is a reduced crime rate in the affected communities.

Plate 4.54 : Police station at Oba Eerin

f. Transportation facility

The major roads that linked the major towns were all tarred by the Government but with lots of pot holes and gallops. They were also narrow and windy at the time of study. The major road that linked the communities is the Papalanto - Shagamu road. This road is very bad as the pot holes have turned to trenches making it very difficult even for Lorries and trailers to pass and certainly impassable to cars. The adjoining roads linking the communities to the Papalanto - Shagamu road as well as the roads within each impacted community were earth roads, and were untarred. They still had lots of pot holes. The roads also had no good drainages. Other feeder roads in the communities were also earth roads and very poor.

Plate 4.55: Devastating state of the major road (Papalanto-Shagamu) to these communities

Plate 4.56: Papalanto–Soderu Road (Earth road).

g. Waste management

The residents of both communities that live by the rivers dump their wastes into the water while other dump their refuse at specific designated places at the back of their homes for final disposal by burning or burying. Most of the people (80%) use the pit latrines or bush while a few (15%) use the river water. It was only about 5% that use the modern day water cistern flush toilets. The people of the impacted communities are generally clean and the entire communities were also seen to be neat.

4.12.6. Community Health

a. Adult Health Problems

The common health problems identified among the adult population were malaria (36%), Gastroenteritis (32%). Dysentery/diarrhea (30%), Body pains/ Rheumatism (30%), Sores/injuries (23%) and Cough/URTI (22%), as shown in Fig 4.29 some individuals have more than one ailment.

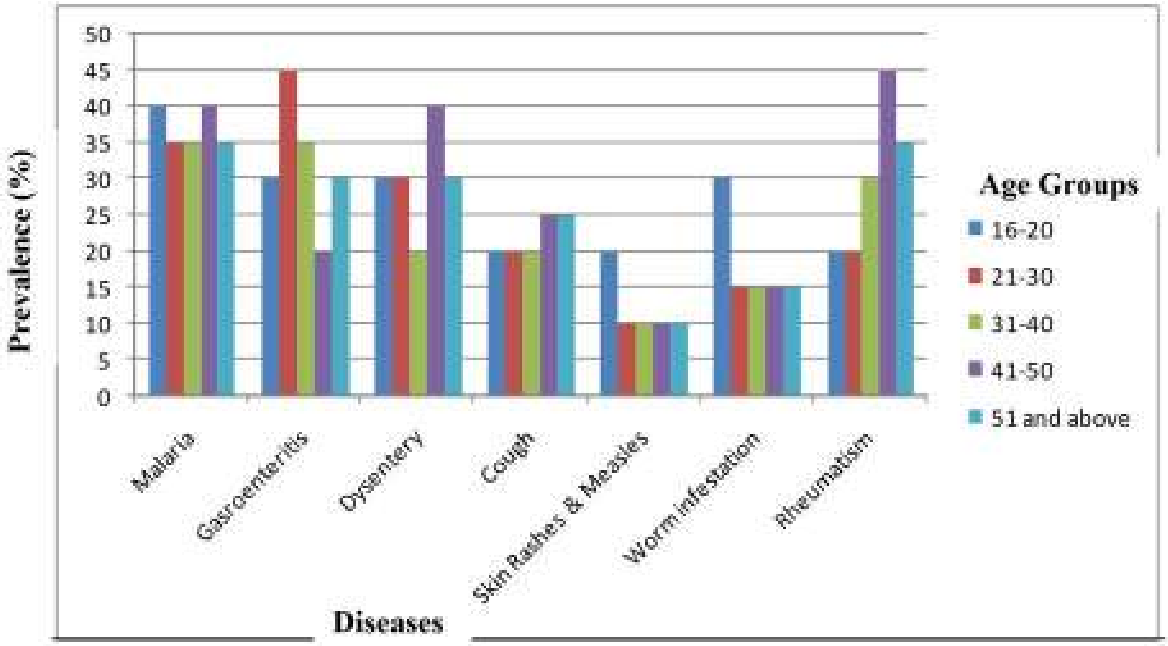

Fig 4.29: Prevalence of diseases according to age groups among adults in the communities based on responses to the questionnaires and clinical/physical examination of the individuals.

b. Children Health Problems

Among the children the most common health problems were also malaria (20%), Dysentery/Diarrhoea (18%) Gastroenteritis (14%) worm infestation (14%) and cough (10%) as shown in Fig. 4.30 some individuals have more than one ailment.

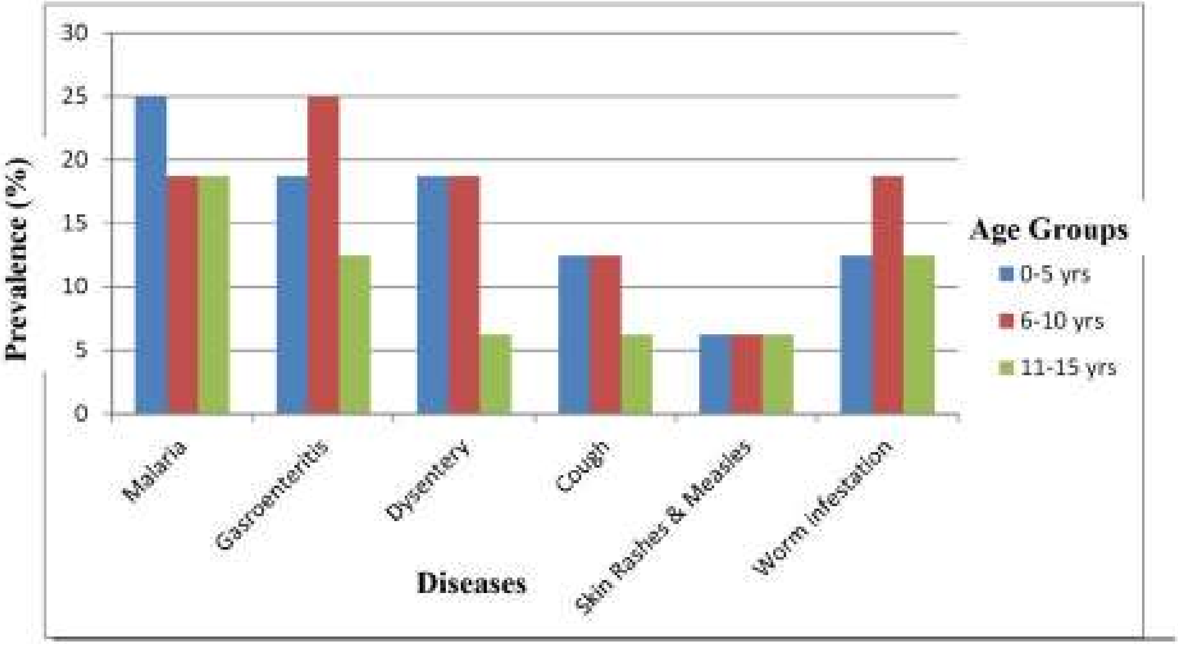

Fig 4.30: Prevalence of diseases according to age groups among children in the communities based on responses to questionnaires by parents and clinical/physical examinations of the children.

The diseases recorded are those that have been endemic in the communities as far back as they can remember and no modern development projects were said to have adversely affected the health of the people.

c. Disease ailments according to Age groups and Sex

Among the adults the most elderly in the 50yrs and above age group had the highest number of cases with diseases while the 21-30 years age group had the least number of cases. Among the children, the number of cases with diseases was highest among the 6-10yrs age group and least among the 11-15yrs age group. Generally males seemed to harbour more cases of diseases ailments than females. This may not be unconnected with the fact that males were probably more exposed to these infections due to their occupation and various outdoor activities.

d. Causes of disease ailments

The major causes of the diseases can be attributed to the poor unhygienic living conditions exposing them to flies and mosquito bites and other disease pathogens in air and water thereby causing malaria fever and other gastrointestinal diseases. Cough and respiratory ailments may be due to air pollution due to poor sanitation and emissions from the Lafarge cement factory in the locality. Among the non-communicable diseases body pains was mostly due to their fishing and farming occupation and hard labour. Injuries were mostly due to occupational or home accidents or due to fighting/assault while boat accidents were least common. Other non-communicable diseases like Hernia, Diabetes and High Blood Pressure seemed to be acquired with age due to the unguarded and unregulated or free lifestyle of the people as the diseases occurred mostly among the elderly people. The people have always had these ailments from time. The prevalent diseases seen during the studies are the typical tropical diseases endemic in local communities.

e. Knowledge, Attitude and practices on health issues

The results showed that the inhabitants know very well the nature and causes of the common diseases e.g. Malaria, Dysentery, Body pains etc. they suffer. They also know how such diseases can be prevented or controlled but their major constraint has been their poor financial status (poverty) and lack of good medical care in the communities. For the same reason most people (60%) buy drugs or obtain herbs to treat themselves (through self-medication) when sick and most pregnant women go to Traditional Birth Attendants (TBA's) to deliver their babies rather than go to the hospitals. However, only (30%) of the people go to the hospital only to take prescription from the doctor and purchase their drugs from chemist stores by themselves. Six percent (6%) of the people go to native herbalists while 4% rely on spiritual healing and go to prayer houses for their healings.

The inhabitants also claimed that children particularly those under 5 years of age seem to die more in the communities than the teenagers and adults. This according to them was due to lack of proper medical care, poor feeding and self-medication practices. They claimed that people only go to hospitals when the sickness is very serious and complicated and after self-medication has failed. On environmental issues on health, the people agreed that poor toilet facilities, poor sanitation and living conditions, poor waste disposal methods, poor housing and poor personal hygiene, all contribute to poor health in the communities.

f. Nutritional status of the respondents.

The food items consumed by the respondents in the communities are starchy staples such as cassava (and its bye-products like *garri, starch, fufu* or *Santana* etc) plantain, cocoyam, rice (*ofada* rice), beans and yams. Animal protein foods are fish, shrimps, snails and bush meat from antelopes, grasscutter and giant rats. Animals such as domestic fowls and ducks are also reared for meat. The people also eat lots of vegetables and fruits (e.g. vegetables are used for production of the local common soup).

Most people (85%) eat twice a day (i.e. morning and evenings (50%) or afternoons and evenings (35%). The rest (15%) claimed to eat only one solid meal in a day and usually between afternoon and evening periods.

There are no special food items for breakfast, lunch or dinner but the people simply eat any food items as they are available at any time of the day.

The Body Mass Index (BMI) was calculated for the adults and it is the weight in kilograms over the height in metres^2. The result showed that 68% of the respondents have normal nutritional status (Table 4.56).

Table 4.58: Nutritional status of Adult respondents as estimated by the Body Mass Index (BMI)

Health indicator	Standard Reference value of BMI	Number of respondents	Percentage of Respondents
Under Nutrition	<20	10	20%
Normal	20-24.9	34	68%
Overweight	25-29.9	6	12%
Obese	30-39.9	-	-
Grossly obese	≥40	-	-
Total		50	100.0%

For the children, indices for stunting, wasting and underweight were calculated.
Underweight (Malnutrition) was obtained by comparing the mean weight of children under study over the mean weight of normal children of same age and compared with standard or reference values.
Stunting was obtained by comparing the mean height of children under study over the mean height of normal children of same age and expressed with standard or reference values.
Wasting was obtained by comparing the mean weight of children of study over the mean weight of normal children of same height and expressed with standard or reference values.

The calculated value of the nutritional status in the children showed no malnutrition, no stunting and no wasting (Table 4.57).

Table 4.59: Calculated values of nutritional status for underweight, Wasting and Stunting for 50 children at the impacted communities

S/No	Age (Months)	(A) WEIGHT FOR AGE (UNDERWEIGHT)			(B) WEIGHT FOR HEIGHT (WASTING)		(C) HEIGHT FOR AGE (STUNTING)	
		Mean weight (kg)	Normal Range	Remarks weight for Age	Percentage weight for height	Remark	Percentage Height for Age	Remarks
1.	0-10	6.50	3.5-9.4	Normal No underweight/ malnutrition	96.50%	Above 80% no wasting	97.50%	Above 90% No Stunting
2.	11-20	10.5	9.5-12.4	"	92.15%	"	97.55%	"
3.	21-30	13.2	12.5-14.4	"	92.45%	"	98.20%	"
4.	31-40	15.6	14.5-17.4	"	95.32%	"	98.77%	"
5.	41-50	18.5	17.5-19.4	"	90.52%	"	99.53%	"

g. Immunization status:

At the family and household levels the immunization coverage of the infants and children for oral polio and measles vaccine could not be correctly ascertained due to absence of health records. Only 20% of parent respondents claimed to have given their children vaccination at birth in the health centers. Everybody was said to benefit in the house to house polio and measles vaccine given by the Federal Government of Nigeria. The immunization given according to the parents, are also always incomplete.

h. Social Habits and life style

(1) Drinking: Generally most adult males (about 60% recorded by the use of questionnaire) drink alcohol in each communities. Those that do not drink are mostly Christians. Of those that drink alcohol, only about 20% were said to occasionally drink excessively. The male to female ratio in alcohol consumption was 10:1

(2) *Smoking*: About 40% of the males smoke cigarettes or snuff ground tobacco while 5% of the female agreed to take snuff ground tobacco only but no female agreed to smoking cigarette. A few unknown numbers among the youths are said to smoke Indian hemp but other drugs like cocaine, heroine etc. are said to be non-existent. Nowadays most people do not smoke due to their Christian faith.

(3) *Physical exercise/leisure*: Except for the very elderly which constituted about (2%) that can no longer move about, other inhabitants in each communities are very active and get exercised during their physical manual labour in the daily occupation of mostly fishing farming and other labourous jobs. Also the youths play various games like tennis, draughts, ludo and also engage in competitive football matches with other communities.

(4) *Prostitution*: Prostitution is known to exist in the communities but only about 5% of the women are said to be involved. The prostitutes are not officially known. Sexually transmitted diseases (STD) are said to be very low in prevalence and only 2.0% (in teenagers 11-15yrs old) and 10% (in adults) infection rates with STD was recorded in the communities. Oral interviews and analysis of questionnaire showed that (100%) members of the communities are aware of the AIDS disease but according to them, no AIDS has been recorded in the communities.

(5) *Personal Cleanliness and Hygiene*

On personal cleanliness and hygiene the respondents claimed to have good hygiene practices and good sanitation in the communities. All respondents (100%) claimed to wash their hands before and after meals and after going to toilet, and all still claimed to sweep their floors as well as take bath every day.

4.12.7. Housing and Living conditions

In the host communities of study most of the houses (about 80%) were permanent structures constructed with brick walls and roofed with corrugated iron sheets (zinc). They are thus semimodern houses with good ventilation. The houses were more or less similar to the type of average living houses found in most towns and cities in Nigeria. There were also modern buildings (accounting for 10%) with up to date modern facilities. The rest (10%) houses are very poor houses with weak walls (made with sticks and mud) and lack proper ventilation but with zinc roof tops. In most houses in the communities the kitchen and toilets are built outside and behind the main house. Houses generally were built in linear patterns with the roads.

Plate 4.57: Block -Cemented and Thatch house in Olorunsogo

4.12.8. Indigenous People

IFC Performance Standard 7 recognizes Indigenous Peoples as social groups with identities that are distinct from mainstream groups in national societies. Indigenous people are not applicable in Nigeria. However, the Federal Government recognises ethnicity. Nigeria has three largest ethnic groups that include the Yoruba, Hausa–Fulani and Igbo, representing 71 percent of the population. The project is located in South-west Nigeria and the people living in this region are mainly the Yoruba ethnicity.

4.12.9. Land Use

The Transmission Line mostly passed through farmland and built-up environment. Farming accounted for 28.6% of land use in the locations followed by fallow land and abandoned farmland with 21.4% each. This pointed to the fact that the locations had more of farming population than other activities.

4.12.10. Property Ownership

Land is owned by families and by the communities under the care of the community head (i.e. the Baale and Chiefs). Land reserved for development is under the care or custodian of the village head and paramount ruler. This is because land is a very scarce commodity and requires good protection for generations yet unborn. The community agrees that all land belong to the Federal Government of Nigeria who have the right to acquire any land for use by Government in the interest of the people. The community members have always complained to the only little land available is for farming but they insist on having the land and do not pay the appropriate compensation.

Families and individual land owners keep their land by cultivating it yearly to prevent its acquisition by other people. At the time of study there were no cases of land dispute and land tenureship in the communities.

4.12.11. Cultural Heritage

There are archaeological and sacred sites, such as traditional burial grounds and shrines in the communities. These sites are highly valued by the people and considered sacred and encroachment in such areas would attract serious resentment from the communities. The people celebrate several traditional festivals, the observance of which is believed to be for the general well-being of the people (see Plates 4.58 - 4.63).

There are shrines believed to meet the need of its people by providing children for the barren, protection from evil, good luck in life endeavor, etc. It is cultural belief to bury their loved ones in front of their houses except in the following cases: if the person commits suicide and/or dies in the course of doing evil/forbidden things then the corpse of such a person is bury at the evil forest which is out of reach to strangers.

Plate 4.58 : Sacred place for Shokpono deity at Abese **Plate 4.59 : Tombs by residential homes at Abese**

Plate 4.60 : Sacred Esu deity at Ijumo **Plate 4.61: Iju-Yemoja Shrine at Oluke Orile**

Plate 4.62 : Esu (devil's) shrine at Abese

Plate 4.63:Masquerade house in Oluke Orile community

4.13. Consultation of Stakeholders

This chapter outlines the public information and consultation process that has been designed and implemented in order to facilitate the informed participation of the project affected persons (PAPs), communities and other stakeholders affected by or with interest in the project. As such, consultation objectives, activities and outcomes are reported.

4.13.1. General Objectives

General stakeholder engagement objectives of this study were to:

Inform stakeholders on the proposed infrastructures and activities and seek their informed opinion about the socio-environmental risks and opportunities potentially associated with the project as well as take the measures and actions in order to manage the anticipated impacts;

Obtain feedback from stakeholders on issues of concern and expectations in order to optimize the project

Generate a social and institutional dialogue in order to assess and strengthen the project's social acceptability;

Help to consolidate, through the ESIA process, the efforts made by the TCN in order to establish lasting relationships with affected communities and other stakeholders.

4.13.2. Stakeholder Information and Consultation Rounds

Three stakeholder information and consultation rounds were planned, and two has been implemented through the development of the line route survey, the ESIA/ESMP study and RAP of this project. They were planned according to key stages, or decision moments, throughout the study where the informed participation of stakeholders were likely to make the most significant contribution to the on-going analysis.

These included the scoping stage (1st round), the initial community sensitization, preliminary route assessment, consultation at affected Local Government and the documentation of the affected communities and displaced households stage (2nd round). The third round of consultations is scheduled for the disclosure of the Final Line Route, ESIA, ESMP and RAP preliminary results (3rd round).

Table 4.58 outlines the studies' stakeholder engagement process and presents, for each consultation round, the specific engagement objectives, target groups and implementation periods.

Table 4.60 Stakeholder Consultation Implementation

ROUND	OBJECTIVES	TARGET GROUPS	IMPLEMENTATION PERIOD
STAGE 1: Environmental and Social Scoping	• Present the project and the ESIA process to key authorities; • Identify key issues, concerns and expectations related to the project and study area; • Complete the stakeholders' list and validate the general approach for consultations.	• Transmission Company of Nigeria (TCN) • Concerned ministries • State and LGA Administration • Customary Chief's of areas affected by the line	May/Jun 2017
STAGE 2: Line Route Study	• Involve key stakeholders in the analysis of the « hot spots » identified along with the provisional line route. • Inform affected communities and involve them in environmental and social optimization of the line route; • Identify the concerns and expectations of affected communities, displaced households and women; • Inform affected households of their rights and options for resettlement.	• Transmission Company of Nigeria (TCN) • Concerned ministries • Local authorities • State-level and LGA-level authorities and technical services. • Affected people and their leaders. • Women representatives. • Customary chiefs.	Oct./Dec. 2017
STAGE 3: Disclosure of Preliminary Results (ESIA, ESMP and RAP)	• Present, validate and enhance preliminary ESIA and RAP results. • Ensure compliance of the proposed measures with the requirements of regulatory authorities; • Evaluate the social acceptability of the project and its proposed measures.	• Transmission Company of Nigeria (TCN) • Concerned ministries at national and state levels. • Local authorities and community leaders from affected LGAs. • NGOs.	To be determined

4.13.3. Stake Holder Identification and Mapping

Target stakeholder groups for the stakeholder engagement process include:

→ Concerned agencies and organisations at State and National levels – (Secondary stakeholder)

→ State-level (Ogun) agencies – (Secondary stakeholder)

→ Customary authorities in communities affected by the line; -Obas, Ba'ales and Village Heads crossed by the line route. – (Primary stakeholder)

→ Industrial and commercial actors affected by the line, including relevant TCN departments, and JICA – (Secondary stakeholder)

→ Security agencies, national civil security and defence corps, department of security service, and the Nigerian Police – (Secondary stakeholder)

In the case of the project, the scenario is such that the land is acquired from the leaders and members of the affected communities who have consented. These communities have been informed and have agreed to release the portions covered by the transmission line and substations based on adequate compensation. The next few paragraphs will discuss the identified stakeholders for the transmission lines as well as indication of their stake in the project.

a. Government Authorities

Federal and State Governments as well as Local Government constitute important stakeholders within the projects engagement framework. Some are regulators who issue the necessary permits while others may provide information on demography, climatic conditions, etc. Engagement with these agencies must live throughout the project life span. During this scoping phase of this project, the following stakeholders were identified.

- Federal Ministry of Environment (FMEnv), Abuja;
- The Federal Ministry of Power, Works and Housing, Abuja;
- National Energy Commission (NEC), Abuja.
- The Nigerian Electricity Regulatory Commission (NERC), Abuja;
- The Nigerian Gas Company (NGC);
- Nigerian Railway Corporation (NRC)
- Nigerian Meteorological Agency (NIMET)
- The Ogun State
- Ifo Local Government
- Ewekoro Local Government
- Obafemi Owode Local Government (Oba LCDA)

The Project falls within three LGAs located within Ogun state. TCN together with the consultants engaged with the relevant departments of the LGAs and asked them to consider the project activities in the wider planning for the LGAs. In addition, concerned Ministries and Ministerial Agencies within Ogun state and Federal Government will be engaged throughout the project lifecycle to ensure that they are kept informed and are given an opportunity to provide input in their respective planning areas.

b. Communities and Traditional Institutions

Traditional institutions, their councils and the leaders of the social groups in the community (such as women, youths, market women and local farmers) are engaged on a continuous basis in a discussion of all aspects. Meetings with these groups follow local practices and norms and is held prior to any wider communication in the villages in order to respect the traditional structures. The Project affected communities identified are listed in Table 4.50

c. Vulnerable Groups

Typical Corporate Social Responsibility (CSR) initiatives are designed to favour these groups as much as practicable. Women have been identified as vulnerable group for the project, due to their economic vulnerability and inability to participate in decision-making processes within the traditional context. Women in the project area are not always able to attend or speak freely at open meetings and/or may have household restrictions on when they are able to attend such meetings. However, the project holds meetings where women leader were present and places convenient to the women in each community. Focus group discussions were also held with women. Women leaders were given opportunity to present the needs/request of all the women in the community during meeting which most times borders around provision of credit facility/ soft loan to enhance their means of livelihood and group pictures were taken as an evidence at the end of the meeting.

Other potential vulnerable groups identified as part of the EIA include the elderly, youth and migrant farmers. Vulnerability of these groups is also based on reduced opportunities to participate in local decision-making, as well as their economic vulnerability, particularly with regard to employment. As such, engagement activities have been designed to ensure representation of these groups among stakeholders, and to seek to understand potential project interactions with their livelihood opportunities and agency within the communities. The elderly were duly represented in the meeting by their designated spokespersons; the youth leaders were eyes of the entire community youth members on issues that borders mostly employment during the project take off.

Plate 4.64.: Women leaders making their Inputs during Stakeholders Consultations at Ewekoro LGA.

d. Non-Governmental Organizations (NGOs)

NGOs are organisations which declare interest in a given project and try to influence decisions on such projects through direct contact or public opinion. NGOs may also have data and insight into the dynamics of a given project and may become useful partners in the project. The main mechanism for engagement with relevant NGOs germane to the project will be through face-to-face meetings at key stages of project development (during the EIA and at the onset of construction). Nigeria Conservation Foundation (NCF) was consulted at their headquarter kilometer 19 Lekki-Epe Expressway on 7th March 2018. NCF was briefed on the transmission line project by the TCN Project Manager in the presence of JICA team and representative of the three consultants and the Executive Director of Nigeria Conservation Foundation promise to partner with TCN, review the ESIA report on their areas of concern.

Plate 4.65.: Consultation with Nigeria Conservation Foundation (NCF)

It is important to note that stakeholder identification is an ongoing process, and thus stakeholders will continue to be identified during different stages of the project. Table 4.59 presents the main stakeholder groups

Table 4.61 List of identified stakeholders

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Neighbouring/Host Communities (See Table 4 for the list of communities)	• Communities living along the Transmission Lines and close to the substations site ; • Other communities within the project area of influence; • Vulnerable groups within these communities; and • Workforce recruited from the communities.	• Village Head ('Baale'); • Community Development Association; • Religious leaders; • Village elders; and • Sagamu, Ewekoro, Obafemi Owode and Ifo LGAs
Institutional Stakeholders	• Social infrastructure, like schools, health facilities and emergency services.	• Political Parties; and • Project investors (TCN, JICA).

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Regulatory Authorities		• Federal Ministry of Environment; • The Federal Ministry of Power, Works and Housing, Abuja; • The Transmission Company of Nigeria (TCN), Abuja; • Ogun State Team • The Nigerian Gas Company • National Environmental Standards and Regulations Enforcement Agency (NESREA)
Other Groups		• NGOs and Civil Society; • Media; • Other projects in the area; and • Universities and other institutions doing research in the area.

Table 4.60 below gives an overview of the stakeholder groups and their concerns, expectations and influence on the project.

