Draft Report

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

(ESIA)

FOR

THE PROPOSED 750MW GAS-FIRED COMBINED CYCLE POWER PLANT PROJECT AT IBENO, IBENO LGA, AKWA IBOM STATE, NIGERIA.

By

DE-SADEL NIGERIA LIMITED

Submitted to

FEDERAL MINISTRY OF ENVIRONMENT MABUSHI, ABUJA. NIGERIA.

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LIST OF ABBREVIATIONS AND ACRONYMS

%	Percent
µSv/yr	Milli Sievert Per Year
a.s.l	Above sea level
AAS	Atomic Absorption Spectrophotometer
AEL	Artificial Evaporative Load
AES	Acoustic Encounter Surveys
AIDS	Acquired Immune Deficiency Syndrome
ALARP	As Low as Reasonably Practicable
ANSI	American National Standards Institute
APHA	American Public Health Association
API	American Petroleum Institute
ASME	American Society for Mechanical Engineering
ASTM	American Society for Testing and Material
BAT	Best Available Technology
BF	Bag Filters
BS	British Standard
BTU/ft^3/hr	British Thermal Unit per Cubic Feet per Hour
BOD_5	Biochemical Oxygen Demand
Ca	Calcium
Ca^{2+}	Calcium ion
$CaCO_3$	Calcium carbonate
HSE	Health, Safety and Environment
CCGP	Combined Cycle Gas Power
Cd	Cadmium
CDC	Community Development Committee
CFU	Colony Forming Units
cfu/g	Colony forming units per gramme
CH_4	Methane
CHC	Community Health Care
CLO	Chief Liaison Officer
CDA	Community Development Agreement
Cl	Chlorine
Cl-	Chloride ion
CLO/CRO	Community Liaison Officer/Community Relations Officer
Cm	Centimeter
cm/sec	Centimeters per second
CNG	Compressed Natural Gas
CO	Carbon Monoxide
Co	Cobalt
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand

Cond.	Conductivity
CO_x	Oxides of carbon
Cr	Chromium
CSR	Corporate Social Responsibility
Cu	Copper
dB (A)	Decibel (Absolute)
DBH	Diameter at Breast Height
DN	Dip Netting
DO	Dissolved Oxygen
ECEC	Effective Cation Exchange Capacity
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
EMT	Environmental Monitoring Team
EPA	Environmental Protection Agency
EPRP	Environmental Protection and Rehabilitation Programme
EPC	Engineering Procurement and Construction
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development
ESMP	Environmental and Social Management Plan
Etc	Etcetera
Fe	Iron
FEPA	Federal Environmental Protection Agency
FGD	Focus Group Discussion
FMEnv	Federal Ministry of Environment
FTU	Formazin Turbidity Unit
FRSC	Federal Road Safety Commission
FSP	Fine Settling Pond
Ft	Feet
G	Gramme
GC	Gas Chromatography
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GPS	Global Positioning System
H_2S	Hydrogen Sulphide
Ha	Hectare
HC	Hydrocarbon
HCN	Hydrogen cyanide
HDPE	High Density Polythylene
Hg	Mercury
HIV/AIDS	Human Immunodeficiency Virus/Acquired Imunned Deficiency Syndrome
HMP	Health Management Plan
HNO_3	Nitricacid

HPI	Health Performance Indicator
Hr	Hour
HSE	Health Safety Environment
HVAC	High Variable Alternating Current
IDF	Inductor Draft Fan
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IQ	Intelligence Quotient
ISO	International Organization for Standardization
ITN	Insecticide Treated Net
IUCN	International Union for Conservation of Nature and Natural Resources
K	Potassium
K^+	Potassium Ion
KCl-	Potassium Chloride
Kg	Kilogram
Km	Kilometer
km^2	Square Kilometer
kW	Kilo Watt
l/s	Liter per Second
Ltd	Limited
M	Meter
m^3	Meter Cube
m^3/d	Meter Cube per Day
m^3/h	Meter Cube per Hour
MBT	Mechanical-Biological Treatment
MD	Measured depth
Meq	Milligram equivalent
Mg	Magnesium
Mg/Kg	Milligram per kilogram
Mg/L	Milligram Per litre
Min	Minimum
ML	Metal Leaching
Ml	Milliliter
Mm	Millimeter
Mn	Manganese
MoU	Memorandum of Understanding
ms^1	meters per second
MSW	Municipal Solid Waste
MTPA	Million Tonne per Annum
MTPH	Metric Tonne per Hour
NA	Nutrients Agar
NBS	National Bureau of Statistics
Na	Sodium

ND	Not detected
NGO	Non -Governmental Organization
NH3	Ammonia
Ni	Nickel
NID	National Immunization Day
NO_3	Nitrate ion
NO_X	Oxides of Nitrogen
NS	North – South
NE	North East
NESREA	National Environmental Standards and Regulations Enforcement Agency
NTU	Nephelometric Turbidity unit
^oC	Degrees Celsius
OHS	Occupational health Safety
AKSMEnv & MR	Akwa Ibom State Ministry of Environment and Mineral Resources
Pb	Lead
PM10	Particulate matter that is 10 micrograms per cubic metre or less in diameter
pH	Hydrogen ion Concentration
PO_4^{3-}	Phosphate
PO43-	Phosphate ion
PPE	Personal Protective Equipment
Ppm	Parts per million
PRA	Participatory Rural Appraisal
PWR	Pressurised Water Reactor
QA/QC	Quality Assurance/Quality Control
RAM	Risk Assessment Matrix
RH	Relative humidity
RMT	Raw Metric Tonne
RO	Reverse Osmosis
ROM	Run Off Mine
S	Southerly
SDR	Semi Dry Reactor
SE	South Easterly
SO_2	Sulphur Dioxide
SO2-4	Sulphate ion
SO_X	Oxides of Sulphur
SPM	Suspended Particulate Matter
Spp	Species
SSA	Sub-Saharan Africa
STDD	Satellite Towns Development Department
STI/STD	Sexually Transmitted Infection/Disease
SW	South Westerly
SWL	Safe Work Load

T	Tonne
TB	Tuberculosis
TBS	Teetered Bed Separator
TDS	Total Dissolve Solids
TH	Total Hardness
THC	Total Hydrocarbon compounds
TOC	Total Organic Carbon
ToR	Terms of Reference
Tph	Tonne per Hour
TS	Top Soil
TSS	Total Suspended Solid
TV	Television
U.S.	United States
UK	United Kingdom
VFD	Variable Frequency Drive
VGT	Vegetation Transect
VIO	Vehicle Inspection Officer
VSDs	Variable Frequency Drives
VSS	Vegetation Study Station
Gas Power Plant	Waste to Energy
WHO	World Health Organization
WS	Wet Substance
Zn	Zinc

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

This report presents the Environmental and Social Impact Assessment for the proposed establishment of a Gas-fired Combined Cycle Power generation plant at Qua Iboe, Ibeno LGA, Akwa Ibom State. Gas-fired Combined Cycle Power is becoming increasingly popular in both developed and developing countries as a sustainable option for power generation.

The federal Government, through its Ministry of Power, is committed to improving energy supply across the country by increasing power supply capacity as a means of addressing the electricity shortage.

In view of this, **DeSadel Nigeria Limited** proposes to construct and operate a Gas-fired Combined Cycle Power plant in Qua Iboe, Ibeno LGA, Akwa Ibom State. This would be used to operate the gigantic high-speed rail project across the country and improve the energy supply to the National grid.

The construction work for this project is proposed to span 24 months. During this period, various activities will be undertaken at the project site, which will result in various positive and negative interactions between planned activities and the physical/biophysical environment. To mitigate or ameliorate the negative impacts of this project during the construction and operational phase, an Environmental Impact Assessment (EIA) is being carried out by Layun International Consult Limited to identify, reduce, prevent and offset any adverse effects that are likely to occur. This complies with the EIA Act Cap E12, LFN 2004 and other extant laws of the

federation.

The Proponent

DeSadel Nigeria Limited, a subsidiary of the esteemed DeSadel Consortium. DeSadel Consortium is a leading innovative venture investment project strategy firm specialising in logistics infrastructure projects and oil & gas. The company is leveraging their expertise in infrastructure and investment strategies. They aim to establish a significant presence in the global energy market while fostering economic growth and regional connectivity in Nigeria. The company was registered with the Corporate Affairs Commission in 2009 with its head office at 14 Abubakar Koko Crescent, Asokoro, Abuja.

Legal and Administrative Framework

Federal statutory regulations have been enacted to regulate construction activities of this nature, with the aim of protecting the environment in the interest of sustainable development, and stakeholders were reviewed. Several regulations in the form of Acts, byelaws, and ratification of conventions that have been put in place to cater for environmental and social compliance by project developers were also reviewed in the course of this study, some of which are:

- Environmental Impact Assessment (EIA) Act Cap E12, LFN 2004
- National Environmental Standards and Regulations Enforcement Agency (NESREA) Act No. 25 of 2007
- Development Control Guidelines 2002

- Akwa Ibom State Ministry of Environment and Mineral Resources
- Harmful Wastes (Special Criminal Provisions etc.) Act No.42 of 1988
- National Environmental (Electrical/Electronic Sector) Regulations, 2011
- National Gas Policy, 2017;
- The Nigerian Oil and Gas Industry Content Development Act 2010;
- Petroleum Act 2021 (Revised);
- Criminal Code Act CAP C38 LFN 2004;
- Labour Act, 1999;
- The National Environmental Standards and Regulations Enforcement Agency (NESREA) Act, 2007;
- Nigerian Upstream Petroleum Regulatory Commission (NUPRC) Nigerian
- Midstream and Downstream Petroleum Regulatory Authority (NMDPRA) (formerly DPR), established by PIA, 2021
- National Environmental (Surface and Groundwater Quality Control) Regulations (No 22 of 2010);
- National Environmental (Control of Vehicular Emissions from Petrol and Diesel Engines) Regulations (No 20 of 2010);
- National Environmental (Noise Standards and Control) Regulations (No 35 of 2009);
- National Environmental (Ozone Layer Protection) Regulations, (No 32 of 2009);
- National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes), S.I.9 of 1991;

- National Health Act, 2014
- Wild Animals Preservation Act Cap 132 LFN 1990;
- Federal Solid and Hazardous Waste Management Regulations (1991);
- National Environmental (Sanitation and Wastes Control) Regulations (No 28 of 2009);
- Associated Gas Re-Injection Act, CAP 20, LFN 2004;
- Guidelines for the Establishment of a Natural Gas Plant Facility in Nigeria, DPR (now NUPRC), 2006;
- National Resources Conservation Council Act, CAP 286, LFN 1990;
- Standards Organisation of Nigeria (SON), Act CAP 412 LFN 1990
- National Energy Policy, 2003
- Nigeria Land Use Act 2004
- Electric Power Sector Reform Act of 2005
- Nigerian Electricity Regulatory Commission (NERC)
- Nigerian Electricity Act 2023
- AKSEPWMA CAP. 47, 200

ESIA Terms of Reference / Objectives

This ESIA study is being undertaken for the following consideration:

- To generate baseline or existing environmental data on the project area, predict the impacts of the proposed project on the environment, propose mitigation measures and establish an environmental management plan.
- To establish the baseline environmental and social setting of the project site and its surroundings.

- To identify adverse environmental problems that may be encountered in the development of the proposed project, which may cause negative environmental, social, health and economic effects on the immediate environment.
- To incorporate mitigation measures into the environmental management programme of the proposed project development process.
- To resolve conflicts that may occur between social, economic, visual, ecological and engineering requirements during all stages of project development.
- Assist project design and planning by identifying and quantifying aspects of construction, operation and decommissioning which may cause adverse environmental, social, health and economic effects and recommend measures to avoid and mitigate adverse effects and enhance beneficial impacts.
- Establish the existing state of the project environment and identify any sensitive components of the environment.
- To develop an Environmental Management Plan (EMP) for all phases of the project

Including compliance, monitoring, auditing, and contingency planning.

- To identify the best practicable environmental options that require the chosen option should result in the least environmental damage.
- To identify the potential and associated impacts of the proposed project development on the ecosystem and human communities within the study area;

- To meet the FMEnv requirements on EIA procedure for approval and certification before project commencement and implementation.

ES.2 PROJECT JUSTIFICATION

As Nigeria's industrial sectors expand and its population shifts from agrarian to urban communities, electricity demand continues to rise. Successive government efforts have aimed to expand supply, improve energy access, and encourage investment in the power sector, yet capacity remains insufficient, leading to frequent outages across the country. In response to this demand, DeSadel Nigeria Limited intend to build and construct a new Combined Cycle Gas Turbine (CCGT) plant with a capacity of 750MW and associated Infrastructure, such as the Gas Transmission line and other supporting facilities. The inclusion of the NNP-MPNU/JV power plant and the 58 km 330 kV transmission Line asset in the portfolio is a pivotal element within the broader vision for the power infrastructure, for which the EIA permit was secured.

- Below is an overview of options currently under consideration by the project team. The preferred option has been indicated, and reasons for selection are provided. The EIA (Environmental Impact Assessment) has assessed in detail the preferred option and indicates the impacts/benefits of this option, as well as considering the other options where relevant.

Value of the Project

The project is estimated to cost (USD 700M) one trillion, seventy-five billion, six hundred and sixty-two million Naira only (N 1,075,662,000,000) from

procurement and engineering to commissioning. The project shall be funded by DeSadel Limited in partnership with the Asian Development and Investment Bank.

Envisaged Sustainability

Some important factors should, however, be considered towards attaining project sustainability. They are related to practical aspects as they relate to economic profitability, technical resources, are with and efficient management. With the growth in electricity demand, adequate and reliable energy supplies are important to economic development. Additional energy resources, including electricity generation and sharing, as well as infrastructure improvements, are key. Consequently, the investments which will be carried out should be useful.

“Site Location Alternative”

An integrated site selection study was done in order to identify a more suitable site for the proposed project. According to the study carried out, the proposed site is considered the most suitable due to the following considerations:

The Greenfield site currently comprises an area of 30 hectares of thick to scattered vegetation, which will be removed to allow development of the site. The on-site vegetation is a mixture of swamp forest and humid tropical rainforest vegetation ecological zone, consisting of light to medium density tree growth, bush and vegetation.

The proposed site is located in an area that will allow for easy delivery of natural gas to the site, which will be achieved through the revitalisation of a 56km pipeline from the Oso to Qua Iboe terminal.

DeSadel Nigeria Limited has identified Ibeno, an industrial settlement in Akwa Ibom State, as an optimal location for the proposed CCGT Plant because of:

- Proximity to fuel supply channels – fuel supply pipelines belonging to the SEPLAT already supplying the location with natural gas in line with the proposed gas master plan that is envisaged to develop more pipelines and gas delivery from Osso platforms to Qua Iboe Terminal (QIT) being operated by Seplat Nigeria Limited.
- Existing space for installation of the power plant; and
- Availability of skilled professionals and support personnel already available within the Ibeno locality and the existing QIT project.

Other considerations include;

- Proximity of the site to the high sea, which will ensure ease of transportation of materials to the site.
- Community support: The selection of a site where the community is supportive of the development of energy is essential for ensuring the success of the project.

Consideration of the above criteria resulted in the selection of the preferred site. No further site location alternatives are considered in the ESIA process.

Summary of Key Alternatives Considered

Project Alternatives

The project alternatives were considered after a thorough review of the following factors:

i) Proximity of the site to the existing Qua Iboe Terminal with assured supply of Gas to the facility.

ii) Site accessibility

Alternative Technology

Alternative 1: Construction of a Coal-Fired Plant

This option was rejected due to the limited availability of raw materials (coal) needed for the operation of the system. A coal-fired plant at the proposed site would require approximately 3300 tons of coal per day and would be significantly larger than the gas turbines being proposed.

Unlike a gas or oil-fired plant, a coal-fired station would require a large area for fuel storage and ash/solid waste disposal. Around 600 tons/day of ash could reasonably be expected to be produced from such a plant, which would necessitate an ash disposal area of the order of $1km^2$ to allow for sufficient disposal space during the course of a 25-year plant lifetime. Creation of such a disposal site could potentially represent a significant loss of land to local agriculture and the communities intending to use the land available for other purposes.

Alternative 2: Construction of a simple cycle gas turbine plant (SCGT)

This option was also rejected. A simple gas-fired simple cycle plant burns

fuel in a gas turbine to generate electricity and releases hot exhaust into the atmosphere, resulting in lower efficiency (around 33-43%). The SCGT plant will offer greater flexibility and response to fluctuations. It is cost-effective. However, SCGT has several disadvantages, including lower efficiency and a significant drop in performance at partial loads, leading to higher fuel consumption and costs. They also produce significant emissions, such as NOx, contributing to air pollution.

Alternative 3: Construction of an Engineered Dam

Earth Dams are more environmentally friendly and present fewer impacts compared to either coal or gas-fired power plants. The construction of a dam was considered as one of the possible options to generate electricity, but several considerations were carefully looked into, including the incessant flooding of the Niger Delta region, the possible intrusion of saline water into the dam, which can affect the turbines and also, no waterfalls are cascading naturally in the area. Coupled with the possibility of flooding and other reasons advanced above, this option was also rejected.

Alternative 4: Construction of a combined cycle gas turbine plant (CCGT)

This is the preferred option as a combined cycle plant captures the exhaust heat from the gas turbine to produce steam, which then drives a steam turbine to generate additional electricity, significantly increasing overall efficiency to 50-60% and power output from the same amount of fuel. Hence, the combined cycle technology is adopted. This gives much higher, with modern plants achieving 50-60% efficiency. Higher power output for

the same amount of fuel, greater fuel economy, and reduced emissions per unit of energy produced. The construction of a CCGT plant represents the most efficient option for the construction of a power-generating plant at the proposed site, as the process recovers waste heat that is lost to the atmosphere when an open cycle configuration is preferred. This technology supports and ensures environmental sustainability.

Project Development Options

No Project

The first project option considered was the 'No-project option. This would mean the high-speed rail system will rely on the National grid or other alternatives such as coal power plants. It would also result 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 their associated health effects as well as increased greenhouse gas effects. Furthermore, economic growth will be stifled. Therefore, this option was rejected.

Delayed Project

This would arise if a situation of issues relating to regulatory requirements, land ownership, 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 prolong the continuous pollution of the environment due to the continuous release of gases, increasing climate change, contamination of soil and groundwater, noise, and further alteration of fauna. It would also delay access to more reliable electricity and slow down investments in the rail system since the power supply will be delayed. The use of industrial generators to power homes, offices and industries will also be prolonged. This will result in increased gaseous emissions with their 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 result in the construction of the project, which will provide relatively clean-burning fossil fuel, fewer emissions of nearly all types of air pollutants and carbon dioxide (CO_2) emissions, improve electricity, making power supply efficient, adequate, and reliable for residents and businesses in the area. It will further discourage the use of domestic and industrial generators to power homes, offices and industries, thereby reducing gaseous emissions with their associated health effects, as well as increasing greenhouse gas effects.

ES.3 PROJECT PROCESS DESCRIPTION

DeSadel Nigeria Limited proposes to construct and operate a new Combined Cycle Gas Turbine (CCGT) power station on land close to the existing Qua Iboe Terminal (QIT) Facility and immediately to the North

East of Ibeno Town along the Qua Ibo Road, in Ibeno Local Government of Akwa Ibom State.

The scope of work for the project shall include:

The scope of work for the proposed Project shall include:

I. Geotechnical Analysis
II. Site Clearance and Earthworks
III. Construction of plant structures
IV. Installation of plant equipment and other ancillary facilities

Project Waste Management Plan

The Waste Management Plan (WMP) outlines the minimum regulatory requirements for managing non-hazardous and hazardous wastes generated within the construction site. The waste management plan is consistent with applicable laws, guidelines and industry best practices.

Objectives

The objectives of the waste management plan are to:

- Promote environmental objectives such as reduction, reuse and recycle as proposed by the contractor handling the project.
- Identify the various waste categories/nature (e.g., solid, liquid, hazardous and non-hazardous), their source and their volumes, for better analysis and understanding.
- **Construction Waste**

Wastes expected from the construction phase of this project include vegetation and demolition waste from site clearance, excavated materials

from earthworks (e.g. cuttings, pile foundations, re-grading works), general construction waste (e.g. wood, scrap metal, concrete, cables, ducks), bentonite slurries from pile construction, chemical wastes generated by general site practices (e.g. vehicle and plant maintenance/servicing), and municipal wastes generated by site workers. The generation of volumes of sediment requiring off-site disposal, though in small quantities, may arise during viaduct construction.

- **Decommissioning Phase**

Activities during the decommissioning phase will involve demolition and site clean-up, disposal of waste, demobilisation of the workers, and a final site review. It involves the disengaging and removal of all equipment used in the course of the project's operational life. Decommissioning of the proposed project entails some activities, which include:

- Dismantling of the equipment and
- Transfer of all equipment and accessories to other locations where they shall be needed.
- Removal of constructed structures (site office building), etc.

Project Schedule

As it is enormous with this type of project, the project proponent had carried out feasibility studies, project analysis, and equipment and material availability and has determined that the project is viable. The project technical design has been completed; site acquisition and consultation also followed the site acquisition till the time of this ESIA

process. ESIA as a frontline activity for this proposed project is scheduled to last for five months, once the project is approved, material procurement shall last for five months, logistic arrangement (movement of materials) shall last for four weeks, site clearance and construction shall last tentatively within period 8 am to 4 pm, Monday to Friday for seventeen months depending on availability of funds for the project, then the project shall be commissioned and demobilization of construction equipment/workers shall follow. The Gantt chart of Table 3.5 is self-explanatory and briefly summarises the project scheduling.

Project Life Span

It is envisaged that with appropriate maintenance operations, this project shall last for 25 years when commissioned for use. During this period, if this technology is not overtaken by a more sustainable one, a general technical assessment of the project shall be carried out, with recommendations for decommissioning.

ES.4 DESCRIPTION OF THE PROJECT ENVIRONMENT

Methodology

The project area was described by the extent to which the proposed project activities are expected to influence the receiving environment; thus, the boundary covered during the study stretched 2km. While one-season (wet season) field data gathering was undertaken between 17th July to 4th of August 2025 for the acquisition of baseline data by a multi-disciplinary ESIA team, for which different section of the natural and social environment was covered, secondary data was sourced for the dry season

from an FMEnv-approved ESIA report within the study location (ESIA for the proposed Construction of Odoro Nkit-Okposio Road, Eket-Ibeno LGA, Akwa Ibom State, 2020). The existing air quality, noise level, soil quality, water quality, sediment and aquatic life, benthic and benthos, vegetation and wildlife, land use, and socio-economic and health issues within the project environment and host communities. A team of experts and a representative of the FMEnv fully participated in the study field. Field investigations, review of relevant literature, interviews and discussions with stakeholders, as well as consultation, were undertaken.