Table 4.62: Stakeholder Mapping

Stakeholder Category	Relevant Stakeholders	Profile/Status	Concerns surrounding the Project	Expectations from the project	Nature of influence on Project
Primary	Communities living along the Transmission Lines and close to the substations site	These communities may directly be impacted by the project and may experience cumulative impacts	Additional impacts and risks to existing situation.	Support in social infrastructure and employment at the site.	Protest and/or causing delays.
Primary	Other communities within the Project area of influence.	Directly impacted by cumulative impacts and risks from Lafarge's site with past impacts and risks.	Additional impacts and risks to existing situation.	Support in social infrastructure and employment at the site.	Protest and/or causing delays.
Primary	Construction labour force recruited from the communities.	Temporary employment and income from construction activities.	Labour and Working Standard risks and employment opportunities.	Employment and good wages.	Protests if employment opportunities are disappointing.
Secondary	Community.	- Discussion of community concern;	- Youth empowerment; - Provision of	- Youth empowerment; - Provision of basic	Protest and/or causing delays.

Stakeholder Category	Relevant Stakeholders	Profile/Status	Concerns surrounding the Project	Expectations from the project	Nature of influence on Project
		- Discussion with the vulnerable groups, women and youths; - Discussion on TCN workers integration into the community; and - The need for a grievance mechanism throughout the project.	basic social amenities and infrastructure; and - Influx of workers.	social amenities and infrastructure; and - Compensation.	
Secondary	Federal Ministry of Environment.	- Registration of the Project; - Scope of data collection and ToR approval; - Issues concerning site visits; - ESIA process and scope of the ESIA - Approval for one season waiver.	No concerns on the status of the project.	Submission of Draft Report and processing fee payment.	ESIA Permit.
Secondary	Transmission Company of Nigeria.	National Grid Connection Approval.	- Transmission Line (TL) and Substation operation; - MOU between TCN and JICA; and - Preliminary Route and Substation Map Approval.	- Agreed MOU; - Approved TL design; and - Approved Preliminary Route Map - Approved Substation site	Permit and Execution of the project.
Secondary	Federal Ministry of Works, Power and Housing.	Moderation of parties involved.	MOU between TCN and JICA	- Agreed MOU; and - Electricity supply.	Permit and Execution of the project.
Secondary	Nigerian Gas Company.	Meeting with TCN on the RoW	Transmission line alignment	Notification on transmission line	Project execution.

Stakeholder Category	Relevant Stakeholders	Profile/Status	Concerns surrounding the Project	Expectations from the project	Nature of influence on Project
		acquisition.	design.	construction.	
Secondary	Ogun State Ministry of Environment; and Ogun State Environmental Protection Agency (OGEPA).	Compliance monitoring of approved EMP.	Environmental degradation.	Compliance with approved EMP.	Project execution.
Secondary	National Environmental Standards and Regulations Enforcement Agency (NESREA).	Compliance monitoring of approved EMP.	Environmental degradation.	Compliance with approved EMP.	Project execution.
Secondary	Local Council Development Authority (LCDA)	- Engagement with affected communities; - Potential positive impacts (employment opportunities for local people and provision of electricity); and - Community Development.	Environmental degradation and community development programme implementation.	Compliance with approved EMP and implementation of community projects.	Project Execution.

The host Local Government Areas are: Ifo, Ewekoro and Obafemi Owode and the host communities include those listed in Table 4.50. Pre-entry consultations were held with the Executive Councils, Elders and Youths of the host communities between December 12 and 14 at Local Government Secretariat. During these periods discussions and consultations enabled the stakeholders to be informed of the intent of the proponent and a collection of the views of the people about the proposed project.

4.13.4. Consultation Activities

The summary of consultation activity conducted to date are summarized in below table.

Table 4.63: Stakeholder Engagement activities to date

Stakeholder Engagement	Engagement Activity	Stakeholders	Number of Participants	Venue	Date/Time	Specific Discussion Areas
STAGE 1 : SCOPING						
Government Agencies – Federal, State and Local Government Authority Regulatory Authorities.	Meeting with Federal, State and Local Council Officials.	Federal Ministry of Environment, Abuja.	9	Abuja & Ogun State	May 30, 2017 June 28, 2017 July 11, 2017 (12pm)	• Registration of the Project; • Scope of data collection and ToR approval; • Issues concerning site verification; • EIA process and scope of the EIA; • Approval for one season waiver; • Approval for the transmission lines; • Initial consultation/ sensitization on the project.
		Ogun States	25 32 28	Abeokuta, Ogun State	May 11, 2017 June 29, 2017 July 27, 2017	
		Ifo LGA Ewekoro Obafemi-Owode	6	LGA Secretariate	July 20, 2017 (11am-1pm)	
STAGE 2: Line Route survey/ESIA Study						
Baseline Data Collection: Community Engagement, engagement with local groups and traditional leaders.	Meeting with Traditional Rulers, women leaders , Youth leaders and Project Affected Persons (PAPs)	The head and chiefs of host communities. (73 communities) women leaders, youth leaders &PAPs	About 500 persons	Palace of Oba/ Palace of Baale	December 18 - 23, 2017 and January 22 – 24, 2018 (between 10am -5pm)	• Formal presentation of the project Background information; • Discussion of community concern; and • The need for a grievance mechanism throughout the project life.
Government Agencies – Federal, State and Local Government Authority Regulatory Authorities.	Meeting with Local Government Officials and Project Affected Communities at the Secretariate. Line route inspection	Ifo LGA; Ewekoro LGA Obafemi-Owode LGA and concern parties TCN & Ogun State ministries	78 142 60 10	LGA Secretariat LGA Secretariat Palace of Oba-Eerin in Oba LCDA Line route for lot 1	Dec. 12, 2017 Dec. 13, 2017 Dec. 23, 2017 (10am-1pm) Oct.25,2017	• Formal Presentation of the project background information. • Engagement with affected communities; • Potential positive impacts (provision of electricity and employment of opportunities for local people; and • Community development in general. • Line route optimization
		JICA consultants & TCN team	20	Ogun state Lagos State	March 2,2018 March 6,2018 (11am-5pm)	• Issues pertaining to hotspots on the lines • Issues pertaining to ESIA/RAP review
		Nigeria Conservation Foundation	12	NCF Head office Lekki- Lagos State	March 7,2018 (11am-12pm)	• Engagement with Nigeria Conservation Foundation to obtain their view on the project and review the report.

4.13.4.1. *First Stage Consultations*

The first consultation round took the combined format of individual semi-structured interviews with community members and customary chiefs as well as group meetings with institutional stakeholders (organisations at national, state and LGA level). This approach has proved to be useful to better define the scope and framework of the RAP study.
The objectives of these meetings are as follows;

- Present the project and the ESIA process to the communities and relevant agencies;
- Identify key issues, concerns and expectations of the communities and agencies related to the project and study area;
- Identify current practices and requirements of each agency related to the project;
- Complete the stakeholders' list and validate the general approach for consultations;
- Identify relevant information sources and collect available data and reports.

4.13.4.2. *Activities Performed in Ogun State*

The activities carried out as part of the first-round stakeholders' engagement in Ogun State for Lot 1are:

- Meeting between TCN top management headed by the MD/CEO and the Governor of Ogun State and other Senior Government Officials at Government House Abeokuta.
- Meetings at State level in Abeokuta with relevant State Ministries, Agencies and affected LGAs in Ogun State.
- Meetings at Local Government and community level, held in each Local Government/ community within the project area in Ogun State as applicable.

Table 4.62 show list of the stakeholders met in Ogun State during the first round of consultations.

Table 4.64 Stakeholder Groups Consulted (Ogun state and others)

Stakeholder Group	Type of Stakeholder	Location of Meeting	Date
Ejio Community	PAPs/ Customary Chiefs	Palace of the Oba of Ejio	18-05-2017
Arigbajo community	PAPs/ Customary Chiefs	Palace of Olu of Arigbajo	20-07-2017
Oluke-Orile Community	PAPs/ Customary Chiefs	Palace of the Oba of Oluke-Orile	25-05-2017
Oba Communities	PAPs/ Customary Chiefs	Palace of the Oba of Oba-erin	23-12-2017
Olorunsogo community	PAPs/ Customary Chiefs	Baale of Olorunsogo Palace	17-05-2017
Ogun State Bureau of Lands	Institutional	Dept of Energy Office, Ogun State	11-05-2017
Ogun State Ministry of Rural Development	Institutional	Dept of Energy Office, Ogun State Secretariat	11-05-2017

Ogun State Ministry of Communication, Development and Cooperation	Institutional	Dept of Energy Office, Ogun State Secretariat	11-05-2017
Ogun State Bureau Of Electrical	Institutional	Dept of Energy Office, Ogun State	11-05-2017
Ogun State Ministry Of Housing	Institutional	Dept of Energy Office, Ogun State	11-05-2017
Ogun Governor's Office	Institutional	Dept of Energy Office, Ogun State	11-05-2017
Ogun State Property Investment Corporation (OPIC)	Institutional	Dept of Energy Office, Ogun State	29-06-2017
Ogun State ministry of Environment	Institutional	Dept of Energy Office, Ogun State	27-07-2017
Transmission Company of Nigeria	Promoter	Dept of Energy Office, Ogun State	11-05-2017
Federal Ministry of Environment	Regulator	TCN Headquarter, Abuja	07-06-2017


A) Plate 4.66: Scoping/kick off Meeting with Governor of Ogun State
B) Plate 4.67: Scoping Meeting with ministries and agencies in Ogun State


C) Plate 4.68: Scoping Meeting with Ejio Community
D) Plate 4.69: Scoping Meeting with Olorunsogo Community

4.13.4.3. *Second Rounds of Consultation*

The second round of stakeholder information and consultation to present the preliminary line route, as well methodology and approach for ESIA and RAP study. At the same obtain feedback to refine the approach and the methodology and include concerns expressed in the study.

4.13.4.4. *Activities Performed*

The activities carried out as part of the second stakeholder engagement round are:

- Meetings in Abuja, Abeokuta, Affected Local Governments and in the communities with relevant ministries and agencies.
- Presentation of Background information document on the proposed transmission line project to stakeholders (TCN Representatives, Local Government Chairmen, concerned citizens and customary chiefs/PAPs) at Local Government secretariat.
- Meetings with PAPs in each community affected by the line route
- Field trips to show to stakeholders where the line will pass (line route optimization).
- Printed and digital line route map as well as images illustrating examples of the type of proposed infrastructure (lines) were also exhibited

PAPs were invited to attend the village level meetings with the Village Chief or District Head in their communities. The meetings included women as well as youths in each village.

Table 4.65 Stakeholder Groups Meeting during Second Round Consultations

Stakeholder Group	Type of Stakeholder	Location of Meeting	Date
Transmission Company of Nigeria	Promoter	TCN Office, Abuja	31-08-17
Field Visit with TCN and Relevant Agencies in Ogun State	Institutional	Various Hotspots along the proposed line route	05-09-17 & 06-09-17
Ifo Local Government Area	Institutional	Local government secretariat hall	12-12-2017
Ewekoro Local Government Area	Institutional	Local government secretariat hall	13-12-2017
Obafemi Owode Local Government Area	Institutional	Oba-eerin Town Hall	23-12-2017
Affected Communities	Community	Olorunsogo	12-12-2017

	leaders and PAPs	Ajegunle	
		Olowofela	
(Ifo, Ewekoro and Obafemi Owode LGAs)		Molaja	
		Ijoko ilefun	
		Mose	
		Fenopa	
		Ikereku	
		Lerin	
		Soderu	
		Italaji	13-12-2017
		Ejio	
		Abese	
		Arigbajo	
		Sepeti	
		Afowowa Eleyele	
		Oreke	
		Akakun	13-12-2017
		Ijumo	
		Oluke-orile	
		Pankere	
		Ajade	
		Itori alase	
		Inandan	
		Otegbola	23-12-2017
		Okuri	
		Opanigangan	
		Ijemo-efun	
		Toolu	
		Ototo	

Plate 4.70: Stake holders Engagement and Presentation of the Line Route, ESIA and RAP to communities (PAPs /Customary Chief) at Ifo LGA Secretariat.


Plate 4.71: Stakeholders Engagement and Presentation of the Line Route, ESIA and RAP to communities (PAPs /Customary Chief) at Ewekoro LGA Secretariat.


Plate 4.72: Stakeholders Engagement and Presentation of the Line Route, ESIA and RAP to communities (PAPs /Customary Chief) at the Town hall of Oba-erin in Obafemi Owode LGA..

4.13.5. Outcome of the Consultation

4.13.5.1. *Outcomes and Results Obtained in Stage 1*

The following results were achieved from the Stage 1 consultations

- The communities understood the objectives and requirements of the project and pledged support and cooperation
- The relevant agencies are aware of the project and the ESIA process (team, objectives and schedules);
- The requirements of Ogun State and Regulations relevant to the project were highlighted by the agencies and understood by TCN and its consultants.
- The main stakeholders' concerns and expectations were documented and have been considered for inclusion in the scope of the studies;

- A preliminary list of stakeholders was completed and the orientations of the Stakeholder Engagement Framework was enhanced;
- The Ogun State Governor established a committee in the State to provide support for the project.
-

Table 4.64 provides a summary of the main comments and recommendations made by stakeholders in Ogun State on different social and environmental issues of concern to them with respect to the project. Responses provided on the spot, where applicable were also provided.

Table 4.64 Comments by Stakeholders in Ogun State during Stage 1 Consultations

Topic	Concerns, Comments and Recommendations	Stakeholders having made the comment / recommendation	Actions to Address Concerns
Location of Proposed Sites	Some sites are under acquisition while others are free. The ones that are free, Government will acquire for the project in the interest of the public but the project will be responsible for the processing charges.	OGSG/ Bureau of Lands and Survey	The lands needed will be compiled and sent to OGSG
	The Governor mentioned need to raise the lines where crossing rail lines eg. Lagos –Ewekoro (Lafarge Cement) rail line at Apomu village, new rail line at Abese community.	Bureau of Lands and Survey	This shall be included in the EPC contract
Project Components	Requested additional substation as follows In Ijebu Area, which will be in Obere to feed Ogun East? Aiyetoro to feed the communities along Benin Border. Idi-Iroko, Wasimi axis. The State Government will provide land and fast track approval of the substation sites and ROW acquisition, while TCN will pay for the processing only.	Department Power/Energy, Governor's Office	TCN explained that there will be no need for building substations as the proposed substations will be sufficient for the areas mentioned. All that is needed is to invest in distribution infrastructure
Line corridor	**Ejio – Ikeja West turn in – turn out** – Free, Government will acquire on behalf of TCN and issue C of O	Bureau for Lands	Application along with supporting documents will be prepared and submitted
	Arigbajo (Ejio) – New New Abeokuta (Kopabe) – free **Olorunsogo- Ejio** – Free ,	Bureau for Lands and Survey	
Community perception on the project(line route, ESIA & RAP)	The project is a welcomed one and the communities pledged their support. Youths of the affected communities should be considered for employment during the project. People whose property were affected should be adequately compensated	PAPs /Customary Chiefs	Employment of youths wherever possible and compensation of affected persons will be carefully carried out.

4.13.5.2. *Outcomes and Results Obtained in Stage 2*

Issues raised by stakeholders during second round consultations are summarised in Table 4.65

Table 4.65 Comments by Stakeholders during Stage 2 Consultations

Sections of the Line	Comments and Recommendations	Stakeholders Having Made the Comment / Recommendation	Actions that addresses comments
Ejio-Arigbajo-Apomu axis (common corridor with LOT 3)	**Option C:** consider running parallel to the Lagos-Ibadan Expressway on the left hand side of the road (Northwards) before going left.	TCN	This was not possible, because of the need to avoid a shrine (6.848790°N, 3.201160°E) in Arigbajo Forest as well as Mobile Petrol Station (6.854169°N, 3.191616°E) along the road
	OPTION B: Try to avoid the structures around Lat 6.835046, Long 3.138859.	TCN	The line route has been amended to avoid the structures indicated
	Option B: Try to avoid a ware house around Lat 6.612138 and Long 3.013081	TCN	The warehouse has been avoided
	Option C: Try to reduce the number of angle greater than 15^0	TCN	The multi-criteria modelling used in analyses of route alternatives took into account the number of angle points.
330kv Line Crossing Lagos-Abeokuta Expressway at Apomu Village	Take the line to avoid Mobil filling station at Apomu village, to minimise compensation costs.	TCN	The Mobile Petrol station has been avoided completely.
330kv line from Olorunsogo – Ejio substation	**Option B:** Realign the line so that the clearance from the existing 330kv line and proposed 330kv line to 43meters instead of the 45meters that was given.	TCN	The final line route maintained the 45meters clearance as agreed by TCN in the field since 43meters is not the maximum value by design standard.
132kv line from Ejio – New Abeokuta	Change line routes in section AP6 to AP8.(to cut off the angular point AP7 & AP8) and take the line straight from AP6 to the Last Angular Point.	TCN	The final line route has been realigned to reduce the number of Angular Points as requested.
General Comments by Community leaders	Compensation should be paid directly to PAPs and not through any third party. PAPs request that they be paid in cash instead of building houses for them. They argue that they want to decide the new location by themselves and control the cost and quality to avoid trust issues	Communities	Although the OP 4.12 discourages cash for land, the Land Use Act allows it. TCN also prefer cash compensation as a policy. Hence, cash payment will be adopted for this project in line with the land use Act, TCN policy and to respect request of the affected people.
Arigbajo Village	The corridor crossed the Arigbajo sacred forest, the shrine house, which cannot be moved. Need to avoid them	Olu of Arigbajo	The line has been re-alligned and the shrine house was avoided though it passes the forest.
Ajade Village	The corridor crossed the middle of the small community of Ajade	Baale of Ajade	The line was adjusted, to pass at the Eastern side of the community, thereby avoiding the community.
Ikereku Village	The village is in between the existing 330kv and the proposed 330kv line	Bale of Ikereku	The village will be relocated since they are not much houses.

CHAPTER FIVE

5.0 ASSOCIATED AND POTENTIAL IMPACT

5.1 Introduction

In this chapter, the likely impacts of the proposed Ogun/Lagos Transmission Lines were identified and evaluated with due consideration to the construction, operation and decommission of the project vis-à-vis the current status of the project site environment. The environmental social and health impacts associated with the project have been identified by examining the ways in which the activities associated with the different components interact with the environment and its different components. Please note that these identified impacts will be applied to all 3 Lots (Lot1, Lot2 and Lot3) for the Project, as the integrated impacts for the Project.

In order to capture all the potential impacts, impact identification, screening and analysis were carried out. The project activity in chapter three and information obtained from the baseline survey were factored into the impact prediction model used in this chapter. Impact magnitude and significance were evaluated and succinctly presented, which served as the fulcrum developing the strategies for optimizing the positive and mitigating the negative impacts (as presented in Chapter Six).

The impacts from both short-term construction phase and the long-term operational phase are being considered.
A description of the assessment methodology used to assess the significance of impacts, taking into account impact magnitude and sensitivity of receptors and resources affected, is provided below.

The following primary project activities culminating in potential impacts are considered in this assessment:

- **Construction Phase**
  - Site preparation (resettlement and compensation, vegetation clearance, demolition of structures, earthworks, preparation of an access road in the RoW);
  - Transportation of construction material, establishment of a construction yard;
  - Assembly of machinery and equipment (towers, conductors, Transmission lines);
  - Use of natural resources (water, energy sources);
  - Disposal of waste materials (like eroded material) and wastewater; and
  - Non-routine events (e.g. spills, traffic accidents, occupational health & safety incidents).
- **Operation Phase**
  - Operation of the transmission line;
  - Routine maintenance of towers, conductions and lines; and
  - Non-routine events (e.g. tower collapse, line snapping, fire)

- **Decommissioning Phase**
- Dismantling, demolition and abandonment of transmission line structures and gadgets.

The following environmental indicators, receptors or resources affected by potential impacts were considered:

Biophysical Environment:

- Air quality;
- Noise, vibration & EMF;
- Soils and geology;
- Water resources;
- Terrestrial ecology.

Human Environment:

- Visual amenities;
- Community level impacts
- Community health, safety and security;
- Resettlement;
- Labour and working conditions;
- Infrastructure;
- Employment and economy; and
- Cultural Heritage.

For each of the above mentioned environmental component, the associated and potential impacts of project activities were identified and evaluated for the significance of the impacts. A summary table of all potential impacts is presented in Tables 5.7a and 5.7bbelow.

5.2 Impact Assessment Methodology

This section describes the overall methodology used for the assessment of impacts. Topic-specific methodologies are described under each section of the impact assessment. In general, the assessment of impacts will pass through an iterative process involving the following five key elements:

1. Impact identification
2. Prediction of potential impacts and their magnitude (i.e., the consequences of the proposals on the natural and social environment);
3. Evaluation of the importance (or significance) of impacts taking the sensitivity of theenvironmental resources or human receptors into account;
4. Development of mitigation measures to avoid, reduce or manage the impacts orenhancement measures to increase positive impacts; and
5. Assessment of residual significant impacts after the application of mitigation andenhancement measures.

Where significant residual impacts remain, further options for mitigation may be considered and impacts re-assessed until they are As Low As Reasonably Practicable (ALARP) for the Project.

5.2.1 Nature/Type of impacts

There are number of ways that impacts may be described and quantified. The definitions adopted for this ESIA are described in Table 5.1 below.

Table 5.1: Definition of impacts

1	**Nature of Impact:** An impact is essentially any change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity. Negative – an impact that is considered to represent an adverse change from the baseline or to introduce a new undesirable factor. Positive – an impact that is considered to represent an improvement to the baseline or to introduce a new desirable factor.
2	**Type of Impact:** Direct (or primary) – impacts that result from the direct interaction between a planned project activity and the receiving environment (e.g., between stack emissions and the ambient air quality). Secondary – impacts that result from the primary interaction between the Project and its environment as a result of subsequent interactions within the environment. Indirect – impacts that result from other activities that are encouraged to happen as a consequence of the Project.
3	**Temporal Scale of Impact:** Temporary - impacts are predicted to be of short duration, reversible and intermittent/occasional in nature. The receptor will return to a previous state when the impact ceases or after a period of recovery. Short-term - impacts that are predicted to last only for a limited period (i.e., during construction) but will cease on completion of the activity, or as a result of mitigation measures and natural recovery (e.g., non-local construction workforce-local community interactions). Long-term - Impacts that will continue for the life of the project but cease when the project stops operating (i.e. 20 years). These will include impacts that may be intermittent or repeated rather than continuous if they occur over an extended time period.
4	**Spatial Scale of Impact:** On-site – impacts that are limited to the Project site. Local - impacts that affect locally important environmental resources or are restricted to a single (local) administrative area or a single community. For this ESIA, local impacts are restricted to the Project site and adjacent areas. Regional - impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries (i.eOgun State). National - impacts that affect nationally important environmental resources; affect an area that

	is nationally important/protected; or have macro-economic consequences (ie Nigeria). International - impacts that affect internationally important resources such as areas protected by International Conventions. Trans-boundary - impacts that are experienced in one country as a result of activities in another.

5.2.2 Assessment of Significance

There is no statutory definition of 'significance' and its determination is therefore necessarily partially subjective. For the purposes of this ESIA, the following definition of significance has been adopted:

"An impact is significant if, in isolation or in combination with other impacts, it should, in the judgment of the ESIA team, be taken into account in the decision-making process, including the identification of mitigation measures (by the Project) and consenting conditions (from Regulators and Stakeholders)."

Criteria for assessing the significance of impacts emanate from the following key elements:

- Status of **compliance** with relevant Nigerian legislation, policies and plans and any relevant Nigerian or industry policies, standards or guidelines;
- The **magnitude** (including nature, scale and duration) of the change to the natural or socio-economic environment (e.g an increase in noise, an increase in employment opportunities), expressed, wherever practicable, in quantitative terms. The magnitude of all impacts is viewed from the perspective of those affected by taking into account the likely perceived importance as understood through stakeholder engagement;
- The nature and **sensitivity** of the impact receptor (physical, biological, or human). Where the receptor is physical, the assessment considers the quality, sensitivity to change and importance of the receptor. For a human receptor, the sensitivity of the household, community or wider societal group is considered along with their ability to adapt to and manage the effects of the impact; and
- The **likelihood** (probability) that the identified impact will occur. This is estimated based upon experience and/or evidence that such an outcome has previously occurred.For this assessment, significance has been defined based on five levels described in Table 5.2.

Table 5.2: Categories of Significance

Positive impacts provide resources or receptors, most often people, with positive benefits. It is noted that concepts of equity need to be considered in assessing the overall positive nature of some impacts such as economic benefits, or opportunities for employment
Negligible impacts (or Insignificant impacts) are where a resource or receptor (including people) will not be affected in any way by a particular activity or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations.
An impact of **Minor** significance ('Minor impact') is one where an effect will be experienced, but the impact magnitude is sufficiently small (with or without mitigation) and well within accepted

standards, and/or the receptor is of low sensitivity/value.
An impact of **Moderate** significance ('Moderate impact') is one within accepted limits and standards. Moderate impacts may cover a broad range, from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is ALARP. This does not necessarily mean that 'Moderate' impacts have to be reduced to 'Minor' impacts, but that moderate impacts are being managed effectively and efficiently.
An impact of **Major** significance ('Major impact') is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of ESIA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (ie ALARP has been applied). It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones such as employment, in coming to a decision on the Project.

For environmental impacts the significance criteria used in this ESIA is shown in **Table 5.3**

Table 5.3 Overall Significance Criteria for Environmental Impacts

Receptor sensitivity (or resource value)	**Impact magnitude**		
	Low	Medium	High
Low	Minor	Minor	Moderate
Medium	Minor	Moderate	Major
High	Moderate	Major	Major

For social impact assessment, the perceptions of stakeholders, expressed as opinions around certain issues, can be as important as actual impacts. Consequently, the concept of perception is explicitly brought into the evaluation of significance after an impact is evaluated. When an impact is of significant stakeholder concern, this may be cause to raise the significance rating. This prompts the formulation of more rigorous and appropriate mitigation measures which focus on the source of the impact and also address stakeholder perceptions. The risk of not addressing stakeholder perceptions is that reputational damage could arise, resulting in the loss of a 'social license to operate'.

Magnitude of Impact

The term 'magnitude' covers all the dimensions of the predicted impact to the natural and social environment, including:

- the nature of the change (what resource or receptor is affected and how);

- the spatial extent of the area impacted or proportion of the population or community affected;
- its temporal extent (i.e. duration, frequency, reversibility); and
- where relevant (accidental or unplanned events), the probability of the impact occurring.

For biophysical impacts, the definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment are provided in Table 5.1.

For social impacts, the magnitude considers the perspective of those affected by taking into account the likely perceived importance of the impact, the ability of people to manage and adapt to change and the extent to which a human receptor gains or loses access to, or control over socio-economic resources (1) resulting in a positive or negative effect on their well-being (a concept combining an individual's health, prosperity, their quality of life, and their satisfaction).

Sensitivity of Resources and Receptors

Sensitivities are defined as aspects of the natural or social environment which support and sustain people and nature. Once affected, their disruption could lead to a disturbance of the stability or the integrity of that environment.

For ecological impacts, sensitivity can be assigned as low, medium or high based on the conservation importance of habitats and species. For habitats, these are based on naturalness, extent, rarity, fragility, diversity and importance as a community resource.

For socio-economic impacts, the degree of sensitivity of a receptor is defined as 'a stakeholder's (or groups of stakeholders') resilience or capacity to cope with sudden changes or economic shocks'. The sensitivity of a resource is based on its quality and value/importance, for example, by its local, regional, national or international designation, its importance to the local or wider community, or its economic value.

Likelihood

Terms used to define likelihood of occurrence of an impact are explained in Table 5.4 below.

Table 5.4: Explanation of Terms Used for Likelihood of Occurrence

Definition of likelihood		
High probability	Refers to a very likely impact	Refers to very frequent impacts
Medium probability	Refers to a likely impact	Refers to occasional impacts
Low probability	Refers to a very unlikely impact	Refers to rare impacts
	As far as one-time events (e.g. air emissions) or slowly developing effects are concerned (e.g. impacts on local life style)	As far as possibly recurring impacts are concerned, such as accident or unplanned events (e.g. traffic accident, fire)

5.3 Significant Impacts of the Proposed Transmission Lines Project

This section will reflects the results of the field measurement vis-a-vis the prediction of the impact of power transmission project at the various stages of preparation, mobilization, construction and decommissioning on the environment. The receptors of the environment consider included, geology, soil, underground and surface water, flora and fauna, air quality, noise/vibration, magnetic field, health and safety, socio-economics and livelihood of the communities. Impacts that are significant were focused in this section of the report.

5.3.1 Air Quality

5.3.2 Construction phase

Emissions from vehicles and equipment (SO_2, CO, NO_x,CO_2, PM)

During mobilization to site, there may be emissions of gaseous and particulate air pollutants from vehicles. The air pollutants may have negative and direct impairment on the air quality of the environment with widespread associated impacts. This same impact on air quality is expected during the supply of construction equipment and materials. Equipment required during site preparation, hydraulic structures construction and towers completion are expected to generate emissions into the environment. However, these emissions are expected to be local and to last only the period of these activities.

The movement of vehicles for the construction will result in PM, SO_2, CO, NO_x,CO_2emissions. It is noteworthy to mention that the quantity of emissions is dependent on the vehicle type, amount and their conditions. Light-duty petrol vehicles not equipped with pollution control devices have the highest exhaust emissions during acceleration, followed by deceleration and idling cycles. Frequent cycle changes characteristic of congested urban traffic patterns thus tends to increase pollutant emissions. At higher cruise speeds HC and CO emissions decrease, while NO_x and CO_2 emissions increase. Emissions from diesel-fuelled vehicles include particulate matter, NO_x, SO_2, CO and HC, the majority of which occurs from the exhaust. Operating at higher air-fuel ratios (about 30:1 as opposed to 15:1 characteristic of petrol-fuelled vehicles with electronic fuel injection engines), diesel-powered vehicles tend to have low HC and CO emissions, despite having considerably higher particulate emissions.

The impact of emissions arising from vehicles and equipment's associated with construction activities is considered to be **minor** due to the relatively low number of vehicles and equipment compared to the already existing traffic load on the roads and relatively short duration of the construction phase.

Dust Emission from Land Preparation and Vehicle Movements

Particulates emitted from diesel vehicles consist of soot formed during combustion, heavy HC condensed or adsorbed on the soot and sulphates. In older diesel-fuelled vehicles the contribution of soot to particulate emissions is between 40% and 80%. The black smoke observed to emanate from poorly maintained diesel-fuelled vehicles is caused by oxygen deficiency during the fuel combustion or expansion phase. Particulate emissions from petrol-driven vehicles are usually negligible. Such emissions when they do occur would result from unburned lubricating oil, and ash-forming fuel and oil additives

Energy provision for construction activities and power generation during the life of the proposed transmission lines construction will generate emissions of gaseous and particulates air pollutants with the quantity depending on fuel consumption rates among other factors. The dust emissions arising from the construction activities of the project are as a result of land preparation activities and vehicle movements. Dust emissions have the potential to create impact on the close receptors due to the physical appearance, deposition on the roof of the residential areas and creating nuisance for the surrounding community. Removal of material usually takes place with a bulldozer, cleared material is then stored in piles for later use or during rehabilitation procedures. Fugitive dust is generated during the clearing of material, as well as from wind-blown dust generated from cleared land and exposed material stockpiles. Dust problems can also be generated during the transportation of the material, usually by truck, to the stock piles. This dust can take the form of entrainment from the vehicle itself or due to dust blown from the back of the trucks during transportation.

The temporary nature of construction differentiates it from other fugitive dust sources as to estimation and control of emissions. Construction consists of a series of different operations, each with its own duration and potential for dust generation. In other words, emissions from any single construction site can be expected (1) to have a definable beginning and an end and (2) to vary substantially over different phases of the construction process. This is in contrast to most other fugitive dust sources, where emissions are either relatively steady or follow a discernible annual cycle. Furthermore, there is often a need to estimate area wide construction emissions, without regard to the actual plans of any individual construction project. For these reasons, either area wide or site-specific emissions are not directly calculated and modelled.

The impact of this phase on air quality is of **minor** significance and consequence because of the relatively short duration of the construction, the limited earthworks required on the site and the involvement of a limited number of construction vehicles.

Climate change impact due to construction activity

A series of stages are involved in estimating the climate change impact of an electricity transmission network. During the construction stage, following activity is considered for climate change impact.

a. Process from material production:

GHG will be emitted from the manufacturing process of construction material. Below is the assumption used for the GHG emission calculation on this item?The weight of the each tower was estimated to be 4.5 tonnes (for 330 kV) and 2.8 tonnes (for 132 kV). Normal Voltage 330 kVrms (for 330 kV) and while 132 kVrms (for 132kv). The average distance between each 330 kV tower and another span between 400 m – 450 m (for 330 kV) and 325 – 350 m (for 132 kV). Right of way for 330 kV TL while that of 132 kV TL is 30 m. It is estimated that the height of towers will range between 42m -57m (for 330 kV) and 28 m – 32 m (for 132 kV) height for 330 kV DC. The principal materials and their Embodied CO_2 are presented in Table 4.16.

The Team confirmed specification of the conductor on 132 kV and 330 kV transmission lines using TCN standard, the specification are as follows:

i.132 kV Transmission Line Type of ConductorAluminum Alloy Conductor Steel Reinforced (ACSR) Size： Code named : Bear (British standard)

ii.330 kV Transmission Line Type of ConductorAluminum Alloy Conductor Steel Reinforced (ACSR) Size： Code named : Bison (British standard)

Table 5.5: Principal Materials and their Embodied CO_2

S/No.	Material	Embodied CO_2 ($kgCO_2/kg$)
1	Aluminium	8.24
2.	Copper	3.88
3.	Steel	2.82
4.	Ceramics (fittings)	1.05
5.	HPDE	1.60
6.	Concrete	0.13
7.	Concrete (2% reinforced)	0.13

b. Energy use in the construction activity

There is on-site energy use in the actual construction of a Transmission Line project, primarily in the form of transport fuel for construction vehicles and the shipping of components. This energy use could be considered a component of direct non-generation emissions, because it is at the project site, even though it occurs before the actual operation of the Transmission Line project. This source of emissions is likely to be very small compared to the lifetime energy and emissions impacts of the Transmission Line project.

Transportation and use of construction equipment: It includes energy consumption and emissions from the transportation of components to site, erection of towers, stringing of cables, transportation of materials and all other procedures undertaken during the installation procedure

c. Land Clearing

New construction of long-distance lines, or even of transmission lines and substations, may affect carbon stored in biomass and soil. An obvious example would be clearing forest for a long-distance transmission line, which would result in a one-time release of the carbon stored in the vegetation. This impact would be common for new transmission investments in areas with high forest cover, and possibly for electrification and distribution projects that involve new feeder lines. Estimated land deforested area is shown in below.

Table 5.6: Estimated land deforested for the proposed line routes

S/N	Line	Km	Voltage	RoW (m)	Area (ha)	Estimated Deforestion (ha)
I	Ejio to Olorunsogo	12.5	330	50	62.5	50.0
II	Ejio to New Abeokuta	35.38	132	30	106.14	84.91
III	Ejio to Ikeja West/Oshogbo	6.94	330	50	34.7	27.8

Table 5.7: Embodied CO_2 Emission from Land Use Change

Landuse Type	Ejio-Sojuolu Route(tCO_2e/yr)	Ejio-Olorunsogo Route(tCO_2e/yr)	Ejio-New Abeokuta Route (tCO_2e/yr)	Total (tCO_2e/yr)
Builtup	0.00	0.00	0.00	0.00
Cultivated Area	253.59	567.24	400.40	1221.23
Fallow Land	140.14	560.57	690.70	1391.40
Marshy Area	63.65	15.91	103.44	183.00
Others	116.78	347.02	146.81	610.62
Plantation	30.03	213.55	150.15	393.73
Primary Forest	0.00	0.00	0.00	0.00
Riparian Vegetation	6.67	3.34	46.71	56.72
Secondary Forest	483.82	340.34	2005.36	2829.52
Waterbody	0.00	0.00	0.00	0.00
Sum	**1094.69**	**2047.96**	**3543.57**	**6686.23**

The estimated GHG emission from land use change for the proposed line routes are presented in Table 5.7. The total estimated GHG emission from the proposed line routes is 6686.23 tCO_2e/yr. The estimates for Ejio-Olorunsogo Route, Ejio-New Abeokuta Route and Ejio-New Abeokuta Route represents about 16.37, 30.63 and 53%, respectively of the total GHG emission from land use change. It is expected that the project's GHG emission will go into the atmosphere. As such, the impact will be **minor** as a result of dilution factor. The measurable impact of the project on the global atmospheric GHG level is thus considered **minor**.

Operation phase

Commissioning and its maintenance will also result air pollution with low likelihood of occurrence. The operation of the transmission line will contribute low levels of atmospheric emissions directly as substation operation will be absent in Lot 1 and hence the predicted impacts are **Negligible**.

5.4 Noise, Vibrations and EMF

5.4.1 Construction Phase

Mobilization to site will require the use of vehicle expected to generate some levels of noise on the road. The resulting noise levels may have negative and direct impairment on the ambient noise levels with widespread associated impacts and high likelihood of occurrence combined with high considerable consequence thus rated moderate. This same impact on ambient noise levels is expected during the supply of construction equipment and materials. Equipment required during site preparation and tower structures construction and completion will generate noise levels in the proposed field which are expected to be local and to last only the period of the activities. Specifically, noise sources associated during the construction phase of the proposed transmission lines project include traffic and equipment's used for earthworks, concreting, installation, tower erection and stringing. The likelihoods are high with considerable consequence thus rated moderate.

Energy provision for construction activities and power generation during the life of the transmission lines will generate noise with the levels depending on age of equipment among other factors.

The proposed construction timeframes for this project estimates that all construction will take place over a period of 9 months. The construction activity will be undertaken during daytime. Construction activities will be concentrated and done sequentially so that no area is prone to extensive duration of noise impacts. There will be some noise generated from the movement of tractors and trucks transporting the materials and equipment but the traffic volumes are expected to be occasional.

Considering the construction activity schedule and nature of construction, overall noise impact on nearby sensitive receptors with embedded controls in place will be of **Moderate** significance, especially at where residential area is close to the construction area.

5.4.2 Operation Phase

The likely noise impacts from operation of the transmission line are due to:

- ✓ Maintenance and repair activities; and
- ✓ Corona discharge' from the overhead lines.

Noise and vibration sources generated during maintenance of the towers will be infrequent and extremely low.

Based on the field measurement around the power generating facility (Olorunsogo Power Plant), emission of EMR is generally low (2.5 kV/m) in term of Electric Field Strength compared to the limit of 5.0. Also, according to Federal Republic of Nigeria Official Gazette (S.1.6 of Electricity Supply Regulations) Section 60 and 61, electromagnetic field impact may be insignificant. However, workers that would maintain the transmission line facilities need to take certain precautionary measures.

A corona discharge is an electrical discharge resulting from the ionization of the air around the conductor, generally generating power losses and ambient noise. The acoustic noise produced by transmission lines is greater with high voltage power lines (400-800 kilo volts [kV]) and even greater with ultra-high voltage lines. Therefore, considering the voltage grade of the Project transmission line and that it will only reach its maximum during rainy events, it is highly unlikely that the corona discharge noise will exceed the normal background noise levels in the area. The impact of noise is considered **minor**during operational stage.

5.5 Geology and Soils

5.5.1 Construction Phase

Impact on geology and soil structure

Generally, the geophysical survey showed that the geological structure of the project area is stable and had no recent history of seismic instability. At the construction stage, installation of concrete base/pillars and towers will increase the weight of the overburden on the underground on the geophysical structure of the area. Areas with weathered formation are towards Abeokuta axis –Opanigangan, Iregun, Inandan, Okuri. The geophysical investigation has showed that the subsurface lithological layer mapped has no specific hazard, therefore caution should be exercise during transmission lines installation. Also, caution should be exercise in areas such as AfowowaEleyele, Sowunmi and Sojuolu communities of the project area where limestone is identified during transmission line installation.

The assessment has revealed that there are no designated sites of geological importance within or adjacent to the site boundary. The proposed transmission lines will result in permanent alterations to the geology of the locations. However, the overall impact is considered to be minor. Change to soil structure (through erosion and compaction) digging of foundation pits for the towers and the cutting of vegetation are the main activities at this phase which are likely to affect soil structure. The study area lies within Ogun State. Ogun state comprises both sedimentary and basement formations as well as transitional zones. The basement complex according to Jones and Hockey (1964) is made up of magmatite - gneiss complex, the schist belt and the older granites which are 800 to 500 million years in age. These rocks are well displayed in Odeda, Abeokuta, Igbo - Ora, and Ijebu Igbo, etc. However, no large scale cut and fill activity is expected during the construction phase.

Figure 5.1: Geological Map of Nigeria identifying Ogun as the Study Area (Obaje 2009)

During site preparation and construction of access roads, vegetation removal with the use of bulldozers for uprooting trees especially along the new line-routes will lead to the compaction of soil. This is particularly so, in areas dominated by clay soil. Compaction of soil is capable of initiating soil erosion and flooding arising from the disruption of hydrological processes in the project area. Hence, soil erosion and flooding potentials are rated moderate, requiring control measures.

During construction of infrastructures in the project area, heavy equipment required for digging, mixing of concrete and lifting pillars will further compact the ground, reduce water infiltration and yield high volume of run-off that can water accumulation in the neighbourhood where lateritic soil is the dominant top-soil.

Most of these impacts are temporary, localised and marginal and significance of impact is therefore rated as **minor.**

Potential contamination of soil from inadvertent release of hazardous or contaminating material
The population of soil micro-organisms as a result of release of hydrocarbon based wastes will affect the fertility of soils due to the disruption of the chemical balance of soils in the project corridor. This in conjunction with the spill of used oil and grease will contaminate the soils. Similar to this is the potentials of soils around the waste dumps to be contaminated. Most of these impacts are temporary, localized and marginal and significance of impact is therefore rated as **minor**.

5.5.2 Operation Phase

The only source of impact on soils during the operation of the transmission line is the potential contamination of soil from inadvertent release of hazardous or contaminating material, such as fuel from vehicles or aluminium oxide pain. Low frequency of inspections and painting as well as involving experience personnel will reduce likelihood of such a contamination considerably. Impact is therefore considered **negligible**.

5.6 Water Resources

5.6.1 Construction Phase

Impact on hydrogeology due to construction of tower foundation and access road.

During the construction stage of the project, significant impact on the aquatic environment are envisaged from the disruption of Stream beds that run across the access roads, introduction of sediments into the river channels and pollution of water down-stream. Some of the villagers use water from these streams as sources of domestic supply; hence the usefulness of such streams becomes limited. The rivers and streams likely to be impacted on include River Ogun, Wagunu River and River Odoipa. The streams are Odo-Osun, Sowunmi and Sojuolu stream. This impact is rated moderate.

Closely connected to this is the migration of aquatic organisms from stream beds upstream in response to ground excavation for towers, angle points and base stations. Storm water runoff from construction site into nearby water bodies is capable of increasing water turbidity and electrical conductivity which leads to siltation, a disruption of the water hydrobiology. If sufficient organic and inorganic materials are found in the runoff, eutrophication of water bodies by these nutrients results. A negative consequence of this is the death or migration of some benthic organism from the water bodies. This impact is rated moderate.

Dumping of solid waste and wastewater discharge during project operation have potentials of causing contamination of surface and groundwater. There would be increased concentration of oil & grease and metals in surface and ground water. The impact of ground and surface water contamination from accidental spills and improper disposal of excavated materials, waste and wastewater is similar to those described in the soils and geology section above. Impact is considered as **minor.**

The use of water during construction include drinking water for construction staff, water for concrete batching (casting of foundations) and dust mitigation represent a relatively small volume of water, which will most likely be sourced from nearby waterbodies through tanks. The impact of water extraction on water resources is therefore considered **negligible**.

5.6.2 Operation Phase

No impact on the surface water and hydrogeology of the area is anticipated from the operation of the transmission line and therefore considered **negligible**.

5.7 Terrestrial Ecology

5.7.1 Construction Phase

Impact on Terrestrial flora and Fauna

Destruction of vegetation begins at the line route survey and continues through the preparation of site, and construction of access road, towers, base station and camp. Vegetation will be cleared/removes to establish the ROW in the additional segments. During construction, concrete will be cast permanently to build the substation, angle points and base camp. Removal of vegetation will affect birds and other vertebrates like reptiles negatively as many of them will lose their habitats. Autochthonous fauna, especially birds and mammals will be prevented from nesting and having their usual nourishment and rest.

The IUCN status of the plant resources for the studied area was evaluated using IUCN version 2017 .3 criterion. The results showed that majority of the plant species encountered do not fall to the categorization of IUCN Red Lists. However, the species identified within the IUCN Red list classification are presented in Table 4.45 in chapter 4. Considering the fact that the above impact will be localized and that the ecosystems have a low sensitivity, the impact is considered **medium.**

Impact due to the introduction of Alien species

Delonixregia, and *Chromolaenaodorata*were the two species found in this study listed as alien to Nigeria while *FicusexasperataChromolaenaodorata*and *Mimosa pudica*so listed as invasive to Nigeria was found in this study. As could be observed *Chromolaenaodorata*censored in this study waslisted as both alien and invasive species to Nigeria. Alien invasive species have the potential to substantially modify wildlife habitat which can impact associated fauna populations. However, impact due to theintroduction of Allienspecies is considered to be **medium** because the project has limited possibility of introducing new species into the study area.

5.7.2 Operation Phase

Impact and terrestrial flora and fauna

Erection of additional towers and other structures is capable of interfering with mass movement and migration of birds. There could be collision of smaller birds with transmission line cables during wanderings in larger clusters and migration. More frequent human activities during operation will further scare animals. There is a risk of avian collision with transmission lines if the lines are located within daily flyways or migration corridors. Since the project area is located far from the area recognised as major bird habitat zone, such as wetland, impact of avian collision is considered to be **minor**. Impact on terrestrial ecology of routine clearance of vegetation is considered **minor**as localized and in an already degraded ecosystem.

Impact on Ecosystem Service

Many use-value species, such as*Thaumatococcusdaniellii* will need to be cleared, reducing their availability for local communities, especially at Ototo and Toolu in New Abeokuta axis.

Moreover, creation of access roads may expose forest areas to increased human activities. This may have impacts on existing flora and fauna that may be of use to the local communities. Impact on ecosystem service is considered to be minor as clearing will be restricted to areas within the Right of Way.

5.8 Aquatic Ecology

5.8.1 Construction Phase

The construction of the roads, vegetation clearing, and pylon construction may cause wetland and riparian habitat loss. Due to their soft and spongy soils, swampy/marshy areas around AfowawaEleyele, Pankere, Ajade, Opanigangan, Ototo, Iludun and Sowunmi cannot support heavy loads, such as vehicles and machinery, and can become greatly damaged. Hence, there may be need to construct temporary access road to each tower spot.

Some species observed to occur solely in riparian habitat, include *Elaeisguineensis, Raphiahookeri, Alstoniaboonei, Lepanodiscuscupanoides, Ceibapentandra*and *Anthocleistavogelii,*aquatic plants such as *Nymphaea lotus, Ludwigiaabyssinica*and *Pteridiumaquilinum* these mainly are found around OlukeOrile, AfowawaEleyele, Opanigangan, Ototo, between Pankere and Ajade.

Construction activities can influence water quality or modify flooding patterns and surface water flow over a certain period of time. The project may not avoid access road construction on wetlands/swamp.

Construction activities could also cause an increase in suspended solids in wetlands and aquatic environments, which could result in siltation of feeding sites and breeding grounds of some species, particularly for fish species. Furthermore, an increase of organic matter in aquatic environments could lead to an increase in biochemical oxygen demand (BOD) and a decrease in dissolved oxygen that could be locally harmful for aquatic fauna species. Water could also become contaminated by accidental oil and hydrocarbon spills. In lentic or stagnant aquatic environments, the contamination could exacerbate the impacts of the spills because contaminants could become locally concentrated. Rapid response measures in case of a spill will reduce associated impacts.

Impact on aquatic and semi-aquatic habitats will be limited in areas where there will be direct construction of pylons and substations *i.e. tower foundation*. Impacts will be local and the magnitude will be moderate. Since these areas are highly sensitive, the impact significance on aquatic ecology is considered**high.**

5.8.2 Operational Phase

No impact on the aquatic ecology is anticipated from the operation of the transmission line and therefore considered **negligible**.

5.9 Visual Amenities

5.9.1 Construction Phase

Site clearance and site development

Before actual construction starts the RoW for the transmission lines will be cleared of high vegetation, all structures and an access road along the RoW will be laid. Construction material and facilities for the labour force will be located at different sites along the RoW and the substations. Towers will be erected in the landscape and lines will be attached to the towers.

These physical interventions will change the view of the landscape near the RoW for the period of the construction, but also during operation of the transmission lines. However, the presence of the construction lay-down area and labour facilities will only be temporary. People living close to the construction sites will experience this change in visual amenities directly. It is estimated that less than 1,000 people of the affected communities along the RoW will experience this change.

However, currently the landscape is not considered very valuable. Some of the locations are close to existing RoW, rural settlements (Ejio, Sojuolu,Ayepe etc.) and swamps. About 58% of the affected areas in the RoW are currently farmland, secondary forest and swamp. This impact is of temporary in nature, affecting a relatively few people, in an already industrial landscape and is therefore considered **minor**.

Offsite Disposal of municipal waste and construction waste

Since no construction camp will be required, domestic waste will be limited to waste generated from construction workers. Domestic waste might be disposed to construction area, creating visual impact. Construction waste will also be generated in the project area during the construction phase of the project. This will have some impact. Such impact is likely to be experienced by the villagers inhabiting near the construction area. The duration of the construction activity is short term in nature. Sensitivity of the area is varied, high in undeveloped area (e.g. Forest area) and low in developed area. The potential impact on Visual and aesthetics due to storage and disposal of municipal waste from labour camp and construction waste without mitigation measure is considered to be **medium**.

5.9.2 Operation Phase

Transmission lines and towers will be visible from far and become an extrinsic element in the landscape. Cumulative with the other power lines this may result in a loss of the visual amenity. The people living in the affected communities may experience this visual change. However, in the already disturbed landscape with industrial and urban activities and with little general beauty in its landscape this impact is considered **minor**.

5.10 Land Planning and Use

5.10.1 Construction Phase

Agricultural activities will be affected during the work because of the restriction of farming within the wayleave. The transmission lines has a total length of 54.82 km, consisting of 35.38km from Ejio (Arigbajo) – New Abeokuta 132kV D/C Transmission line which will traverse some communities, forest, farmlands, river/streams etc, and terminate at New Abeokuta substation in Kobape area ObafemiOwode LGA. Then 12.5km from Olorunsogo – Ejio (Arigbajo) 330kV D/C Transmission Line will emerge from Olorunsogo Power Station in Ifo LGA traversing Agricultural farmlands, railway line, Gas pipeline, major road etc. and terminates at the proposed Ejio (Arigbajo) substation in Ewekoro LGA. Finally 6.94km fromEjio (Arigbajo) – Ikeja West/Osogbo 330kV D/C turn in- turn out transmission line will traverse few communities, major road, forest etc. and terminates at Sojuolu also in Ewekoro LGA.

Over a thousand families will lose certain portions of their crop land. Loss of land and crops will have to be compensated before the beginning of the construction. These aspects will be detailed in the RAP. Impacts of land acquisition and changes in land use can lead to moderate magnitude with long-term effects. Since there will be some form of loss of land, the impact significance is considered high because it has to do with means of livelihood.

5.10.2 Operation Phase

Enhancement of local economy as a result of stabilization of electric power may change the land use in the project area. The degree and nature of the impact would be varied and it is difficult to predict the impact. However, stabilization of the electricity would mainly contribute to improve the condition of existing development area and no significant land conversion from natural environmental area (forest, swampy area) is assumed. Therefore, the impact on land use during the operational stage is considered to be generally **positive.**

5.11 Stakeholder and Community Expectations/Relations Management

5.11.1 Construction Phase

The construction activities for the Transmission Lines may cause community concerns linked to impacts associated with issues like air and dust emissions, traffic, influx and community safety/security, noise/vibrations and the adverse impacts and inconveniences experienced from these issues. In addition to the above, community/stakeholder perceptions may arise around cumulative impacts resulting from existing Abeokuta Independent Power Project (Energy Culture)- A 147 megawatt gas powered power plant with a 500 m transmission line, Olorunsogo Power Plant Phase I & II, 132 kV Ewekoro cement Plant Line 1, Ewekoro cement Plant Line 2 and Transmission line that links Abeokuta to Ota and the associated two substations (Papalanto and Kobape) in Ewekoro and Abeokuta respectively and Olorunsogo 330kv Transmission line. This impact is considered to be **moderate.**

Some people living around project corridor may feel concerned about the additional activities of the transmission line construction of potential impacts on their health, safety and/or security.