Standard methods and procedures for data acquisition, collation, presentation and analysis were strictly adhered to in the course of this study. Quality assurance and quality control (QA/QC) measures were implemented during sample collection, labelling, analyses and data verification. Sample handling, transportation, logging and cross-checking in the laboratory were also implemented. All analyses were carried out in the AKS MST-RD Laboratory, located at the Ministry of Science & Technology, Uyo, Akwa Ibom State. The methods of analysis used in this study were those internationally accepted analytical procedures, in order to ensure the reliability and integrity of the data obtained.

Weather and Climate over the Study Area

Thirty-five (35) years of data were acquired from the Nigerian Meteorological Agency (NIMET) of the Federal Ministry of Aviation, Abuja. Akwa Ibom State experiences a warm, humid tropical climate (Ojo, 1997). The weather conditions are influenced by the circulation of two air masses:

the cold, dry and dusty continental air that originates from the Sahara Desert in the North and warm, humid tropical maritime wind which originates from the Atlantic Ocean in the South. The zone separating these two air masses is referred to as the Intertropical Discontinuity (ITD). The climatic elements of the area studied include: rainfall, relative humidity, wind speed, temperature and wind speed and direction.

Baseline Data of the Study Area

Air Quality and Noise Level

The quality of air in the project area for the wet season (one-season sampling) is within the FMEnv limit. Suspended particulate matter showed low concentration within FMEnv. The concentrations of the pollutant gases were within the FMEnv permissible limit. Noise levels were also within the FMEnv permissible limit of 70db(A) for 8 hours. Chances of pollutant gases such as CO_2, CO, NO_2, SO_2, H_2S, CH_4 and particulate matter are being emitted in low concentrations as vehicular operation and human habitation as observed within the study boundary. Vehicular movement along the access road and fauna sounds determine the noise level of the area.

Relief and Topography

The project area has relatively flat terrain with no significant elevations. There were also no significant outcrops in the area. The topmost formation (Benin formation) is overlain by various Quaternary deposits.

Geology of the Study Area

The project area is in the Niger Delta basin, which is situated in the

continental margin of the Gulf of Guinea in equatorial West Africa, between latitudes 3° and 6° N and longitudes 5° and 8° E. It ranks amongst the world's most prolific petroleum-producing Tertiary deltas that together account for about 5% of the world's oil and gas reserves, and for about 2.5% of the present-day basin area on the earth.

Soil of the project area

Ibeno Local Government Area, situated on the coastal plain, has soils that are primarily Ultisols, derived from weathered sandy parent materials of the Cross River, Qua Iboe River, and the Gulf of Guinea. These soils are generally characterised by low fertility, high susceptibility to erosion, and low-activity clays. Due to significant oil and gas activities, the soil quality is often degraded, exhibiting pollution from heavy metals like cadmium and copper, and changes in physicochemical properties such as increased acidity from gas flaring. The texture of the soils in the area is generally sandy except in the subsoil of where the texture is sandy loam and clay. The sand content is very high and above 50% in most places sampled, while the silt and clay contents are low. The contents of these smaller particles are more in the subsoil (15 - 30cm) than in the top (0 - 15cm) soils.

Vegetation

Vegetation studies are important in understanding the existing state of the vegetation, including the species composition, diversity, and population of plant species, as well as their health status (plant pathology). This is useful for the assessment of environmental impacts due to the operation of the facility. Cleared vegetation normally leads to environmental impacts, such as loss of ecologically important plant species and habitats for some

animals, as well as enhancement of soil erosion. The present study has determined the nature of the existing vegetation around the project site.

Generally, the entire project area falls within the coastal swamp forests, mangrove swamps, and brackish water vegetation type, with variations in floristic composition. This type of vegetation is common to the southern coastal areas of Nigeria and the Niger Delta region, which are known for their salt-tolerant plants and freshwater and estuary environments. The assessment of the vegetation was done to identify the types of plants, crops, and grasses that are found within the study area. This was done through visual inspection and observation along the project area. An inventory of plant species in the project area was taken at intervals. The characterisation, identification and classification of the plant species and communities were undertaken both in the field and with reference materials. Generally, the vegetation is thicker along the entire water course of the Douglas Creek, dominated by Nipa palm (Nypa fruiticans) and climbers, as well as salt-tolerant trees and shrubs that grow along intertidal coastlines. The most abundant species across the proposed site include Elaesis guineensis, Crytosperla senegalensis, Alchornea laxiflora, Tectona grandis, Griselinia littoralis and Anthocleista vogelii

Fauna

The faunal diversity of the area is categorised based on habitat requirement, niche differentiation and energy pathways (food chain).

The animal communities are important because of their uses as sources of biodiversity conservation and research studies, recreation, and, more

importantly, the provision of protein in the diet of rural communities. An inventory of the terrestrial wildlife fauna of the project area was drawn up from various sources. These included direct sighting of individual fauna, examination of indirect evidence such as faecal droppings, feathers, footmarks and vocal cues, and interviews with local hunters and residents. The fauna was assessed in accordance with the wildlife census ground and indirect methods of Ayeni et al. (1982).

Ecologically, the animal population plays an important role in the transfer of food energy and cycling of essential elements in the ecosystem. The project area is endowed with a large variety of animal species. They vary from small arthropods like mites and ticks to very large mammals.

The wildlife resources have been grouped under the following major headings: mammals, avifauna, reptiles and amphibians. Wildlife was rare and limited largely to reptiles, birds and mammals. Birds were the most conspicuous form of vertebrate wildlife. The mammalian species were predominantly rodents (small mammals) like Cricetomys gambianus (giant rat), Rattus rattus (common rat) and Xerus erythropus (ground squirrel), with a few of the large mammals represented by the monkeys (Family: Cercopithecidae). The small mammals have naturally high fecundity as well as adaptability to changing habitat conditions.

The reptiles associated with the study area include Veranus niloticus (monitor lizard), Osteolaeleamus tetraspis (dwarf crocodile) and many snake species, which include Dendroaspis angusticepts (green member) Python regius (royal python), Bitis gabonica (gabon viper) were

particularly abundant in the study area.

Birds are one of the best-known faunal groups in the world (Tvardikova, 2010). They are ecologically highly diverse and inhabit a wide range of habitats. They are frequently used taxa to indicate the effects of environmental changes (Carignan et al, 2002). Several birds were encountered in the study area. The avifauna was the most conspicuous form of vertebrate wildlife and included weaver birds (Plesiositagra cucullatus), kites (Milvus migrans) and water birds (Halcyon senegalensis).

Groundwater Study Inference

Most residents receive water supply through a borehole facility installed in their houses. Therefore, a sample of groundwater is sourced from one (1) borehole within the area 90m from the site. The result of physical and chemical parameters of groundwater from the study area showed that the analyzed was mildly acidic in nature. The mean pH value of the water sample is 6.990. The mean conductivity value recorded is 585.00µS/cm. The salinity value of the water sample was 43.447mg/L, while that of Total Suspended Solids was 0.00mg/L. The Total Dissolved Solids were 124.400mg/L. This is lower than the WHO (2011) permissible level of 500mg/L. The concentrations of heavy metals in the water samples were generally low and, in some cases, not detected. All heavy metals had mean values less than the regulatory limits.

Surface Water Study

The project area is drained by a surface water body locally called Adick Mkpank (Douglas Creek) that flows 10m Northern axis ward of the project

site. The river meanders through the project area and drains into the Qua Iboe River and into the Atlantic Ocean. The river is characterised by a brown, oily surface. During the rainy season, its volume increases by 40% reaches a height almost at the bridge level. The bank of the river has evergreen fauna all through the year, characterised by Nipa palm (Nypa fruticans) and Musa species, ferns and grasses. Samples of the water and sediment were taken at three points from the river (Upstream, 200m midstream and 400m downstream).

Socioeconomic

Affected Community and People

Ibeno is the host community, and it is made up of several rural settlement that accommodates low-income earners are predominantly homes of the Ibeno ethnic group. There are other Nigerians from various ethnic groups residing in Ibeno. These include Ibibios, Annangs, Oron, Ekid, etc. There are also residents in Ibeno from the State. These include Igbo, Yoruba, Hausa, Ijaws, Andoni, Ilajes, Ghanaians and Ijaws, among others. Some of these are public and private sector workers in the employment of Local, State and Federal Governments, oil and gas industry workers, traders, artisans, and various entrepreneurs. The adjoining villages to the project are Mkpanak, Itak Ifaha, Upenekang, Inua Eyet Ikot, Esuk Ikim Ekeme, Itak Abasi, Iwuo-kpom, Atia and Okorutip. Other communities included Ikot Inwang, Okomita, Okposo 1, Esuk Ikim Akwaha, Iwuo-achang, Opolom, Itak Idim Ekpe, Ndito Eka Iba, Okoroitak and Okposo 11.

ES.5 ENVIRONMENTAL IMPACTS

The determination of the proposed project and potential impacts on the environment and Socio-Economic variables within the project location was carried out using the Rau Ad-Hoc Method. This model is subjective, but very useful in its applications. It indicates weighted impact values of beneficial (+) positive and adverse (—) negative impacts. It is possible to quickly decide the order of magnitude weight in such significance levels of no effect, problematic, duration — short-term, long-term, reversible, and irreversible impacts.

The impacts of the proposed project are seen from the perspectives of effects related to vehicular traffic, air quality, noise level, visual landscape, health, socioeconomics, construction waste management, water supply, runoff water, fauna and flora. The potential impacts of the proposed project will also have a bearing on biodiversity and the general ecosystem of the area due to the interface of the project components. The potential and associated impact assessment covers all stages of the project, from site acquisition and preparation through construction operation to activities, decommissioning and closure.

Project Specific Adverse/Beneficial Effects

Major adverse effects include:

The proposed Power Station project will have potential impacts that are both positive and negative. The positive impacts identified are:

- Job creation
- Business Opportunities/Economic Enhancement
- Improvement of infrastructure

- Skills acquisition
- Increase in efficiency of gas use and electricity generation
- Increase in revenue to the Government and DESADEL
- Exposure to emerging international utility management techniques
- Reduction in gas flaring by harnessing gas into useful production.

These are important for the enhanced socio-economic advancement of the country.

The significant negative impacts identified for this project include:

- Increase in potential for road traffic volume and accidents/injuries
- Increase in noise nuisance
- Movement of heavy equipment to the worksite, which may pose a danger to the public
- Increase in community unrest
- Stress on existing facilities, e.g. the access road
- Influx of people resulting in:
  - Increase in the cost of living/inflation
  - Stress on existing facilities, e.g. housing
  - Increase in communicable diseases (including STIs)
  - Increase in social vices/awareness
  - Increase in local population
  - stress on existing security structures
- Injury/fatalities in the workforce/communities
- Increase in respiratory diseases
- Loss of farmland
- Emotional disturbances

- Shift in traditional occupations
- Reduction in air quality
- Soil pollution and Soil/Groundwater contamination
- Pollution of water bodies
- Risk/exposure to electric shock/electrocution when work is in progress

By clearly establishing a cause-and-effect relationship based on an integrated list of significant impacts, appropriate mitigation measures for significant negative impacts have been developed. These significant negative impacts have been mitigated from either high or medium significant impact to either medium or as low as reasonably practicable (ALARP). Residual impacts after implementation of mitigation measures were assumed to be as low as reasonably practicable.

These residual impacts include:

- Influx of people leading to:
  - Increase in the cost of living/inflation
  - Increase in social vices/awareness
  - Security implications
- Increase in road traffic volume and accidents/injuries
- Increase in community unrest
- Stress on existing security structures

Practical proposals for the enhancement of significant positive impacts have also been made.

Residual impacts are those impacts that mitigation measures

cannot be applied against them such as land-take, visual aesthetics, noise pollution, etc.

The identified significant negative impacts associated with the project and their recommended mitigation measures are presented below.

ES.6 MITIGATION MEASURES

Construction Phase

- Undertake site clearing during the rainy season, or sprinkle water on the site if done during the dry season to avoid dust impacts.
- Ensure powered mechanical equipment and machinery are filtered with noise-abating gear such as mufflers for effective sound reduction, in compliance with the national regulations.
- Develop and implement stormwater control measures during construction
- Disposal of water and waste products arising from the site via a suitably designed temporary drainage system in a manner that will not cause pollution problems or other nuisance
- Develop embankments on steep slopes to protect them from erosion.
- Establish all relevant safety measures as required by law and good engineering practices

Operation Phase

Immigration of workers will be controlled through the employment of locals. The accredited waste contractor shall be responsible for the efficient management of solid waste that shall be generated by the project. The

contractor shall use energy-efficient lighting systems to light the entire area. This will contribute immensely to energy saving during the operational phase of the project. All measures shall be put in place to avoid environmental pollution and contamination. The proponent shall ensure adherence to the occupational health and safety rules and regulations during maintenance operations.

Mitigation Measures during Decommissioning Phase

Decommissioning shall be done stage by stage after consultation with FMEnv. All waste from decommissioning activities shall be recycled or reused to ensure that materials that would otherwise be disposed of as waste are diverted for productive uses as much as possible. Appropriate signs shall be put at the project area stating that the closure and decommissioning on ongoing. Traffic shall be redirected away from the road. PPEs shall be provided for the decommissioning workers, and dust suppression shall be done to reduce particulate emissions.

ES.7 ENVIRONMENTAL MANAGEMENT PLAN/ MONITORING PLAN

The Environmental Management Plan (EMP) provides an effective means of managing the project life cycle with respect to environmental, social and health issues. The plan consists of specific actions that need to be implemented to mitigate potential impacts, objectives of the action and who is responsible for implementation and monitoring. For effective implementation of the recommendations of this EIA and its management plan, as well as to ensure that all environmental (biophysical, social and health)

considerations are integrated into project execution, DESADEL shall:

- Establish an Environmental Monitoring Team (EMT) with the project HSE Team Leader as the focal point for all environmental matters relating to this Power Station Project;
- Prepare a comprehensive EMP document that shall be used by regulators in the monitoring of the project once the proposals in this EIA have been accepted.

  This team shall liaise at a predetermined level with contractors, engineers, quality assurance officers, supervisors and relevant departments, as well as other stakeholders on all environmental matters.

  All environment-related regulations as they apply to the Power Station Project have been documented and described in this EIA report. A set of minimum standards and guidelines has also been developed and agreed upon by the project managers. DESADEL management shall ensure compliance with these regulations, standards and guidelines throughout the project's lifecycle.

  DESADEL shall comply with all mitigation measures for the identified impacts to ensure activities are carried out in an environmentally responsible and sustainable manner. Mitigation measures have been proposed for all phases of the project. Monitoring requirements, duration, and frequency of monitoring of key performance indicators, as well as the action parties to

manage the biophysical, health and social environments at the various phases, have also been proposed. Monitoring has been proposed for:

-Air, soil and water quality

-Noise levels

-Wildlife and fisheries

-Communicable and stress-related diseases

-Crime/violence

-Accidents (occupational, road & domestic)

-Demography

-Development of infrastructure

-Macro-economy

-Natural resources

-Lifestyle & social values and;

-Social equity

-Geology and hydrology

-Disease monitoring, like STDs and HIV/AIDS

The frequency, duration, and the action parties to be involved shall all be spelt out in chapter seven of this report.

The EMP is a dynamic working tool that shall be revised and updated when necessary during the lifespan of the project to

incorporate improved environmental technologies, management systems, guidelines, policies and changes in regulations. Practical and economically feasible suggestions by users (contractors, site engineers and operations personnel) shall be assessed by the EMT. These shall be integrated into the EMP during revisions as necessary.

Wastes emanating from operational activities from the pipeline construction activities are mainly effluents, atmospheric emissions, spent oil and pigging wastes. These wastes shall be handled in compliance with the Petroleum (Drilling & Productions) Regulations 1969, sections 25, 36, 49 and (b), (c), and

(d) which stipulates *inter alia* that:

"The licenses or lessee shall adopt all practical precautions, including the provision of up-to-date equipment to prevent the pollution of inland waters, rivers, creeks, water courses, the territorial waters of Nigeria or the high seas by oil, mud or other fluids or substances which might contaminate the water or marine life, and where any such pollution occurs or has occurred, shall take prompt steps to control and, if possible, end it".

DESADEL has established a contingency plan for prompt and effective response to emergencies as may be detected near a public or private building or near the DESADEL pipeline facility or explosion occurring near or directly involving the DESADEL

facility.

The abandonment process will involve the following:

- Plant shutdown
- Removal of all hydrocarbons from the system
- Purging of buried pipeline with inert gas such as Nitrogen
- Dismantling/removal of all surface facilities and safeguarding of facilities/parts
- Capping and sealing of all open ends of the buried pipeline
- Remediation of all impacted sites to restore them to their original condition as far as possible,
- Civil structures shall be broken up and disposed of at approved sites or handed over to the host communities for use. Pavements shall be scarified and prepared for re-vegetation

Managing Stakeholder Perceptions

The project will have impacts on the surrounding communities through disturbances during construction and operation, as well as through the influx of the workforce. Public interest is therefore expected to be high. Although effective and realistic measures have been proposed to mitigate the significant negative impacts, stakeholder perceptions and reservations are likely to persist. Specific proposals to manage these perceptions and reservations, in the spirit of securing the social license to operate within the host communities, have been made.

ES.8 DECOMMISSIONING AND CLOSURE

At the end of the project life span, it shall be decommissioned and replaced or closed out. The decommissioning and close-out plan includes the effects of the closure and decommissioning on other stakeholders of the project and the economy of Nigeria in general.

Detailed HSE studies, engineering and decommissioning plan shall be prepared based on prevailing laws and regulations in force at that time before commencing the decommissioning process. Consultations and negotiations with stakeholders, particularly the communities, employees and regulatory agencies, shall commence early and be concluded before commencement of the execution of the decommissioning plan.

This shall be a survey of the site to determine if the site is contaminated, the extent of contamination and the best decontamination technique that will safeguard the environment and guarantee health and safety. The Federal Ministry of Environment, NESREA, Akwa Ibom State Environmental Ministry of Environment and Ibeno LGA, Akwa Ibom State shall be informed about the plan. Furthermore, the guidelines for site restoration and remediation prevailing at that time shall be used.

ES.9 CONCLUSIONS AND RECOMMENDATIONS

The Environmental and Social Impact Assessment of the proposed construction of proposed 750MW Gas Power Project in Ibeno, Ibeno LGA, Akwa Ibom State, by DeSadel Nigeria Limited is in accordance with the ESIA Act Cap E12 LFN 2004. This has afforded a critical review of the

anticipated impacts of the development project, considering its adverse and beneficial effects. Measures to be put in place to offset the negative impacts have been outlined in the report. However, the potential and associated impacts of the proposed project on the socio-economic environment of the area are beneficial because it will increase electricity accessibility to the area and Nigeria at large, as well as power the high-speed railway system. Hence, it is recommended that the necessary approvals be given for the project construction to commence.

CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND INFORMATION

This report presents the Environmental and Social Impact Assessment for the proposed establishment of Gas-fired Combined Cycle Power generation plant at Qua Iboe, Ibeno LGA, Akwa Ibom State. Gas-fired Combined Cycle Power is becoming increasingly popular in both developed and developing countries as a sustainable option for power generation.

The federal Government through its ministry of power is committed to improve energy supply in across the country by increasing the capacity of power supply as a means of tackling the shortage of electricity power supply encountered.

In view of this, **De-sadel Nigeria Limited** proposes to construct and operate a Gas-fired Combined Cycle Power plant in Qua Iboe, Ibeno LGA, Akwa Ibom State. This would be used to operate the gigantic high-speed rail project across the country and improve the energy supply to the National grid.

The construction work for this project is proposed to span through 24 months. During this period, various activities will be undertaken at the project site which will result in various positive and negative interactions between planned activities and the physical/biophysical environment. To mitigate or ameliorate the negative impacts of this project during the construction and operational phase, an Environmental Impact Assessment (EIA) is being carried out to identify, reduce, prevent and offset any adverse effects that

are likely to occur. This complies with the EIA Act Cap E12, LFN 2004 and other extant laws of the federation.

The government of Nigeria through the Federal Ministry of Environment (FMEnv), National Environmental Standards and Regulations Enforcement Agency (NESREA), Akwa Ibom State Ministry of Environment and Mineral Resources and other regulatory agencies has over the years, legislated and enforced the implementation of environmental laws on all industries to help sustainable development through compliance and adherence to the principle of best practices by ensuring that an impact assessment of projects is carried out. It is on this basis that the management of De-sadel Limited commissioned Layun International Consult Limited to carry out the ESIA of the proposed 750 MW Gas-fired Combined Cycle Power Plant at Qua Iboe in Ibeno LGA in line with the EIA guidelines of the Federal Ministry of Environment.

The study commenced with a reconnaissance survey and delineation of the study area by the EIA team and the proponent on 15th August 2025 with the objectives of setting boundaries of the study area and mapping out sampling locations. The data gathering began on 16th July and ended on 4th August 2025.

1.1 The Proponent

De-Sadel Nigeria Limited, a subsidiary of the esteemed De-Sadel Consortium. De-Sadel Consortium is a leading innovative venture investment projects strategy firm specializing in logistics infrastructure projects and oil & gas. The company is Leveraging their expertise in infrastructure and investment strategies, they aim to establish a significant

presence in the global energy market while fostering economic growth and regional connectivity in Nigeria. The company is registered with Corporate Affairs Commission in 2009 with its head office 14 Abubakar koko crescent, Asokoro, Abuja.

1.2 Terms of Reference (TOR)

In line with the Federal Ministry of Environment's (FMEnv) EIA Process, Terms of Reference (TOR) for the EIA was prepared and submitted to the Ministry. The TOR provided a framework for achieving the overall objectives of the EIA. Accordingly, the TOR as specified in the proposed project document contains the EIA study activities to be carried out. The summary of the ToR is as follows:

- Conduct baseline studies that are required to characterize the existing environment
- Assess detailed project descriptions, including general layout & physical descriptions, and project implementation descriptions.
- Provide information on the size and nature of the proposed project activities including planning, design, construction, operation and maintenance, and decommissioning.
- Outline the general scope of the EIA study including the overall data requirements on the proposed project environment.
- Highlight the procedures and protocols for identifying and assessing associated and potential impacts of the proposed project as well as selecting appropriate mitigation measures for such impacts including environmental management plan.
- Assess the types of project alternatives to be considered.
- Assess consultations with relevant stakeholders.