Although the number of people may be considered as limited and the construction activities are only temporary, the impact can be very serious for some people, especially for people with reduced resilience. The potential impact is considered **moderate**.

5.11.2 Operation Phase

Community concerns about cumulative impacts of the existing activities along proposed Transmission Lines will continue from the construction phase into the operation phase.

The operation and maintenance of the proposed projects may cause community concerns linked to impacts associated with issues like nuisance of noise and concerns of potential electrocution, bush fires and electromagnetic fields and interference of radio/TV transmission.

Noise can be generated by transmission lines, by the corona effects. This is a limited breakdown of electricity in the air. Conductors are designed to reduce this effect. However, at certain times a 'hissing' sound can be heard, sometimes with a low frequency 'hum'. Other noise emissions in the operation phase maybe experienced in times of maintenance at the towers or lines. This will only be temporary and with limited frequency.

There is risk of electrocution when people come in contact with the lines, which are energized. This may happen when towers collapse or lines would fall to the ground due to e.g. strong winds or overheating. When a snapped line comes in contact with dry bush, a wild fire may be ignited. However, these are very rare incidents.

Further, the people living close to the RoW may have concerns about electromagnetic fields imposing health impacts. A wide safety zone within which no human habitation or activity is allowed will ensure that such effects are reduced to the minimum. Exposure stays within the limits set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Some people living really close to existing Ejio and Olorunsogo Transmission Lines RoW of the proposed Transmission Lines and Substations, in Ikereku, Soderu, Akilagun,Sowumietcmay feel concerned about the accumulation of these nuisances and potential impacts on their health, safety and/or security. Although the number of affected people may be considered limited, the impact can be very serious for some people, especially for people with reduced resilience. These reported stakeholder concerns, will potentially reflect on the new projects in the operation phase. The impact is considered **major.** Again, households living near the RoW, who have currently erratic power supply and who will not get connected to the transmission line, may feel disappointed by not benefiting from the project and still experience adverse impacts as a result of the operations of transmission line project. This will count for the communities affected by the RoW.

This is considered a **major** impact, because there may be some accumulation of disappointment over time, as already for some period reliable electricity supply is not provided, while industrial activity, power distribution and transmission are increasing in the area. However, the number of people living in these communities is relatively limited.

5.12 Community Health, Safety and Security

5.12.1 Construction Phase

Construction activities in the area, creating increased traffic movements, use of heavy equipment, influx of outside worker and the clearance of the RoW, generate potential impacts on community health, safety and security. The following potential impacts and risks have been identified.

Safety risk due to construction activities

There will be increased risks of traffic safety incidents on public roads affecting especially people living close to the access roads to the construction sites and the users of these roads. Currently, there is existence of constant traffic hold up along the Lagos-Abeokuta Expressway. The proposed project will involve transportation of heavy equipment and construction material to the site, which is an additional load to the current traffic on the roads. Roads may temporarily be obstructed or diverted to allow for movement of heavy equipment and materials. As this is a temporary activity with limited transportation movements, this risk is considered **minor**.

Health risk due to the construction activity

Right from the mobilization of workers and equipment, community health issues become significant. One health concern is the possible increase in the occurrences of STDs, HIV/AIDs and other communicable diseases in the locality. This is likely to persist through the operation stage of the project. However, with the limited number of workers and the fact that workers do not stay overnight in the communities, makes this risk of minor severance. There will a temporary influx of outside workers to the construction site, but also passing through the communities. There is no labour camp foreseen; the workers will stay overnight with their households or existing accommodation may be sought nearby. The presence of non-resident workers may create opportunities for local businesses, especially in food and beverage business. Temporarily this may contribute to an increased income to the area.

The clearance of the RoW and the movements of heavy equipment create small and fragmented pools of water leading to an increase in mosquito breeding areas and infestation on site. This may potentially induce an increase in prevalence of malaria and other mosquito borne diseases in communities. However, because of the temporary nature and the limited number of people living close to the construction sites, this risk is considered **minor**.

Clearing of vegetation and movement of equipment in the RoW will lead to soil surface exposure and compaction, especially along Sowumi - Akinlagun – Olorunsogo axisand Gbagban, Ototo in New Abeokuta axis where the soil is largely clayed. Herewith, potentially soil erosion may carry soil to nearby streams, affecting the water quality in these streams. The water of these streams is used for domestic use (no drinking water) by the households living close, so that temporarily they may not be able to use the water for their purposes. Based on the temporary nature of the impact and the limited number of people affected this impact is considered **minor**.

Vegetation clearing and movement of equipment in the RoW will lead to soil surface exposure and compaction, especially along Sowumi - Akinlagun – Olorunsogo axis and Gbagban in New Abeokuta axiswhere the rock formations have undergone significant weathering, giving rise to potential soil erosion. Potentially soil erosion may carry soil to nearby streams, affecting the water quality in these streams. Households living close to the project sites rely on water from these streams for domestic use, so that they may not be able to put these water to domestic use temporarily. Using polluted or contaminated water for domestic purposes, including drinking may result in ill-health to these households. However, based on the temporary nature of this impact and the limited number of people affected, these impacts are considered **minor.**

Security risk due to the construction activity

There will be increased population due to increased influx of construction workers and other people working for private business to be attracted into the project area will definitely lead to increase in social vices such as robbery, kidnapping, equipment vandalization, etc.as people with criminal tendencies who will carry out such acts will equally be attracted to the project area. Impact on security risk due to construction is therefore considered **high** because human life and properties may be affected.

5.12.2 Operation Phase

During the operation phase, safety risks occur when towers collapse or transmission lines snap and consequent electrocution occurs at the immediate site by the high tensions touching the ground. When inflammable material (like dry bushes) is present at the electrocution site a wild fire maybe ignited, resulting potentially in damage of properties or injuries. The design requirements include towers and foundations within specified high tolerances and they will be inherently safe (see 330/132 kV transmission line specifications, volume 3A of 5, Material & Installation Specifications, TCN, December 2013). Past experience indicates that, although such failure would create a potentially serious hazard, the probability of such failure is extremely low. When ignorant people think they can tap electricity from the high voltage line, direct electrocution may occur.

The operation and maintenance of transmission lines create a number of potential external safety risks to the communities living close to the RoW. The likelihood of these risks is generally low, because the RoW under the transmission lines will be cleared of any structure, high vegetation and there will be no people residing in this area anymore after the resettlement process.

Electrocution and related fires can have severe impacts to the people experiencing this. However, the likelihood is low and the lines are not crossing areas that are densely used, so that these impacts are considered**minor.**

5.13 Resettlement

Land take for ROW in communities means reduction of available farmlands and loss of crops (farm produce) during site clearance and construction of access routes to camp and sub-stations.

While compensation is paid to affected individuals, the feeling of attachment to land re-vibrates leading to agitations for additional compensation.

The land in the RoW for the Transmission Lines need to be acquired by TCN according to the Nigerian and International legislation. It is prohibited to keep structures like houses or sheds or tall trees in the RoW. Also, the use of the area for growing crops is prohibited. A separate Resettlement Action Plan has been prepared for the Proposed Transmission Line and Substation projects, providing all details of the land take and related impacts (see RAP Report).

5.14 Labour and Working Conditions

5.14.1 Construction Phase.

Occupational accident risk

In the construction, occupational accidents may occur particularly among unskilled labour force, ranging between minor incidents such as cuts and major incidents related with working at height, tower collapse and the risk of electrocution. Also, the area aroundSepeti, Adubiaro, Gbabgan is undeveloped area and there would be possible hazards, like snake bite and scorpion sting in the clearance of the vegetation. In view of the number of construction workers, the use of quite some unskilled labour, albeit internationally managed, the risk of occupational accidents is considered moderate.

Security risk

The construction activities will attract valuable materials and equipment and the presence of a labour force to the construction site. Local youth or organized crime may be tempted to steal materials from the site, to raid construction workers or try to obtain some benefits from the project in diverse ways. These security risks may threaten all staff working at the construction site.

In view of that, construction yard will be secured by an access control such as perimeter fence at an early stage of construction. Security guards will be employed to patrol the site and control access 24 hours a day. All vehicles entering and leaving the site will be searched. All personnel will be required to display personal identification and all visitors will be required to sign in. The EPC Contractor will be responsible for site security during construction. Since there will be provision for adequate security, such as trained guards on site and Government and TCN security forces , the risk is considered **minor**.

5.14.2 Operation Phase

Operation and maintenance of the transmission line will involve regular surveillance and clearing of transmission line RoW to avoid interference of activities in the RoW with the transmission lines. All tall vegetation and trees (including potential economic trees) within 10 meters of the conductor wires on the line will be cut. Safety audits and repairs will be implemented in the operation phase. In case of snapped lines or collapsed towers emergency repairs will have to be done.

A potential negative social impact is community agitations over lopsided employment during the project operation. It is often claimed that indigenes are given low income/status job. This is rated moderate among the community unlike agitation in volatile communities.

Similar to the construction phase, potentially workers may be exploited and occupational health & safety risks may occur in the regular and emergency maintenance and repair works. The likelihood of these risks is lower, as there will be less labour hired and fewer activities, compared to the construction phase. The securityrisk here and the health and safety risks are considered **medium**.

5.15 Employment and Economy

5.15.1 Construction Phase

Significant positive impact on the socio-economic lives of the communities is predicted in terms of employment creation from sight preparation to construction. More income would accrue to the indigenes who are employed as labourers on temporary basis and staff, on permanent or long-term basis.During the construction stage, community residents would serve as suppliers of construction materials. The higher economic power would result in emergence of small scale businesses locally. Similarly, there would be provision of social amenities, potable water supply, electricity through IPP, asphalt roads etc. by TCN for the host communities. This will further boost the local business and economy of the host communities.

It is expected that the majority of the workers can probably be sourced locally, from within 30 km of the construction location. The majority of the employees required during construction will be unskilled and semi-skilled labourers. The construction project areas are close to Ifo, Papalanto, Itori, Obada-Oko and Abeokuta that a worker's accommodation camp may not be needed, and workers can stay in their households. To manage construction traffic and parking needs, transport will be provided.

Next to local labour in the construction, there will be opportunities for Nigerian staff, who have specific skills and experience in working in transmission line projects. The employment opportunities form a positive impact, although temporarily.
Overall, the impact on employment and economy during construction stage would be provide, but temporary incentive to the local economy.

5.15.2 Operation Phase

Employment opportunities for local people in the operation and maintenance of the Transmission Lines and substations are quite limited. There are no regular jobs related to the operation of the transmission line. TCN will have their own staff to perform safety audits, maintenance and repair. Only for the regular clearance of vegetation and possibly other objects in the RoW, local unskilled labour may be hired for only a few days' work. The improved electricity supply for the national grid is expected to create opportunities for businesses and socio-economic development in the country. This will create a **positive** contribution to the national socio-economic development of Nigeria.

5.16 Infrastructure

5.16.1 Construction Phase

The temporary influx of outside workers to the area in the construction phase may pose an additional pressure on social infrastructure, like medical posts, emergency services, water supply and sanitation, solid waste management and road infrastructure. However, the major road along which the Transmission line will run and cross at some points is the existing Papalanto - Sagamu Road, Lagos -Abeokuta Express road. ..

The available health facilities in the project area may experience additional pressure as a result of potential occupational health and safety incidents, traffic accidents and an increase in malaria and STD prevalence.

Social infrastructures are currently not very well developed (see chapter 4) and additional demand for these services may result in reduced capacity for the communities to cope with poor level of developed infrastructure within the project area. However, the number of outside workers is expected to be limited and no labour camp is foreseen. Therefor this impact is considered **minor**.

5.16.2 Operation Phase

In the operation phase this impact is not applicable.

5.17 Cultural Heritage

5.17.1 Construction Phase

Among others,Ogun. Yemoja and Alale, shrines are located within the RoW and they need to be relocated. The shrines are located along proposed Transmission Lines corridor. In the Resettlement Action Plan, the relocation of these shrines is described. The shrines will be relocated to a nearby location in consultation with the local communities through compensation process. Worshipping at the shrines can continue at the new location.

There are various cultural festivals in the area. Potentially the construction works generating additional traffic, noise and dust may interact with these cultural festivals, affecting the experience and value of these festivals. Since relocation of shrines will be involved, the impact on cultural heritage is considered **major**.

5.17.2 Operation Phase

Potentially, the operation and maintenance works generating additional traffic, noise and dust may interact with the cultural festivals of the project area, affecting the activities and values of these festivals just like the Construction phase. This is a **minor** impact.

5.18 Cumulative Impacts

5.18.1 Defining Cumulative Impacts

In theory, any development such as the proposed Project may be taking place at the same time as other developments, causing impacts affecting the same resources or receptors, such that the impacts on these resources and receptors from all potential development will be cumulative. According to the Performance Standard, cumulative impacts can be defined as impacts that:

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

Generally, Cumulative Impacts are considered to be impacts that act with impacts from other projects such that:

- The sum of the impacts is greater than the parts; or
- The sum of the impacts reaches a threshold level such that the impact becomes significant.

The types of cumulative impacts that may be relevance are detailed in ***Table 5.6*** below:

Table 5.8: Types of Cumulative Impacts Relevant to the Project

Accumulative: the overall effect of different types of impacts at the same location. An example would be fugitive dust emissions, construction noise and construction traffic all impacting the local communities as a nuisance/ disturbance.
Interactive: where two different types of impacts (which may not singly be important) react with each other to create a new impact (that might be important) (e.g. water abstraction from a watercourse might exacerbate the impacts caused by increased sediment loading).
Additive or In-combination: where impacts from the primary activity (i.e. the construction and operation of the Project) are added to impacts from third party activities e.g. other major projects in the vicinity of the Project which are already occurring, planned or may happen in the foreseeable future).

Performance Standard suggests that in identifying cumulative impacts, "cumulative impacts are limited to those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities".

5.18.2 Identification of Relevant Development(s)

The focus of the cumulative impact assessment is on the combination effects of the Project with potential future development in the immediate area around the Project site. Our assessment cumulative impacts regarding the potential project in view, depends on the status of other projects and the level of data available to characterize the magnitude of the impacts.

In view of the paucity of available information regarding such future developments, this assessment follows a generic pattern and focuses on key issues and sensitivities for this project and how these might be influenced by cumulative impacts with a combination of other developments. Consultations with local and state authorities and identification of relevant and significant developments via searches of relevant documents provided invaluable assistant in this assessment. The main developments identified are;

- Cumulative impacts from other projects within 10 km square radius
- Those likely to arise from other transmission line projects

The following proposed and existing projects within 10 km square radius are expected to exert cumulative impacts. They are

- Existing Ewekoro cement Plant Line 1- An operating 1.3million tonnes per annum clinker cement plant
- Existing Ewekoro cement Plant Line 2–An Operating 2.7 million tonnes per annum clinker cement plant
- Existing Abeokuta Independent Power Project (Energy Culture)- A 147 megawatt gas powered power plant with a 500m transmission line
- Existing Olorunsogo Gas Fired Power Plants Phase I and II (333MW open cycle and 750MW- combined cycle respectively)
- 132kv transmission line – An existing transmission line linking Ota to Abeokuta.
- 330kv transmission line – An existing transmission line linking Olorunsogo Power Plant to.
- All existing small scale farms within the project area.
- An existing Railway line running from behind Ewekoro cement factory to Osoosun Railway station.

Apart from these projects, the area is largely undeveloped with small scale agriculture being the predominant economic activity. The potential cumulative impacts that have been identified relating to other proposed and existing projects in the area listed in this section are discussed as follows;

Other proposed projects in the area include ongoing construction of a railway line (footprint not yet determined) connecting Lagos and Abeokuta and beyond. These projects are expected to cumulatively impact on the project areas. Some of the mitigation shall be to ensure the use of appropriate vertical clearance for the transmissions line crossings to avoid and minimize its contact with trains during operation of the rail lines. TCN shall make adjustment to the EMSP document as required and proffer additional mitigation measures if necessary during the operation phase of this project.

5.18.3 Cumulative impact

Air Quality and Noise

Given the findings of impact assessment and distance of the Ewekoro cement plant (line 1 and 2) from the project area, it appears unlikely that the cumulative impact on noise and air quality will be significant. Also, the cumulative impact of Olorunsogo Power Plant Phase I & II from the project area will be localized to immediate environment. It should however be noted that this statement is based on professional judgment only.

Traffic

The construction phase will require large amounts of material and equipment to be transported to the Project site. It is expected that the Abeokuta IPP and ongoing construction of railway line project will use similar transport routes (Lagos – Abeokuta express way) which will place pressure on the local road network especially during the construction phases of the projects.

Given the foregoing, there is increased potential for accidents and disruption to the road traffic network for local users associated with the increase in traffic movements from overlapping construction traffic. It is expected that the traffic management plan to be developed for the project will consider other traffic movements associated with the development of the project in view which will help to mitigate this impact. However, in overall consideration, this impact is considered to be ***moderate*** due to the high likelihood of accidents occurring.

Economy, Employment and Skills

The operation of the various considered projects earlier outlined is proposed to occur simultaneously with the project in view. As such, the economic, employment and skills development opportunities will be greater for all the projects combined than a single project.

It should be noted that expectations regarding economic development, employment and skills development will be high amongst stakeholders in the local community and as such, in the event that one project does not meet expectations, there is the potential for all projects within the area to be the target of this negative outcome.

Based on the above, the cumulative impacts of the various proposed industrial projects on the economy, employment opportunities and skills development within the communities is expected to be positive.

5.19 Summary of Impacts

Tables 5.10a and 5.10b presents the summary of various activities involved in the project development and the significant impacts associated with each of them on the environment and social.

Table 5.9a Environmental and Social Management and Mitigation Measure (Construction Phase)

Indicator	Potential impact	Receptor
Air quality	Localized impairment of air quality by exhaust emissions from vehicles and equipment engines (SO_2, CO, NO_x, CO_2, PM)	Affected communities in area of influence
	Elevated dust levels due to vehicle movements, wind, and handling of dusty material	Affected communities in area of influence
Climate change	GHG emissions that could add to climate change effects	Global warming
Noise, vibration	Nuisance noise from construction activities	Affected communities in area of influence Construction workers
Soils, geology and land-use	Change to soil structure (erosion and compaction) as a result of excavation and backfilling and removal of vegetation	Soil on construction site
	Potential contamination of soil from inadvertent release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, etc)	Soil on construction site, especially by each tower
Water resources	Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater	Local groundwater-well and bore hole
	Potential impact on hydrological condition due to the construction activities including the construction of foundation as well as the access road within the swampy area.	Rivers and streams crossed
Terrestrial	Vegetation loss and disturbance to habitats,	Flora and fauna and habitat in the

Indicator	Potential impact	Receptor
ecology	fauna and flora by construction activities	area of influence Flora and fauna and habitat in the area of influence
	Vegetation clearing will cause habitat disturbances that could create suitable conditions for invasive species to spread	Flora and fauna and habitat in the area of influence
	Potential avian collision	Birds in the area of influence
	Loss of species that offer Provisioning Services	Local communities who rely on provisioning service, especially around swampy area.
Aquatic ecology	Loss/disturbance of aquatic species	Rivers/streams/Swampy area crossed
Visual amenities	Temporary presence of an active construction site with storage of materials and equipment within the ROW and/or the site for the substation.	People living close to the construction sites.
Land planning and use	Change in land use cause by land take for towers, vegetation clearance, and access restriction	Land on the RoW
Stakeholder and Community expectation/ relations Management	Community concerns linked to impacts associated with construction phase issues (like air and dust emissions, traffic, influx and community safety/security, noise/vibration, etc) and adverse impact/inconveniencies resulting from it.	Affected communities in area of influence
Community Health,	Increased risks of traffic safety incidents on public roads	People living close to access roads and road users

Indicator	Potential impact	Receptor
Safety and Security	Temporary influx of outside workers in the communities, risking tensions between outside (partly possibly expatriate) labour and local population, due to differences in wealth and culture.	Affected communities in area of influence
	Potential for increase in prevalence of sexually transmitted diseases in local communities and other diseases	Affected communities in area of influence
Resettlement	Land acquisition	Affected properties and livelihood
Labour and working conditions	Exploitation of workers	Labour force
	Activities and staff at site may create security risk (e.g. infiltration of criminal)	Workers and local communities
	Creation of tension between security personnel and local communities	Local communities
	Risk of health & safety incidents amongst labour force, including minor incident's such as cuts and major incidents such as loss of life	Construction labour force
Employment and economy	Creation of temporary jobs for locals residents and Nigerian nationals with skilled trades	Local residents of affected communities and Nigerian nationals
	Supply chain opportunities for Nigerian companies that can provide goods and services needed by the company	Nigerian companies and local shops
Infrastructure	Influx of outside workers may pose additional pressure on social infrastructure, like medical posts, emergency services, water supply, solid waste management	Affected communities in area of influence
Cultural heritage	shrines are located within the RoW along the transmission line and need to be relocated.	Affected cultural heritage
	Potential interactions between construction works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities along the RoW and substation

Table 5.9b Environmental and Social Management and Mitigation Measure (Operations Phase)

Indicator	Potential impact	Receptor
Air pollution / Climate Change:	Accidental significant leaks of SF6 from aging equipment, and gas losses occur during equipment maintenance and servicing	Air quality
Noise, vibration & EMF	Noise & EMF from overhead line due to Corona effect and EMF effect	Affected communities along the RoW and Substations
Terrestrial ecology	Impairments of natural habitats and associated flora communities	Flora and fauna around the ROW
		Bats and Birds in the area of influence
	Potential Impact due to introduction of alien species	Flora and fauna around the ROW
	Loss of species that offer Provisioning Services	Local communities who rely on provisioning service, especially around swampy area.
Aquatic ecology	Degradation of aquatic species	River crossings along the ROW
Visual amenities	Transmission lines and towers will be visible from far and become an extrinsic element in the landscape.	Communities around the project area
Stakeholder and Community expectation/ relations Management	Management of Community concerns linked to impacts associated with operation phase issues	Affected communities in the area of influence

Indicator	Potential impact	Receptor
Community Health, Safety and Security	External safety risks of electrocutions, bush fires, line snapping, tower collapses	Affected communities along the RoW and substations
Labour and working conditions	Exploitation of workers	Labour force for maintenance work
	Occupational H&S risks in operation and maintenance	Labour force
Employment and Economy	Improved electricity supply for the national grid, creating opportunities for businesses and economic development in the country.	National level Nigeria
Cultural heritage	Potential interactions between maintenance works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities in the RoW

CHAPTER SIX

6.0 MITIGATION MEASURE

6.1 INTRODUCTION

The potential and associated impacts of the proposed Lagos/OgunTransmission line project have been evaluated, followed by a discussion on the impacts significance in chapter five. However, the mitigation and enhancement measures for the adverse and beneficial impacts of the proposed project are presented in this chapter. Please note that these identified mitigation measures will be applied to all 3 Lots (Lot1, Lot2 and Lot3) for the project, as the integrated impacts for the project.

Mitigation measures are activities aimed at preventing, eliminating or minimizing the impacts and their effects to levels that are considered as low as reasonably practicable (ALARP). In proffering mitigation measures, the primary objectives include the following:

Prevention: methods aimed at impeding the occurrence of negative impacts, and/or preventing such occurrence from having harmful environmental/ social outcomes.

Reduction: limiting or reducing the degree, extent, magnitude, or duration of adverse impacts. Reduction can be achieved by scaling down, relocating, or redesigning elements of the project.

Control: ensuring that residual associated impacts are reduced to a level as low as reasonably practicable. The following were taken into consideration in developing the proffered mitigation measures for the predicted impacts of the proposed project activities:

- Best Available Technology (BAT) for sustainable development.
- Environmental laws in Nigeria, with emphasis on permissible limits for waste streams (FMEnv (formerly FEPA), 1991);
- View some concerns of stakeholders as expressed during extensive consultations carried out during the study.
- Feasibility of application of the proposed mitigation measures in Nigeria;

6.2 Methodology

The framework for determining the form of mitigation measures to be applied for the significant impacts identified for the project is shown in Figure 6.1 below. The frequency, severity, sensitivity, scale, magnitude and nature of the impacts were taken into consideration in the assessment.

	LOW	MEDIUM	HIGH
High	Formal Control	Physical Control	Avoidance
Medium	Training	Formal Control	Physical Control
Low	Informal Control	Training	Formal Control

Likelihood of Occurrence

Figure 6.1: Mitigation Definition Criteria

Informal Control
This involves the application of sound judgement and best practice in mitigating the impacts of the of the project activities.

Formal Control

This involves the application of documented policy, process or procedure in mitigating the impacts of the project activities. It ensures that residual associated impacts are reduced to an acceptable level.

Definition of Mitigation Measures

Mitigationmeasures aredeveloped to avoid, reduce, remedy orcompensateforanynegative impactsidentified,andto createorenhance positive impactssuchas environmentaland social benefits.Inthis context, the term"mitigationmeasure" includes operational controls as well as managementactions. These measuresare oftenestablished through industry standardsandmay include:

- Changes to the design of the project during the design process (egchangingthedevelopmentapproach);
- Engineeringcontrolsandother physicalmeasuresapplied (e.g.wastewatertreatmentfacilities);
- Operationalplansandprocedures (e.g.wastemanagementplans);and
- Theprovisionoflike-for-likereplacementrestorationor compensation.

The definition of the impact significance are as follows;

Definition of Impact Significance
The Impact significance are defined as follows;
Major significance: Here a change in design is usually required to avoid or reduce these.

Moderate significance: Here specific mitigation measures such as engineering controls are usually required to reduce these impacts to ALARP levels. This approach takes into account the technical and financial feasibility of mitigation measures.

Minor significance: These are usually managed through good industry practice, operational plans and procedures. In developing mitigation measures, the first focus is on measures that will prevent or minimize impacts through the design and management of the project rather than on reinstatement and compensation measures.

Assessing Residual Impacts

A residual impact is the impact that is predicted to remain once mitigation measures have been designed into the intended activity. Impact prediction takes into account any mitigation, control and operational management measures that are part of the project design and project plan. The residual impacts are described in terms of their significance in accordance with the categories identified in chapter 5.

Social, economic and biophysical impacts are inherently and inextricably interconnected. Change in any of these component of the environment will lead to changes in the other components. This examines how the local way of life might change as a result of the proposed potential changes of the project to local culture, livelihoods, health and well-being, personal and communal property rights.

6.3 Air Quality

Construction Phase

Impact due to Air pollutant emission

Regarding impacts of emissions from vehicles and equipment engines, the following mitigation measures are recommended:

- All vehicles and equipment engines should be maintained and operated in accordance with manufacturers recommendations;
- Stationary generators to be located to facilitate dispersion;
- Loose materials should be properly covered and top layers kept moist;
- Practice of regular cleaning of equipment, drains and roads to avoid excessive build-up of dirt should be adopted;
- The use of binder materials for erosion and dust control for long term exposed surfaces should be adopted.
- Prior to excavation, spray surfaces.
- Employ the use of covered trucks for the transportation of materials that have potentials to release dust emissions
- Apply speed limits on-site of 15kph on unpaved roads and surfaces.

If the above measures are implemented accordingly, the residual air quality impacts can be considered to be **minor**.

Green House Gas Emission

In consideration of the Climate Change under the construction phase, the impact of vegetation clearing, resulting to reduction of carbon sink ability of the environment and the use of equipment and vehicles during the construction resulting to the release of GHG gases shall be mitigated through the use of good international practice, including maintaining and operating all vehicles and equipment engines in accordance with manufacturers recommendations, location of stationary generators to facilitate dispersion, restriction of vegetation clearing to only the required area and the use of experienced drivers and fuel efficient equipment, vehicles and machineries during construction activities. Even the implementation of above mitigation measure, GHG emission cannot be avoided. Therefore, the impact on climate change is considered to be kept as **minor**.

Operation Phase

For Climate Change, the impact of SF_6 shall be mitigated through the improvements in the leak rate of new equipment, refurbishing older equipment, and the use of more efficient operation and maintenance techniques. Since impact is considered **minor**, the best practices measures have been identified to mitigate the impact to the minimum level.

6.4 Noise, Vibration and EMF

Construction Phase

The following recommendations for mitigation measures are outlined below:

- Avoid dropping materials from height, where practicable;
- Avoid metal-to-metal contact on equipment;

- Maintain and operate all vehicles and equipment in accordance with manufacturers recommendations;
- Avoid mobile plant clustering near residences and other sensitive land uses;
- Ensure periods of respite are provided in the case of unavoidable maximum noise level events;
- Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the TCN Community Relation Officer;
- Noisy activities (activities that can be heard in nearby communities) restricted to day-time working hours.
- Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings;
- Select 'low noise' equipment or methods of work;
- Use temporary noise barriers for equipment (e.g. sound proofing walls around stationary power generating sources);

With the implementation of the above measures the residual air quality impacts can be expected to be **minor**.

Operation Phase

The noise impact during the operation phase is considered to be minor and this impact can be reduced by choosing conductors designed and constructed to minimize corona effects and avoid overloading of transmission lines because of EMF effect. Also, installation of mesh at strategic areas will reduce EMF effect to the minimal level. In addition, ROW will be secured where no residential structure is allowed to be built However, the noise emission cannot be completely blocked. Therefore, the residual impact will be **minor**.

6.5 Soil and Geology

Construction Phase

Impact on geology and soil structure

Where the subsoil is clayey and unyielding, the transmission line tower foundation should be anchored on friction piles to prevent settlement. The fractured/weathered condition of rocks around the Abeokuta axis makes it vulnerable to erosion in that part of the project area if not well managed.

The following mitigation measures to reduce impacts on soil structure from compaction and erosion are recommended:

- Protect excavated soil materials from erosion;
- Ensure that the land is physically restored (include re-vegetation where possible) before leaving to next tower location and before the next rainy season; and
- Use of existing track for transport of man and material to the extent possible;
- Construction of foundations to be undertaken in the dry season;
- Backfill foundation pits by the excavated soils which will resemble the order of the original soil layers;

Potential soil contamination

With regards to soil contamination impacts, the following measures will be implemented:

- Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages;
- Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques;
- Implement effective site drainage on the construction camp to allow for the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas;
- Install oil/water separators and silt traps before effluent leaves the site;
- Minimize bare ground and stockpiles to avoid silt runoff;
- Bunding of areas where hazardous substances are stored (e.g. fuel, waste oil areas,etc);
- Remove all water accumulation within bunds using manually controlled positive lift pumps as against gravity drains;
- Develop and apply procedure regarding dealing with contaminated soils;
- Development and implementation of a Waste Management Plan (as part of the ESMP) to ensure that waste is disposed of correctly; and
- Spread sheet underneath the tower structure prior to commencement of any painting activity.

With the implementation of the above measures the residual soil and geology quality impacts can be expected to be **minor**.

Operation Phase

Since impact is considered **negligible**, no additional measures have been identified.

6.6 Water Resources

Construction Phase

Impact on Hydrogeology

The discharge of hazardous or contaminated materials such as liquid fuel, solvents, lubricants (oil), aluminum oxide paints, etc., into the groundwater and surface water can lead to their contamination and this can be mitigated through the following actions;

- Development of access road within swampy and marshy areas around Afowawa Eleyele, Pankere, Ajade, Opanigangan, Ototo, Sowunmi and Iludun communities respectively.
- Avoiding storage of materials with possibility of leaching into soil in the open
- Construction of bund wall for fuel and oil storage areas.
- Regular maintenance of construction equipment to avoid oil leakages within project sites.

With the implementation of these actions, the impact is expected to be reduced to **negligible.**

Potential contamination on water resource

Measures identified for prevention of spills and leakage of hazardous substances into surface and ground water apply here. The residual impacts on surface and groundwater can be expected to be **Negligible**.

Operation Phase

Since impact is considered **negligible**, no additional measures have been identified.

6.7 Terrestrial Ecology

Construction Phase

Impact on Terrestrial flora and Fauna

The following recommendations for mitigation measures are outlined below:

- Limit lightening on site;
- Sensitivity training to staff and anti-poaching policy; and
- Site clearance activities to be restricted to the minimum required area of the RoW.

The residual impacts on terrestrial ecology can be expected to be **minor**.

Impact due to the introduction of alien species

The potentials of the ROW of the Transmission Line being colonized by alien and invasive species exist. Such species could use the line corridor as a spreading area and consequently infest nearby habitats. The implementation of the following measures will result in a reduction of the impact of the Alien Species to a **Minor** level of impact.

- Herbicides should not be used for vegetation clearing
- Re-vegetation should use species locally native to the site and not use any environmental weeds for erosion control
- Implementation of the invasive species management plan as part of the Vegetation Management Plan.
- Retention of native species where possible along the line route.
- Clearing should be minimized and restricted to the area required for construction purposes only and disturbance to adjacent vegetation communities and/or remnant trees within the corridor should be strictly controlled.
- A monitoring program of invasive species propagation within the right-of-way should be instituted and, if present, must be removed

Impact on Ecosystem Service

The identified impacts of the project on ecosystem services will reduced to **minor** level after implementing the following measures;

- Accommodate the existence of species that do not grow above 4m within the ROW
- Preserve all species that provide services as much is possible.
- In the event of identified cultural ecosystem services, compensate for the relocation of shrines.

Operation Phase

Impact on Ecosystem Service

Due to significant level of reduced project activities, the impacts of the project during the operation phase on ecosystem services is negligible, in order to maximize this status, plants shall be trimmed during ROW maintenance instead of complete removal.

Impact on Terrestrial flora and Fauna and Impact due to the introduction of alien species

These impacts are negligible during operation phase as a result of reduced level of project activities that will engender negative impacts on the environmental resources.

Avian Collision

In order to reduce risk of avian collusion, place "bird diverters" on the top (ground) wire to make the lines more visible to birds. With these measures, bird collision impacts shall be reduced to **minor** level.

6.8 Aquatic ecology

Construction Phase

The following measures shall be implemented in order to minimize the impacts of the project on aquatic ecology during construction. When these measures are implemented it is expected to reduce the impact of this project on aquatic ecology to **minor level.**

- Avoid blocking or obstruction of natural flow of river courses.
- Maintain construction equipment regularly to avoid discharge of waste oil into rivers.
- As much as possible, conduct activities during the dry season to minimize disturbance of sensitive shoreline, wetland areas and aquatic organisms.
- Adjust pylon siting to span rivers and wetlands areas, or limit equipment access in wetlands, wherever possible.
- Perform all vegetation clearing work manually along streams/rivers and swamps.
- Avoid vegetation clearing along stream shores and on steep slopes.
- Avoid construction of permanent access roads along river banks, in swamps or in areas where soils are saturated.
- From project design phase, avoid erecting towers within wetlands. If unavoidable, select the most optimized site for each tower considering human uses and areas of higher ecological integrity.
- Maintain vegetation buffer zones within and around wetlands and along both sides of watercourse crossings. Restore as soon as possible any disturbed areas in the riparian buffer zone.
- Do not move equipment and vehicles in rivers, floodplains and wetland areas. If unavoidable, reduce access to a minimum length in wetlands and floodplains and adopt the selection of the most optimized site for the access considering human uses and areas of higher ecological integrity.
- Dismantle temporary access roads built for construction phase in swamps and wetland areas. Perform this dismantling during the dry season and dispose of materials outside wetland areas.

Operation Phase

In order to minimize impacts to a negligible level on aquatic ecology during operation and maintenance phase, the following measures shall be implemented.

- Vegetation wastes or other types of wastes shall not be disposed along water courses or sensitive areas.
- Natural water courses shall not be obstructed or blocked.
- Existing access roads shall be utilized during maintenance of the ROW.

- Equipment and vehicle movements in rivers, floodplains and wetland areas should be avoided. If unavoidable, reduce access to a minimum length in wetlands and floodplains and select the most optimized site for the access considering human uses and areas of higher ecological integrity.

6.9Visual Amenities

Construction Phase

The minor impact of the change in visual amenities can be reduced by maintaining the construction site in orderly condition and do not distribute material over many sites before usage. Following mitigation measure will be implemented.

- Provision of education to construction workers for waste management.
- Construction waste will be appropriated managed at the site and treated and disposed by licensed company.

  Applying above mitigation measure, the residual impact will be **negligible**.

Operation Phase

To reduce the permanent impact on the visual amenities of the landscape it is advised that smaller trees and vegetation can be kept, so that there is still green scenery present. The towers have quite an open structure which will not hampering the view very much. However, since the presence of transmission tower and line, changed the landscape in the area, especially forest area, the residual impact is still considered **negligible.**

6.10Land Planning and Use

Construction Phase

The project will result into conversion of cropland and residential housing into ROW. This is because TCN does not allow farming or any structure in the ROW for safety reasons. However, this cannot be mitigated via Resettlement action plan (RAP) which has been prepared and shall be implemented in line with requirements of the land use act and the world bank safeguard policy OP 4.12 on involuntary resettlement, which shall include;

- Livelihood restoration strategies
- Valuation and budget for replacement of assets lost as a result of the project
- Institutional framework for effective implementation
- Grievance redress mechanism
- Compensation shall be paid and key aspects of the RAP implemented before construction commences.
- Chopped woody resources and residues shall be made available to local population in order to reduce additional pressures on natural resources.

These measures will reduce impacts to a **minor**level.

Operational Phase

During the operations phase, the impacts of the project on land planning and use has been evaluated to be **positive**. To maximize the positive impact, the following actions will enhance the beneficial effects.

- Provide maintenance for the activities to be conducted in the ROW.

6.11 Stakeholder and Community Expectation/RelationsManagement

Construction Phase

The concerns of the close-by communities of cumulative effects of environmental and safety/security impacts and inconveniences of the transmission lines in combination with the existing activities within 5km radius of the project site will need serious attention. By implementing a package of mitigation and enhancement measures, the concerns can be reduced to a manageable level for the majority of the community members. However, there may be vulnerable people, who need special attention to reduce the effects to an acceptable level.

A combination of the following measures should be applied:

- Enhance on going consultations with local communities (with good representation) by TCN to create continuous dialogue, trust and planning of community development activities. Coordinate Stakeholder Engagement of all partners of industrial site, develop and implementa Stakeholder Engagement Plan.
- Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in the ESMP;
- Engage communities in the monitoring activities to enhance transparency and involvement.
- Follow mitigation for construction phase air quality, noise and traffic;
- Disseminate information to communities about details of construction activities (e.g., employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by billboards, posters and community meeting.
- Develop, manage and effectively manage construction phase grievance mechanism system
- Progress reporting to stakeholders on the overall environmental performance of the plant and the steps taken to mitigate any adverse environmental impacts.

With a proper, continuous and serious implementation of the above-mentioned measures the experience of community impacts can be reduced to a **moderate** level.

Operation Phase`

The operation phase may share the same mix of mitigation and enhancement measures with the construction phase, and so the mitigation measures should be extended from the construction phase as described above to operation phase. This package, when implemented rigorously, continuously and with participation of the affected communities, can support the project in bringing the community impact to a **minor** to **moderate** level. However, possibility that certain community members may not be satisfied with the mitigation and enhancement measures and may still provide resistance cannot be ruled out. They may demand to negotiate better benefit sharing mechanisms. The following measures apply in the operation phase:

- Follow mitigation for operation phase air quality, noise and traffic;
- Disseminate information to communities about details of operation activities (e.g., employment opportunities by billboards, posters and plant visit;
- Develop, manage and manage grievance mechanism.

- Progress reporting to stakeholders on the overall environmental performance of the plant and the steps taken to mitigate any adverse environmental impacts;
- Deliver explanation on the effects of electromagnetic fields to communities in order to allay their fears. Keep fields within limits of International Commission on Non-Ionizing Radiation Protection (ICNIRP); and
- Interference with radio/TC transmission during rain needs to be properly explained to the communities.
- Knowledge sharing of independent monitoring reports of all monitoring actions as mentioned in this ESMP;
- Engage communities in the monitoring activities to enhance transparency and involvement;
- Create Broad Community Support; enhance ongoing consultations with local communities (with good representation) by TCN to create continuous dialogue, trust and planning of community development activities. Coordinate Stakeholder Engagement of all partners of industrial site, prepare and implement Stakeholder Engagement Plan.

6.12 Community Health, Safety and Security

Construction Phase

The following mitigation measures should be implemented in order to reduce the potential adverse impacts and risks associated with construction activities on the community health, safety and security. To reduce traffic accident risks, the Contractor should implement a traffic safety plan including design of access point, signalization, speed limits, training of drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines), maintain log of traffic related incidents, sensitization of road users and people living close to the construction site. If this plan is thoroughly implemented, this residual risk can be **negligible**.

To reduce the risk of an increase in STD prevalence, awareness raising material and condoms should be provided to all workers. Herewith the risk can be mitigated to a **negligible** level.
The construction site should be managed to eliminate potential mosquito breeding sites. This includes the prevention of surface water ponding and an avoidance of outside storage of vehicle tires. For unavoidableponds, monitor for mosquito larvae, treat with a US EPA (or similar) approved mosquito larvicide as needed. These measures can bring this risk to a **negligible** level.

To mitigate security risk such as conflict between security and local communities, develop a Local Content Plan to facilitate involvement of local labour, including security labour as much as possible. The implementation of the plan will enhance ability to locate local hires and Nigerian nationals in particular. This plan should be gender and vulnerable group inclusive as it should include provisions for hiring women and for "equal pay for work of equal value". A local hiring office (or offices) to be set-up for use by all contractors to advertise positions, receive applications, and provide guidance to applicants. Further a code of behaviours for workers should be developed, which should be trained and periodically refreshed, as needed based on community liaison/grievance mechanism feedback. This will help in reducing the potential for frictions between outside labour and local community members to a **minor** level.

Erosion prevention measures are required to prevent soil entering nearby fields,especially in locations close to Abeokuta axis with weathered rock formation/fractures. Construction sites should be kept flat, clearing lose soil from the site and covering with geo-textile if needed. These measures can bring this impact to a **negligible** level.

Operation Phase

To reduce the external safety risks for the people living close to the operational transmission line the following measures should be implemented by TCN, as operator of the lines:

Annually, a safety audit of transmission lines, towers and RoW should be performed to identify potential safety risks in an early stage and keep maintenance at high standards, so that snapping of lines or collapsing of towers is prevented as much as possible; and

- To prevent as much as possible, emergencies and to manage the response to emergencies when they occur. In the operation phase of the project, an emergency response plan should be developed and implemented following TCN's standards and international best practice including provisions for prevention and response to electrocution, bush fires, repair of snapped lines and collapsed towers, roles and responsibilities and emergency response. This plan should be coordinated with TCN and the Local Government;

The affected communities in the area of influence of the transmission lines should be informed about the safety risks related to the high voltage electricity, the do's and don'ts in the RoW and the response measures in place, when an incident happens (from the emergency response plan). Sign boards will be placed on the towers to warn about the electrocution risk. With the serious implementation of the above measures the residual safety risks can be expected to be reduced to a **minor** level.

6.13 Resettlement

The owners of the assets in the RoW will receive compensation for their lost assets. These affected people experience economic impacts by losing their cropping plots, valuable trees, (unfinished) structures and various kinds of businesses. However, majority of these people are not highly dependent on these assets for their livelihood. Compensation of the value of these assets will off-set these economic impacts.

The farms or businesses located in the RoW, will need to develop new farms outside theRoW. The businesses will be compensated by a fixed economic rehabilitation grant. The shrines located in the RoW will be relocated just outside the RoW in consultation with the affected communities through compensation process.

If the plan is properly implemented, the impacts of the physical resettlement of households and the economic impact of the owners of assets in the RoW can be managed to an acceptable minor level (see RAP report for details).

A separate resettlement framework has been prepared, describing the land take, resettlement process, compensation eligibility, way forward, grievance mechanism and foreseen monitoring. For the affected households, which need to be physically resettled micro-plans will be developed to secure their livelihood, legal rights and proper compensation.

6.14Labourand Working Conditions

Construction Phase

To prevent the exploitation of the workforce, the Contractor should comply with the provisions in the Labour Act of Nigeria and the international ILO conventions. The following items apply specifically for this project:

- There should be no use of child labour (workers under age 18) and forced labour is not allowed;
- Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required;
- Provide proper work place facilities for water/sanitation/rest rooms;
- In the event of retrenchment needs, first viable alternatives are analyzed and then adverse impacts of retrenchment on workers are reduced as much as possible. A transparent retrenchment plan will be prepared;
- There should be no hiring of short-term labour to be made at the site gate; and
- Develop transparent human resources policies and procedures for recruitment process, working conditions, terms of employment wages, worker-employer relations, non-discrimination policy, monitoring, roles and responsibilities;
- Provide reasonable, and if applicable negotiated, working terms and conditions;
- Develop worker's grievance redress mechanism, so that potential conflicts can be dealt with in an early and proper way;

Indeed the Contractors' implementation of their human resources procedures in line with the Nigerian Labour Act and ILO Conventions is required, and as he upholds these through their construction contract, the risk of exploitation of the labour force can be kept to a **negligible** level.

Security risks can be mitigated by preparing and implementing a security and emergency response plan in close cooperation with Ewekero Cement factory security and other local security forces. If security measures are well implemented, these risks can be reduced to a **minor** level.

To prevent and respond effectively to occupational health & safety incidents a project specific health and safety procedures needs to be developed and implemented based on TCN's HSE guidelines, including the provisions for training and certifications to be followed by all workers including subcontractors. In particular, slip-trip and fall hazards with tower erection and electrocution need special attention. The need to consult with local health facilities to be prepared in case of incidents that need medical help is important.

To prevent and manage occupational health & safety risks, the following measures need to be implemented:

- audit management of electrocution incidents;
- emergency prevention and management;
- provide and maintain first aid facilities at all places where electrocution risks exist and train staff to use these; and
- provide and use personal protection equipment (PPE).
- ensure proper design, construction and installation of towers and associated facilities;
- train staff regularly and thoroughly in prevention and response of electrocution incidents, monitor and keep record;
- special focus on slip-trip, fall from height and electrocution in maintenance and repair works;

When all measures mentioned above are well implemented, the risk of occupational health & safety incidents can be kept to an acceptable level, to a **minor** level.

Operation Phase
The same mitigation measures for the construction phase is applicable in the operation phase to reduce the risks of labour force exploitation, to a **negligible** level and the risks of occupational health & safety, to a **minor** level. However, TCN is the responsible organization for the implementation of these measures, following their TCN procedures for the management of these risks.
The following main items apply to reduce risks of labour exploitation to an acceptable level:

- The use of child labour (workers under age 18) or forced labour is prohibited;
- Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required;
- A workers' grievance redress mechanism will be in place.
- Adhere to human resources policies and procedures of TCN, following Nigerian Labour Law and ILO conventions;
- Provide reasonable, and if applicable negotiated, working terms and conditions;
- Develop workers' grievance redress mechanism, so that potential conflicts can be dealt with in an early and proper way

The mitigation measures applicable for the operation phase are the same for the construction phase to reduce the risks of labour force exploitation, to a negligible level and the risks of occupational health & safety, to a minor level. However, TCN is organization responsible for the implementation of these measures, in line with the TCN procedures for the management of these risks.

TCN should follow their Occupational HSE plan as adapted from Nigerian and international requirements:

- audit management of electrocution incidents;
- emergency prevention and management;
- provide and maintain first aid facilities at all places where electrocution risks exist and train staff to use these; and
- provide and use personal protection equipment(PPEs)
- regular and thorough training of staff in prevention and response of electrocution incidents, monitor and record keeping;
- special focus on slip-trip, fall from height and electrocution in maintenance and repair works;

6.15 Employment and Economy

Construction Phase
Employment and economy associated with this project are regarded as a positive impact at this phase. To enhance the **positive** impact of employment opportunities for local residents, a local content plan needs to be prepared to enhance the ability to locate local hires and Nigerian nationals. This plan should be gender and vulnerable group inclusive, including provisions for hiring women and youth and for "equal pay for work of equal value". A local hiring office (or offices) is required to be set-up for use by all contractors to advertise positions, receive applications, and provide guidance to applicants.

To enhance this positive impact of opportunities for local businesses and entrepreneurs, the local content plan should also facilitate identification and selection of qualified local and competent Nigerian companies to provide needed supplies and services. This plan should include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities.

Operation Phase

The **positive** impact of an important contribution to the national grid, enhancing socio-economic development in the country, can only be reached when the transmission lines are kept in good order ensuring reliable electricity supply, without power cuts and at a stable frequency and voltage.

6.16 Infrastructure

Construction Phase

In the preparation and execution of the construction works, the Contractor (in conjunction with TCN) should coordinate with medical posts and emergency services about the potential of an increase demand of these services. Preparedness can be raised for temporary water supply to the communities, additional waste management and an increase in demand for medical services.

Proper and independent facilities for water supply, sanitation, solid and liquid waste need to be installed at the construction site, so that pressure on community infrastructure will be reduced.

New access roads shall be constructed only where it becomes necessary, otherwise as much as possible existing roads shall be used. Temporary access created in swampy and marshy areas, and other sensitive areas shall be removed and restored to their original state if possible, when they are no longer useful for the project. During construction of access road in dry season if required, the affected area should properly be sprayed with water to reduce dust impact and the removal of vegetation should be restricted to the area needed for the access road only. Also, during construction of the road, all HSE rules such as use PPE, placing necessary signages around the construction sites, etc, shall be observed. By implementing these measures the impact of the project on infrastructure can be managed to a **negligible** level.

Operation Phase

In the operation phase of the project, the impact on infrastructure is **positive** due to improved level of electricity supply.

6.17 Cultural Heritage

Construction Phase

The shrines discovered to be present in the RoW, will be relocated to a location outside the RoW. However, the new location shall be a result of negotiated agreement with the local communities through compensation processes, where the adherents can continue to use them. The exact location and ceremony for relocation will be managed by the communities. The residual impact will be**minor**. When the timing of construction activities is coordinated with the local cultural festivals, the potential of undesirable conflicts can be avoided, bringing this impactto a**minor** level.

Operation Phase

Also, in the operation phase, the timing of maintenance activities should be coordinated with the Communities to avoid interference between maintenance and the festivals. The residual impact is **negligible.**

6.18 Summary of Mitigation Measures

Tables 6.1a and 6.1b presents the summary of mitigation measures on various activities involved in the project development and the significant impacts associated with each of them on the environment and social concern at the Construction and Operation phase respectively.

Table 6.1a Environmental and Social Management and Mitigation Measure (ConstructionPhase)

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
Air quality	Localized impairment of air quality by exhaust emissions from vehicles and equipment engines (SO_2, CO, NO_x, CO_2, PM)	Affected communities in area of influence	×	×	Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations Stationary generators to be located to facilitate dispersion
	Elevated dust levels due to vehicle movements, wind, and handling of dusty material	Affected communities in area of influence	×	×	Cover properly loose materials and keep top layers moist Regular cleaning of equipment, drains and roads to avoid excessive buildup of dirt Spray surfaces prior to excavation Use covered trucks for the transportation of materials that release dust emissions Speed limits on-site of 15kph on unhardened roads and surfaces
Climate change	GHG emissions that could add to climate change effects	Global warming	×	×	Maintain and operate all vehicles and equipment engines in accordance with manufacturers specifications, location of stationary generators to facilitate dispersion, restriction of vegetation clearing to only the required area
Noise, vibration	Nuisance noise from construction activities	Affected communities in area of influence Construction workers	×	×	Select 'low noise' equipment or methods of work Use temporary noise barriers for equipment (e.g. sound proofing walls around stationary power generating sources). Maintain and operate all vehicles and equipment's in accordance with manufacturers

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
					recommendations Ensure periods of respite are provided in the case of unavoidable maximum noise level events Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the responsible person. Noisy activities (activities that can be heard in nearby communities) restricted to day-time working hours Provide appropriate PPE to construction workers and visitors
Soils, geology and land-use	Change to soil structure (erosion and compaction) as a result of excavation and backfilling and removal of vegetation	Soil on construction site	×	×	Construction of foundations to be undertaken in the dry period as reasonable as possible. Protect excavated soil materials from erosion (e.g. store the excavated soil at the location which is not affected by rain runoff). Ensure that the land is physically restored (include revegetation where possible) before leaving to next tower location and before the next rainy season. Use of existing road for transport of man and material to the extent possible.
	Potential contamination of soil from inadvertent release of hazardous or	Soil on construction site, especially by	×	×	Implement effective site drainage on the construction yard to allow for the directed flow of surface water off site.