- Undertake health and ssafety, environmental and socio-economic impact assessments that include qualitative and quantitative risk assessments among other tools and techniques.
- Propose mitigating and ameliorating measures as applied to the construction and operation of the project.
- Recommend practical and cost-effective mitigation measures to limit or completely eliminate negative impacts.
- Develop Environmental Management Plan that appropriately incorporate monitoring, mitigation and management systems that are consistent with identified impacts and that provide a contingency for unforeseen impacts.
- Preparation of a detailed EIA report which will form the basis for the issuance of Environmental Impact Statement (EIS) by FMEnv.

1.3 Objectives of the EIA

This EIA study is being undertaken for the following consideration:

- To generate baseline or existing environmental data on the project area, predict the impacts of the proposed project on the environment propose mitigation measures and establish an environmental management plan.
- To establish the baseline environmental and social setting of the project site and its surroundings.
- To identify adverse environmental problems that may be encountered in the development of the proposed project which may cause negative environmental, social, health and economic effect on the immediate environment.

- To incorporate mitigation measures on environmental management programme of the proposed project development process.
- To resolve conflict that may occur between social, economic, visual, ecological and engineering requirements during all stages of project development.
- Assist project design and planning by identifying and quantifying aspects of construction, operation and decommissioning which may cause adverse environmental, social, health and economic effects and recommend measures to avoid and mitigate adverse effects and enhance beneficial impacts.
- Establish the existing state of the project environment and identify any sensitive components of the environment.
- To develop an Environmental Management Plan (EMP) for all phases of the project, including compliance, monitoring, auditing, and contingency planning.
- To identify the best practicable environmental options that requires that the chosen option should result in the least environmental damage.
- To identify the potential and associated impacts of the proposed project development on the ecosystem and human communities within the study area;
- To meet the FMEnv requirements on EIA procedure for approval and certification before project commencement and implementation.

1.4 Scope of the EIA

The scope of the EIA covers the following:

- Review of the national and international laws regulation and codes applicable to the study;
- Descriptions of actions/activities that will be carried out in the course of the proposed project;
- Review the existing literature on the project area and its influence, identifying the data gap as well as undertaking field survey and laboratory analysis to complement the existing data;
- Analysis of data obtained and description of the study area prior to the proposed project activities, with particular regard to the significant environmental components and/ or receptors;
- Identification and evaluation of adverse environmental impacts of the project on the nearby communities including impacts on cultural properties, social infrastructure and impacts on lifestyle/ values in the study area;
- Identification of health hazards that may result from the different phases of the project during execution including construction, operation and decommissioning and evaluation of local population exposure to these hazards;
- Recommendation of appropriate and cost-effective mitigation measures and Environmental Management Plan (EMP);
- Preparation of EIA Report in conformity with the national and international guidelines and standards on EIA; and
- Procurement of other relevant approvals and EIA certificate from FMEnv;

1.5 Scope of the Project

Environmental impacts from the construction and operation of the proposed Construction of Gas-fired Combined Cycle Power Plant Project will potentially arise and it was considered imperative to evaluate these likely impacts and recommend mitigation strategies and potentially viable alternatives to the proposed project. The scope of work for the proposed Project shall include:

- Geotechnical Analysis
- Site Clearance and Earthworks
- Construction of plant structures
- Installation of plant equipment and other ancillary facilities

1.6 Methodology

Generally, the study involved desktop studies, field research, consultation, impact assessment and proffering of mitigation measures and the development of an Environmental Impact Assessment (EIA). The approach used involved the use of a blend of multidisciplinary standard methods used in obtaining basic data for impact prediction/ identification which was followed up with designing of appropriate mitigation measures.

The EIA Methodology adopted for this study is shown in Figure 1.1.

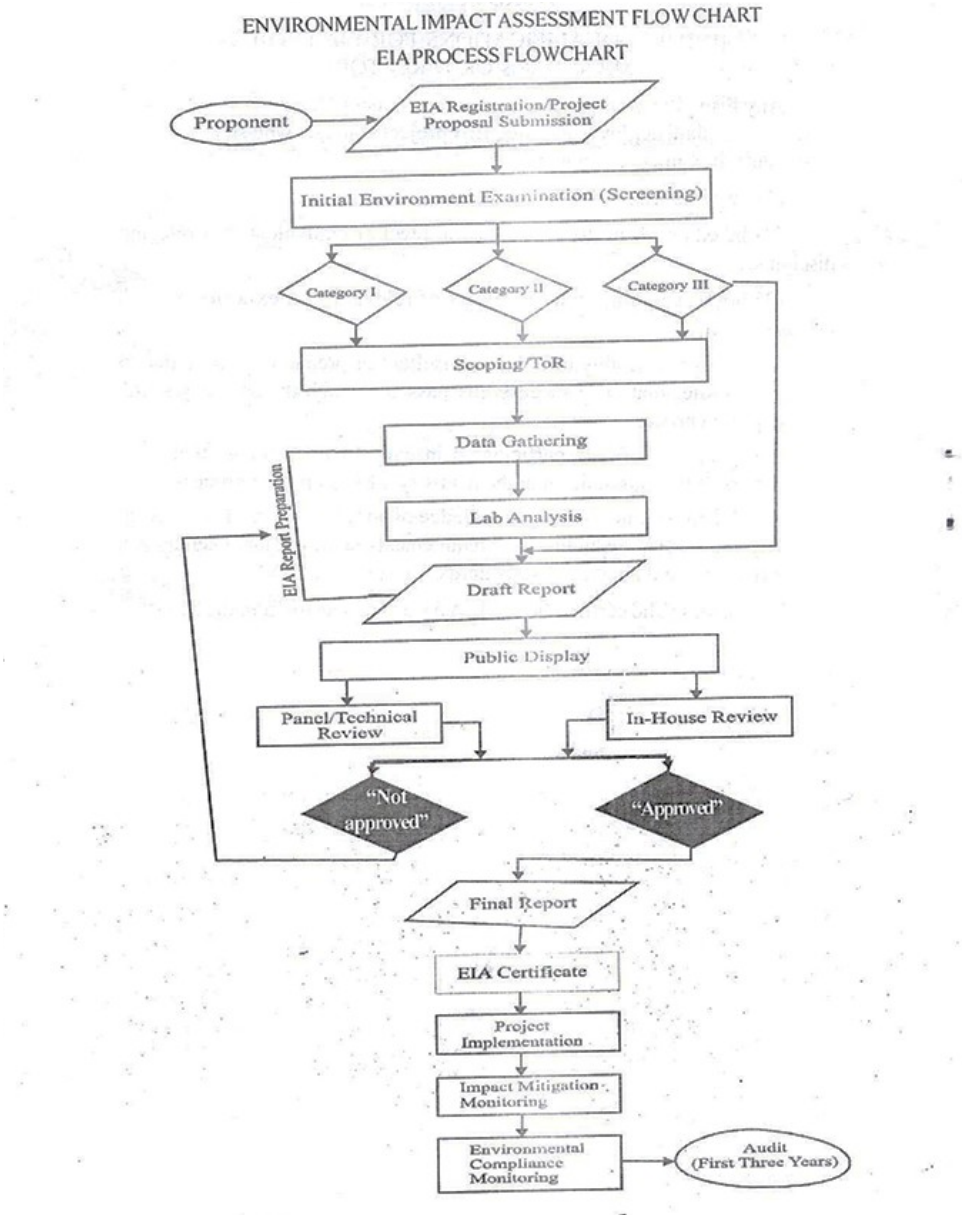

Figure 1:1: FMEnv EIA Implementation Flowchart
Source: https://ead.gov.ng/wp-content/uploads/2017/04/EIA-Flowchart-new.pdf

1.7 Legal and Administrative Framework

There are a number of relevant national and international environmental policies and regulations that are applicable to this project are here under-discussed.

- Environmental Impact Assessment (EIA) Act CAP E12 LFN 2004

- National Environmental Standards and Regulation Enforcement Agency (NESREA) Act No. 25 of 2007
- AKSEPWMA CAP. 47, 200
- Land Use Act of 1978 (modified in 1990)
- Development Control guidelines 2002.

1.7.1 National Environmental Legislation

In Nigeria, there are several national laws, regulations and standards which seek to protect the natural environment and assure sustainable development in the country. A number of these regulatory instruments were developed following the Koko toxic waste episode of 1987 which led to the promulgation of the Harmful Waste Act No. 42 of 1988 and the establishment of the Federal Environmental Protection Agency (FEPA). Laws establishing some government agencies also contain provisions to ensure environmental protection as development progresses.

1.7.2 Federal Ministry of Environment

Act 58 of 1988 established the FEPA. In 1999, FEPA and other relevant departments in other ministries were merged to form the Federal Ministry of Environment (FMEnv). Currently, the power to enforce all activities that may impact the Nigerian environment is vested in the Federal Ministry of Environment (FMEnv). The ministry has a mandate to co-ordinate the environmental protection and conservation of natural resources for sustainable development in Nigeria. The specific responsibilities of the ministry include:

- Monitor and enforce environmental protection measures.
- Enforce international laws, conventions, protocols and treaties on the environment.
- Prescribe standards and make regulations on air quality, water quality, pollution and effluent limitations, the atmosphere and ozone layer protection, control of toxic and hazardous substances and
- Promote cooperation with similar bodies in other countries and international agencies connected with environmental protection.
- Pursuant to the FEPA Act 58 of 1988, a number of other environmental regulations now exist.

EIA Act Cap E12 LFN2004

The Environmental Impact Assessment (EIA) Act No. 86 of 1992 as amended by EIA Act Cap E12 LFN, 2004 is the principal legislative instrument relating to activities that may likely or, to a significant extent, affect the environment. The Act sets the goals and objectives of EIA and procedures including the minimum requirements for the conduct of EIA of public or private projects. The Act makes EIA mandatory for all major development projects likely to have adverse impacts on the environment and gives specific powers to FMEnv to facilitate environmental assessment of projects in Nigeria.

FMEnv categorizes mandatory study activities into three categories: Category 3 activities are considered to have beneficial impacts on the environment. For Category 2 activities (unless within the Environmentally Sensitive Area) full EIA is not mandatory, while Category 1 activities require full and mandatory EIA. Projects are pre-listed into these categories based on the type and whether it would involve the physical intervention of the

environment. Either the listing or the result of an Initial Environmental Evaluation (IEE) is used to determine projects requiring full EIA. Renewable energy projects, including solar power plants, are listed under Category 1 which requires a full EIA requiring panel review or Category 2 requiring a partial EIA focusing on mitigation and environmental planning measures. The categorisation largely depends on the IEE and where such a project is located near an "Environmentally Sensitive Area" (ESA), the project is placed in Category 1.

1.7.3 National Policy on Environment (2016)

In November 1989, the present Nigeria Environmental Policy was launched to guide environmental activities in Nigeria. The main objective of the policy is to achieve sustainable development which can be achieved by:

- Securing for all Nigerians a quality of environment adequate for their health and well-being.
- Conserving and using the natural resources for the benefit of the present and future generations.
- Restoring, maintaining and enhancing the ecosystem and ecological process essential for
- the preservation of biological diversity.
- Raising public awareness and promoting understanding of the essential linkages between environment and development.
- Co-operation with other countries and international organizations and agencies to achieve the above specific goals, and prevent transboundary environmental pollution.

Federal Ministry of Environment (FMEnv)

The need to protect the environment in Nigeria started with the pronouncement prohibiting water pollution through the colonial hygiene of public health inspectors. In 1975, a division was created in the Federal Ministry of Economic Development to deal with pollution and other industrial matters. Lack of effective implementation of its mandate led to the relocation of the division from one Ministry to another.

The discovery of six ship loads of toxic waste of Italian origin in Koko, Delta State in 1988, exposed the need for stringent environmental laws and its effective enforcement with monitoring mechanism put in place. The Federal Government promulgated the Harmful Wastes Criminal Provision Decree 42 of 1988, which made it a criminal offence to import or trade in toxic waste. The Federal Environmental Protection Agency (FEPA) was created by Decree 58 of 1988 as a parastatal of the Ministry of Works and Housing. The agency authority was strengthened through Decree 59 of 1992 and October 12th, 1999 saw the creation of the Federal Ministry of Environment (FMEnv). The Federal Ministry of Environment is charged with the overall responsibility of protecting the Nigerian environment including biodiversity, conservation and sustainable development of natural resources.

National Adaptation Strategy and Action Plan on Climate Change in Nigeria (NASPA-CCN)

The National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN) have been prepared for the Special Climate Change Unit of Nigeria’s Federal Ministry of Environment. It was prepared by the building Nigeria's Response to Climate Change (BNRCC) project. This Strategy envisions a Nigeria in which climate change adaptation is an

integrated component of sustainable development, reducing the vulnerability and enhancing the resilience and adaptive capacity of all economic sectors and of all people -- particularly women, children, and resource-poor men – to the adverse impacts of climate change, while also capturing the opportunities that arise as a result of climate change. The objective is to reduce the impacts of climate change through adaptation measures that can be undertaken by the Federal, State and Local Governments, civil society, private sector, communities and individuals, including measures that will:

1. Improve awareness and preparedness for climate change impacts
2. Mobilize communities for climate change adaptation actions
3. Reduce the impacts of climate change on key sectors and vulnerable communities
4. Integrate climate change adaptation into national, sectoral, State and Local Government planning and into the plans of universities, research and educational organizations, civil society organizations, the private sector and the media.

National Guideline for Decommissioning of Facilities

The Federal Ministry of Environment, being the apex environmental regulatory authority, have developed this guideline to guide facility owners on the appropriate processes to follow for successful decommissioning of a facility and rehabilitation of the surrounding environment.

The purpose of this guideline is to provide clear directions and guidance on the step-by-step process involved in decommissioning a facility in Nigeria. The guideline is to aid in achieving an effective and environmentally sustainable decommissioning process that shall be compatible with

intended future land use on health concerns and environmental impacts.

Objectives of this guideline

The objectives of this guideline are to:

i. Ensure that proper closure and decommissioning principles and processes are followed.
ii. Develop a comprehensive framework for assessing the applicability of decommissioning and reclamation plans.
iii. Render assistance to industries in planning and implementing safe and environmentally friendly decommissioning procedures/plan.
iv. Establish safety requirements for all aspects of decommissioning, from the siting and design, of a facility to the termination of the authorization for decommissioning.

National Environmental Standards and Regulation Enforcement Agency (NESREA)

The basis of environmental policy in Nigeria is contained in the 1999 Constitution of the Federal Republic of Nigeria. Section 20 of the Constitution empowers the state to protect and improve the environment; and safeguard the water, air and land, forest and wildlife of Nigeria. Hitherto, various laws and regulations have been enacted to safeguard the Nigerian environment. These include:

- National Environmental Protection (Effluent Limitation) Regulations;
- National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations; and
- National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations.

  - National Environmental Health Practice Regulations 2007; and
  - Nigerian Radioactive Waste Management Regulations 2006.
- Environmental Impact Assessment Act Cap E12, LFN 2004
- Harmful Wastes (Special Criminal Provisions etc.) Act of 1988 (Harmful Wastes Act).
- Nigerian Radioactive Waste Management Regulations 2006 issued pursuant to the Nuclear Safety and Radiation Protection Act 1995
- The National Environmental Standards and Regulations Agency 2007 (NESREA Act).

The NESREA Act was enacted on the 31st July 2007 to provide for the establishment of the National Environmental Standards and Regulations Agency (NESREA). This Act repealed the Federal Environmental Protection Agency Act (the FEPA Act) pursuant to which the FEPA which was formerly charged with the protection and development of the environment in Nigeria was established. However, all regulations, authorizations and directions made pursuant to the FEPA act and which were in force at the commencement of the NESREA Act shall continue to be in force and have effect as if made by the NESREA Act. The NESREA Act applies to the regulation and the protection and development of the environment in Nigeria with the exception of the oil and gas sector.

The NESREA is responsible for the protection and development of environmental standards, regulations, rules, laws, policies and guidelines within Nigeria. The NESREA's functions do not however include enforcement of environmental standards, regulations, policies and guidelines in the oil and gas sector of Nigeria. The NESREA Act gives authorized officers of the NESREA powers to:

- Enter and search any land, building, vehicle, tent, vessel, floating craft or any inland water for the purpose of conducting inspection, searching and taking samples for analysis which are reasonably believed to be carrying out activities or storing goods which contravene environmental standards or legislation
- seize or detain for such a period as may be necessary articles which are reasonably believed to contravene provisions of the legislation or any of its regulations and
- obtain an order of a court to suspend activities, seal and close down premises including land, vehicle, tent, vessel, floating craft or any inland water and other structure.

Functions of NESREA Act

- Under the NESREA Act, the minister charged with the responsibility of the environment is empowered by regulations to prescribe any specific removal methods and reporting obligations on the owners or operators of vessels discharging harmful substances and waste into the environment.
- Public authorities are statutorily required to inform the public of environment-related issues. The NESREA Act requires NESREA to enforce compliance with environmental regulations, to create public awareness, provide environmental education on sustainable environmental management and to publish data resulting from the performance of its functions.

- The NESREA Act provides that a person who breaches the provisions of the Act commits an offence and shall on conviction be liable to a fine, or imprisonment, or both.
- The NESREA Act also provides that where there has been a discharge of any hazardous substance in violation of environmental laws/permits, the person responsible for the discharge will bear the liability of the costs of removal and clean up.
- In executing its functions, the NESREA is required to conduct environmental audits and establish a data bank on regulatory and enforcement standards.

1.7.4 Statutory Regulations Guiding Solid Waste Management in Nigeria

- ***The National Environmental Standards and Regulations Enforcement Agency Act 2007 (NESREA ACT)***

After the repealing of the Federal Environmental Protection Act of 1988, the NESREA Act, 2007 became the major statutory regulation or instrument guiding environmental matters in Nigeria. It specially makes provision for solid waste management and its administration and prescribes sanction for offences or acts which run contrary to proper and adequate waste disposal procedures and practices.

- **National Environmental (Sanitation and Wastes Control) Regulations,2009**

The Regulations provide the legal framework for the adoption of sustainable and environment friendly practices in sanitation and control of solid wastes, hazardous wastes and effluent discharges to minimize pollution. Part 3 of the Regulations states that all owners or occupiers of

premises shall provide waste receptacles for storage before collection by licensed waste managers. In addition, the Regulations make it mandatory for facilities that generate waste, to reduce, re-use, recycle and ensure safe disposal to minimize pollution. The Regulations also spell out roles and responsibilities of State and Local Government Authorities.

- **National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations,2004**

The Regulations, S.1.9 of 2004 prohibits industry or facility from release of hazardous or toxic substances into the air, water of Nigeria's ecosystems beyond the permissible limits of FEPA (now FMEnv). The Regulations further charge any industry or facility to:

- Establish and maintain a pollution monitoring unit within their premises.
- Ensure on site pollution control and
- Assign the responsibility for pollution control to a person or body accredited by the FMEnv. Section 5 of the Regulations mandate industry or facility to submit to the nearest office of FMEnv a list of chemicals used in the manufacture of its products, details of stored chemicals and storage conditions and where these chemicals were obtained, bought or sold.

- **National Environmental Protection (Management of Solid and Hazardous Wastes) Regulations,1991**

These Regulations, S.1.15 of 1991 (No.102, Vol. 78, August, 1991 address handling and management of solid, radioactive and (infectious) hazardous waste. They define the objectives of management of solid and hazardous waste, the functions of appropriate government agencies and obligations of industries. The Regulations mandate all industries to inform FMEnv of all toxic, hazardous and radioactive substances which they keep in their

premises and/or which they discharge during their production processes. Schedule 12 and 13 of the Regulations provide a comprehensive list of all waste deemed to be hazardous and dangerous.

- ***The National Effluents Limitations Regulation***

This instrument makes it mandatory that industrial facilities install anti-pollution equipment, make provision for further effluent treatment, prescribe maximum limit of effluent parameters allowed for discharge, and spell out penalties for contravention.

- ***The National Guidelines and Standards for Environmental Pollution Control in Nigeria***

This was launched on March 12th 1991 and represents the basic instrument for monitoring and controlling industrial and urban pollution.

1.7.5 Nigeria Environmental Laws

- Endangered Species (Control of International Trade & Traffic) (Amendment) Act, 2016
- Exclusive Economic Zone Act No.42 of 1998
- Land Use Act (LUA) Cap.202, 1990
- Nigeria National Health Act 2014

The Nigerian Urban and Regional Planning Act Cap N138, LFN 2004

- 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.

Land Use Act, Cap 202, LFN 2004

The Land Use Act places the ownership, management and control of land in each state of the federation in the Governor. Land is therefore allocated with his authority for commercial, agricultural and other purposes.

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 Endangered Species (Control of International Trade & Traffic) (Amendment) Act, 2016

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 of animal species, either presently or likely to be 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.

Exclusive Economic Zone Act, Cap E11, LFN 2004

The Exclusive Economic Zone Act makes it illegal to explore or exploit natural resources within the Exclusive Zone without lawful authority. The Federal Government regulates the activities of the Exclusive Zone.

Criminal Code Act of 1990 CAP 77 LFN 2004

The Act contains the basic criminal law offences that relate to damage to the environment, public health and natural resources. Some environmental offences include: causing a public nuisance; fouling the water of any spring, stream, well or reservoir of a place; and violating the atmosphere in any place so as to make it noxious to the health of persons in general in the neighbourhood.

Criminal Code Act, CAP C38, LFN, 2004 The Act contains the basic criminal law offences that relate to damage to the environment, public health and natural resources. Some environmental offences include: causing a public

nuisance; fouling the water of any spring, stream, well or reservoir of a place; and violating the atmosphere in any place to make it noxious to the health of persons in general in the neighbourhood.

Nigeria National Health Act 2014

The aim of the Act is to establish a national framework for the regulation, development and management of a national health system, to set standards for rendering health services in Nigeria. Other key provisions include:

- Establishment of the National Health Systems,
- Provides for exemption from payment for health services in public health establishments, and
- Provides for the establishment of the Basic Health Care provision fund among others.