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
	contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, etc)	each tower			This shall include cut-off drains to divert surface runoff from exposed soils or construction areas. Install oil/water separators and silt traps before effluent, leaves the site. Minimize bare ground and stockpiles to avoid silt runoff. Bunding of areas where hazardous substances are stored (eg fuel, waste areas). Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages. Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques. Set-up and apply procedure regarding dealing with contaminated soils. Development and implementation of a Waste Management Plan to ensure that waste is disposed of correctly. Spread sheet underneath the tower structure prior to start any painting activity.
Water resources	Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater	Local groundwater -well and bore hole	×	×	See above measures to mitigate 'Potential contamination of soil' impact
	Potential impact on	Rivers and	×		Natural flow of a River shall not

Indicator	Potential impact	Receptor	Project Component: Transmission Line	Project Component: Sub-station	Mitigation or enhancement measures
	hydrological condition due to the construction activities including the construction of foundation as well as the access road within the swampy area.	streams crossed			be blocked Based on an appropriate project design, avoid erecting towers within wetlands. If unavoidable, select the most optimized site for each tower considering human uses and areas of higher ecological integrity. Prohibit construction of permanent access roads along river banks, in swamps or in areas where soils are saturated Consider and Select the engineering design for construction work, including construction of foundation as well as access road, which would minimize the impact on hydrological condition.
Terrestrial ecology	Vegetation loss and disturbance to habitats, fauna and flora by construction activities	Flora and fauna and habitat in the area of influence Flora and fauna and habitat in the area of influence	×	×	Minimize the construction of new access roads. Promote the use of existing access roads for machinery and vehicle movements. Promote the use of existing roads for transporting material and tower parts to the construction sites in order to reduce the project's footprint and minimize the need for new access roads Herbicides should not be used for vegetation clearing Clearing should be minimised and restricted to the area required for construction purposes only and disturbance to adjacent vegetation communities and/or remnant trees within the corridor should be strictly

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
					controlled.
					Revegetation will be carried out, as necessary. Revegetation will use species locally native to the site. The site of revegetation shall be identified and provided by the relevant government agency.
	Vegetation clearing will cause habitat disturbances that could create suitable conditions for invasive species to spread	Flora and fauna and habitat in the area of influence	×		Implementation of the invasive species management plan as part of the Vegetation Management Plan.
	Potential avian collision	Birds in the area of influence	×	×	Consult with relevant agency (e.g local NGO) to seek any advice for mitigation measures to be considered for the design and construction of the transmission line. "Bird diverters" on the top (ground) wire to make the lines more visible to birds shall be installed, particular in the swampy areas. Complete tree and/or brush cutting prior to or after the core nesting season
	Loss of species that offer Provisioning Services	Local communities who rely on provisioning service, especially around swampy area.	×		Site clearance activities to be restricted to the minimum required area
					Provide a training/education for the sustainable livelihood practice to local communities, as necessary, with cooperation of relevant agency.

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
Aquatic ecology	Loss/disturbance of aquatic species	Rivers/streams/Swampy area crossed	×		Natural flow of a River shall not be blocked Conduct activities during the dry period to minimize disturbance of sensitive shoreline and wetland areas Adjust pylon siting to span rivers and wetlands areas, or limit equipment access in wetlands, wherever possible. Perform all vegetation clearing work manually along streams/rivers and swamps. Avoid vegetation clearing along stream shores and on steep slopes. Based on an appropriate project design, avoid erecting towers within wetlands. If unavoidable, select the most optimized site for each tower considering human uses and areas of higher ecological integrity. Prohibit construction of permanent access roads along river banks, in swamps or in areas where soils are saturated Dismantle temporary access roads built for construction phase in swamps and wetland areas. Perform this dismantlement during the dry season and dispose of materials outside wetland areas; Avoid equipment and vehicle movements in rivers, floodplains and wetland areas. If unavoidable, reduce access to a minimum length in wetlands and

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
					floodplains and select the most optimized site for the access considering human uses and areas of higher ecological integrity
Visual amenities	Temporary presence of an active construction site with storage of materials and equipment within the ROW and/or the site for the substation.	People living close to the construction sites.	×	×	Maintain construction site in orderly condition and do not distribute material over many sites before usage.
Land planning and use	Change in land use cause by land take for towers, vegetation clearance, and access restriction	Land on the RoW	×		Site clearance activities to be restricted to the minimum required area. Provision of predefined route, barriers or boundary markings to prevent incursion of machinery and workers into neighboring areas See below measures under 'Resettlement'
Stakeholder and Community expectation/ relations Management	Community concerns linked to impacts associated with construction phase issues (like air and dust emissions, traffic, influx and community safety/security, noise/vibration, etc) and adverse impact/inconveniencies resulting from it.	Affected communities in area of influence	×	×	Follow mitigation for construction phase air quality, water quality, noise and traffic. Inform communities about details of construction activities (e.g., employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by billboards, posters and community meeting Set-up and effectively monitor construction grievance redress mechanism Engage communities in the monitoring activities to enhance transparency and involvement.

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
Community Health, Safety and Security	Increased risks of traffic safety incidents on public roads	People living close to access roads and road users	×	×	Implement a traffic management plan including design of access point, signalization, speed limits, training of drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines), maintain log of traffic related incidents, sensitization of road users and people living close to the construction site.
	Temporary influx of outside workers in the communities, risking tensions between outside (partly possibly expatriate) labour and local population, due to differences in wealth and culture.	Affected communities in area of influence	×	×	Priority of employment shall be given to locals. A Local Content Plan should be prepared to facilitate involvement of local labour. Develop a code of behaviours for workers. All workers to receive training on community relations and code of behaviour. Periodic refreshing as needed based on community liaison/grievance mechanism feedback.
	Potential for increase in prevalence of sexually transmitted diseases in local communities and other diseases	Affected communities in area of influence	×	×	Do sensitization and awareness to all EPC workers regarding sexually transmitted diseases Provide Sexually transmitted disease awareness material to all EPC workers and host communities
Resettlement	Land acquisition	Affected properties and livelihood	×	×	Follow principles and procedures of Resettlement Action Plan (RAP), including way forward, micro-plans per affected household.
Labour and working	Exploitation of workers	Labour force	×	×	Develop transparent human resources policies and procedures for recruitment

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
conditions					process, working conditions and Terms of Employment wages, worker-employer relations, Grievance Redress Mechanism, non-discrimination, monitoring, roles and responsibilities following Nigerian Labour Law and ILO conventions. Provide reasonable, and if applicable negotiated, working terms and conditions. Establish worker's grievance redress mechanism, so that potential conflicts can be dealt with in an early and proper way. No use of child labour (workers under age 18) or forced labour Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. Provide proper work place facilities for water/sanitation/rest rooms etc. A worker's grievance redress mechanism will be in place.
	Activities and staff at site may create security risk (e.g. infiltration of criminal)	Workers and local communities	×	×	Liaise with community security structure Provision of security during the construction work Make security plan and emergency response and contacts with security forces. Coordinate if applicable with TCN security measures for their site. Provide the identification tag for

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
					all workers and visitors.
	Creation of tension between security personel and local communities	Local communities	×	×	Provide the training and awareness to security personnel Establish the communication with local communities and awareness
	Risk of health & safety incidents amongst labour force, including minor incident's such as cuts and major incidents such as loss of life	Construction labour force	×	×	Develop project specific health and safety procedure, including provisions for training and certifications to be followed by all workers including subcontractors.
Employment and economy	Creation of temporary jobs for locals residents and Nigerian nationals with skilled trades	Local residents of affected communities and Nigerian nationals	×	×	Prepare a local content plan to enhance ability to locate local hires and Nigerian nationals. Include provisions for hiring women and youth and for "equal pay for work of equal value". A local hiring office (or offices) to be set-up for use by all contractors to advertise positions, receive applications, and provide guidance to applicants.
	Supply chain opportunities for Nigerian companies that can provide goods and services needed by the company	Nigerian companies and local shops	×	×	Prepare a local content plan to facilitate identification and selection of qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities.

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub-station	
Infrastructure	Influx of outside workers may pose additional pressure on social infrastructure, like medical posts, emergency services, water supply, solid waste management	Affected communities in area of influence	×	×	Coordinate with medical posts and emergency services to prepare for water supply and waste management. Install proper and independent facilities at construction site for water supply, sanitation, solid and liquid waste, so that pressure on community infrastructure is limited.
Cultural heritage	shrines are located within the RoW along the transmission line and need to be relocated.	Affected cultural heritage	×		The shrines will be relocated to outside the RoW, where the local communities will continue to use them. The exact location and ceremony for relocation will be managed by the communities
	Potential interactions between construction works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities along the RoW and substation	×	×	Consult with local communities on festivals and potentials for interaction with construction works. If required cease works on the specific dates.

Table 6.1b Environmental and Social Management and Mitigation Measure (Operations Phase)

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
Air pollution / Climate Change:	Accidental significant leaks of SF6 from aging equipment, and gas losses occur during equipment maintenance and servicing	Air quality	×	×	Impact of SF6 shall be mitigated through the improvements in the leak rate of new equipment, refurbishing older equipment, and the use of more efficient operation and maintenance techniques.
Noise, vibration & EMF	Noise & EMF from overhead line due to Corona effect and EMF effect	Affected communities along the RoW and Substations	×	×	Avoiding over loading Transmission Lines Keep residences and other permanent structures such as schools, shops or offices out of the RoW to minimize exposure to Noise and EMFs.
Terrestrial ecology	Impairments of natural habitats and associated flora communities	Flora and fauna around the ROW	×		Maintain all maintenance work inside the footprint of RoW to reduce encroachment on natural habitats Clearly mark the extent of vegetation control in the ROW. Identify and mark the vegetation to be preserved along sections of the ROW Undertake selective control of the vegetation in order to keep low scrubby and herbaceous species that do not represent a risk for the powerline (species that cannot grow more than 4m in height) Use mechanical method for vegetation control inside the ROW. Forbid use of chemical pesticides to control vegetation

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
					in the ROW
		Bats and Birds in the area of influence	×		Schedule RoW maintenance activities to avoid breeding and nesting seasons of bird species with special status Develop and implement a mortality monitoring program, as necessary, with cooperation of local NGO.
	Potential Impact due to introduction of alien species	Flora and fauna around the ROW	×		Develop and implement vegetation management plan to control the introduction of alien species A monitoring program of invasive species propagation within the right-of-way should be instituted and, if present, shall be removed.
	Loss of species that offer Provisioning Services	Local communities who rely on provisioning service, especially around swampy area.	×		Undertake monitoring of natural resources exploitation and implement a sensitization program in order to educate and increase local communities' awareness on natural resources protection
Aquatic ecology	Degradation of aquatic species	River crossings along the ROW	×		Wastes shall not be disposed along water courses or sensitive areas. Existing access roads shall be utilized during maintenance of the ROW. Avoid equipment and vehicle movements in rivers,

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
					floodplains and wetland areas as reasonable as practicable. Forbid use of chemical pesticides to control vegetation in the ROW
Visual amenities	Transmission lines and towers will be visible from far and become an extrinsic element in the landscape.	Communities around the project area	×		Vegetation will be felled, but if possible smaller trees can be kept. .
Stakeholder and Community expectation/ relations Management	Management of Community concerns linked to impacts associated with operation phase issues	Affected communities in the area of influence	×	×	Set-up, manage and manage grievance redress mechanism Engage communities in the monitoring activities to enhance transparency and involvement. Prepare and implement Stakeholder Engagement Plan(SEP). Enhance ongoing consultations with local communities by TCN to create continuous dialogue, trust and planning of community development activities according to SEP. Explain effects of electromagnetic fields to communities to limit concerns. Keep fields within limits of International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
Community Health, Safety and Security	External safety risks of electrocutions, bush fires, line snapping, tower collapses	Affected communities along the RoW and substations	×	×	Develop an emergency response plan following TCN and international best practice including provisions for prevention and response to electrocution, fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with emergency services of LGAs Keep residences and other permanent structures such as schools, shops or offices out of the wayleave to minimize exposure to EMFs Communicate to communities in RoW the safety risks of the transmission lines and provide response measures. Put sign boards on towers about electrocution risk. Implement the anti-climbing device for on the Transmission Tower.
Labour and working conditions	Exploitation of workers	Labour force for maintenance work	×	×	Develop transparent human resources policies and procedures for recruitment process, working conditions and Terms of Employment wages, worker-employer relations, Grievance Redress Mechanism, non-discrimination, monitoring, roles and responsibilities following Nigerian Labour Law and ILO conventions. Provide reasonable, and if applicable negotiated, working terms and conditions. Establish worker's grievance

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
					mechanism, so that potential conflicts can be dealt with in an early and proper way. No use of child labour (workers under age 18) or forced labour. Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. A worker's grievance mechanism will be in place.
	Occupational H&S risks in operation and maintenance	Labour force	×	×	TCN should follow their Occupational HSE plan following Nigerian and international requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height and electrocution in maintenance and repair works, emergency prevention and management. Use personal protection equipment. Have medical emergency equipment at hand.
Employment and Economy	Improved electricity supply for the national grid, creating opportunities for businesses and economic development in the country.	National level Nigeria	×	×	Regular maintenance of the project to ensure reliable production of power

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures
			Transmission Line	Sub station	
Cultural heritage	Potential interactions between maintenance works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities in the RoW	×		Consult with local communities on festivals and potentials for interaction with maintenance works. If required cease works on the specific dates.

CHAPTER SEVEN

7.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 Introduction

This chapter provides the ESMP for the Lagos and Ogun Transmission Line Project. Elements of this plan will be taken forward and incorporated into a comprehensive project Environmental and Social Management System (ESMS) that will be used to deliver the Project's HSE regulatory compliance objectives and other related commitments. Please note that this ESMP is designed for and will be applied to all 3 Lots (Lot1, Lot2 and Lot3) for the Project, as the integrated ESMP for the Project.

This ESMP is a delivery mechanism for environmental and social mitigation and enhancement measures made in the ESIA Report. The purpose of the ESMP is to ensure that these recommendations are translated into practical management actions which can be adequately resourced and integrated into the Project phases. The ESMP is, therefore, a management tool used to ensure that undue or reasonably avoidable adverse impacts of construction and operation are prevented or reduced and that the positive benefits of the Projects are enhanced (Lochner, 2005).

The ESMP has been developed to meet international standards on environmental and social management performance, specifically those set out by the World Bank, IFC and JICA Guidelines. The ESMP is intended to cover those activities described in Chapter 3 of this EIA report. It covers project activities during construction and operation and will be subject to thorough reviews prior to the commencement of activities to ensure completeness. The ESMP does not include measures for activities related to equipment and facility fabrication being done offsite. It should be noted that this provides the outline requirements for environmental management. Provision will be made for updating the outline ESMP once the detailed project design is complete and for adapting the ESMP to relevant project stages as part of the overall ESMS.

The plan details the mitigation and enhancement measures TCN have committed to implement through the life of the Project and includes desired outcomes; performance indicators; targets or acceptance criteria; monitoring and timing for actions and responsibilities. TCN will have principal responsibility for all measures outlined in the ESMP for the construction phase. TCN is responsible for the implementation of the measures in the operation phase. Both may delegate responsibility to its contractors, where appropriate. In cases where other individuals or organizations have responsibility for mitigation or enhancement measures, this is clearly indicated in Tables 7.2a and 7.2b. Capacity building and training requirements are also described, where these relate to specific skills required to deliver the ESMP action in question.

7.2 Objectives of the ESMP

The ESMP is needed to successfully manage the project's environmental and social performance throughout its lifecycle. It provides integration of environmental and social management with overall project engineering, procurement, construction, and operations. The ESMP is prepared to achieve the following objectives.

i. promote environmental and social management in the project implementation in all phases;
ii. ensure that all relevant stakeholders are aware of their respective responsibility - promoter, contractors, regulators and other relevant agencies;
iii. incorporate environmental and social management into project design and operating procedures and activities;
iv. serve as an action plan for environmental and social management for the project;
v. provide a framework for implementing environmental and social commitments described in chapter seven;
vi. prepare and maintain records of project environmental performance for monitoring and evaluating performance.

7.2.1 Institutional Framework for Implementation

7.2.2 Pre-Construction and Construction stage

7.2.3 Responsibility

Responsibilities in the implementation and monitoring of the Environmental and Social Management Plan (ESMP) during pre-construction and construction stage are shared between multiple stakeholders, including the TCN, the EPC contractors and regulators. TCN has set up a Project Implementation Unit (PIU), who will be responsible for the project execution during this stage.

In the PIU, Environmental and Social Unit will be a responsible administrator to manage environmental and social aspect including the implementation of ESMP. PIU will coordinate with TCN Management and TCN Lagos Regional Office for the necessary support for the preparation and implementation of ESMP. Figure 71 illustrates the structure of the institutional arrangements.

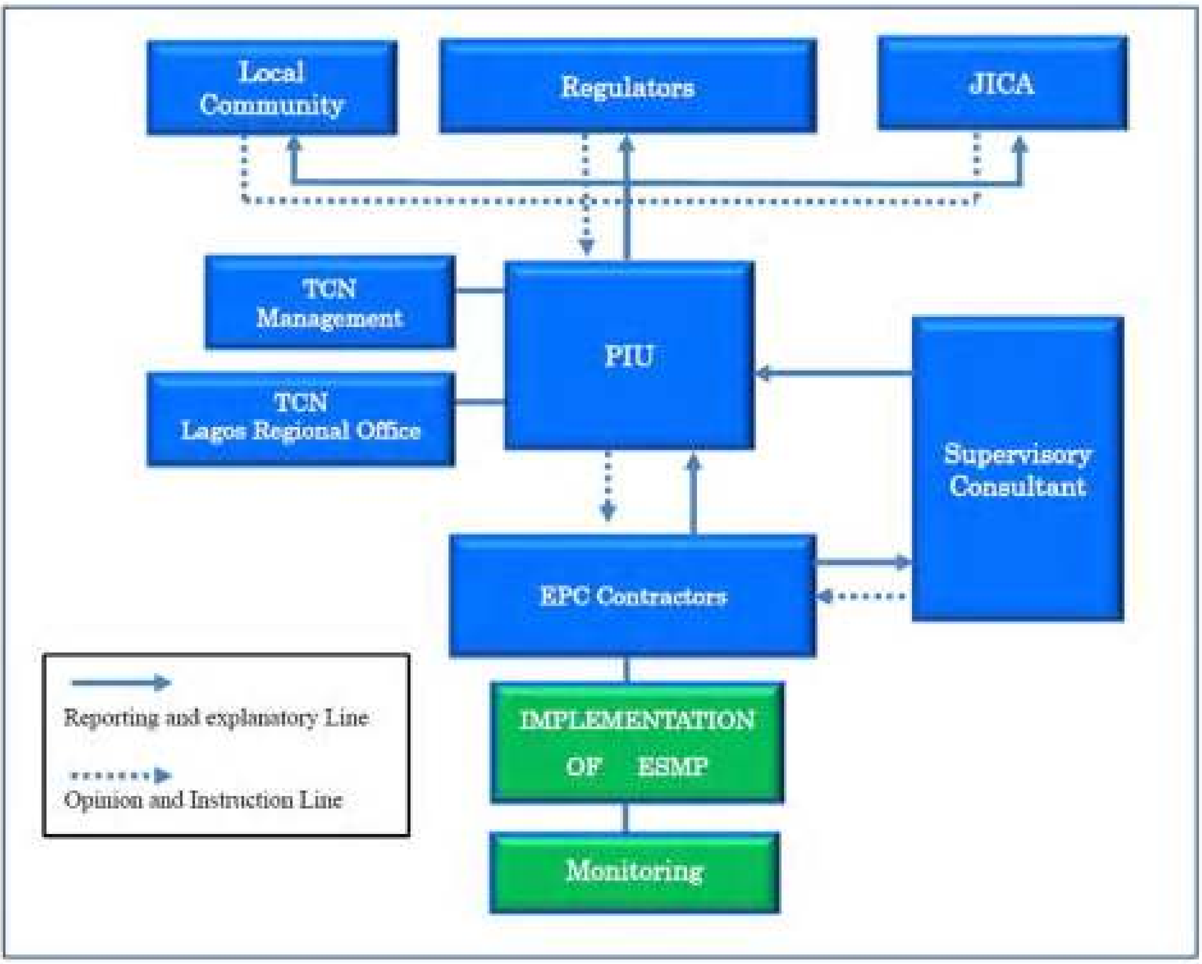

Figure 7.1 Institutional Arrangements for ESMP Implementation

7.2.4 Project Implementation Unit (PIU)

The PIU for JICA financed projects has been set up for the project implementation. It is headed by a Project Manager who reports to the CEO of TCN. Members of the PIU consist of technical experts and officers of Environmental Resettlement and Social Unit (ERSU) drawn from Environmental and Social Management Organization of TCN.

PIU is responsible for the overall project planning and execution, including preparation of bidding documents, hiring of project management consultants, EPC contractors and supervision of the works. These include ensure proper implementation of the environmental and social management measures contained in the ESMP, the RAP and their surveillance and monitoring. ESRU will be a main responsible unit for the implementation of ESMP and RAP.

- Oversee the proper application of mitigation and enhancement measures presented in the ESMP (including those relating to the RAP) that are the responsibility of the Contractor
- Implement management measure of the ESMP.

- Coordinate with TCN Management, including TCN HSE Sub sectors (in Head Quarter) and TCN Lagos regional office for the necessary support for the preparation and implementation of ESMP including RAP.
- Monitor the environmental and social performance of the project in accordance with the programs presented in the ESMP
- Do internal coordination within PIU for supervising the contractor in charge of the project construction.
- Establish mechanism for handling complaints and distributes with the communities and relevant authorities.
- Oversee compensation and resettlement activities of the project

7.2.5 TCN Management

TCN HSE Sub-sector

The HSE sub- sector was created in TCN in August 2014. It was the bringing up of two divisions together namely the Chemical Resettlement and Environment Division (CR&E) and the Occupational Health and Safety Division (OH&S). The TCN Sub-sector shall be responsible for ensuring implementation of management measures during operation phase (post-commissioning), including audits, compliance monitoring and preparation of periodic reports required by regulations. The function of HSE subsector includes;

- Developing and maintaining of the Environmental Management Plan (EMP) and associated plan for material management, waste management, accident preparedness and response, inspection and monitoring.
- Conducting and organizing period environment and safety audits.
- Preparing and managing documentations related to environmental performance
- Regular and incidental reporting to the TCN management
- Liaising and reporting to the appropriate environmental regulatory authorities

In addition, HSE sub-sector, mainly CR&E division shall be responsible for the land acquisition of the TCN project, which includes;

- Support to liaise with the TCN Way-lease/ROW department on ROW acquisition process
- Support to verify the compensation rates/budget and schedule as used in RAP to ensure proper implementation and provide recommendations to PIU for improvement/approval.
- Support to carry out internal monitoring and evaluation of RAP activities

TCN Lagos regional office

Lagos regional office of TCN will involve the management and monitoring of Environmental and social performance of the project, including constriction and operational stage. TCN Lagos regional office has Environment unit, OHS (Occupational Health safety) unit and Wayleave unit. These unit will support for the implementation and monitoring of ESMP and RAP at site level.

7.2.6 Regulatory Agencies and Other Concerned Authorities

The Federal Ministry of Environment (FMEnv) has the responsibility for the implementation of the EIA Act 86 of 1992. Furthermore, State Ministries for Environment (Lagos and Ogun States) and affected LGAs of Ewekoro, Ifo, ObafemiOwode, Ado Odo/Ota and Badagry have certain oversight roles, which they perform under coordination of the FMEnv. Other agencies concerned about the project, which shall be involved in the implementation include;

Responsibilities for the ESIA and its implementation are shared between multiple stakeholders, including concerned ministries, competent authorities, the project implementation unit (PIU), the TCN and the contractors. These include the following;

- The Federal Government of Nigeria (FGN)
- Federal Ministry of Environment
- Transmission Company of Nigeria (TCN)
- JICA Project Implementation Unit (PIU)
- Ikeja Electricity Distribution Company
- Eko Electricity Distribution Company
- Ogun State Ministry of Environment
- Ogun State Environmental Protection Agency ("OGEPA")
- Ogun State Bureau for Lands and Survey
- Ogun State Power Unit, Office of Governor
- Lagos Waste Management Authority ("LAWMA")
- Lagos State Environmental Protection Agency ("LASEPA")
- Lagos State Bureau for Lands
- Surveyor General Lagos State
- Local Government Authority (LGA):
    - ✓ Ewekoro Local Government Area
    - ✓ Ifo Local Government Area
    - ✓ ObafemiOwode Local Government Area
    - ✓ Ado Odo/Ota Local Government Area
    - ✓ Badagry Local Government Area
- The Customary District Councils headed by Obas of each Kingdom affected
- Village Chiefs (Baale) of Affected Communities

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

The Federal Government of Nigeria

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

Federal Ministry of Environment

The Federal Ministry of Environment is responsible for the overall environmental policy of the Country. It has the responsibility for ESIA implementation and approval, in accordance with the EIA Act. 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. And they can 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.

Electricity Distribution Companies (Ibadan, Ikeja and Eko)

These three electricity distribution companies part of 13 distribution companies unbundled from defunct PHCN during electricity reform in 2004. They are responsible for distributing electricity to homes and other consumers within the Lagos and Ogun State Regions. This role makes them the direct customers of TCN and a major stakeholder in ensuring improved electricity supply to consumers and realizing other objectives of this project.

Ogun State Ministry of Environment

The Ministry of Environment was established in July 2003 with the aim of creating better living and conducive environment for the entire people of Ogun State. The Ministry has five (5) departments and two (2) sister Agencies namely, Ogun Environmental Protection Agency (OGEPA) and Ogun State Emergency Management Agency (SEMA).

- Department of Administration & Supplies: is involved in the management, co-ordination and facilitation of the activities of other Departments.
- Department of Environmental Conservation & Resources Management: is responsible for environmental Sanitation, landscaping and beautification, environmental and natural resources conservation, meteorological services, water shed management and water quality monitoring, climate change, etc.
- Department of Planning, Research & Statistics: plan, undertake research and gather data or information which will allow the Ministry to grow and develop.
- Department of Finance & Accounts: responsible for budgeting and other financial management responsibilities.
- Department of Flood & Erosion Control: Management of flood and erosion issues, including planning, designing, and construction and maintenance of control structures.

Ogun State Bureau for Lands and Survey

This bureau is responsible for the issuance of right of way (ROW) and certificate of occupancy (C of O) for portions of line route and substation sites that falls within Ogun State. Other functions of the Agency include

- Preparation and issuance of Certificates-of-Occupancy and other certificate evidencing titles.
- Preparation and issuance of Right-of-Occupancy.
- Production and printing of Titled Deed Plan (TDP).
- Street naming and house numbering in Ogun State.
- Provision of Geospatial information infrastructure.
- Textual and graphic data on Ogun State, including land record, aerial photographs, satellite images, engineering drawing, and scanned pictures of building.
- Property search and verification of land record.
- Land application processing and administration.

Ogun State Ministry for Physical Planning

The Ministry is the apex body of Physical Planning in Ogun State. It is responsible for the formulation of Physical Planning policies and the coordination of physical development within the State. It derives its statutory functions from section 3 line 246 of the State Urban and Regional Planning Law No.20 of 2005. Though the Ministry is the policy making body, it has the Urban and Regional Planning Board as its parastatal.

The Ogun State Urban and Regional Planning Board:

This Board is a parastatal of the Ministry of Urban and Physical Planning established the enactment of Ogun State Urban and Regional Planning law No.20 of 2005. The Board, which have 20 Zonal Town Planning Offices spread across the State is responsible for:

- Controlling all various physical developments be it Residential, Commercial, Industrial, Public, and Institutional uses.
- Monitoring all the development in order to control the growth of Urban Sprawl in Ogun State.

Ogun State Ministry of Women Affairs and Social Development: has the responsibility

- To promote Gender Equality and provide Empowerment facilities for Socio-economic Development
- To promote the survival, protection, participation and development of children
- To promote family harmony and reduce juvenile delinquency
- To provide care, support, rehabilitation and empowerment for the vulnerable groups(challenged persons, older persons, destitute and the likes)
- To collaborate and network with Non-Governmental Organizations, Professional Institutions and other MDAs on issues affecting women, children/vulnerable ones.

Ogun State Ministry of Agriculture

This Ministry is the organ of Government responsible for formulating policies on food and agriculture for the State. The ministry is to enhance self-sufficiency in food production, provide raw materials for agro-based industries, generate employment opportunities and obtain desirable levels of export in order to improve the country's foreign exchange earnings.

Ogun State has 1.2million hectares of arable land which is 74% of the State's total land area. Only 30% of this arable land or 35,000 hectares is under cultivation. The major crops grown or cultivated in the State include: Cassava, Rice, Maize, Oil-Palm, Cocoa, Rubber, Citrus, Cotton, Soya-Bean, Vegetable, Pine apple, Sugar-Cane, among others. Livestock and fish farming are strong and viable in the State.

The mandate of the ministry include;

- Formulating and implementing agricultural policies and programmes for Ogun State.
- Regulation of farm practice and certification of farm produce.
- Ensuring food safety and food security.
- Promotion of mechanized agriculture.
- Ensuring availability and provision of quality agricultural inputs
- Coordinating agricultural cooperative societies and commodity groups
- Promoting and managing Irrigation Schemes
- Delivery of agricultural research proven technologies to farmers for adoption through effective Extension Services
- Promoting the development of the Livestock and Fishery industries in the State.

Lagos State Ministry of Environment

The Ministry of Environment coordinates the environmental activities in the State through the agencies created under the Environmental Management Protection Law, 2017 ("EMPL 2017"). These include LASEPA and LAWMA.

LASEPA is responsible for regulations, establishing discharge limits, and issuance of permits among others.

Lagos State Bureau for Lands and Survey

This bureau is responsible for the issuance of right of way (ROW) and certificate of occupancy (C of O) for portions of line route and substation sites that falls within Lagos State. Other functions of the Agency include

- Preparation and issuance of Certificates-of-Occupancy and other certificate evidencing titles.
- Preparation and issuance of Right-of-Occupancy.
- Production and printing of Titled Deed Plan (TDP).
- Street naming and house numbering in Lagos State.
- Provision of Geospatial information infrastructure.

- Textual and graphic data on Lagos State, including land record, aerial photographs, satellite images, engineering drawing, and scanned pictures of building.
- Property search and verification of land record.
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Lagos State Ministry for Physical Planning

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Lagos State Ministry of Women Affairs and Social Development:

has the responsibility

- To promote Gender Equality and provide Empowerment facilities for Socio-economic Development for people displaced by the project in Lagos State
- To promote the survival, protection, participation and development of children
- To promote family harmony and reduce juvenile delinquency
- To provide care, support, rehabilitation and empowerment for the vulnerable groups(challenged persons, older persons, destitute and the likes)
- To collaborate and network with Non-Governmental Organizations, Professional Institutions and other MDAs on issues affecting women, children/vulnerable ones.

Local Government Areas (LGAs)

The project will pass through four LGAs, four in Ogun State -Ewekoro, Ifo,ObafemiOwodeand Ado Odo/Ota as well as Badagry LGA in Lagos State. These LGAs are involved in the ESIA approval process. According to the EIA act, the LGAs will have representatives in the panel that will review the report and advise the Minister to make decisions on the project. The LGAs also have roles in the administration of lands in rural areas and hence, will be involved in the resettlement process as well as sites for the substations.

The Customary District Councils

The line route will pass through the Chiefdoms as several villages under them. The Obas (traditional head of chiefdom) and Village Heads (Baales) have important role to play in the project with respect to mobilization of the community members to support the project, grievance redress, peace and security of personnel, equipment and facilities to be installed. Close contact and regular consultation shall be maintained with customary chiefs throughout the life of the project

7.2.7 Contractors

Each contractor shall appoint a qualified environmental manager who, after approval by the PIU, will be responsible for daily management on-site and for the respect of management measures from the ESMP. This manager will report regularly to the environment and social expert of the PIU during the entire construction period.

Contractors must hold all necessary licenses and permits before the work begins. It will befall on them to provide to the PIU all of the required legal documents, among which the signed agreements with owners, authorizations for borrow pits and for temporary storage sites, etc.

7.2.8 Communities

Leaders and traditional institutions of the potentially affected communities will assist in public sensitization effort to advance implementation of ESMP.Training and awareness

TCN will identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environment or social conditions. The Project recognizes that it is important that employees at each relevant function and level are aware of the Project's environmental and social policy; potential impacts of their activities; and roles and responsibilities in achieving conformance with the policy and procedures.

This will be achieved through a formal training process. Employee training will include awareness and competency with respect to:

- environmental and social impacts that could potentially arise from their activities (including dust, biodiversity and soil/water contamination);
- necessity of conforming to the requirements of the ESIA and ESMP, in order to avoid or reduce those impacts; and
- roles and responsibilities to achieve that conformity, including those in respect of change management and emergency response.

The HSE Coordinator is responsible for coordinating training, maintaining employee-training records, and ensuring that these are monitored and reviewed on a regular basis. The HSE Coordinator will also periodically verify that staffs are performing competently through discussion and observation.

Employees responsible for performing site inspections will receive training by drawing on external resources as necessary. Training will be coordinated by the HSE coordinator prior to commissioning of the facilities. Upon completion of training and once deemed competent by management, staff will be ready to train other people.

Similarly, the Project will require that each of the sub-contractors institute training programmes for its personnel. Each subcontractor is responsible for site HSE awareness training for personnel working on the job sites. The subcontractors are also responsible for identification of any additional training requirements to maintain required competency levels.

The subcontractor training program will be subject to approval by TCN and it will be audited to ensure that:

- training programs are adequate;
- all personnel requiring training have been trained; and
- competency is being verified.

TCN's training programme will be followed to make permanent staff, contractor staff and temporarily hired staff aware of the ESIA and ESMP contents, their roles and responsibilities in the implementation of the ESMP and the additional requirements related to international standards.

7.3 Operational stage

7.3.1 Responsibility

TCN after the transfer of operation will take a responsibility for the implementation of ESMP during operational stage. The HSE coordinator of TCN will be the responsible for all environmental and issue, including;

- Communicate with the regulatory authorities and communities.
- Communicate with communities
- Prepare relevant HSE documents,
- Implement the necessary mitigation measures as described in ESMO
- Carry out monitoring and prepare monitoring report
- Conduct internal audit

7.4 Operational Control Procedures

Each potentially significant impact identified in the ESIA will have an operational control associated with it that specifies appropriate procedures, work instructions, best management practices, roles, responsibilities, authorities, monitoring, measurement and record keeping for avoiding or reducing impacts. Operational controls are monitored for compliance and effectiveness on a regular basis through a monitoring and auditing procedure described in the ESMP.

Operational control procedures will be reviewed and, where appropriate, amended to include instructions for planning and minimizing impacts, or to at least reference relevant documents that address impact avoidance and mitigation.

7.4.1 Managing Changes to Project Activities

Changes in the Project may occur due to unanticipated situations. Adaptive changes may also occur during the course of final design, commissioning or even operations. The Project will implement a formal procedure to manage changes in the Project that will apply to all project activities.

The objective of the procedure is to ensure that the impact of changes on the health and safety of personnel, the environment, plant and equipment are identified and assessed prior to changes being implemented.

The management of change procedure will ensure that:

- proposed changes have a sound technical, safety, environmental, and commercial justification;
- changes are reviewed by competent personnel and the impact of changes is reflected in documentation, including operating procedures and drawings;
- hazards resulting from changes that alter the conditions assessed in the ESIA have been identified and assessed and the impact(s) of changes do not adversely affect the management of health, safety or the environment;
- changes are communicated to personnel who are provided with the necessary skills, via training, to effectively implement changes; and
- the appropriate TCN person accepts the responsibility for the change.

As information regarding the uncertainties becomes available, the Project ESMP will be updated to include that information in subsequent revisions. Environmental and social, as well as engineering feasibility and cost, considerations will be taken into account when choosing between possible alternatives.

7.2.2 Emergency Preparedness and Response

TCN will prepare plans and procedures to identify the potential for, and response to, environmental accidents and health and safety emergency situations and for preventing and mitigating potentially adverse environmental and social impacts that may be associated with them.

Emergency preparedness and response will be reviewed by TCN on at least an annual basis and after the occurrence of any accidents or emergency situations to ensure that lessons learnt inform continuous improvement.

Emergency exercises will be undertaken on a regular basis to confirm adequacy of response strategies. Investigations of accidents or incidents will follow formal documented procedures.

7.4.3 Checking and Corrective Actions

Checking includes inspections and monitoring as well as audit activities to confirm proper implementation of checking systems as well as effectiveness of mitigations. Corrective actions include response to out-of-control situations, non-compliances, and non-conformances. Actions also include those intended to improve performance.

7.4.4 Monitoring

Monitoring will be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts. Monitoring parameters are included in the ESMP table provided in Tables 7.1 and 7.2.

Monitoring methodologies or processes must be put in place in order to ensure the efficacy of the mitigation measures identified in the ESIA. Monitoring methodologies should be established to address the following:

- Alteration to the biological, chemical, physical, social and health characteristics of the recipient environment;
- Alterations in the interactions between project activities and environmental and social sensitivities, and interactions among the various sensitivities;
- Monitor the effectiveness of the mitigation and enhancement measures;
- Determination of long term and residual effects;
- Identification of Project specific cumulative environmental and social effects, if applicable;
- Social monitoring is focused on following the community relations of TCN. The quarterly FMEnv monitoring shall be performed with involvement of the communities. This joint monitoring will support good community relations, by creating trust and involvement;
- At the construction site inspections should be performed on human resources procedures, occupational health, safety and security risks management, emergency planning and the open water on malaria larvae; and
- The recruitment, human resources procedures, HSE training and awareness of the labour force in the construction as well as the operation phase should be monitored to know their origin in line with the local content plant and the level of knowledge and awareness on the code of conduct, STD prevention and occupational H&S measures.

The FMEnv.guidelines require an environmental monitoring plan as part of an ESIA. The aim of the monitoring programme is to ensure that the negative environmental and social impacts identified in this ESIA are effectively mitigated in the construction and operation stages of the proposed Project.

7.4.5 Auditing

Beyond the routine inspection and monitoring activities conducted, audits will be carried out by TCN to ensure compliance with regulatory requirements as well as their own HSE standards and policies. Audits to be conducted will also cover the subcontractor self-reported monitoring and inspection activities. The audit shall be performed by qualified staff and the results shall be reported to TCN to be addressed.

The audit will include a review of compliance with the requirements of the ESIA and ESMP and include, at a minimum, the following:

- completeness of HSE documentation, including planning documents and inspection records;
- conformance with monitoring requirements;
- efficacy of activities to address any non-conformance with monitoring requirements; and
- training activities and record keeping.

There will be a cycle of audits into specific areas of the Project. The frequency of audits will be risk based and will vary with the stage of the Project and will depend on the results of previous audits.

Regulatory compliance audit is a mandatory requirement to be carried out by independent accredited consultant every three years during operation phase and the reports submitted to Federal Ministry of Environment.

7.4.6 Corrective action

Investigating a 'near-miss' or actual incident after it occurs can be used to obtain valuable lessons and information that can be used to prevent similar or more serious occurrences in the future.

TCN will implement a formal non-compliance and corrective action tracking procedure for investigating the causes of, and identifying corrective actions to, accidents or environmental or social non-compliances. This will ensure coordinated action EPC Contractor and its subcontractors. The HSE coordinator will be responsible for keeping records of corrective actions and for overseeing the modification of environmental or social protection procedures and/or training programs to avoid repetition of non- conformances and non-compliances.

7.4.7 Reporting

Throughout the Project, TCN will keep the regulatory authorities informed of the Project performance with respect to HSE matters by way of written status reports and face-to-face meetings. TCN will prepare a report on environmental and social performance and submit it to FMEnv. The frequency of this reporting will be determined byFMEnv, in a letter of approval of the project. These reports are prepared as part of requirements for impact mitigation monitoring to be carried by FME_{NV}, $OGME_{NV}$ and $LAME_{NV}$.

If required, TCN will provide appropriate documentation of HSE related activities, including internal inspection records, training records, and reports to the relevant authorities. Subcontractors are also required to provide HSE performance reporting to TCN on a regular basis through weekly and monthly reports. These will be used as inputs to the above.

7.5 Grievance Mechanisms

During implementation of the ESMP, it is possible that disputes/disagreements between the project developer and the PAPs will occur. There are great challenges associated with grievance redress especially in a linear project of this magnitude. A grievance procedure based on community grievance resolution channels, regulatory agencies and finally the law courts for resolution of the disputes and complaints.

7.5.1 Customary Mediation

All the communities affected by this project have internal mechanisms for resolution of disputes through the customary chiefdoms. Such customary avenues should provide a first culturally and amicable grievance procedure that will facilitate formal and/or informal grievance resolution.

A Customary Grievance Redress Committee shall be set up by the PIU in each LGA to address complaints. PAPs' complaints should first be lodged verbally or in writing through the customary chief, who in turn will invite the PIU. The PIU and the customary chiefs and other council in chief will try to resolve the issue amicably. If the complaint cannot be resolved at this level, or if the plaintiff is not satisfied with the settlement proposed, the matter should be reported to the regulatory agencies.

7.5.2 Regulatory Agencies

Lagos and Ogun States Ministry of Environment and the Federal Ministry of Environment have the statutory responsibility for an oversight and monitoring the implementation of the ESMP. The agencies shall pronounce judgment on any environmental complaint or dispute reported to them based on regulatory requirements. At this stage if the plaintiff is still not satisfied with the settlement he/she can then proceed to the official legal procedures.

7.5.3 Courts of Law

The judicial process in accordance with applicable laws will be followed and the law courts will pass binding judgment on the matter.

7.5.4 Grievance Resolution Procedures

The first level is the Village Chief and the PIU: The aggrieved person shall first report the matter to the Village Chief for resolution. Issues that can be resolved at this level include, ownership tussle, management of deceased property, boundary issues, etc. The type of issues to report to the PIU for possible include, perceived damage to property or means of livelihood, incorrect PAP data, inadequacy of compensation received, etc. If the issue is not resolved at this stage, it can then be escalated to customary mediation described in Section 7.5.1 and if still no acceptable resolution is achieved, the parties may choose to go to the regulatory agencies and thereafter to the court in accordance with laws of the Federal Republic of Nigeria. Figure 7.2 illustrates the procedure for grievance resolution.

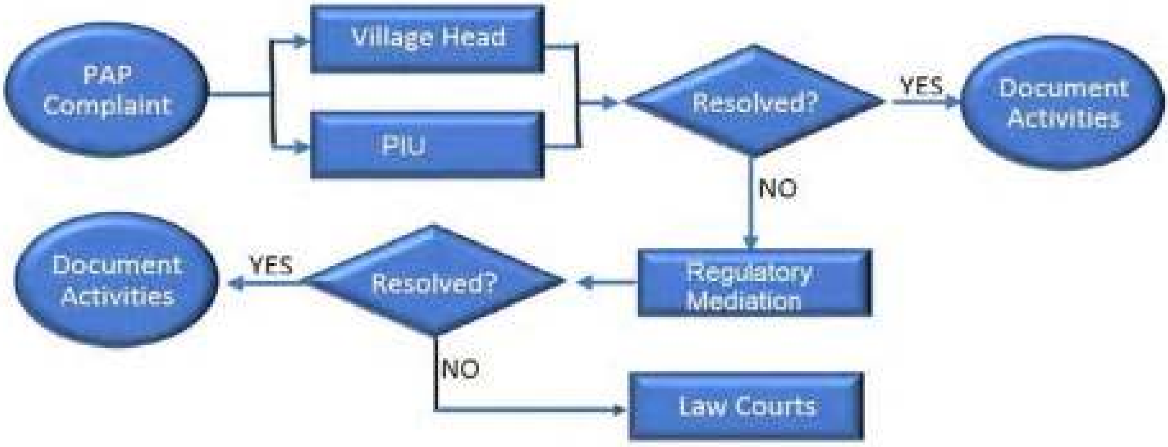

Figure 7.2 Grievance Resolution Procedure

7.6 Proposed Management Plan

The Environmental and Social mitigation/enhancement measures are in Tables 7.1 and 7.2. The EPC contractor has responsibility for implementing the mitigation actions during construction phase. The budget for implementation shall be included in the EPC contract as part of the overall construction cost.

The monitoring plan in Tables 7.3 and 7.4 contain details of responsibilities, parameters to be monitored. Monitoring methods and standards/targets as well as locations and monitoring frequency. The cost estimates cover costs of analyses of samples (where required), travelling expenses and regulatory costs. The budget for environmental and social monitoring during construction (Table 7.3) shall be added to the EPC contract budget, and the EPC Contractor shall be required to disburse when needed, as may be directed by the Project Manager.

The budget for the monitoring during operations shall be provided by TCN management in its annual budgeting process and administered directly by the GM HSE, who has responsibility for ensuring mitigation actions are implemented effectively. These measures shall be adopted by TCN and imposed as conditions of contract on the sub-contractors hired for the Project.

Additional detailed policies and specific plans have been developed to support the implementation which are included in the standalone ESMP report. The list of the management plans for this project is provided below and details are in the ESMP Report:

- Waste Management Plan;
- Vegetation Management Plan
- Local Content Plan
- Traffic Management Plan;
- Occupational Health and Safety Management Plan.

Table 0.1 Environmental and Social Management and Mitigation Measure (Construction Phase)

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
Air quality	Localized impairment of air quality by exhaust emissions from vehicles and equipment engines (SO_2, CO, NO_x, CO_2, PM)	Affected communities in area of influence	×	×	▪ Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations ▪ Stationary generators to be located to facilitate dispersion	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv
	Elevated dust levels due to vehicle movements, wind, and handling of dusty material	Affected communities in area of influence	×	×	▪ Cover properly loose materials and keep top layers moist ▪ Regular cleaning of equipment, drains and roads to avoid excessive buildup of dirt ▪ Spray surfaces prior to excavation ▪ Use covered trucks for the transportation of materials that release dust emissions ▪ Speed limits on-site of 15kph on unhardened roads and surfaces	EPC Contractor	PIU Supervision Consultant	FME$_{NV}$, OGMenv and LAMEnv
Climate change	GHG emissions that could add to climate change effects	Global warming	×	×	▪ Maintain and operate all vehicles and equipment engines in accordance with manufacturers specifications, location of stationary generators to facilitate dispersion, restriction of vegetation clearing to only the required area	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv
Noise, vibration	Nuisance noise from construction activities	Affected communities in area of influence Construction workers	×	×	▪ Select 'low noise' equipment or methods of work ▪ Use temporary noise barriers for equipment (e.g. sound proofing walls around stationary power generating sources). ▪ Maintain and operate all vehicles and equipment's in accordance with manufacturers recommendations ▪ Ensure periods of respite are provided in the case of unavoidable maximum noise level events ▪ Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the responsible person. ▪ Noisy activities (activities that can be heard in nearby	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					communities) restricted to day-time working hours ▪ Provide appropriate PPE to construction workers and visitors			
Soils, geology and land-use	Change to soil structure (erosion and compaction) as a result of excavation and backfilling and removal of vegetation	Soil on construction site	×	×	▪ Construction of foundations to be undertaken in the dry period as reasonable as possible. ▪ Protect excavated soil materials from erosion (e.g. store the excavated soil at the location which is not affected by rain runoff). ▪ Ensure that the land is physically restored (include re-vegetation where possible) before leaving to next tower location and before the next rainy season. ▪ Use of existing road for transport of man and material to the extent possible.	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv
	Potential contamination of soil from inadvertent release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, etc)	Soil on construction site, especially by each tower	×	×	▪ Implement effective site drainage on the construction yard to allow for the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas. ▪ Install oil/water separators and silt traps before effluent, leaves the site.	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv
					▪ Minimise bare ground and stockpiles to avoid silt runoff. ▪ Bunding of areas where hazardous substances are stored (eg fuel, waste areas). ▪ Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages. ▪ Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques. ▪ Set-up and apply procedure regarding dealing with contaminated soils. ▪ Development and implementation of a Waste Management Plan to ensure that waste is disposed of correctly. ▪ Spread sheet underneath the tower structure prior to start any painting activity.	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
Water resources	Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater	Local groundwater-well and bore hole	×	×	▪ See above measures to mitigate 'Potential contamination of soil' impact	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv
	Potential impact on hydrological condition due to the construction activities including the construction of foundation as well as the access road within the swampy area.	Rivers and streams crossed	×		▪ Natural flow of a River shall not be blocked ▪ Based on an appropriate project design, avoid erecting towers within wetlands. If unavoidable, select the most optimized site for each tower considering human uses and areas of higher ecological integrity. ▪ Prohibit construction of permanent access roads along river banks, in swamps or in areas where soils are saturated ▪ Consider and Select the engineering design for construction work, including construction of foundation as well as access road, which would minimize the impact on hydrological condition.	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv
Terrestrial ecology	Vegetation loss and disturbance to habitats, fauna and flora by construction activities	Flora and fauna and habitat in the area of influence	×	×	▪ Minimize the construction of new access roads. Promote the use of existing access roads for machinery and vehicle movements. ▪ Promote the use of existing roads for transporting material and tower parts to the construction sites in order to reduce the project's footprint and minimize the need for new access roads ▪ Herbicides should not be used for vegetation clearing ▪ Clearing should be minimized and restricted to the area required for construction purposes only and disturbance to adjacent vegetation communities and/or remnant trees within the corridor should be strictly controlled.	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv
		Flora and fauna and habitat in the area of influence			▪ Re-vegetation will be carried out, as necessary. Re-vegetation will use species locally native to the site. The site of re-vegetation shall be identified and provided by the relevant government agency.	TCN 100,000USD	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	Vegetation clearing will cause habitat disturbances that could create suitable conditions for invasive species to spread	Flora and fauna and habitat in the area of influence	×		▪ Implementation of the invasive species management plan as part of the Vegetation Management Plan.	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv
	Potential avian collision	Birds in the area of influence	×	×	▪ Consult with relevant agency (e.g local NGO) to seek any advice for mitigation measures to be considered for the design and construction of the transmission line. ▪ "Bird diverters" on the top (ground) wire to make the lines more visible to birds shall be installed, particular in the swampy areas of Badagry ▪ Complete tree and/or brush cutting prior to or after the core nesting season	EPC Contractor	PIU Supervision Consultant	FMEnv, OGMEnv and LAMEnv
	Loss of species that offer Provisioning Services	Local communities who rely on provisioning service, especially around swampy area.	×		▪ Site clearance activities to be restricted to the minimum required area	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV
					▪ Provide a training/education for the sustainable livelihood practice to local communities, as necessary, with cooperation of relevant agency.	PIU 50,000USD	TCN	FMENV, OGMENV and LAMENV
Aquatic ecology	Loss/disturbance of aquatic species	Rivers/streams/Swampy area crossed	×		▪ Natural flow of a River shall not be blocked ▪ Conduct activities during the dry period to minimize disturbance of sensitive shoreline and wetland areas ▪ Adjust pylon siting to span rivers and wetlands areas, or limit equipment access in wetlands, wherever possible. ▪ Perform all vegetation clearing work manually along streams/rivers and swamps. ▪ Avoid vegetation clearing along stream shores and on steep slopes. ▪ Based on an appropriate project design, avoid erecting towers	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					within wetlands. If unavoidable, select the most optimized site for each tower considering human uses and areas of higher ecological integrity. ▪ Prohibit construction of permanent access roads along river banks, in swamps or in areas where soils are saturated ▪ Dismantle temporary access roads built for construction phase in swamps and wetland areas. Perform this dismantlement during the dry season and dispose of materials outside wetland areas; ▪ Avoid equipment and vehicle movements in rivers, floodplains and wetland areas. If unavoidable, reduce access to a minimum length in wetlands and floodplains and select the most optimized site for the access considering human uses and areas of higher ecological integrity			
Visual amenities	Temporary presence of an active construction site with storage of materials and equipment within the ROW and/or the site for the substation.	People living close to the construction sites.	×	×	▪ Maintain construction site in orderly condition and do not distribute material over many sites before usage.	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV
Land planning and use	Change in land use cause by land take for towers, vegetation clearance, and access restriction	Land on the RoW	×		▪ Site clearance activities to be restricted to the minimum required area. ▪ Provision of predefined route, barriers or boundary markings to prevent incursion of machinery and workers into neighboring areas ▪ See below measures under 'Resettlement'	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
Stakeholder and Community expectation/ relations Management	Community concerns linked to impacts associated with construction phase issues (like air and dust emissions, traffic, influx and community safety/security, noise/vibration, etc) and adverse impact/inconveniencies resulting from it.	Affected communities in area of influence	×	×	▪ Follow mitigation for construction phase air quality, water quality, noise and traffic. ▪ Inform communities about details of construction activities (e.g., employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by billboards, posters and community meeting ▪ Set-up and effectively monitor construction grievance redress mechanism ▪ Engagecommunities in the monitoring activities to enhance transparency and involvement.	PIU RIC	TCN	FMENV, OGMENV and LAMENV
Community Health, Safety and Security	Increased risks of traffic safety incidents on public roads	People living close to access roads and road users	×	×	▪ Implement a traffic management plan including design of access point, signalization, speed limits, training of drivers, use of traffic guards, procedures for transport of oversized loads (e.g., engines), maintain log of traffic related incidents, sensitization of road users and people living close to the construction site.	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV
	Temporary influx of outside workers in the communities, risking tensions between outside (partly possibly expatriate) labour and local population, due to differences in wealth and culture.	Affected communities in area of influence	×	×	▪ Priority of employment shall be given to locals. ▪ A Local Content Plan should be prepared to facilitate involvement of local labour. ▪ Develop acode of behaviours for workers. All workers to receive training on community relations and code of behaviour. ▪ Periodic refreshing as needed based on community liaison/grievance mechanism feedback.	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV
	Potential for increase in prevalence of sexually transmitted diseases in local communities and	Affected communities in area of influence	×	×	▪ Do sensitization and awareness to all EPC workers regarding sexually transmitted diseases ▪ Provide Sexually transmitted disease awareness material to all EPC workers and host communities	EPC Contractor	PIU Supervision	National Agency for Control of AIDS