National Environmental Health Practice Regulation Act 27, 2016

The purpose of the Regulations is to:

- Provide a guideline for the enforcement of the regulatory powers in the Act;
- Prevent and abate nuisance, protect, preserve and promote the physical and social well-being of the public;
- Prevent and control the incidence of communicable diseases through environmental health intervention;
- Reduce environmental hazards to health, safeguard and maintain the aesthetic value of the environment;
- Promote the general welfare of the public by regulating the sanitary construction and sanitation of all premises; and

- Regulate private and public sector collaboration for purposes of maintaining adequate sanitation and promotion of public health and safety.

National Policy on Occupational Safety and Health 2006 revised in 2020

The National Policy on Occupational Safety and Health derived its main ground from the 1999 Constitution as amended, which in section 17 (3c) prescribes that the Nigerian state shall make laws and bye-laws for the preservation of the health and well-being of workers in the workplaces; men and women at work. The goal of the National Policy on Occupational Safety and Health 2020 is to facilitate the improvement of occupational safety and health performance in all sectors of the economy and ensure harmonization of workers' rights protection with regional and international standards.

Labour Act (Cap L1 LFN 2004)

The Labour Act provides comprehensive legislation on conditions of work and employment. Part I sets out general provisions relating to wages, contracts and terms of employment. Employers shall not advance more than one month's wages to an employee (s. 4). Section 8 requires that workers entering a contract be medically examined at the employer's expense. Section 20 governs redundancy. Part II regulates recruiting, including the licensing of recruiters (s. 25), and the right to be accompanied by family (not exceeding 2 wives) (s. 34). Part III relates to special classes of workers, including apprentices (ss. 49-53), women (ss. 54-58), and young persons (ss. 59-64). In general, women and young persons are prohibited from performing underground and night work. Section 73 prohibits forced

labour. Part IV contains supplemental provisions relating to administration and the settlement of disputes. Section 90 repeals the Labour Code Act.

Employees Compensation Act, 2010

This Act repeals the Workmen's Compensation Act Cap. W6 Laws of the Federation of Nigeria, 2004 makes comprehensive provisions for payment of compensation to employees who suffer from occupational diseases or sustain injuries arising from accidents at the workplace or in the course of employment.

Fire and Rescue Service Act 2004

The Fire and Rescue Services Act 2004 sets out the responsibilities of Fire and Rescue Authorities (FRAs). There are four key responsibilities for FRAs that they must ensure that they make provision for including:
extinguishing fires in their area. protecting life and property in the event of fires in their area.

The key objectives of the Act are;

- To prevent uncontrolled fires in our environment, especially our markets, public and private buildings and structures and reduce the incidence of loss of lives and property.
- Enhance response capabilities of the Fire Services and strengthen the regulatory and revenue generation potentials of government as it relates to the distribution and maintenance of fire protection equipment and
- Promote inter-agency collaboration in the distribution and maintenance of fire protection equipment in order to minimize fire incidences.

Water Resources Act, Cap W2, LFN, 2004

The Act is aimed at promoting the optimum planning, development and use of Nigeria's water resources; ensuring the co-ordination of activities that are likely to influence the quality, quantity; distribution, use and management of water; ensuring the application of appropriate standards and techniques for the investigation, use, control, protection, management and administration of water resources; and facilitating technical assistance and rehabilitation for water supplies.

National Inland Waterways Authority Act No. 13 of 1997

Act No. 13 of 1997 established the National Inland Waterways Authority. Section 2 of Part I of the Act defines the objectives of the Authority. Part II lists the function and powers of the Authority. Of relevance to the Power Plant Development Project is Section 9, subsection (i) on page 9. This subsection states that the Authority shall grant permit and licenses for utility line, water intake… from any Federal Navigable waterway. Section 13, subsection 2(c) of Part III on page 12 of this Act states that 'no person including a state shall carry out any of the activities as specified in Section 9 of this Act without the written consent, approval or permission of the Authority'. Section 23, subsection 2 of Part VI (Miscellaneous) of this Act spells out the penalty to any person who willfully or negligently and without the consent of the Authority uses the waterways for any activity

1.7.6 Other Ministries Departments and Agencies (MDAs)

A number of other government Ministries Departments and Agencies have enabling laws, which support the objectives of this ESIA. Some of these laws also seek to eliminate or minimize environmental and social impacts

of activities associated with their various functions. The key MDAs are discussed.

1. National Gas Policy, 2007

The Nigerian National Gas Policy (NNGP) was approved in June 2017 as a strategic roadmap to address the challenges faced by the country in the development of its natural gas resources. Nigeria has significant reserves of natural gas, estimated at over 200 trillion cubic feet (TCF), which is the largest in Africa and the ninth largest in the world. However, the country has not fully leveraged this resource due to a lack of infrastructure, inadequate regulatory framework, and limited investment in the sector. The policy harps on the use of natural gas for power generation, which is a critical component of Nigeria's energy mix. It seeks to increase the contribution of gas to the country's power sector from the current level of about 20% to at least 50%. The NNGP encourages the use of natural gas as a transportation fuel, particularly for heavy-duty vehicles such as trucks and buses. It aims to develop a comprehensive natural gas vehicle policy and infrastructure that will enable the adoption of natural gas as a transportation fuel.

2. The Nigerian Oil and Gas Industry Content Development Act 2010

The Nigerian Oil and Gas Industry Content Development Act of 2010 is a significant legislative framework aimed at promoting and enhancing the participation of Nigerian businesses and citizens in the country's oil and gas sector. Enacted as a response to the need for indigenous capacity building and economic empowerment, this Act seeks to foster local content development in the oil and gas industry. Key provisions of the Act include

requirements for Nigerian content in oil and gas activities, such as exploration, production, and development. The legislation mandates operators, contractors, and service providers in the industry to prioritize the use of locally manufactured goods, services, and manpower in their operations. This prioritization is intended to create opportunities for Nigerian businesses, promote technology transfer, and contribute to the overall growth of the domestic economy. Furthermore, the Act establishes the Nigerian Content Development and Monitoring Board (NCDMB) as the regulatory body responsible for overseeing and ensuring compliance with the provisions of the legislation. The NCDMB plays a pivotal role in developing strategies, guidelines, and policies to drive the implementation of Nigerian content in the oil and gas sector. The Act also encourages joint ventures and strategic alliances between Nigerian and international companies to facilitate knowledge transfer and skill acquisition. It emphasizes the need for capacity development, training, and the transfer of technology to empower Nigerians to actively participate in various aspects of the oil and gas value chain.

3. Petroleum Act, 2021

The key objective of the Act is to restructure and transform the Nigerian oil and gas industry. The Act provides legal, governance, regulatory and fiscal frameworks for the Nigerian oil and gas industry and the development of petroleum host communities. The Act repeals the following laws: Associated Gas Reinjection Act; Hydrocarbon Oil Refineries Act; Motor Spirit (Returns) Act; Nigerian National Petroleum Corporation (“NNPC”) (Projects) Act; NNPC Act (when NNPC ceases to exist under section 54(3) of

the Act); Petroleum Products Pricing Regulatory (Establishment) Act; Petroleum Equalisation Fund Act; Petroleum Profit Tax Act ("PPTA"); and Deep Offshore and Inland Basin Production Sharing Contract Act. However, while some of the repeals will take effect from the effective date of the Act, others are contingent upon the occurrence of certain events. The provisions of certain laws are saved until the termination or expiration of all existing oil prospecting licenses and oil mining leases.

4. **Nigerian Upstream Petroleum Regulatory Commission (NUPRC) Nigerian Midstream and Downstream Petroleum Regulatory Authority (NMDPRA) (formerly DPR), Established by PIA, 2021**

The Nigerian Midstream and Downstream Petroleum Regulatory Authority (Otherwise known as "The Authority") was created in August 2021 in line with the Petroleum Industry Act 2021 which provides legal, governance, regulatory and fiscal framework for the Nigerian Petroleum Industry as well as development of Host Communities. NMDPRA encompasses a merger of three defunct regulatory agencies: the Petroleum Products Pricing Regulatory Agency (PPPRA), the Petroleum Equalization Fund {Management} Board (PEFMB), and the Midstream and Downstream Divisions of the Department of Petroleum Resources (DPR). This birth has ushered a new dawn for establishing a progressive regulatory framework that encourages investment and full optimization of the midstream and downstream sectors of the petroleum industry in Nigeria. The Authority is responsible for the regulation of the midstream and downstream petroleum operations in Nigeria which includes technical, operational, and commercial activities.

The functions of the agency include;

• Regulate and monitor midstream and downstream operations in Nigeria.

• Determine appropriate tariff methodology.

• Set cost benchmarks for midstream and downstream operations.

• Advise the Government and stakeholders on commercial matters relating to tariff and pricing framework.

• Regulate the bulk storage, distribution, marketing, and transportation pipelines of petroleum products.

• Monitor and enforce compliance with the terms and conditions of licenses, permits, and authorizations issued by the authority.

• Set, define, and enforce approved standards and regulations for the design, construction, fabrication, operation, and maintenance of plants, installations, and facilities used or to be used in midstream and downstream petroleum operations.

• Ensure security of supply, development of the market and competition in the natural gas and petroleum products market.

• Establish customer protection measures in accordance with the provisions of the enabling Act. • Promote competition and private sector participation in midstream and downstream petroleum operations

5. Electrical Power Sector Reform Act (2005)

This legislation replaced earlier National Electrical Power Authority (NEPA) laws. It enables private companies to participate in electricity generation,

transmission, and distribution. It marked the beginning of the much talked about restructuring of the Nigerian power sector and the privatization of NEPA.

This law establishes the Nigerian Electricity Regulatory Commission (NERC) to monitor and regulate the power sector. It recognizes that companies licensed to generate, transmit or distribute electricity may require land and lays down provisions for declaring such land as required by the Commission. Such declarations are however affected by exceptions such as the need to:

- Protect the physical environment.

Ensure there is no greater damage to streets or interference with traffic than is reasonably necessary.

6. National Environmental (Electrical/Electronic Sector) Regulations, 2011

The principal thrust of this Regulation is to prevent and minimize pollution from all operations and ancillary activities of the Electrical/Electronic Sector. This Regulation covers both new and used Electrical/Electronic Equipment (EEE/UEEE). The principles of the Regulations are anchored on the 5Rs which are: Reduce, Repair and Re-use, Recycle and Recover as the primary drivers of the sector.

7. National Energy Policy, 2003

The National Energy Policy highlights strategies for systematic exploitation of the energy resources, the development and effective use of energy manpower, supply of rural energy needs, efficient energy technology

development and use, energy security, energy financing and private sector participation. The strategies are harmonized and grouped into short, medium and long – term measures for easier implementation.

Specifically for solar energy, the policy emphasizes that the nation shall aggressively pursue the integration of solar energy into the nation's energy mix and shall keep abreast of worldwide developments in solar energy technology. Some of the overarching objectives of the policy regarding solar energy are summarized as follows:

- To develop the nation's capability in the utilization of solar energy.
- To use solar energy as a complementary energy resource in the rural and urban areas.
- To develop the market for solar energy technologies and
- To develop solar energy conversion technologies locally.

The strategies adopted in the policy to achieve the above objectives include intensification of research and development in solar energy technology; promotion of training and manpower development; provision of adequate incentives to local manufacturers for the production of solar energy components and equipment; provision of adequate incentives to suppliers of solar energy products and services; introducing measures to support the local solar energy industry; providing fiscal incentives for the installation of solar energy systems; and setting up and maintaining a comprehensive information system on available solar energy resources and technologies.

8. The Electricity Act, 2023

A core objective of the Electricity Act, 2023 (the "Act") is to provide a holistic integrated policy plan that recognizes all sources for the generation, transmission, and distribution of electricity, including the integration of renewable energy into Nigeria's energy mix.

9. Energy Commission of Nigeria Act CAP 109 LFN 1990

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

10. Nigerian Electricity Supply and Installation Standards (NESIS) Regulations 2015

These Regulations provide guidance, license terms and conditions to any person engaged in the generation, transmission, distribution, system operation, and trading in electricity or in any aspect in the value chain of electricity supply, including but not limited to engineering designs, installations, commissioning, decommissioning and maintenance of electric power systems for the purpose of achieving safe and reliable supply, and utilization of electricity in Nigeria.

11.* Acquisition of Land Access Rights for Electricity Projects *Regulations, 2012

This is a Nigerian Electricity Regulatory Commission Act which provides a regulatory framework for the acquisition of land and access rights for electricity projects in Nigeria. This Act also stipulates provisions for the payment of compensation and resettlement of persons affected by the acquisition of their land for the establishment of electricity projects as well as the monitoring and evaluation of project designs of licensees to ensure compliance with environmental standards. The Regulations apply to the

acquisition of land access rights for electricity in Nigeria, including projects related to generation, transmission and distribution of electricity.

12. Road map for Power Sector Reform of August, 2010

The Road map reviews and fine-tunes plans and strategies to finalize the drive to complete power sector reform and sets the nation on a steady course to produce clean and efficient electricity for her citizenry at competitive rates. The Road map contained two core and fundamental objectives, which are.

- To transition the Nigerian power sector into a private sector-led market by implementing the EPSRA 2005 transition ("The Reform Objective") and
- To support and improve service delivery levels during this transition to the Nigerian public ("The Service Delivery Objective").
- **Federal Ministry of Power**

The Federal Ministry of Power (FMP) has the overall responsibility for the provision of power in the country by implementing generation, transmission and distribution projects in the sector and facilitating the emergence of a private sector led competitive and efficient electric power industry. The Ministry 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 Road map for Power Sector Reform of August 2010.

The Ministry has four (5) parastatals relevant to the implementation of sub-projects:

- Energy Commission of Nigeria (ECN),
- Nigerian Electricity Regulatory Commission (NERC),
- Transmission Company of Nigeria (TCN)and

- The Rural Electrification Agency (REA).
- Nigerian Bulk Electricity Trading Plc (NBET)

- **Nigerian Electricity Regulatory Commission (NERC)**

NERC is an independent regulatory body established by the EPSR of 2005 to undertake technical and economic regulation of the Nigerian electricity supply industry. Essentially, NERC is set up to license operators, determine operating codes and standards, establish customer rights and obligations and set cost reflective industry tariffs. NERC is responsible for the review of electricity tariffs, subsidy policies, promotion of efficient and environmentally friendly electricity generation and enforcing standards for electricity creation and use in Nigeria. NERC is largely responsible for regulating tariffs of power generating companies.

- **Transmission Company of Nigeria (TCN)**

The Transmission Company of Nigeria (TCN) emerged from the defunct National Electric Power Authority (NEPA) as a product of the merger of the Transmission and Operations sectors and was incorporated in November 2005. TCN licensed activities include: electricity transmission, system operation and electricity trading which is ring fenced. The sub-projects will entail Grid Connection Agreement with TCN.

- **Nigerian Bulk Electricity Trading Plc (NBET)**

The Nigerian Bulk Electricity Trading Plc (NBET) otherwise known as the ***Bulk Trader*** was incorporated on July 29, 2010, as the Special Purpose Vehicle (SPV) to carry out the bulk purchase and resale of electric power and ancillary services from Independent Power Producers (IPP) and from the success or

generation companies. NBET purchases electricity from the generating companies through Power Purchase Agreements (PPAs) and sells to the distribution companies (Dis Cos) and eligible customers through Vesting Contracts.

- **Energy Commission of Nigeria (ECN)**

Energy Commission of Nigeria was created and saddled with the responsibility for coordinating and general surveillance over the systematic development of the various energy resources of Nigeria. The Commission is also charged with the responsibility for the strategic planning and co-ordination of national policies in the field of energy in all its ramifications.

Other regulations considered include the following.

- ✓ Local Content Act;
- ✓ National Guidelines for Environmental Audit 2011;
- ✓ Abandonment Guidelines 1995;
- ✓ the Nigeria Climate Change Act 2021;
- ✓ Nigeria's Cultural Policy; 1996;
- ✓ National Guidelines on Registration of Environmentally Friendly products 1999;
- ✓ National Guidelines for Environmental Audit 1999;
- ✓ National Guidelines on Environmental Management System 1999;
- ✓ Nigeria Energy Transition Plan 2022;
- ✓ Electricity (Private Licenses) Regulations, 1965;
- ✓ Electricity (Annual Returns) Regulations, 1974;
- ✓ Electricity Installation Regulations, 1996;
- ✓ Electricity Supply Regulations, 1996; as well as
- ✓ Energy Commission of Nigeria Act, Cap 109 LFN 1990.

State Laws

The proposed Project falls within the jurisdiction of the Akwa Ibom State Government. The key State administrative authorities and legal instruments that are relevant to the proposed project are briefly described below:

Akwa Ibom State Ministry of Environment and Mineral Resources

The applicable State regulations have been taken into cognizance in the execution of the proposed project. The functions of the State Ministry of Environment are:

- Routine liaising and ensuring effective harmonization with the Federal Ministry of Environment in order to achieve the objective of the National Council on Environment;
- Monitoring the implementation of the EIA and the Environmental Audit Report (EAR) guidelines and procedures on all development policies and projects within the state.
- Regulate the generation, handling, storage, disposal and management of all wastes of whatever origin in Akwa Ibom State Enhance and where possible, restore the quality of the environment and, Protect the biodiversity of the flora and fauna of Akwa Ibom State.

Akwa Ibom State Environmental Protection and Waste Management Law, CAP. 47 (2000)

Akwa Ibom State Environmental Protection and Waste Management Board (AKSEPWMA) is the primary agency for environmental law enforcement within the state. The Board is primarily responsible for maintaining cleanliness, public health, and environmental sanitation throughout the

state. It works to ensure that communities, urban centers, and public spaces are kept clean and free from pollutants, playing a crucial role in promoting public health and a sustainable environment.

Local Government Laws on Environmental Protection

The site for the proposed project falls within Ibeno LGA of Akwa Ibom State. The LGA has an Environmental Health Department which ensures compliance with environmental sanitation law, which includes maintaining good housekeeping at the proposed Project

De-sadel 's Health, Safety and Environment (HSE) Strategy

Policy Statements and Objectives

De-sadel - has indicated in the Company's Corporate Environmental Policy statement (see **Appendix 4**) that it will conduct its operations in such a manner as to:

- Provide a safe working environment
- Ensure the safety and health of work force and contractors working within company's direct areas of operations
- Protect the public from injury or ill health and prevent properties from loss or damage resulting from its activities and
- Safeguard the conservation of the environment.
- Comply with applicable environmental standards and legislation in Nigeria

De-sadel is also committed reviewing at intervals, its HSE policy to reflect the reality of the prevailing situations and legislations.

Safety Health and Environmental Targets

In taking steps to ensure a healthy and safe working environment, the Company, its contractors and their employees aim at the following goals:

- No fatalities
- Prevention of lost time and any significant accidents
- Prevention of occupational disease and environmental degradation.

Implementation Aspects

The Corporate Health, Safety and Environmental policy is implemented with special attention to the following specific aspects:

- The requirements of the relevant government legislation are followed
- Company standards, specifications, procedures and regulations are applied
- Safety is accorded equal importance as productivity and project cost
- Each employee is given specific procedures related to his work
- Work instructions are clear and due regard paid to safety
- Experience gained, lessons learnt from accidents/incidents and new technical developments are widely distributed amongst staff/contractors
- Installations are designed, built and operated in a way that work can be carried out safely and in an environmentally sound manner
- Only materials, tools and equipment which meet high safety standards are used
- Safety aspects of installations, materials and tools are reviewed continually
- Contractors are required to adopt and maintain the same high standards as company employees

- All work carried out, whether by the Company or its contractors are effectively monitored by Company Representatives and
- Safety meetings are held at all levels in the organization to ensure safety occupies an important place in work planning and execution.

1.7.7 International Environmental Legislation

Apart from the national laws, Acts and Regulations, Nigeria is a signatory or party to many International Environmental Conventions and Treaties and has participated in many related conferences. A list of some of the relevant International Environmental Conventions and Treaties ratified by the Government of the Federal Republic of Nigeria are presented in Table 1.1.

Table 1.1: Selected international agreements and conventions to which Nigeria is a signatory

S/N	Regulations	Year Adopted
1	United Nations Framework Convention on Climate Change (UNFCCC)	1992
2	Convention on Oil Pollution Preparedness, Response, and Co-operation	1990
3	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	1989
4	Vienna Convention for the Protection of the Ozone Layer	1985
5	Convention on Conservation of Migratory Species of Wild Animals	1979
6	Convention on the Protection of the World Cultural and Natural Heritage (World Heritage Convention), Paris	1973
7	Convention to Regulate international trade in Endangered species of Fauna and Flora (CITES)	1988
8	Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) (Signatory only)	1988
9	African Convention on the Conservation of Nature and Nature Resource	1968
10	Gulf of Guinea Large Marine Ecosystem Project (GOG-LME)	1999
11	Convention on Biological Diversity (CBD)	1994

12	United Nations Framework Convention on Climate Change (UNFCC), 1992 and Kyoto Protocol on Greenhouse Gas Emission Reductions	2004
13	IFC performance Standards on Environmental and Social Sustainability	2012
14	Equator principle (EP4)	2020
15	United Nation's Environment Programme (UNEP) Climate and Clean Air Coalition	2012
16	Sustainable Development Goals (SDGs) on Clean Energy, Energy Efficiency and Sustainable Waste Management	

The Nigerian government is an important player in the international support for the protection of the environment. As such, the country is a signatory to some international laws and conventions, which are targeted towards conservation and protection of the environment in order to ensure sustainable development. Such conventions and laws clearly state the responsibilities, attitudes, contributions, etc of signatory nations towards that particular cause.

Some of the international conventions are outlined below:

- **African Convention on the Conservation of Nature and Natural Resources**

The African Convention on the Conservation of Nature and Natural Resources was adopted in Algiers, Algeria, on September 15, 1968 and entered into force on June 16, 1969. The Convention stipulates that the contracting States shall undertake to adopt the measures necessary to ensure conservation, utilization and development of soil, water, flora and fauna resources in accordance with scientific principles and with due regard to the best interests of the people.

- **Convention Concerning the Protection of the World Cultural and Natural Heritage**

The Convention was adopted in Paris, France on October 17, 1972. The Convention sets aside areas of cultural and natural heritage for protection. It places obligations to each State Party to recognize that the duty of ensuring the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage situated on its territory, belongs primarily to that State.

- **Convention on the Conservation of Migratory Species of Wild Animals**

This Convention also known as the Bonn Convention was adopted in 1979 and entered into force in 1983. It stipulates actions for the conservation and management of migratory species including habitat conservation.

- **Vienna Convention for the Protection of the Ozone Layer**

The Vienna Convention was adopted in 1985 and entered into force on September 22, 1988. It places general obligations on countries to make appropriate measures to protect human health and the environment against adverse effects resulting from human activities which tend to modify the ozone layer.

- **The Montreal Protocol on Substances that Deplete the Ozone Layer**

The Protocol was adopted on September 16, 1987 as an international treaty to eliminate ozone depleting chemicals production and consumption.

- **Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes and their Disposal**

The Convention was adopted on March 22, 1989 and entered into force on May, 1989. It focuses attention on the hazards of the generation and

disposal of hazardous wastes. The Convention defines the wastes to be regulated and controlled, warned on their trans-boundary movements in other to protect human and environmental health against their adverse effects.

❖ **The United Nations Convention on Biological Diversity**

The convention was adopted in 1994. The objectives of the Convention include the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising out of the utilization of genetic resources.

❖ **The United Nations Convention on Climate Change**

The Convention on Climate Change was adopted in 1992 during the Rio Earth Summit in Rio De Janeiro, Brazil and entered into force in 1994; to limit Greenhouse Gas (GHG) emissions which cause global warming.

❖ **United Nations Framework Convention on Climate Change (UNFCC), 1992 and Kyoto Protocol on Greenhouse Gas Emission Reductions 2004**

Green Houses Gases (GHG) emissions, particularly of carbon dioxide (CO_2) are implicated in global warming of the atmosphere causing global change/increase in the earth's atmospheric temperature and the latter is responsible for series of adverse climatic/meteorological changes such as sea level rise, excessive heat, flooding, desertification, reduced agricultural productivity, human ill health and death of grazing mammals, among others. The Convention and its Protocol called for the protection of climate system for the benefit of present and future generations of humankind,

reduction or prevention of anthropogenic emissions of GHG in energy, transport, industry, agriculture, forestry and waste management sector.

The Paris Agreement

Climate change is a global emergency that goes beyond national borders. It is an issue that requires international cooperation and coordinated solutions at all levels.

To tackle climate change and its negative impacts, world leaders at the UN Climate Change Conference (COP21) in Paris reached a breakthrough on 12 December 2015: the historic Paris Agreement.

The Agreement sets long-term goals to guide all nations:

- substantially reduce global greenhouse gas emissions to limit the global temperature increase in this century to 2 degrees Celsius while pursuing efforts to limit the increase even further to 1.5 degrees;
- review countries' commitments every five years;
- provide financing to developing countries to mitigate climate change, strengthen resilience and enhance abilities to adapt to climate impacts.

The Agreement is a legally binding international treaty. It entered into force on 4 November 2016. Today, 194 Parties (193 States plus the European Union) have joined the Paris Agreement.

The Paris Agreement provides a durable framework guiding the global effort for decades to come. It marks the beginning of a shift towards a net-zero emissions world. Implementation of the Agreement is also essential for the achievement of the Sustainable Development Goals.

Glasgow Accord, 2021 (COP 26)

Nations (including Nigeria) adopted the Glasgow Climate Pact, aiming to turn the 2020s into a decade of climate action and support. The package of decisions consists of a range of agreed items, including strengthened efforts to build resilience to climate change, to curb greenhouse gas emissions and to provide the necessary finance for both. Nations reaffirmed their duty to fulfill the pledge of providing 100 billion dollars annually from developed to developing countries. And they collectively agreed to work to reduce the gap between existing emission reduction plans and what is required to reduce emissions, so that the rise in the global average temperature can be limited to 1.5 degrees.

1.7.8 World Bank Environmental and Social Framework

The World Bank's Environmental and Social Framework (ESF) enables the Bank and her borrowers to better manage environmental and social risks of projects and to improve development outcomes. It offers broad and systematic coverage of environmental and social risks. It makes important advances in areas such as transparency, non-discrimination, public participation, and accountability— including expanded roles for grievance mechanisms. It brings the World Bank's environmental and social protections into closer harmony with those of other development institutions (https://www.worldbank.org/en/projects-operations/environmental-and-social framework)

The ESF consists of:

- The World Bank's Vision for Sustainable Development.
- The World Bank's Environmental and Social Policy for Investment Project

Financing (IPF), which sets out the requirements that apply to the Bank.

- The 10 Environmental and Social Standards (ESS), which set out the requirements that apply to Borrowers.
- Bank Directive: Environmental and Social Directive for Investment Project Financing
- Bank Directive on Addressing Risks and Impacts on Disadvantaged or Vulnerable Individuals or Groups

The Environmental and Social Standards (ESS) are designed to help borrowers to manage the risks and impacts of a project, and improve their environmental and social performance, through a risk and outcomes-based approach. The relevant ESS are highlighted thus:

- **Environmental and Social Standard1**: Assessment and Management of Environmental and Social Risks and Impacts.
- **Environmental and Social Standard 2**: Labor and Working Conditions.
- **Environmental and Social Standard 3**: Resource Efficiency and Pollution Prevention and Management.
- **Environmental and Social Standard 4**: Community Health and Safety.
- **Environmental and Social Standard 6**: Biodiversity Conservation and Sustainable Management of Living Natural Resources.
- **Environmental and Social Standard 8**: Cultural Heritage.
- **Environmental and Social Standard 9**: Financial Intermediaries and
- **Environmental and Social Standard 10**: Stakeholder Engagement and Information Disclosure.

Other relevant international regulations include:

- World Bank Energy Outlook 2009
- Wastes and their Disposal, 1989.

- Workmen Compensation Act, 1987.
- Abandonment Guidelines 1995.

1.7.9 The Core Labour Standards

Although other labour standards exist, four labour standards are internationally accepted as the "core" labor standards (CLS).

- Effective Abolition of Child Labor
- Elimination of Discrimination in Employment and Occupation
- Elimination of All F Forms of Forced or Compulsory Labor
- Freedom of Association and the Effective Recognition of the Right to Collective Bargaining

The standards are a set of internationally recognized basic rights and principles at work. There is a global recognition that the CLS are generally applicable to all countries including Nigeria. They do not establish a particular level of working conditions, wages, or health and safety standards to be applied internationally nor do they seek to change the comparative advantage of any country.

They are basic rights that have been repeatedly articulated in international human rights instruments and declarations, such as the Universal Declaration of Human Rights in 1948 and the Convention on the Rights of the Child, 1989.

1.7.10 Adequacy of Environmental Legislation

Sections 3.1 to 3.5 have provided an overview of existing laws, regulations and standards available in Nigeria. International laws that are relevant to the PPP were also highlighted. As is evident, there is no dearth of legislative instruments to assure sustainable development in Nigeria. Indeed, some

sector operators believe they are over-regulated. This is a position espoused by the oil and gas operators whose activities seem to attract interest of several regulators. The challenge of enforcing environmental regulations in Nigeria is therefore not so much the adequacy of environmental legislation but a number of other factors including conflict in roles and a general lack of environmental governance. According to Adegoroye (1994), factors contributing to the poor enforcement of environmental laws in Nigeria include:

- Influential individuals and groups.
- Industries with environmentally unacceptable technology.
- Role conflicts among government MDAs.
- Political instability - leading to the scrapping of the enforcement arm of FEPA. If allowed to function properly, the establishment of NESREA should however address this problem.
- Need for capacity building

1.8 EIA Report Structure

This report is presented in 9 (nine) chapters.

Chapter One - Introduction

Chapter Two - Project Justification

Chapter Three - Project and Process Description

Chapter Four - Description of the Project Environment

Chapter Five - Associated and Potential Impacts of the Project

Chapter Six - Mitigation Measures

Chapter Seven - Environmental Management Plan

Chapter Eight - Remediation Plan after Decommissioning/Closure

Chapter Nine - Recommendations and Conclusions

References

Appendices

Attendance

CHAPTER TWO

PROJECT JUSTIFICATION

2.0 Overview

The Nigerian economy has experienced consistent growth, supported by Africa's largest oil production and natural gas reserves. Akwa Ibom State, a key oil-producing region, holds a significant share of these resources, contributing immensely to Nigeria's energy potential. However, despite this resource wealth, Nigeria faces persistent electricity shortages, which hinder national development. The strong link between socio-economic progress and reliable electricity access highlights the importance of addressing these gaps, especially in regions like Akwa Ibom that are rich in energy resources.

Currently, the major electricity supply source in Nigeria is largely government owned. The in-efficiency is due to poor maintenance and over-stretching of existing facilities by ever increasing population, thereby its increasingly difficult to have good and optimum electricity supply which is the bedrock for any industrial and technological development of any nation making.

As Nigeria's industrial sectors expand and its population shifts from agrarian to urban communities, electricity demand continues to rise. Successive government efforts have aimed to expand supply, improve energy access, and encourage investment in the power sector, yet capacity remains insufficient, leading to frequent outages across the country. In

response to this demand, De-sadel Nigeria Limited intend to build and construct a new Combined Cycle Gas Turbine (CCGT) plant with a capacity of 750MW and associated Infrastructure such as the Gas Transmission line and other supporting facilities. The inclusion of the NNP-MPNU/JV power plant and the 58Km 330Kva Transmission Line asset in the portfolio is a pivotal element within the broader vision for the power infrastructure, for which the EIA permit was secured.

Below is an overview of options currently under consideration by the project team. The preferred option has been indicated and reasons for selection are provided. The EIA (Environmental Impact Assessment) has assessed in detail the preferred option and indicates the impacts/benefits of this option as well as considering the other options where relevant.

2.1 Need for the Project

Access to public electric power in Nigeria is also reported to be only 144.53 kWh per capita as at 2019 which is very poor when compared to values for other African countries such as South Africa 3,739.6kWh per capita, Botswana 1,616.64kWh per capita, Namibia 1,535.99 kWh per capita and Ghana 333.17kWh per capita (Godfrey,L. et al, 2019). Energy crisis in Nigeria and indeed the states have reached an alarming rate owing to the fact that the country cannot meet the increasing demand for electricity by the ever-increasing population of over 200 million people.

The proposed project addresses a critical need stemming from Nigeria's

longstanding challenge of inadequate power supply, which has severely impacted various sectors of the economy and hindered industrial growth. Despite efforts such as the enactment of the Electric Power Sector Reform Act (EPSRA) in 2005 aimed at privatizing and enhancing the power sector, the electricity demand continues to outstrip supply

The Gas Infrastructure Project plays a pivotal role in supporting the broader vision of the integrated Gas, Power, and Rail Project. serving as the essential conduit for power generation, this infrastructure will contribute to the ambitious goal of generating an impressive 8,500MW. The utilization of gas as the primary fuel source aligns with global sustainability goals, promoting a cleaner and more environmentally friendly energy solution for Nigeria.

The Power Generation facet of De-Sadel Nigeria Limited's integrated Gas, Power, and Rail Project stands as a cornerstone in the pursuit of energy sustainability and economic empowerment. At its core is the establishment of a visionary 750MW Gas-Fired Combined Cycle Power Plant, strategically positioned to revolutionize the nation's power landscape. The proposed project shall enhance the state's power generation performance.

In this context and in accordance with the idea of sustainable development, the development of the proposed project has become necessary to improve power generation in the country and ensure the sustainability of the high speed railway project.

The project seeks to achieve the following objectives;

- Increase the overall power generation capacity in Nigeria,

thereby enhancing the reliability of grid electricity supply and meeting a larger portion of the country's electricity demand.

- Facilitate the utilization of indigenous natural gas reserves for domestic electricity consumption, thereby contributing to the development of national industrial and economic activities.
- Introduce modern and efficient generating units to the national power generation portfolio, improving the efficiency and sustainability of the energy sector.
- Generate employment opportunities for qualified individuals in the local community and across Nigeria, thereby contributing to socioeconomic development.
- Is an efficient use of fuel gas by implementing technology (Combined Cycle Gas Turbines, CCGT) for power generation with associated reduction in emissions of various pollutants?
- Increase in power demand has necessitated the building of a new power plant to guarantee the present epileptic power supply and distribution being experienced in the Country.
- Ensures the sustainability of the high-speed rail project by De-sadel.

2.2 Benefits of the Project

Building a new 750MW power plant at Qua Iboe would increase the operational capacity in Nigeria by more than 20%. As a consequence, the project would make a major contribution towards reducing the shortage of electricity in the country as well as assisting in the overall stability of the

electricity grid distribution system and the rail system.

Key benefits of the Project include:

The benefits of this project for the people and environs in particular, and the Nigerian economy at large are numerous. Following the conclusion and commissioning of the project, benefits that will be derived shall be.

- Improved and more reliable electric power supply.
- Enhances productivity and efficiency in both public and private organizations within the area.
- Support for Industrial and Economic Growth: With a steady and reliable power supply, local industries, businesses, and manufacturing sectors in Akwa Ibom will experience improved operational efficiency. This, in turn, will boost productivity, foster job creation, and promote the growth of small and medium-sized enterprises (SMEs). The availability of power is crucial for attracting new investments and supporting the state's industrialization goals.
- It will help 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 and noise reduction through the overall decrease of the use of personal power generating sets.
- General improvement of the standard of living for the populace.

2.3 Value of the Project

The project is estimated to cost (USD 700M) one trillion, seventy-five billion, six hundred and sixty-two million Naira only (N 1,075,662,000,000) from procurement and engineering to commissioning. The project shall be funded by De-sadel Limited in partnership with Asian Development and Investment Bank.

The project shall also be valuable to its proposed environment. Some of its value amongst others shall include a reliable supply of electric power to power the high speed rail system, enhancement of productivity, and promotions of SMEs thereby creating job opportunities and improved standard of living.

2.4 Envisaged Sustainability

Some important factors should however be considered towards attaining project sustainability. They are related to practical aspects as they relate to economic profitability, technical resources, are with and efficient management. With the growth in electricity demand, 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.

2.4.1 Technical Sustainability

The proposed project shall be technically viable because, it is professionally designed and the technology employed is readily available (Combined Cycle). Also, the availability of adequate and qualified

manpower for the project execution and operation shall form part of the technical sustainability of the proposed project. The installation of any of this equipment will be undertaken with a firm understanding of the implications of its impact on process mass balance, and electrical capacity from the use of solar power and other ancillary services.

Additionally, the proposed project is considered economically viable and sustainable given the following considerations:

(i) Stringent safety measures would be built into the design and fabrication of facilities. The design and safety considerations that would be employed in this project shall originate from tested specification packages in strict compliance with with local Nigerian standards, where applicable.

(ii) De-sadel Nigeria Limited's management is committed to continuous development and motivation of its human resource base through effective training or re-training, and an attractive remuneration and reward system. Furthermore, to ensure the transfer of relevant technologies, staff training on different aspects of the project would be an integral part of the key contractors' responsibilities.

2.4.2 Economic Sustainability

The fact that Nigeria's electricity generation is at deficit can never be over-emphasized. This hampered industrial and economic growth within the project location, its environs and the country in general. In addition, industrial energy demand from existing companies, factories and

industries and other production and manufacturing entities in Nigeria are rising by the day which further confirms that it is an economically viable venture for this country.

The proposed project will be economically sustainable as there is high demand for power and the Return on Investment (ROI) is surely high.

2.4.3 Environmental Sustainability

The site of the proposed has been carefully selected by considering sensitive ecosystems in the area as much as possible. In addition, practical mitigation measures have been proffered for the identified environmental impacts of the proposed project. ***De-sadel Nigeria Limited*** is fully committed to complying with the relevant applicable national environmental laws, applicable international conventions and World Bank environmental safeguard policies. Furthermore, ***De-sadel Nigeria Limited*** is also committed to implementing the EMP developed to further guarantee the environmental sustainability. Gas-fired combined cycle power plants benefit environmental sustainability through higher energy efficiency, which reduces fuel consumption and lowers greenhouse gas emissions per unit of electricity produced compared to conventional plants and coal-fired plants. They also offer flexibility to balance intermittent renewable energy sources and produce less waste and water consumption than older technologies.

2.4.4 Social Sustainability

The project has secured its first social license – the host community's

acceptance of the proposed project and the people have demonstrated their eagerness to see it succeed. The proposed project shall create job opportunities for unemployed indigenes and Nigerians.

In addition, ***De-sadel Nigeria Limited*** is committed to effective and continuous stakeholders' engagements and consultations. Grievance Redress Mechanism shall be developed and effectively implemented during the project life cycle to ensure social sustainability.

De-sadel Nigeria Limited is committed to complying with applicable national social laws, relevant international conventions and World Bank social safeguard policies.

2.5 Project Alternatives

Project alternatives have been evaluated and alternatives that provide cost effective, low environmental impact generation of electricity were preferred. The key consideration in evaluating the alternatives was the need for a reliable source of electricity with the required flexibility of operation for successful integration into the Nigerian electricity transmission system. Considerations for various aspects of the system included the choice of fuel used, power generation technology, waste disposal system, plant and sanitary wastes discharge, pollution control and management systems.

The project alternatives were considered after a thorough review of the following factors:

i) Proximity of the site to existing Qua Iboe Terminal with assured supply of Gas to the facility.
ii) Site accessibility

2.5.1 "Site Location Alternative"

An integrated site selection study was done in order to identify a more suitable site for the proposed project. According to the study carried out, the proposed site is considered the most suitable due to the following considerations:

ssssssssssssssThe Greenfield site currently comprises an area of 30 hectares of thick to scattered vegetation which will be removed to allow development of the site. The on-site vegetation is mixture of swamp forest and humid tropical rainforest vegetation ecological zone, consisting of light to medium density tree growth, bush and vegetation.

The proposed site is located in an area that will allow for easy delivery of natural gas to the site which will be achieved through the revitalization of a 56km pipeline from the Oso to Qua Iboe terminal.

DeSadel Nigeria Limited has identified Ibeno, an industrial settlement in Akwa Ibom State as an optimal location for the proposed CCGT Plant because of:

- Proximity to fuel supply channels – fuel supply pipelines belonging to the SEPLAT already supplying the location with natural gas in line with the proposed gas master plan that is envisaged to develop more

pipeline and gas delivery from Osso platforms to Qua Iboe Terminal (QIT) being operated by Seplat Nigeria Limited.

- Existing space for installation of the power plant; and
- Availability of skilled professional and support personnel already available within the Ibeno locality and the existing QIT project.

Other consideration includes;

- Proximity of the site to high sea, this will ensure easy of transportation of materials to site.
- Community support: The selection of site where the community is supportive of the development of energy is essential for ensuring the success of the project.
- Consideration of the above criteria resulted in the selection of the preferred site. No further site location alternatives are considered in the ESIA process.

2.5.2 Alternative Technology

Alternative 1: Construction of a Coal Fired Plant

This option was rejected due to the limited availability of raw materials (coal) needed for the operation of the system. A coal fired plant at the proposed site would require approximately 3300 tons of coal per day and would be significantly larger than the gas turbines being proposed.

Unlike a gas or oil fired plant, a coal fired station would require a large area for fuel storage and ash/solid wastes disposal. Around 600 tons/day of ash could reasonably be expected to be produced from such a plant which would necessitate an ash disposal area of the order of 1km^2 to allow for

sufficient disposal space during the course of a 25 year plant lifetime. Creation of such a disposal site could potentially represent significant loss of land to local agriculture and the communities intending to use the land available for other purposes.

Such a plant would also require greater quantities of water than gas or oil that would need to be transported from, approximately 5km away leading to additional costs to the project in terms of money and increased and increased auxiliary loads of the plant. The overall environmental impact of a coal fired power station will be significantly greater than that associated with gas or oil fired power stations. As a result of the above impacts on land use and water, such plant will generate significantly greater emissions to air than gas or oil fired plant

Alternative 2: Construction of a simple cycle gas turbine plant (SCGT)

This option was also rejected. A simple gas-fired simple cycle plant burns fuel in a gas turbine to generate electricity and releases hot exhaust into the atmosphere, resulting in lower efficiency (around 33-43%). SCGT plant will offer greater flexibility and response to fluctuations. It is cost effective. However, SCGT has several disadvantages, including lower efficiency and a significant drop in performance at partial loads, leading to higher fuel consumption and costs. They also produce significant emissions, such as NOx, contributing to air pollution.

Alternative 3: Construction of an Engineered Dam

Earth Dams are more environmentally friendly and presents less impacts

compared to either coal or gas fired power plants. The construction of dam was considered as one of the possible options to generate electricity, but several considerations were carefully looked into including the incessant flooding of the Niger Delta region, the possible intrusion of saline water into the dam which can affect the turbines and also there are no water-falls cascading naturally in the area. Coupled with the possibility of flooding and other reasons advanced above, this option was also rejected.

Alternative 4: Construction of a combined cycle gas turbine plant (CCGT)

This is the preferred option as a combined cycle plant captures the exhaust heat from the gas turbine to produce steam, which then drives a steam turbine to generate additional electricity, significantly increasing overall efficiency to 50-60% and power output from the same amount of fuel. Hence, the combined cycle technology is adopted. This gives much higher, with modern plants achieving 50-60% efficiency. Higher power output for the same amount of fuel, greater fuel economy, and reduced emissions per unit of energy produced. The construction of a CCGT plant represents the most efficient option for construction of a power generating plant at the proposed site as the process recovers waste heat that is lost to the atmosphere when an open cycle configuration is preferred. This technology supports and ensures environmental sustainability.

2.6 Project Options

2.6.1 No-Project Option

The first project option considered was the ‘No-project option. This would

mean the high speed rail system will rely on National grid or other alternatives such as coal power plants. It would also result 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.

2.6.2 Delayed Project Option

This would arise if a situation of issues relating to regulatory requirement, land ownership, 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 prolong the continuous pollution of the environment due continuous release of gases increasing climate change, contamination of soil and groundwater, noise, and further alteration of fauna. It would also delay access to more reliable electricity and slow down investments in the rail system since power supply will delayed. The use of industrial generators to power homes, offices and industries will also be prolonged. This will result in increased gaseous emissions with its associated health effects, as well as increased greenhouse gas effects. Therefore, this option was rejected.

2.6.3 Project Implementation Option

The third option considered was the execution of the proposed project as planned. This option was accepted because it will result in construction of the project which will provide relatively clean-burning fossil fuel, fewer emissions of nearly all types of air pollutants and carbon dioxide (CO_2) emissions, improve electricity, making power supply efficient, adequate, and reliable for residents and businesses in area. It will further discourage the use of domestic and industrial generators to power homes, offices and industries thereby reducing gaseous emissions with its associated health effects, as well as increased greenhouse gas effects.