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	other diseases						Consultant	(NACA)
Resettlement	Land acquisition	Affected properties and livelihood	×	×	▪ Follow principles and procedures of Resettlement Action Plan (RAP), including way forward, micro-plans per affected household.	PIU RIC	TCN	Witness NGO
Labour and working conditions	Exploitation of workers	Labour force	×	×	▪ Develop transparent human resources policies and procedures for recruitment process, working conditions and Terms of Employment wages, worker-employer relations, Grievance Redress Mechanism, non-discrimination, monitoring, roles and responsibilities following Nigerian Labour Law and ILO conventions. ▪ Provide reasonable, and if applicable negotiated, working terms and conditions. ▪ Establish worker's grievance redress mechanism, so that potential conflicts can be dealt with in an early and proper way. ▪ No use of child labour (workers under age 18) or forced labour ▪ Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. ▪ Provide proper work place facilities for water/sanitation/rest rooms etc. ▪ A worker's grievance redress mechanism will be in place.	EPC Contractor	PIU Supervision Consultant	TCN
	Activities and staff at site may create security risk (e.g. infiltration of criminal)	Workers and local communities	×	×	▪ Liaise with community security structure ▪ Provision of security during the construction work ▪ Make security plan and emergency response and contacts with security forces. Coordinate if applicable with TCN security measures for their site. ▪ Provide the identification tag for all workers and visitors.	EPC Contractor	PIU Supervision Consultant Nigerian Security and Civil Defense (NSCDC)	Nigerian Police Force
	Creation of tension between security personel	Local communities	×	×	▪ Provide the training and awareness to security personnel ▪ Establish the communication with local communities and	EPC	PIU	Nigerian

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	and local communities				awareness	Contractor	Supervision Consultant Nigerian Security and Civil Defense (NSCDC)	Police Force
	Risk of health & safety incidents amongst labour force, including minor incident's such as cuts and major incidents such as loss of life	Construction labour force	×	×	▪ Develop project specific health and safety procedure, including provisions for training and certifications to be followed by all workers including subcontractors.	EPC Contractor	PIU	TCN
Employment and economy	Creation of temporary jobs for locals residents and Nigerian nationals with skilled trades	Local residents of affected communities and Nigerian nationals	×	×	▪ Prepare a local content plan to enhance ability to locate local hires and Nigerian nationals. Include provisions for hiring women and youth and for "equal pay for work of equal value". ▪ A local hiring office (or offices) to be set-up for use by all contractors to advertise positions, receive applications, and provide guidance to applicants.	EPC Contractor	PIU	TCN
	Supply chain opportunities for Nigerian companies that can provide goods and services needed by the company	Nigerian companies and local shops	×	×	▪ Prepare a local content plan to facilitate identification and selection of qualified local and Nigerian companies to provide needed supplies and services. Include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities.	EPC Contractor	PIU	TCN
Infrastructure	Influx of outside workers may pose additional pressure on social infrastructure, like medical posts, emergency services, water supply, solid waste management	Affected communities in area of influence	×	×	▪ Coordinate with medical posts and emergency services to prepare for water supply and waste management. ▪ Install proper and independent facilities at construction site for water supply, sanitation, solid and liquid waste, so that pressure on community infrastructure is limited.	EPC Contractor	PIU	TCN

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
Cultural heritage	shrines are located within the RoW along the transmission line and need to be relocated.	Affected cultural heritage	×		▪ The shrines will be relocated to outside the RoW, where the local communities will continue to use them. The exact location and ceremony for relocation will be managed by the communities	RIC	PIU	Witness NGO
	Potential interactions between construction works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities along the RoW and substation	×	×	▪ Consult with local communities on festivals and potentials for interaction with construction works. If required cease works on the specific dates.	RIC	PIU	Witness NGO

Table 0.2 Environmental and Social Management and Mitigation Measure (Operations Phase)

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
Air pollution / Climate Change:	Accidental significant leaks of SF6 from aging equipment, and gas losses occur during equipment maintenance and servicing	Air quality	×	×	▪ Impact of SF6 shall be mitigated through the improvements in the leak rate of new equipment, refurbishing older equipment, and the use of more efficient operation and maintenance techniques.	TCN	TCN HSE Dept	FMENV,
Noise, vibration & EMF	Noise & EMF from overhead line due to Corona effect and EMF effect	Affected communities along the RoW and Substations	×	×	▪ Avoiding over loading Transmission Lines ▪ Keep residences and other permanent structures such as schools, shops or offices out of the RoW to minimize exposure to Noise and EMFs.	TCN	TCN HSE Dept	FMENV,
Terrestrial ecology	Impairments of natural habitats and associated flora communities	Flora and fauna around the ROW	×		▪ Maintain all maintenance work inside the footprint of RoW to reduce encroachment on natural habitats ▪ Clearly mark the extent of vegetation control in the ROW. Identify and mark the vegetation to be preserved along sections of the ROW ▪ Undertake selective control of the vegetation in order to keep low scrubby and herbaceous species that do not represent a risk for the powerline (species that cannot grow more than 4m in height) ▪ Usemechanical method for vegetation control inside the ROW. ▪ Forbid use of chemical pesticides to control vegetation in the ROW	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV
		Bats and Birds in the area of influence	×		▪ Schedule RoW maintenance activities to avoid breeding and nesting seasons of bird species with special status ▪ Develop and implement a mortality monitoring program, as necessary, with cooperation of local NGO.	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
	Potential Impact due to introduction of alien species	Flora and fauna around the ROW	×		▪ Develop and implement vegetation management plan to control the introduction of alien species ▪ A monitoring program of invasive species propagation within the right-of-way should be instituted and, if present, shall be removed.	TCN	TCN HSE Dept.	FMENV, OGMENV and LAMENV
	Loss of species that offer Provisioning Services	Local communities who rely on provisioning service, especially around swampy area.	×		▪ Undertake monitoring of natural resources exploitation and implement a sensitization program in order to educate and increase local communities' awareness on natural resources protection	TCN	TCN HSE Dept.	FMENV, OGMENV and LAMENV
Aquatic ecology	Degradation of aquatic species	River crossings along the ROW	×		▪ Wastes shall not be disposed along water courses or sensitive areas. ▪ Existing access roads shall be utilized during maintenance of the ROW. ▪ Avoid equipment and vehicle movements in rivers, floodplains and wetland areas as reasonable as practicable. ▪ Forbid use of chemical pesticides to control vegetation in the ROW	TCN	TCN HSE Dept.	FMENV, OGMENV and LAMENV
Visual amenities	Transmission lines and towers will be visible from far and become an extrinsic element in the landscape.	Communities around the project area	×		▪ Vegetation will be felled, but if possible smaller trees can be kept. .	TCN	TCN HSE Dept.	FMENV, OGMENV and LAMENV
Stakeholder and Community expectation/ relations Management	Management of Community concerns linked to impacts associated with operation phase issues	Affected communities in the area of influence	×	×	▪ Set-up, manage and manage grievance redress mechanism ▪ Engage communities in the monitoring activities to enhance transparency and involvement. ▪ Prepare and implement Stakeholder Engagement Plan(SEP). ▪ Enhance ongoing consultations with local communities by TCN to create continuous dialogue, trust and planning of community development activities according to SEP. ▪ Explain effects of electromagnetic fields to communities to limit	TCN	TCN HSE Dept.	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
					concerns. Keep fields within limits of International Commission on Non-Ionizing Radiation Protection (ICNIRP). ▪			
Community Health, Safety and Security	External safety risks of electrocutions, bush fires, line snapping, tower collapses	Affected communities along the RoW and substations	×	×	▪ Develop an emergency response plan following TCN and international best practice including provisions for prevention and response to electrocution, fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with emergency services of LGAs ▪ Keep residences and other permanent structures such as schools, shops or offices out of the wayleave to minimize exposure to EMFs ▪ Communicate to communities in RoW the safety risks of the transmission lines and provide response measures. Put sign boards on towers about electrocution risk. ▪ Implement the anti-climbing device for on the Transmission Tower.	TCN	TCN HSE Dept.	FMENV, OGMENV and LAMENV
Labour and working conditions	Exploitation of workers	Labour force for maintenance work	×	×	▪ Develop transparent human resources policies and procedures for recruitment process, working conditions and Terms of Employment wages, worker-employer relations, Grievance Redress Mechanism, non-discrimination, monitoring, roles and responsibilities following Nigerian Labour Law and ILO conventions. ▪ Provide reasonable, and if applicable negotiated, working terms and conditions. ▪ Establish worker's grievance mechanism, so that potential conflicts can be dealt with in an early and proper way. ▪ No use of child labour (workers under age 18) or forced labour. ▪ Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. ▪ A worker's grievance mechanism will be in place. ▪	TCN	TCN HSE Dept.	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
	Occupational H&S risks in operation and maintenance	Labour force	×	×	• TCN should follow their Occupational HSE plan following Nigerian and international requirements: train staff, monitor and keep record. Special focus on slip-trip, fall from height and electrocution in maintenance and repair works, emergency prevention and management. Use personal protection equipment. • Have medical emergency equipment at hand.	TCN	TCN HSE Dept.	FMENV, OGMENV and LAMENV
Employment and Economy	Improved electricity supply for the national grid, creating opportunities for businesses and economic development in the country.	National level Nigeria	×	×	• Regular maintenance of the project to ensure reliable production of power	TCN	TCN HSE Dept.	FMENV, OGMENV and LAMENV
Cultural heritage	Potential interactions between maintenance works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities in the RoW	×		• Consult with local communities on festivals and potentials for interaction with maintenance works. If required cease works on the specific dates.	TCN	TCN HSE Dept.	FMENV, OGMENV and LAMENV

Table 0.3 Environmental and Social Monitoring Plan (Construction Phase)

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
Air quality	SO_2, NO_x, CO, VOC, PM, SF6	Visual inspection of substations and access roads; verification of equipment and machinery records Ambient air quality measurements	Avoid significant degradation of baseline conditions. WHO and National ambient air quality standards (FMENV)	Substations (6)	Every 3 years	TCN-HSE Dept.	1,500,000/3 years

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
Noise and EMF	Noise Levels, EMF Levels	Noise level measurements EMF measurement	Avoid significant degradation of baseline conditions. WHO and FMENV noise standards ICNIRP EMF exposure limits	Along ROW and around substations (20)	Every 3 years	TCN-HSE Dept.	6,000,000/3 years
Soils integrity	Visual signs of contamination Status of drainages, bundwalls, stockpiles, etc	Visual inspection of substation sites	Avoid the use of erosive processes or control them Reduce soil compaction Avoid soil profile structure destruction Avoid any soil contaminations	Substations (6)	Every 3 years	TCN-HSE Dept.	Included in TCN`s administrative cost
	Soil biological, physical and chemical properties	Sampling and analyses of soils	Compare with baseline condition	3 locations/ substations(6) Total 18	Every 3 years	TCN-HSE Dept.	6,500,000/3 years
Terrestrial ecology	Introduction of Alien species	Visual inspection of alien species within and around the ROW	Avoid the introduction of alien species	Around ROW	Every 3 years	TCN-HSE Dept.	Included in TCN`s administrative cost
	Avian collision	Visual inspection of incident of bird strike around the transmission line	Avoid avian collision	Around ROW	Every 1 year for fist 3 Year	TCN-HSE Dept.	Included in TCN`s administrative cost
	Natural resource exploitation	Visual inspection and interview with communities	Increase awareness on natural resource protection	Around ROW	Continuous	TCN-HSE Dept.	Included in TCN`s administrative cost

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
Vegetation integrity and Fauna protection	Vegetation cover Pictorial comparison (before and after the maintenance)	Visual inspection of areas around substations and along the ROW	Avoid significant degradation outside the ROW and undeveloped areas. Protection of flora species with conservation status Avoid habitat loss and disturbances for local fauna	ROW	At the time of ROW maintenance	TCN-HSE Dept.	Included in TCN's administrative cost
Visual amenities	Orderliness and cleanliness of sites	Visual inspection of areas around substations and along the ROW	Good housekeeping practice Site clearance activities to be restricted to the minimum required area.	ROW	Daily	TCN-HSE Dept.	Included in TCN's administrative cost
Land planning and use	disturbance outside acquired sites		Provision of predefined route, barriers or boundary markings to prevent incursion of machinery and workers into neighboring areas				
Stakeholder relations Management	No of complaints/ concerns received Status of grievance resolutions	Interview neighboring communities Stakeholder meetings Inspection of complaints/grievance log book	Grievances are resolved effectively Complaints and issues are addressed timely	Neighboring communities	Every 3 years	TCN-HSE Dept.	Included in TCN's administrative cost
Health, Safety and Security	Incidences	Inspection and review of incidence log	ILO requirements and Factories Act minimum labour standards	Transmission Tower and Substations	Daily	TCN-HSE Dept.	Included in TCN's administrative cost
Employment and economy	Proportion of employees from local community materials procured from local community made in Nigeria materials used	Inspect employee records Random interview with workers Inspection of procurement records Interview with suppliers and vendors	Semi-skilled and non-skilled labour employed from local community if requierd Made in Nigeria products are utilized, except where not available	Transmission and Substations	As required	TCN-HSE Dept	Included in TCN's administrative cost

Table 0.4 Environmental and Social Monitoring Plan (Operational Phase)

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
Air quality	Dust	Visual inspection of construction sites, access roads; verification of equipment and machinery	Avoid significant degradation of baseline conditions.	Along ROW, access roads and work areas	daily	EPC Contractor	Included in EPC Contractor Fee
	SO2, NOx, CO, PM10, PM2.5, TSP	Ambient air quality measurements	IFC and National ambient air quality standards (FMENV)	Around substations (6)	quarterly	PIU	8,000,000/ year
Noise, vibration	Noise Levels,	Noise level measurements	IFC and FMENV noise standards	Along ROW and around substations (20)	quarterly	PIU	19,200,000/ year
Soils integrity	Visual signs of contamination Status of drainages, bundwalls, stockpiles, etc	Visual inspection of construction sites and access roads	Avoid the use of erosive processes or control them Reduce soil compaction Avoid soil prof ile structure destruction Avoid any soil contaminations	Along ROW, access roads and work areas	daily	EPC Contractor	Included in EPC Contractor Fee
	Soil biological, physical and chemical properties	Sampling and analyses of soils	Compare with Baseline condition	Around substations (6)	Once the construction completed	PIU	10,800,000/ year
Water quality	Water physico-chemical and microbiological -pH, temperature, TSS, turbidity, phosphorus, metals, sulphate, BOD, COD, coliform, fungi,	Analysis of surface and ground water samples Visual detection of pollution signs (presence of oil, waste, etc.)	Avoid significant degradation of baseline conditions WHO and FMENV water quality standards	Groundwater: Around substations (max 8)	Twice a year	PIU	50,400,000/year

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
	etc.			Surface water: Rivers and Surface water (50)			
Aquatic ecology	Degradation of aquatic ecology	Visual inspection of rivers and streams	Avoid equipment and vehicle movements in rivers and swamps.	The construction area around rivers and swamps	Daily	EPC Contractor	Included in EPC Contractor Fee
Vegetation integrity and Fauna protection	Vegetation cover Pictorial comparison (before and after)	Visual inspection of construction sites	Avoid significant degradation outside the ROW. Protection of flora species with conservation status	ROW	Once during vegetation removal in the ROW	EPC Contractor	Included in EPC Contractor Fee
Visual amenities Land planning and use	Orderliness and cleanliness of sites disturbance outside ROW	Visual inspection of construction sites and access roads	Good housekeeping practice Site clearance activities to be restricted to the minimum required area. Provision of predefined route, barriers or boundary markings to prevent incursion of machinery and workers into neighboring areas	ROW and substation sites	Daily	EPC Contractor	Included in EPC Contractor Fee
Stakeholder relations Management	No of complaints/ concerns received Status of grievance resolutions	Interview neighboring communities Stakeholder meetings Inspection of complaints/grievance log book	As per Resettlement Action Plan	Neighboring communities	Continuous	PIU	Included in RAP cost
Health, Safety and Security	Incidences	Inspection and review of incidence log	ILO requirements and Factories Act minimum labour standards	All work sites and base camps	Daily	EPC Contractor	Included in EPC Contractor Fee

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
Employment and economy	Proportion of employees from local community materials procured from local community made in Nigeria materials used	Inspect employee records Random interview with workers on site Inspection of procurement records Interview with suppliers and vendors	Semi-skilled and non-skilled labour employed from local community Materials available in the communities are used Made in Nigeria products are utilized, except where not available	Work sites and base camps	Daily	EPC Contractor	Included in EPC Contractor Fee

CHAPTER EIGHT

8.0 DECOMMISSIONING PLAN

8.1 Introduction

The proposed transmission line project with the facilities and their ancillary installations is anticipated to be in operation for >25 years. Following the operational term of the project, a decision will be made by TCN the project proponent to decommission. The decommissioning will be donein accordance with a plan and TCN standard procedures that meet local regulatory requirements and international standards. As required in the Guidelines for the ESIA study. This section describes the activities that will be completed to restore the project location to an acceptable condition for its intended use. The incorporation of remediation plans into the overall project planning is essential because it allows proponents to understand the need for restoring the environment into its original, or near its original status when abandonment plans are being conceptualized.

8.2 Stakeholders Consultation for Decommissioning

Prior to decommissioning, TCN will consult with various stakeholders (e.g. regulatory bodies, local government, host communities) regarding the details of decommissioning and would prepare an updated and comprehensive decommissioning plan as required to meet regulatory requirements in effect at that time.

8.3 Pre-decommissioning Activities

Prior to engaging in decommissioning works, the Proponent will develop a decommissioning plan in accordance with regulatory requirements at the time of decommissioning. Decommissioning and restoration activities will be performed in accordance with all relevant statutes in place at the time of decommissioning.

8.4 Decommissioning Activities

At the end of the facilities utility, all equipment will be decommissioned. In general, the activities to be carried out during the decommissioning phase shall include the following:

- Dismantling of towers including excavation
- Dismantling of all surface equipment including conductors
- Removal of foundations
- Environment and waste removal etc.

Managing Excess Materials and Waste

Most of the materials resulting from the decommissioning can be recycled or have residual value for reuse conductors, and similar materials that cannot be re-used or recycled should be disposed of in the appropriate manner consistent with the requirements in place at the time. .

8.5 Impacts and Mitigation Measures

Impacts
Typical activities during the decommissioning include removal of aboveground components and gravel from access roadsand other ancillary facility sites, breaking up of concrete pads and foundations, recontouring the ground surface, and revegetation. Potential impacts from these activities are presented below, by the type of affected resource.
The potential impacts that might result from the decommissioning phase of the proposed project include:

- physical disturbance of the environment arising from the removal of the towers and ancillary equipment,
- potential hazards/accidents associated with decommissioning activities, and
- waste management problems

Acoustics (Noise): Sources of noise during decommissioning would be similar to those during construction and would be caused primarily by construction equipment and vehicular traffic
Air Quality: Emissions generated by activities during the decommissioning include vehicle emissions; diesel emissions from large construction equipment and generators; and fugitive dust from many sources such as structure removal, backfilling, dumping, reclamation of disturbed areas (grading, seeding, planting), and truck and equipment traffic.
Ecological Resources: Removal of aboveground structures would eliminate the impacts to wildlife that occur during operation (e.g., bird collisions with transmission lines and habitat fragmentation).
Environmental Justice: Issues that could be of concern during decommissioning and site reclamation are noise, dust, and visual impacts, as well as possible restoration of fish and wildlife populations for subsistence users.
Hazardous Materials and Waste Management: Impacts could result if these wastes were not properly handled and were released to the environment.
Human Health and Safety: Potential impacts to worker and public health and safety during decommissioning and site reclamation would be similar to those during construction; and relate to earthmoving, use of large equipment, dismantling of industrial components, and transportation of overweight and oversized materials.

Land Use: Upon decommissioning, land use impacts resulting from construction and operation of an energy transmission project could be largely reversed depending on the end use selected for the ROW. No permanent land use impacts would occur during this phase.

Socioeconomics: Direct impacts would include the creation of new jobs for workers during decommissioning.

Soils and Geologic Resources:Activities during decommissioning that would result in impacts to soils include removal of access roads, transmission line components, and other ancillary structures. Surface disturbance, heavy equipment traffic, and changes to surface runoff patterns could cause soil erosion. Soil erosion impacts include soil nutrient loss and reduced water quality in nearby surface water bodies.

Transportation: Short-term increases in the use of local roadways would occur during decommissioning and site reclamation. Overweight and oversized loads could cause temporary disruptions to local traffic.

Water Resources: Water would be used for dust control for road traffic, dismantling of towers, pipelines, substations, and other buildings, and for consumptive use by the construction crew. It might be trucked in from off-site or obtained from local groundwater wells or nearby surface water bodies, depending on availability.

Mitigation Measures

The strategy to be adopted for site remediation shall depend on the prevailing biophysical and social environmental attributes and the attendant impacts that may result from such an action as discussed in Chapter 6. The following measures need to be planned for implementation after decommissioning:

- Facilities and ancillary equipment shall be dismantled completely
- All equipment and debris shall be removed from the environment
- Good waste management plan shall be implemented.

For abandonment, strict adherence to facilities abandonment policy of TCN, which includes restoring the project environment to its original status as much as possible, shall be encouraged. The procedure shall be in accordance with approved Environmental and Social Management Plan (ESMP) and international industry standards. It is expected that if these measures are implemented, an environmentally friendly site restoration after decommissioning will be achieved.

Decommissioning of the transmission line and the ancillary installations will result in potential for work-related injuries and fatality from the dismantling process but increase land available for agriculture and other land use from the restoration of land to its original situation as much as possible and hand over of the reclaimed land to the original community and landowners

All facility components that can be used or recycled will be identified and quantified. Vehicles for the operation and other facilities will be scrapped and / or moved to other locations. Cleared locations will be re- vegetated using fast growing native plant species.

8.6 Reporting

As required by regulations, a post-decommissioning report will be prepared and submitted to the Nigerian Regulators. The report will provide the following details:

- Overview of decommissioning facilities
- Details of methods used for decommissioning
- Nature of decommissioning (partial or whole)
- Record of consultation meetings
- Details of recyclable/reusable materials/facility components
- Decontaminated facilities
- Decommissioning schedule
- State of the surrounding environment
- Waste management plan
- Plans for restoration/remediation where necessary.

CHAPTER NINE

9.0 Conclusion

The conduct of this ESIA for the proposed TCN Transmission line project in Ogun State was executed in strict compliance with acceptable National and International regulatory requirements. The ESIA process involved an extensive literature review, and wide-ranging consultation with all the identified communities and stakeholders, sampling and determination of the conditions of biophysical, social and health environmental components of the project area. The study sought the views and concerns of the host communities on essential aspects of the proposed transmission line project through special interaction and incorporated in the impact assessment process.

This ESIA has identified and assessed both positive and negative impacts of the proposed project and accordingly evaluated the associated and potential negative effects on the environment (biophysical), socio-economic and health characteristics of the project area in detail and mitigation measures have also been prescribed for significant negative impacts. For effective implementation of the recommended mitigation measures, an Environmental and Social Management Plan (ESMP) has been developed to ensure environmental sustainability during the construction and operation phases of the proposed transmission line project.

The Environmental and Social Impact Assessment of the TCN transmission line project revealed that the project will have significant transformative impacts on the socio-economic life of the host communities and Ogun State in particular as well as the national economy in general. Nonetheless, some households will be displaced. Consequential to this, a Livelihood Restoration Plan shall be developed while commensurable compensation shall be ensured.
In general, the proposed transmission line would pose limited environmental and social risks, taken into account the proposed mitigation measures.

It is recommended that environmental performance should be regularly monitored to ensure compliance and that corrective measures be taken if necessary. In addition, it is very necessary that this information should be made available to the host communities on a regular basis.

The Environmental and Social Management Plan (ESMP) should be used as an on-site reference document during all phases (Planning, Construction and Operation) of the proposed transmission line project.
Environmental auditing should be regularly undertaken, in order to determine compliance with the proposed ESMP, and parties responsible for the implementation of the ESMP should be held responsible for any inadequacy during the implementation process.

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