CHAPTER THREE

PROJECT PROCESS DESCRIPTION

3.1 Project Overview

DeSadel Nigeria Limited proposes to construct and operate a new Combined Cycle Gas Turbine (CCGT) power station on land close to the existing Qua Iboe Terminal (QIT) Facility and immediately to the Northeast of Ibeno Town along the Qua Ibo Road, in Ibeno Local Government of Akwa Ibom State. The proposed power plant will require approximately thirty (30) hectares of land within proximity to the existing QIT Facility.

The Power Station will provide up to 750MW, at site ambient conditions, primarily for the DeSadel High Speed Rail System (HSRS) Phase One (1) Project with a total distance of 2100km and subsequently to the Nigerian Electricity transmission system. The plant will be designed to be constructed in phases and operate as a Combined Cycle using Natural Gas and Heat Recovery Steam Generator (HRSG) as fuel, and is intended to form part of phase 1 program for the development of a total of 8500MW for the integrated HSRS generating capacity. The project is initiated by DeSadel and the Federal Government of Nigeria to meet the dedicated supply requirement of the HSRS.

3.1.1 DeSadel High Speed Rail System (HSRS) Background

The Nigerian government has identified the need for a 4000+ km HSR network that runs at 350km/h and a fully integrated electric-powered highway network to connect various states in Nigeria across multiple lines. The proposed interstate HSR network will deliver several social,

economic, and environmental benefits, including the facilitation of interstate trade and economic development, increased GDP contribution from transportation, job creation, carbon footprint reduction, foreign direct investment, and others. This project is being commissioned by De-Sadel Consortium, a multi-national company with facilities around the world and a team of highly experienced personnel with a proven record of excellence in their respective fields.

3.1.2 Objective of the High Speed Rail System

Nigeria's current transportation infrastructure is inadequate to meet the growing demand for efficient and affordable mobility. Road travel is slow and often hazardous due to poor road conditions, congestion, and accidents. Air travel, on the other hand, is expensive and limited to only a few major cities and high-net-worth individuals. A high-speed railway system can overcome these challenges and provide a reliable, economic and sustainable transportation alternative.

3.1.3 The key objectives of the Highspeed Rail project are:

a. To develop an interstate high-speed railway network that connects major cities
in Nigeria.

b. To reduce travel time and enhance the accessibility of transportation.

c. To provide a safe, affordable, and reliable mode of transportation for passengers.

d. To promote economic growth by facilitating the movement of people across

the country.

3.1.4 Project Phases

The railway project will be developed in two phases. Refer to the route map below.

Phase 1: This will involve the development of the Red and Yellow lines with a total distance of 2,100 KM. (Lagos-Abuja-Kano; Abuja – Enugu-Harcourt-Uyo).

Phase 2: This will involve the development of the Yellow and Blue lines, both having a distance of 1,900 KM (Sokoto-Kano-Maiduguri; Kaduna-Jos-Yola).

Figure 3.1: Map of Nigeria Showing Proposed DeSadel High Speed Rail Network

3.2 Project Location

The 750MW Combined Cycle Gas Thermal Plant and 300m Gas Pipeline Project is designed to be installed with 4 units of Alstom GT13 E2 Series Turbines with a combined capacity of 750MW. The power plant will be utilised for base load operations, mainly dedicated to the HSRS.

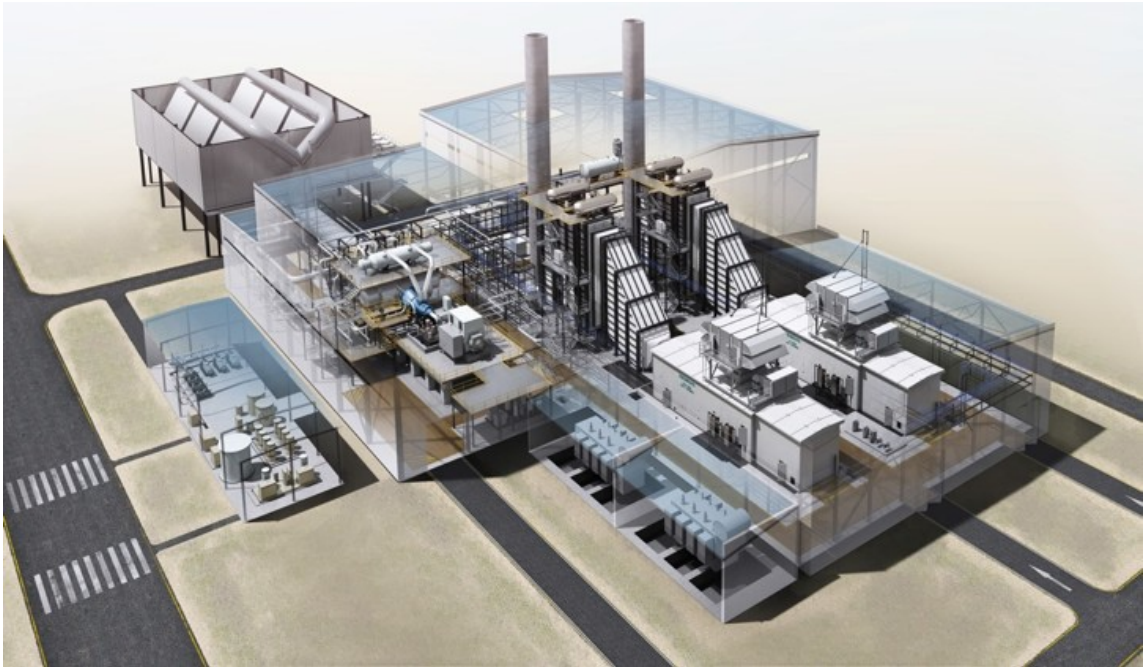

Figure 3.2: Model CCGT Power Plant (Courtesy Siemens Energy)
Source: Siemens Energy

DeSadel Nigeria Limited has identified Ibeno, an industrial settlement in Akwa Ibom State, as an optimal location for the proposed CCGT Plant because of:

- Proximity to fuel supply channels – fuel supply pipelines belonging to the SEPLAT already supplying the location with natural gas in line with the proposed gas master plan that is envisaged to develop more pipelines and gas delivery from Osso platforms to Qua Iboe Terminal (QIT) being operated by Seplat Nigeria Limited.
- Existing space for installation of the power plant; and

- Availability of skilled professionals and support personnel already available within the Ibeno locality and the existing QIT project.

The project is located about 300m from the existing QIT gas plant. Its micro location is equally within proximity of the existing Qua Ibo Road towards Eket in Akwa Ibom State. The power plant is to be established for a base load supply regime. DeSadel is engaged in the processes of acquiring the land and water component from the State, the communities and Local Government Authorities. Specifically, the project site falls on latitude 4.558452°N and longitude 8.019125°E at an elevation of 7m above sea level. Figures 3.3 show the administrative map of Nigeria and Akwa Ibom State, showing Ibeno and the project, while Figure 3.4 presents a satellite aerial view of the project area.

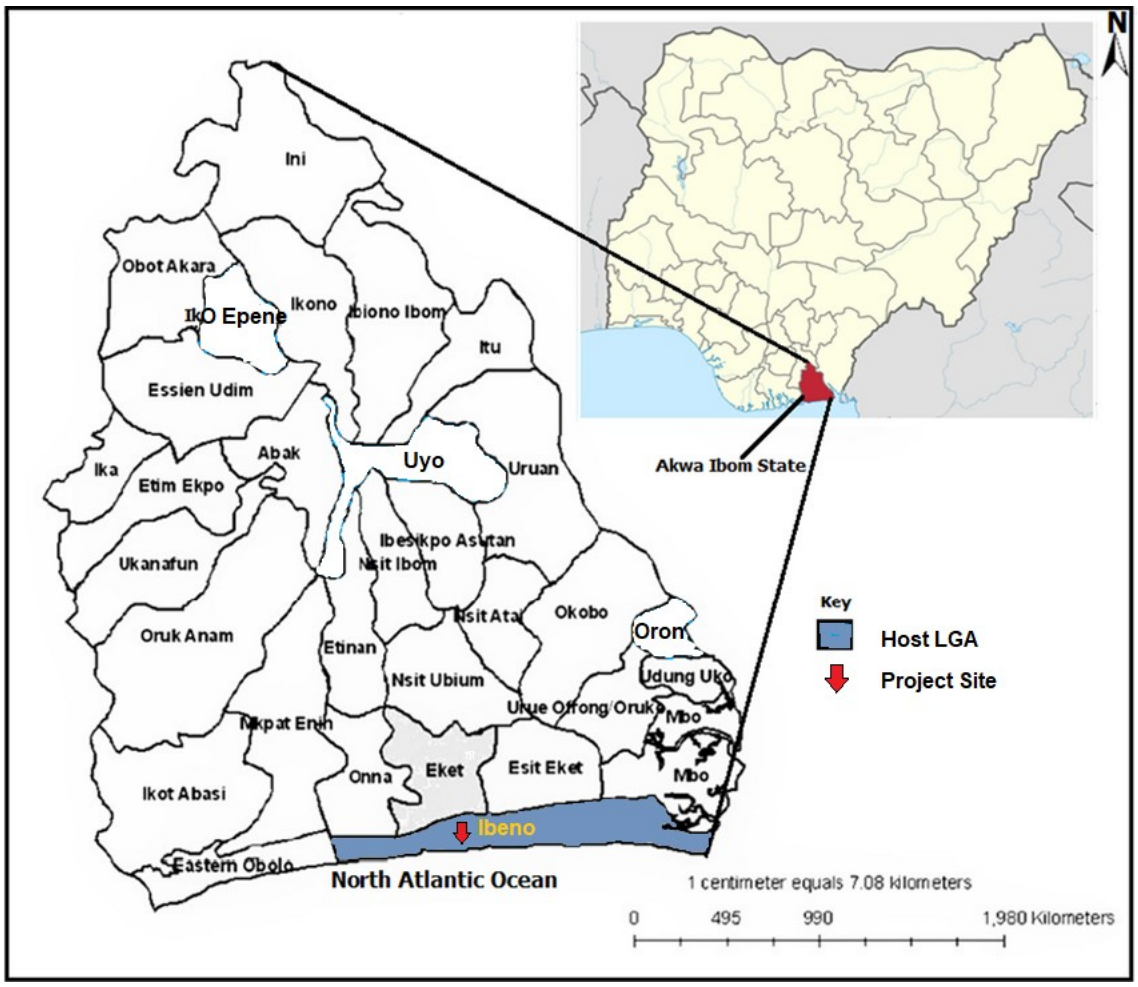

Figure 3.3: Administrative Map of Nigeria, indicating Akwa Ibom State hosting the Proposed Project, indicating Ibeno LGA, the Area hosting the Project.

Figure 3.4: Aerial View of the Project Location

3.3 The Proposed Plant and Process Description

This section briefly describes the proposed 750MW CCGT plant, the final design of which will only be known once the tendering process is complete. The proposed plant shall operate on natural gas and utilise an HRSG, and shall initially comprise 4 generating units of 180MW each, using Alstom GT13 E2 Series or any equivalent. The first 3 units will comprise each of a gas turbine and ancillary equipment, an air-cooled generator, air intake, instrumentation and a dedicated heat recovery steam Generator (HRSG) and exhaust stack. The heat recovered shall be channelled to the Boilers to generate the steam required for the steam turbine. State-of-the-art firing controls will also be used to enable the combustion to be optimised for all operating conditions.

The plant will be designed for a minimum net operational life of about

25 years. Under normal operating conditions, power for the starter motor of the gas turbine units is provided by the DeSadel Black Start Generator through step-up transformers and the unit auxiliary transformers. It is anticipated that the provision for black start capacity of the power station will be an additional value for the grid emergency and ancillary operations. In the event that power supply from the power system fails through a general power outage, the emergency diesel generator shall operate to maintain power supply to all plant auxiliaries and station lighting, thereby allowing prompt start of the generating units upon re-establishment of the main power supply.

Due to the ambient conditions in Nigeria (heavy rainfall during the rainy season and dust-laden during the harmattan), the gas turbines are expected to be housed in buildings. This provides the benefit that maintenance can be carried out without being constrained by the weather. Natural gas will be burned in each of the three (3) gas turbines in a combustion chamber. The air required for the combustion will be filtered at the air intake and compressed prior to mixing with the fuel in the combustion chamber. The combustion of natural gas will produce hot gases that will expand through the gas turbines, travelling across the turbine blades and driving an electrical generator. Waste heat and gases will be recovered from each unit and used for the steam boilers to generate steam. The afterburner gases will then be emitted to the atmosphere via a dedicated single flue stack. A schematic diagram of the DeSadel Combined Cycle Gas Turbine combustion process is presented in Figure 3.3.

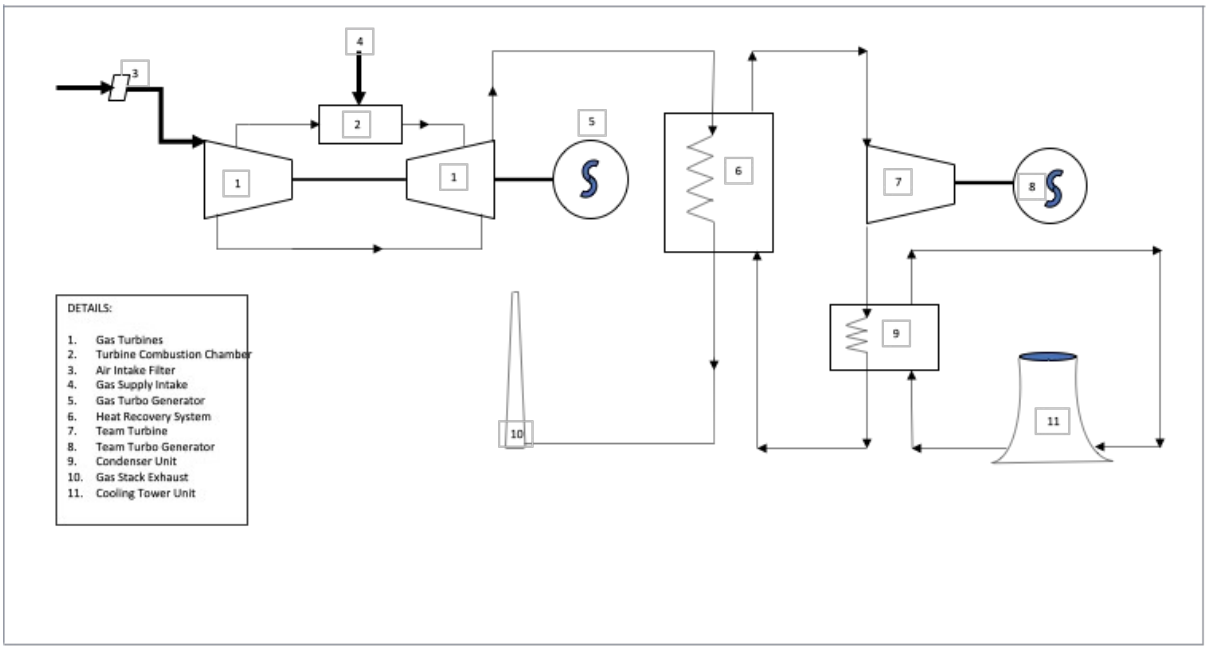

Figure 3.5: Schematic Diagram of DeSadel Combined Cycle Gas Turbine System with Key Components

Combustion in gas turbines is conducted at high air rates, typically 200-300% excess air. There are, therefore, very low levels of Carbon monoxide, unburnt carbon (i.e. particulate matter) or unburnt hydrocarbons present in the products of the combustion of natural gas.

The combustion of natural gas, therefore, results in the emission of flue gases, carbon dioxide, water vapour, oxygen, nitrogen, carbon monoxide (CO), oxides of nitrogen (NOx) and negligible traces of SO2. The gas turbines will be fitted with proven pollution prevention control technology, dry-low NOx burners that represent the best available technique (BAT) for the combustion of natural gas, limiting the emissions of NOx to less than 50mg/Nm3. The plant is not planned to include the capability for the use of distillate fuel oil as a secondary fuel. During normal operation and under meteorological conditions, all gaseous discharges from the stack will be colourless and odourless. At start-up,

under certain weather conditions, it may be possible for a faint brown haze to be seen for a few minutes only.

Each gas turbine unit will discharge through an HRSG platform where the heat is recovered and dedicated to the boiler and the stack. The height of the stacks will be determined following a comprehensive atmospheric dispersion modelling study to be conducted in the future. It is currently anticipated that the stack height will be of the order of 30-40m, which is typical for open and combined cycle operation. CCGT generation technology does not have the water/steam requirements associated with other forms of thermal power generation. Therefore, water use at the proposed site will be minimal.

Cooling will be required for the plant auxiliaries such as the lubricating oil systems, generators and air compressors. This will be by a closed loop system, with the heat gained in the closed loop being evacuated to the air via a fin fan cooler, i.e. a fan-assisted air-cooled radiator. The IPP will include a small water treatment plant that will be used to treat any effluent or demineralised water. Subject to obtaining a discharge consent, the treated wastewater and runoff waters from the site will be discharged into a pond very close to the project site.

The plant will also include a small sewage treatment plant that will be of sufficient size to accommodate all on-site staff and maintenance contractors. Water will be required for domestic/sanitary purposes at an approximate rate of 0.2m^3 per person per day. All aqueous effluents will be suitably treated, such as passing through oil interceptors as appropriate, before release beyond the site boundary. It is anticipated that all effluents from the IPP will ultimately be discharged into the

nearby pond, with the exception of the GT compressor wash water, which will need to be transported off-site for specialist treatment and disposal by a suitably licensed contractor. A withholding tank for this wash water will be provided for a minimum of two washes with storage in a suitably bunded area to contain any spillages.

The plant will be designed with a view to auto/remote control operation, with a minimum of operator intervention being necessary. All facilities for interfacing alarms, information and control systems will be installed so that the plant can be operated from the central control room via the Distributed Control Systems (DCS). The pollutant characteristics of the flue gases will be continuously monitored to ensure correct and efficient operation of the IPP. Any major deviations will be alerted and corrections carried out on occurrence. Records of plant performance will be maintained together with reasons and corrective measures for any deviations from normal operation. The plant will employ conventional protective features, including emergency relief valves, shut-down sequences, interlocks, safety interlocks, fail-safes, detection and alarm systems, and mechanical and electrical protective devices. There will be back-up systems and protective measures to deal with emergency situations such as electrical power failures, water supply failures, compressed air failure, major equipment failure and lightning strikes.

Major plant maintenance shut-downs will be planned and on a long-term basis, with intermediate stoppages being infrequent and of short duration only. Planned maintenance will be scheduled to minimise any disruption in power supply from the plant through the programming of such works during times of the year where electricity demand is lowest.

The design of buildings, enclosures and plant will also help towards minimising outage times. Materials and finishes will be selected to meet this objective and to ensure that the appearance of the plant does not deteriorate with time. Sufficient spare parts will be held on site to ensure that plant availability remains high. These will be housed in a store fully equipped to facilitate in-house repairs, fabrications and welding of components. During maintenance activities, oily wastes, metallic junks, etc, shall be generated. Measures shall be adopted to dispose of these wastes without causing environmental hazards.

3.3.1 Project Phases and Configuration

- **Phase 1 ("3 x 180MW"):**
  - DeSadel Power Requirement: 540M
  - Configuration: 2 x Running GT13-E2 Series Simple Cycle & 1x Simple Cycle on standby (3x GT13-E2 Series in total)
  - Configuration Total Power Output: 540MW
  - Efficiency: 38.70%
- **Phase 2 ("4x 180MW"):**
  - DeSadel Power Requirement: 750MW
  - Configuration: 3 x running GT13-E2 Series Simple Cycle & 1 x Steam GT13- E2 Series (4 x GT13-E2 Series in total)
  - Configuration Total Power Output: 750MW
  - Efficiency: 38.70%

  Comment: The configuration total power output is less than the Riverside power requirement. However, we believe that we will be able to achieve the 750MW by adding gas turbine intake cooling to all turbines.
- **Overall Configuration:**
  - DeSadel Power Requirement: 750 MW
  - Configuration: 4 x running GT13-E2 Series Combined Cycle
  - Configuration Total Power Output: 750MW
  - Efficiency: 38.70%

  Comment: With intake cooling, we should be able to achieve the

750MW requirement. See Table 3.1 for the Alstom GT13-E2 Series Energy's proposed solution for Phase 1 and Phase 2:

Table 3.1: DeSadel CCGT Project Phases and Configuration

Description	DeSadel Power Requirement	Configuration	Configuration Total Power Output	Efficiency
Phase 1 ("3 x 180MW")	750MW	2 x Running GT13-E2 Series Simple Cycle & 1 x standby GT13-E2 (3 x GT13-E2 in total)	540MW	38.70%
Phase 2 ("4 x 180MW")		3 x running 13GT-E2 Series Simple Cycle & 1 x Steam GT13-E2 Series (4 x GT13-E2 Series in total)	750MW	38.70%

- Phase one (1) of project 2 x GT13-E2 Series Simple Cycle and 1x GT13-E2

  The series Simple Cycle on standby will be running in normal operation.

- Phase two (2) of project 3 x GT13-E2 Series Simple Cycle and 1x GT13-E2

  The series will be running in normal operation (a 4^{th} unit is a steam unit).

- Gas fuel is natural gas.

3.4 Operating Regime

The plant will be connected to the DeSadel electricity transmission system, providing power to trains, stations and ancillary utilities with DeSadel substation connections throughout the location across phase 1

of the project. The plant shall be designed for base load with two shifting operations; however, the intended operating regime for the immediate future will be predominantly base load with maximum availability. The annual capacity factor is expected to be in the region of 95%.

3.4.1 Grid Connection and Transmission Facility

The DeSadel CCGT power plant is designed to connect to the HSRS dedicated transmission system via the 11/330kV Step-Up transformers. The power evacuation will be achieved through the 330/132kV Substation, which is interconnected with the HSRS by means of the High Voltage Direct Current (HVDC) converter. This system is designed to convert Alternating Current (AC) to Direct Current (DC) at the sending end and convert it back to AC at the receiving end of the 330kV and 132kV, respectively, enabling efficient, long-distance power transport. The system offers multiple advantages and is highly reliable for the operations of the HSRS with minimal power losses along the transmission lines.

Power transmission will be connected using the designed corridors of the overhead concrete towers erected along the rail system and interconnecting with the stations across segments of the routes on phase 1 of the project. Phase one (1) of the project includes seven cities aligned on 3 routes, consisting of Lagos-Abuja-Kano on the first leg, Lagos-Port Harcourt-Calabar and Abuja-Enugu-Port Harcourt on the second and third legs of the routes, respectively. The entire HVDC transmission covers a total distance of 2000km, and the system is designed with redundancy to guarantee optimal performance with high efficiency. The

type and sizes of conductors are carefully selected in adherence to the Grid Code and in compliance with the general guidelines regarding HVDC transmission wiring requirements using concrete towers. See Figure 3.4 showing the DeSadel HVDC transmission system network.

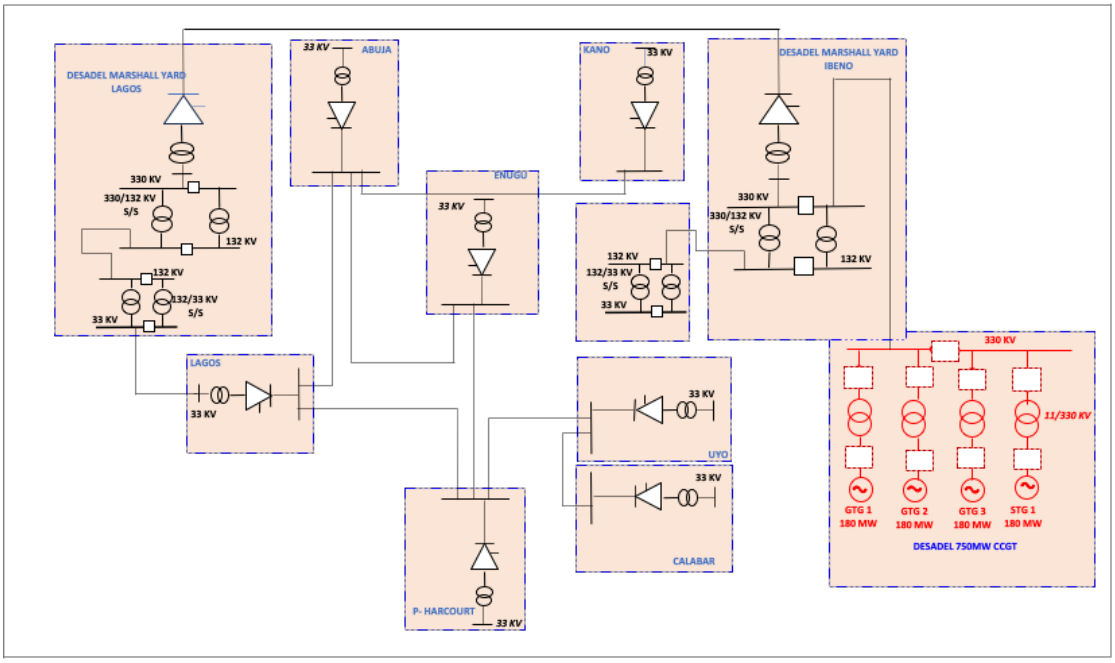

Figure 3.6: Proposed DeSadel 750MW CCGT Plant Single Line Diagram Interconnection with HSRS Phase One (1).

The alternative grid supply interconnection with the DeSadel 330kV Switch Yard is designed to meet the requirements of the generation and grid codes for interconnection with the Transmission Company of Nigeria (TCN) Grid. The interconnection will accommodate some 58km of DC 330kV transmission line from Ikot Abasi substation and relay to the 330kV transmission line at Ikot Ekpene Substation. The provision of the DeSadel Plant provides additional advantage to the national grid as required by the Generation and Grid Codes guiding the Nigerian Electricity Supply Industry. See Figure 3.8 showing Transmission

Company of Nigeria interconnection as a requirement of the Generation and Grid codes.

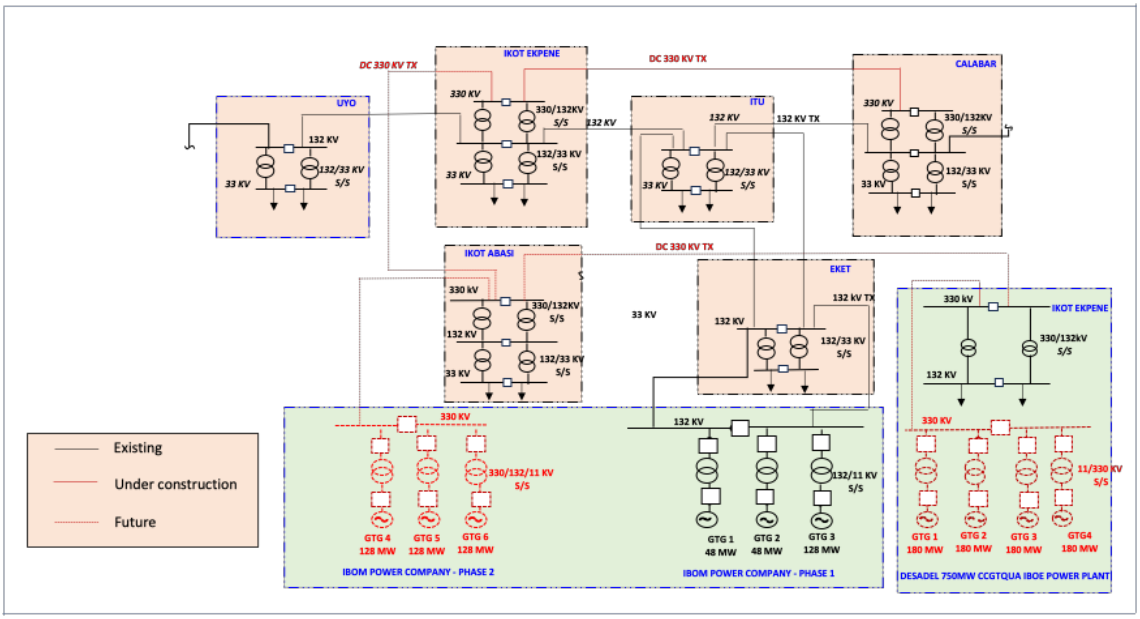

Figure 3.7: DeSadel 750MW CCGT Single Line Diagram Option with Transmission Company Nigeria (TCN) Grid Connection.

3.4.2 Fuel

The primary fuel will be natural gas. Gas shall be supplied to the plant from nearby QIT through a gas transmission pipeline of 20” that will be buried underground, at a minimum gas pressure of 30 bars via a 300m pipeline to be constructed across the Douglas Creek from the QIT Metering Station to the IPP. The gas supply shall be gas gathered from several wells across the Osso gas pipeline system, with future gas supplies from other gas transmission network following the completion of the pipeline programme under the QIT Gas Project.

About 106MSCF of gas per day for the 3units of the Alstom GT13 E2 Series turbines will be required for power generation and heat recovery

at full capacity. The Gas-Supply Component and Arrangement is through Pressure Reducing and Metering Station (PRMS) and pipe network.

An indicative Calorific Value of the natural gas is 47000kJ/kg (LHV), the maximum required gas consumption is anticipated to be 106 mmscf/day. There will be a small gas treatment station on-site to adjust the conditions (i.e. temperature and pressure) to the required inlet gas specifications of the turbines. No natural gas will be stored on-site.

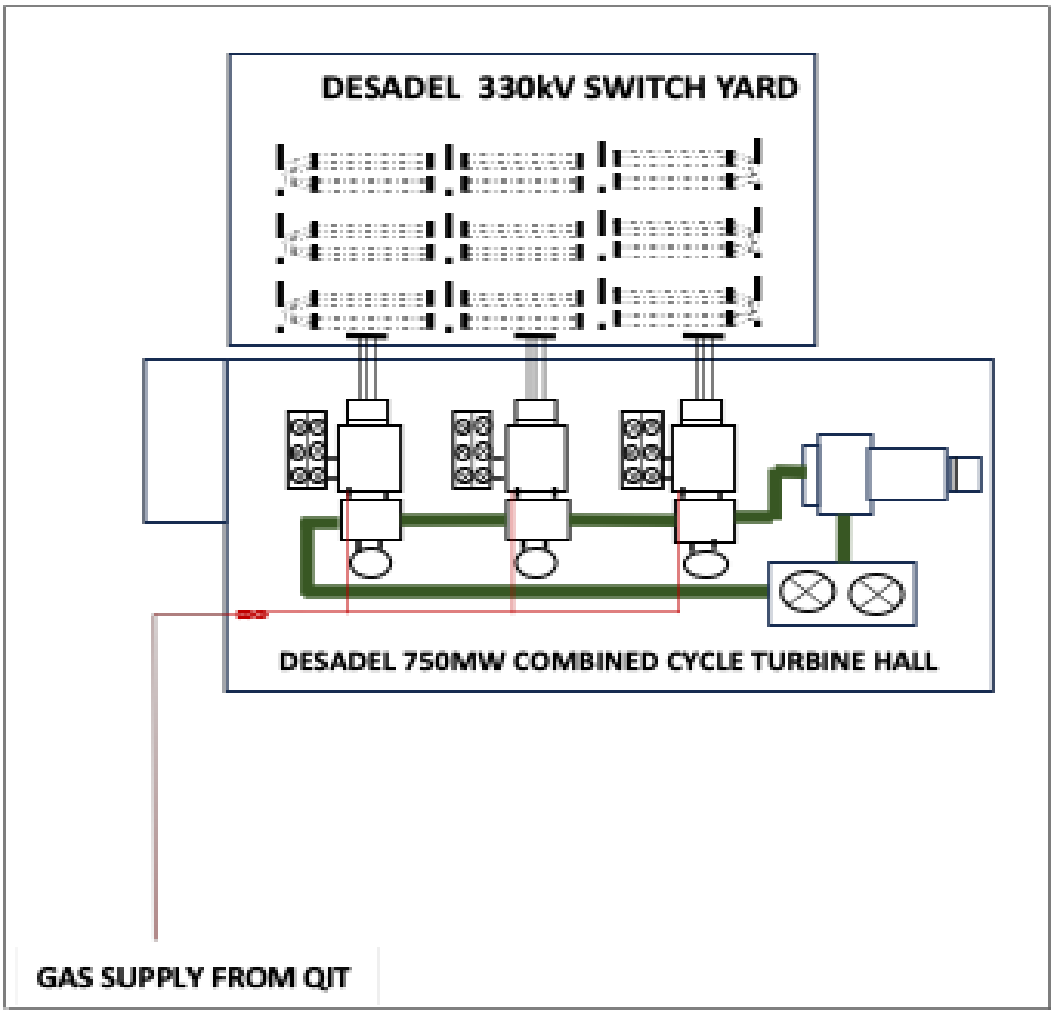

Figure 3.8: Proposed Desadel 750MW CCGT showing Gas Supply Connection

3.5 Project Component and Site Layout

The power plant components are as follows:

- Gas reducing station;
- Gas turbine;
- Heat Recovery Steam Generator;
- Steam Turbine;
- Fire water tanks;
- Fire pump skid;
- Fire mains;
- Fire hydrants;
- Lube oil cooler;
- Pipe-rack system;
- Air compressors;
- Electrical and administration buildings;
- step up transformers

The project layout showing the locations of plant components is presented in Figure 3.9 (attached).

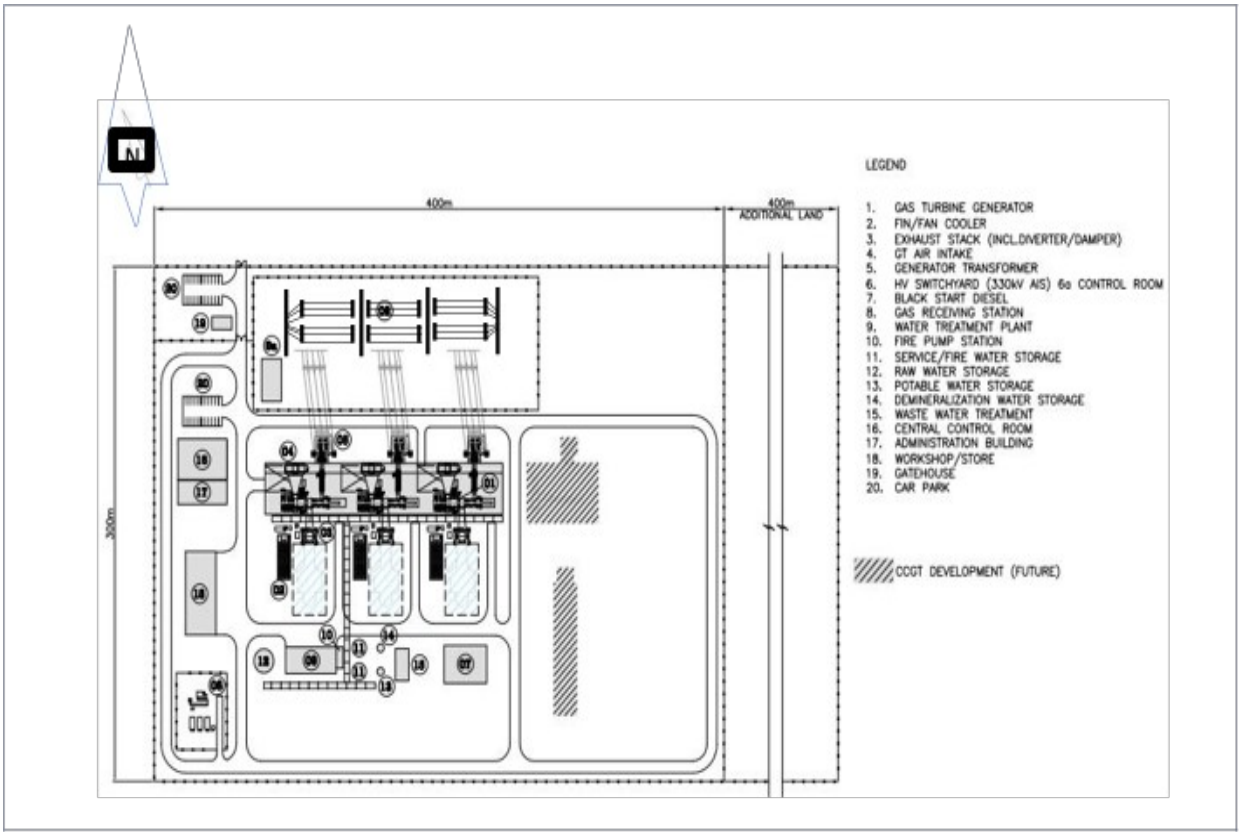

Figure 3.9: DeSadel CCGT Plant Layout Showing Locations of Plant Components

3.5.1 Site Layout

The site of the CCGT plant is influenced by the size, shape and location of the site area, the interfaces with main services external to the site, the access and lay down requirements for construction of the plant, and the potential for future development. A preliminary site layout based on 4 units of turbines is shown below in Figure 3.10.

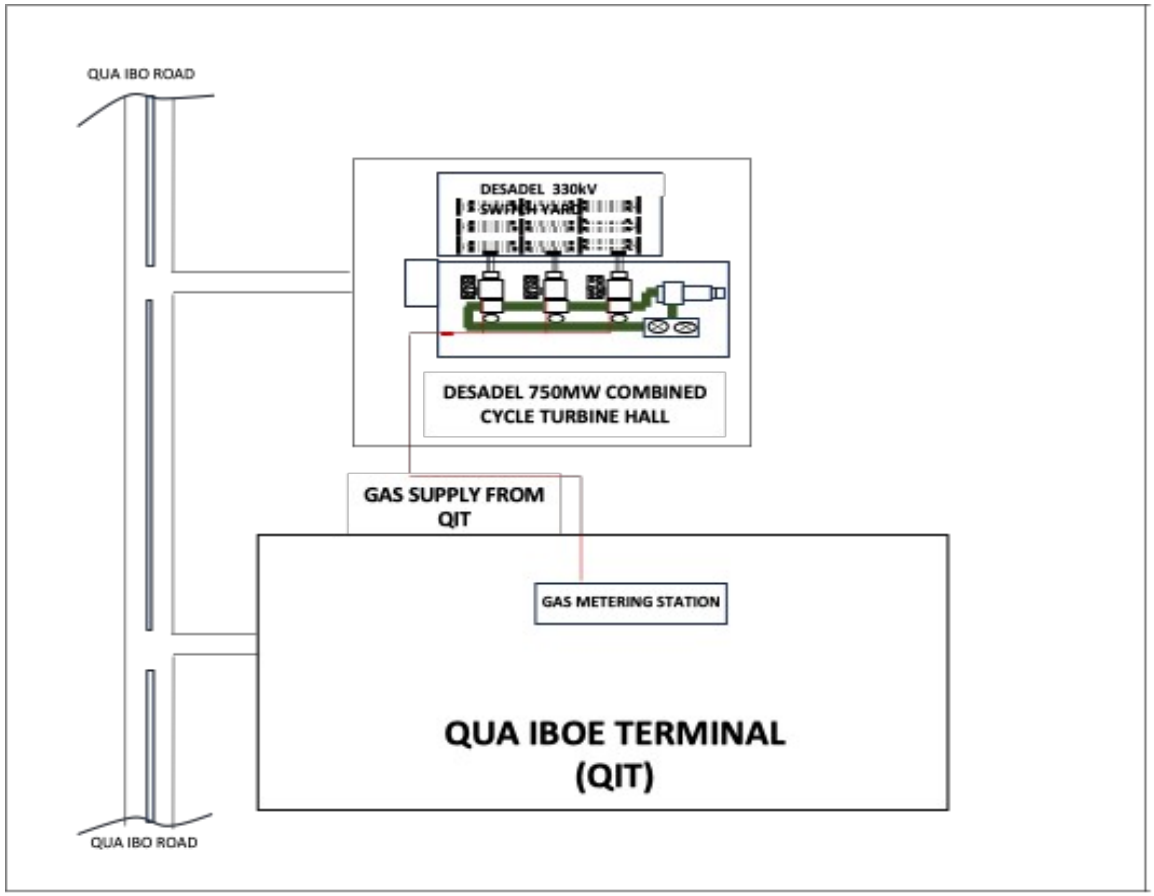

Figure 3.10: Desadel Proposed CCGT Lay Out with QIT Gas Supply

The proposed plant layout has been designed considering the following factors:

- Road access

-Connection to the electrical network

-Provision to minimise noise and visual impact

- Compliance with regulatory requirements- plant and personnel safety; and

- Technical requirements

At this stage, the plant has not yet been subject to a detailed engineering and design phase; the final layout will only be confirmed once a contract has been awarded for the design and construction of the plant. However,

the main consideration in the project layout is the shape and orientation relative to the external interconnecting points, especially for the power export. There is a gradual downward gradient from the north to the south across the site, with the gradient increasing closer to the southern side. Taking this into consideration, together with the direction of power export and the requirements for future expansion, the layout has been developed with the switchyard located on the northern site boundary.

The 330kV switchgear for the on-site substation shall be located outdoors in a secured fence area and air insulated (AIS) with sufficient equipment to facilitate monitoring, metering and control of power flow. The 330kV switch yard shall be designed for a Turn-In-Turn-Out configuration with either two or three incoming 330kV feeders from the step-up generator transformers (depending upon plant configuration), and one outgoing double circuit overhead line providing a connection with the High Voltage Direct Current 330kV substation and the wider DeSadel electricity transmission system. The gas turbines will be located towards the western part of the site, with an east-west orientation. The plant layout has been designed to allow for accommodation not only of the 4 initially proposed CCGT units (of 180MW each) but also the potential installation of additional units to the east in the future.

Provision shall be made for a storage building, an office building for administrative, operation and maintenance personnel, as well as a canteen and a small first aid clinic for emergency cases. There shall also be a vehicle parking area and a security post. The plant will gain access to the existing road infrastructure via a new access road in the north-western corner of the proposed site. A solid wall will be constructed

around the site for security reasons, and the site will be fitted with closed-circuit television. The layout of the plant, fire-fighting and detection facilities will be arranged to minimise the risk of resultant damage and loss of generation capability. Pipe work and cabling are to be segregated and protected from physical damage, including the use of fire barriers to prevent the spread of flame.

The plant will be arranged to give ease of access to all areas for fire-fighting and for access to the site by the emergency services if they occur at any given time.

3.5.2 Storage

Stores fully equipped with racks and an inventory system for spare parts shall be provided. Air conditioning shall be provided for the safe storage of special spare parts. Wastes generated from unpacking of delivered materials shall be carefully disposed of in an approved waste dump site with the supervision of the State Ministry of Environment and the Ibeno Local Government Council. Lubricating oils will be stored on the site in steel tanks in an impermeable bund sized to contain 100% of the contents of each tank. The oils are used to lubricate the gas turbines. Used lubricating oils will also be stored on the site for re-use or will be disposed of off-site. Storage of chemicals will be provided in appropriately bunded and secured areas. Any unloading areas will be designed for spill containment. Miscellaneous materials such as oils, greases, cleaning substances and materials, laboratory chemicals, etc, will be stored in suitable storage conditions or in containers on-site before disposing of them in an environmentally designated waste dump facility being operated by the government or any identified vendor.

3.5.3 Plant Dimensions

The indicative dimensions of the main items of the plant will be in the order of the following:

Table 3.2: The Dimensions of the proposed IPP

	Height	**Length**	**Breadth**
Gas turbine building (4-unit option) Gas turbine Building (6-unit	27 m 27 m	168 m 50 m	30 m 20 m
		Height	**Diameter**
Stacks		30m	7.5 m

Note: The stack height will be determined via a full air dispersion modelling study to meet necessary air quality standards or limits for ground-level concentrations of NOx and CO.

3.5.4 Safety

The design of the plant will incorporate all necessary features to ensure that it complies with all relevant safety regulations and requirements. A comprehensive fire protection system will be installed to cover equipment on-site, which could constitute a significant fire risk. For the protection of equipment within the gas turbine package, where water spray would cause damage, a total flood carbon dioxide system will be used.

An automatic high velocity water spray system for the protection of the turbine lubricating oil tank, coolers and associated pipe work will also be provided. Heat sensors or smoke detectors will be used in conjunction with automatic spray nozzles. Periodic testing of the detectors and the CO_2 bottles will be undertaken to ensure effectiveness. Venting and emergency relief valves will be provided on the natural gas system to enable safe start-up, shut-down down and operation of the natural gas supply system. In the event of a gas turbine trip, the plant will shut down

automatically. All tests of electrical equipment shall be carried out according to relevant IEC Standards or other internationally recognised standards.

3.5.5 Emergency Plans

The hazards and risks associated with CCGT power stations have been studied over many years, and a considerable volume of design and procedural experience has been established in this area. A pre-Health and Safety Plan will be prepared in order to identify and address all potential health and safety hazards associated with the installation of the proposed plant, in order to allow tenderers to prepare for the construction stage Health and Safety Plan. The design of all plants will be required to demonstrate compliance with all applicable national and international safety regulations. A comprehensive fire protection system will be installed to cover all equipment on site that could constitute a fire risk. For the protection of equipment within each gas turbine package, where water spray will cause damage, a total flood Carbon dioxide system will be used. An automatic high velocity water spray system for the protection of the turbines' lubricating oil tank, coolers and associated pipe work will also be provided. Heat sensors will also be used in conjunction with automatic spray nozzles and smoke detectors.

The design of these systems will comply with the requirements of the internationally recognised NFPA Standards and will be fully considered during site safety studies. Continuous natural gas monitoring systems will be provided, and venting systems will be designed to prevent the explosion of air/gas accumulations. Ignition sources will be protected

from damage, and testing of fire protection systems will be carried out as appropriate. The fire-fighting system will use treated service water as the primary source, with the possibility of a combined fire/service water storage tank retaining a dedicated capacity of fire water in accordance with NFPA requirements. Generally, in the design of the plant buildings, the construction materials will be fire-resistant and structures will be protected against fire in accordance with the appropriate regulations, codes and standards. The fire water supply system will include storage, pumping and a pressurised ring main system from which all fire-fighting water supplies are derived.

The environmental risks, hazards and consequences presented by potential accidents on the facility will be identified, assessed, minimised and managed by the Environmental Unit of the Company in close liaison with the apex regulatory body on environment. The plant will employ conventional protective features, including emergency relief valves, shut-down sequence interlocks, safety interlocks, fail-safe systems, detection and alarm systems, mechanical and electrical protective devices, etc. There will be backup systems and protective measures to deal with emergency situations such as electrical power failure, compressed air failure, major equipment failure and lightning strikes.

There will be no drains within the bunds, and all valves and couplings will be within the bunded area. In the event of leakage or spillage from any lube oil storage tank, any oil will be contained within the bund surrounding the tank. Any oil found in the bund will be removed for disposal at an appropriate disposal site. Access to the site will be strictly

controlled. Site security will be achieved by providing suitable fencing to the site perimeter and cameras. An oil spill or chemical spill is recognised as being the principal environmental emergency that could arise at the station. Emergency response plans will be developed as follows:

- Emergency procedures for chemical container failure
- Emergency procedures in the event of a spill of lubricating oil.

There will be no emergencies at the proposed plant that could compromise the safety of the public in the vicinity of the site.

3.6 Project Activities

The proposed power plant development would be achieved via the following sequence:

- Pre-construction (engineering design and site preparation);
- Construction and installation;
- Operation; and
- Decommissioning.

3.6.1 Pre-construction Phase (Site planning and preparation)

It all starts with project planning and preparation. Much of the planning and preparation in the proposed project area is to be done by land survey teams and engineers. These professionals will ascertain the bearing capacity of the soil. They will create reference points along the shoulders and plant markers to guide the construction crew.

3.6.2 Soil Excavation

The proposed site is currently bare. During the ground groundbreaking, excavation of the top soil shall be done to pave the way for the construction. The soil excavation process shall be done with utmost care to ensure that the excavated soil is not improperly heaped or carried away by any surface flows to Douglass Creeks, causing siltation. The excavated soil will be used to backfill, and any remainder shall be disposed of appropriately in accordance with the environmental management plan. Company safety and environmental policy and other established local environmental protection regulations/standards shall guide the contractor. This will include safety wear at all times, and the contractor will appoint a safety officer on-site during all construction activities.

3.6.3 Construction Overview

The Turnkey contractor will undertake the construction of the proposed plant. The major activities during the construction phase of the project include, for civil works:

- Preparation of site works
- Construction of foundations
- Construction of buildings.

Site preparation works will comprise the levelling of the site, earthworks and the excavations for foundations, trenching, installation of underground services, and provision of temporary construction facilities and services will then take place. Subject to the results of the geotechnical studies, piling is likely to be required for the gas turbines and electrical generator foundations due to the heavy loading and the tight tolerance on settlement. The remaining foundations, for the turbine

building, skids, pumps and the like, will be spread footings and slabs of various thicknesses to suit the structural needs. An area for the lay down and storage of plant and equipment will be located on the site for the duration of the construction period. An area will also be set aside for vehicle parking. All necessary measures shall be taken to return the lay-down and parking areas to their previous state on completion of the construction phase.

The programme for the mechanical and electrical plant can be considered in terms of the following activities:

- Gas turbine manufacture
- Power plant erection;
- Power plant commissioning;
- Power plant commercial operation;
- Plant take-over; and
- Guarantee period

The contract for the construction of the works will be on a turnkey basis. The turnkey contract will include all major and auxiliary plant items. Commissioning of each unit will take of the order of 8 weeks and will be progressive from final erection checks. Pre-commissioning and setting to work on individual parts through to the overall testing to prove acceptance of the plant. Tests on completion will demonstrate the fitness for purpose of each CCGT unit before commercial operation. Performance tests will demonstrate that the plant complies with the performance guarantees. Reliability will be demonstrated by operating each unit under commercial conditions for a period of 14 days.

Installation of Utilities

The next step is the installation of underground utilities like water mains, storm drains, cable duct and sewer plants. This is a very intensive phase in the project because it involves the installation of new water and sewer pipes, the fitting of valves, and the construction of new sewer holes. The new piping systems are then connected to the existing drainage, water and sewer network and then redirected to the affected homes.

Post Construction Activities

The proposed project shall be commissioned if and when its functionality can be substantially achieved. As part of the commissioning activities, the project contractor shall prepare and finalise as-built drawings for the entire civil engineering works.

Site Clean Up

Before the demobilisation of construction personnel and equipment, cleanup activities shall be carried out in accordance with environmental standards and industry best practice. Cleanup activities shall consist of the removal and disposal of temporary structures, equipment, tools and excess material brought on site or generated during the construction and commissioning program.

Permanent Reinstatement

Permanent reinstatement shall be undertaken in all the areas that have been subjected to disturbance by the construction works.

To facilitate natural re-vegetation of disturbed areas, the separately stockpiled excavated material and topsoil shall be spread back in the

reverse order in which they were excavated. The key reinstatement principles are summarised below:

- Minimise reduction of soil quality and structure during construction.
- Reinstate all third-party assets affected by project activities in accordance with the construction contract documents and other pre-entry agreements.
- Carry out site landscape based on a landscape plan prepared by a landscape professional.
- A target minimum cover of pre-existing ground vegetation established within one year of final reinstatement shall be set.
- An aftercare monitoring and corrective action program shall be developed and implemented based on examining the bio restoration process periodically after reinstatement.
- Any fences, services, structures or other facilities affected by the construction works shall be repaired or replaced to a condition that is at least as good as that found before construction.

3.6.4 Operation and Management Phase

The plant will be operated under an O&M Agreement between DeSadel and an operator to be selected following an open tender procedure. The EPC Contractor and the Equipment Suppliers will have the opportunity to submit proposals. Gas turbine maintenance will be undertaken under the terms of a Long Service Agreement.

The staff will be selected on the basis of a background appropriate to their discipline and will be trained in the operation of the gas turbine plant. Staff at all levels will receive proper training related to process

and emission control. The manufacturer's know-how will be transferred to the operating staff through participation in the trial runs and testing during the commissioning. The plant will be operated in accordance with the manufacturer's instructions.

Major repairs and overhauls will be carried out by outside contractors. An Environmental Management and Monitoring Plan shall be developed for the project and the site, specifically in Chapter Seven of this report.

Electrical Scope of Work

The electrical scope of work for the proposed CCGT is described in this section:

i) Design, supply, erection, testing and commissioning of:

- Generator transformers
- Station transformers
- 330kV Substation consisting of bays
- Plant illumination system
- Black start diesel generator
- Cable and cable carrier system
- Junction boxes and marshalling panels for 330kV Substation

ii) Erection, testing and commissioning of the following major equipment

systems under the supervision of OEM:

- Generator and Auxiliaries
- Generator Circuit Breaker
- Isolated phase bus duct
- Unit transformers
- Distribution transformers
- Neutral earthling equipment

- MV Switchgear
- LV Switchgear
- UPS System
- Cables and Cable Carrier System
- 220V DC System
- Earthling and Lightning protection system
- Miscellaneous Electrical items (JBs, Marshalling Panels, Local Push and Button Stations, etc.)

Gas Turbine Unit Mode of Operation

The gas turbine unit can be started from the control panel of the gas turbine control system. Plant permissible circuits must be satisfied that the unit is capable of coming to full speed and synchronising to the system. The following systems must be placed in the ready-to-start mode:

- MCC breakers set in automatic mode
- Cooling water module and local disconnect switches closed.
- Fuel system made ready.
- Gas turbine/generator permissive to start systems ready

Starting and Loading

All starting is done automatically, with the operator allowed to hold the start-up sequence at either the crank (pre-ignition) or fire (post-ignition, pre-accelerate) points of the startup. An “Auto” mode selection results in a start without any holds.

Operating

Once the unit is online, it may be controlled either manually or automatically from the gas turbine control system operator interface. Manual control is provided by the governor raises/lowers control displayed on the operator interface screen. Automatic operation is

switched on when the operator selects load points (pre-select or base) from the turbine control interface.

For a fully automatic start with automatic loading to base load, the operator selects the “Auto” operating mode, enables auto synchronisation and selects “Base load”. Given a “Start” signal, the unit will then start synchronising and load to Base load with no further input on the part of the operator.

Shutdown

On shutdown, the system will automatically unload, coast down and initiate slow speed rotation until proper wheel space cool down temperatures are reached.

Safety and Protective Features

The Turbine is constructed for safe and reliable operation. It is operated with the Speedtronic Mark V (TMR) Control System. Systems of event recorders to facilitate fault diagnosis and operational records shall be provided. The CCGT shall have the following monitoring and protective devices to ensure safe operation and maintenance:

- Boroscope openings for maintenance inspection
- Proximity-type sensors for shaft line displacement monitoring
- Thermocouples for measuring exhaust temperature
- Thermocouples for bearing metal and lube oil temperature devices
- Fire detection and protection systems with Thermic detectors
- Seismic-type vibration sensors on bearing caps for protection
- Resistance Temperature Detectors (RTDs) for the generator stator winding, exciter and gas path temperature devices...

Alarms and shutdown settings are provided to protect the CCGT from the

following events:

- Over speed
- Over voltage
- Over temperature
- Loss of flame
- Excess vibration
- Low lube oil pressure
- High lube oil temperature
- Differential relay operation
- Short circuit earth fault
- Fire detection, which shuts down the power plant and releases CO2

fire protection

Fire Protection

The primary fire protection for the CCGT is the thermic and smoke detectors, which actuate pressurised CO2, which is released into the CCGT compartment. This is accompanied by the shutdown of the CCGTs and a fire alarm. Periodic testing of the detectors and the CO2 bottles is essential to ensure effectiveness.

The CO2 Fire Protection system consists of the following:

a) One (1) H.P. CO2 bottle rack

- Inside a storage container
- With a ventilation system
- With an air conditioning system
- With a remote weighing device

b) Unit fire detection and protection panel c) CO2 piping

Planned maintenance: A proactive and systematic maintenance

approach will be implemented to ensure the longevity and optimal functioning of plant equipment. This approach will encompass regular checks, inspections, and preventive measures to identify and address wear and tear, mitigate potential issues, and extend the lifespan of critical components.

Transmission Line Maintenance: Regular inspections and maintenance of the transmission lines will be conducted to ensure their integrity and reliability. This will include routine patrols to identify and address any signs of wear, damage, or vegetation encroachment that may affect the performance or safety of the transmission infrastructure.

Design Concepts and Applicable Code and Standards

The overall philosophy for the project is to have an effectively operated, efficient, durable and environmentally friendly Power Generating Plant and Substations. The conceptual design of the proposed project was based on the practices consistent with the following set of codes and standards, and shall be applied to all components of the proposed project. Table 3.3 below describes various design codes and standards for the power plant.

Table 3.3: Applicable Design Codes and Standards

	Quality Assurance
BS.EN ISO 9001	Quality System-Model for Quality Assurance in Design, Development, Production, Installation and Servicing
Safety Management	
API RP 521	Guide for Pressure Relieving and De-pressuring
API RP 2004	Inspection for Fire Protection
API RP 2021	Guide for Fighting Fire and Fuel Storage Tank
BPP 122	Hazard Management Process
BS 6266	Fire Protection for Electronic Data Processing

MUA 140	Noise Protection Specification
IRI IM 2.5.2	Plant Layout and Spacing for Oil and Chemical Plants
ISO 834	Fire Resistance Tests
ISO 7240	Components of Automatic Fire Detection Systems
NFPA 11	Low Expansion Foam and Combined Agent Systems
NFPA 12	Carbon dioxide Systems
NFPA 15	Water Spray Fixed Systems for Fire Protection
NFPA 16	Deluge, Foam-water Sprinkler and Foam Water Spray
NFPA 20	Centrifugal Fire Pumps
NFPA 72E	Automatic Fire Detectors
	Civil and Architectural
GB 50229-96	Code for Fire Protection Design for Thermal Power Plant and Substation
DL T 5022-93	Technical Stipulation for the Design of CMI Structure of Thermal Power Plant
GBJ 10-89	Code of Practice for Design of Concrete Structures
GBJ 17-88	Code of Practice for Design of Steel Structures
GBJ 3-38	Code of Practice for Design of Masonry Structures
GBJ 7-89	Code of Practice for Design of Building Foundations and Foundation Base
DL 5024-93	Ground Treatment Technical Regulation for Thermal
GB 50040-96	Code of Design for Dynamic Machine Foundation
GBJ 9-87	Code Requirements for Design Loads for Buildings
GBJ 69-84	Code of Practice for Design of Structures for Feed
BS 594	Hot Rolled Asphalt for Roads and Other Paved Areas
BS 598	Sampling and Examination of Bituminous Mixtures for Roads and Other
BS 882	Specifications for Aggregates from Natural Sources for
BS 1470	Specifications for Wrought Aluminium and Aluminium Alloys for General
	Engineering Purposes, Plate, Sheet and Strip
BS 4211	Specification for Ladders for Permanent Access to Chimneys and other High Structures
	Mechanical
API 650	Welded Steel Tanks for Oil Storage
API 2000	Venting Atmosphere and Low-Pressure Storage Tanks
ASME IV	Heating Boilers
ANSI/AWS-DI-I	American Welding Society Code
BS 3505	Code of Practice for Safeguarding Machinery
BS 5343 PT2	Classification of Hazardous Areas
BS EN 10002	Tensile Testing of Metallic Materials

NFPA 8502	Standards for the Prevention of Explosions/Multiple Burners, Boilers
	Electrical
IEE 16th	Regulations of Electrical Installation
ASME PTC 22	Gas Turbine Power Test Code
IEC 76	Power Transformers
IEC 478	Stabilised Power Supplies, DC Output Institute of Electrical Regulations for the Installation of Electrical Equipment Engineers in Buildings
	Instrumentation
AGA-3	Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids
API RP 520	Design and Installation of Pressure Relief and De-
BS 476	Fire Tests on Building Materials and Structures Part 7- surface Spread of Flame Test for Materials
DIN V 19234	Measurement and Control: Electrical Distance Sensors
IEC 331	Fire-Resistant Cabling
IEC 332.1	Fire Retardant Cabling
IEC 605	Equipment Reliability Testing
NFPA 101	Code for Safety to Life from Fire in Buildings and

3.6.5 Project's Decommissioning Activities

At the end of the useful lifetime of the IPP, decommissioning could take place for the whole plant or on a unit-by-unit basis. If market conditions and/or electricity supply constraints at that time indicate that it would be appropriate to extend the life of the plant, decommissioning could be deferred to a later date. In such an event, the plant would be re-engineered and re-permitted as required, dependent on the legislative requirements at that time and in order to ensure ongoing electrical and environmental performance.

The key factors that determine when the plant is to be decommissioned are the economics of maintaining safety, such that it remains safe to operate, compliant with environmental requirements and reliable, together with the cost of fuel and the capability of the plant to earn

revenues in the prevailing electricity market conditions. Decommissioning, therefore, has to be reviewed regularly once it is evident that the plant is approaching the end of its working life.

Independently validated plant closure/demolition methodologies have been developed for power plants that are at the end of their useful life. These methodologies detail the demolition of the plant and buildings and the removal of any contaminated and hazardous material from the site. When demolishing the power plant, it will be a matter of policy to ensure that the site is left with no environmental or safety risks. The decommissioning phase is likely to take place over several months.

The extent of dismantling, demolition and site clearance will depend on any proposed future uses of the site. The need for soil surveys and any subsequent remediation works will also be considered in the light of the intended use of the site and its history of contamination.

Only relatively small quantities of potentially hazardous substances are likely to be stored and used at the proposed plant. These substances include lubricating oils. No significant problems are anticipated in dealing with any of these substances. Most of the plant and equipment will probably be at the end of its useful operating life and will be unsuitable for further use, and will need to be dismantled for recycling. Decisions on re-use of plant items, recycling of material or the disposal of waste will be made at the time of decommissioning in the light of the technology then available, economic considerations and legislation.

A competent contractor or the proponent shall appoint a reputable

contractor to undertake dismantling, disposal and demolition. Lead contractors will be nominated and will produce safety plans for the work. Stored materials suitable for re-use will be sold and taken from the site. The plant must be made safe for work in accordance with the normal safety procedures, such as the use of permits to work. The plant will be permanently disconnected from sources of energy, such as electricity, gas and water supplies.

The plant will be made safe for dismantling by draining and venting water and gas stored in vessels and pipe work, and purging pipes and vessels of gases. Closed vessels, pipes and other areas which could have hazardous gases present will be tested to ensure that they are safe before entry is permitted. Uncontaminated water will be drained to the site drainage system. Gases will be vented into the atmosphere in accordance with normal operating procedures. Any stored substances, hazardous or non-hazardous, will be moved from the site for disposal. Interiors of plant items that could possibly be contaminated will be surveyed and tested for hazardous materials before work is permitted in them or they are dismantled. Disposal of all waste materials, whether hazardous or not, will only be via appropriate and authorised routes.

The surface water drainage system for the proposed plant will continue to operate through the decommissioning phase. Any areas where oil spillage could occur will continue to drain into an oil interceptor, which will continue to be maintained. Once the plant is completely disconnected, drained, purged and tested as appropriate, it will be certified as being out of commission and handed over to the competent

contractor to complete the dismantling and demolition work, thereby handing it over to the host communities or government for other intended usage. Decommissioning will take into account the environmental legislation and the technology available at the time of decommissioning. The Federal Ministry of Environment's guidelines and methodologies on decommissioning shall be adhered to completely, and both the Federal, State and Local Government regulatory bodies shall be involved in the decommissioning studies.

3.6.6 Sourcing and Transportation of Construction Materials

The materials to be used in the construction of the project shall be sourced locally and internationally, should the need arise. Greater emphasis shall be laid on the procurement of materials from sites located closer to the site being worked on. This shall make both economic and environmental sense as it shall reduce cost and negative impacts of transportation of the materials to the proposed project site through reduced distance of travel by the materials transport vehicles. Materials shall be transported to the proposed project site from their extraction, manufacture or storage sites using heavy-duty transport trucks.

It is expected that construction of the plant will entail quality materials and procedures to ensure quality work, occupational and public safety and environmental sustainability. The following inputs will be required for construction:

- Raw construction materials, e.g., sand, cement, natural building stone blocks, hard core, gravel, ballast, timber, nails, and concrete, among others.

- Timber (e.g., doors and frames, fixed furniture, etc.),
- Paints, solvents, whitewash, etc..
- Labour force (of both skilled and unskilled workers).
- Transformers.
- Busbars, switch gears, circuit breakers and capacitors
- Lightning arrestors and steel structure members
- Water
- Paints, solvents, whitewash, etc..

3.6.7 Siting of Project Yard

The proposed project execution shall require a yard for its workers and for the storage of machinery and equipment, processing and storage of materials. The construction camps will be located at least 500m away from habitations and 1km away from sensitive locations. Yard will be provided with a water supply and sanitary facilities for adequate water supply for construction.

3.6.8 Main Resources, Materials and Consumables

- Water

Water shall be used during the construction activities, such as washing of machines. During this phase, approximately 500,000 litres of water will be needed for activities such as concrete curing, dust suppression, and other site works. Daily water requirements will vary based on the schedule of activities, but adequate provisions will be made to ensure a continuous supply. Additionally, compressed air will be generated using portable compressors to support construction needs, such as powering

pneumatic tools and systems. Also, water shall be used for restrooms and other domestic activities. For human consumption, bottled and sachet water shall be distributed to the workers.

- **Rock Aggregates**

Rock aggregates shall be required as raw material for facility construction; this shall be sourced from sources closest to the project area to reduce impact from transport trucks and the extraction process.

- **Power Supply**

Generators for site yards, light vehicles and heavy-duty equipment such as tractors and trucks shall be required; the burning of fuel and diesel by this equipment shall lead to pollution of the atmosphere. Slow-moving equipment shall be fueled by a mobile tank truck filled with fuel. High-mobility equipment/vehicles, such as trucks, are refilled at a fuel station.

Diesel consumption during construction is estimated at approximately 100,000 litres, accounting for fuel requirements for generators and construction equipment. This includes power generation for temporary site facilities, lighting, and equipment operation. Careful management of fuel and energy resources will ensure that construction progresses efficiently while minimising environmental impact.

3.7 Project Waste Management Plan

The Waste Management Plan (WMP) outlines the minimum regulatory requirements for managing non-hazardous and hazardous wastes generated within the construction site. The waste management plan is consistent with applicable laws, guidelines and industry best practices.

3.7.1 Objectives

The objectives of the waste management plan are to:

- Promote environmental objectives such as reduction, reuse and recycle as proposed by the contractor handling the project.
- Identify the various waste categories/nature (e.g., solid, liquid, hazardous and non-hazardous), their source and their volumes, for better analysis and understanding.

3.7.2 Waste Classification

Construction and operation of the Processing plant shall generate relatively some volumes of waste; waste generated shall be classified under the following categories for moral, legal and economic purposes.

1) Non-hazardous solid waste
2) Hazardous solid waste
3) Non-hazardous liquid waste
4) Hazardous liquid waste

Waste inventories shall be created to qualify and characterise waste streams at each stage of the project. Separate inventories shall be developed for construction wastes and for commissioning/operational wastes.

The waste streams generated during the plant's operation will include both liquid and solid wastes. Liquid waste will primarily consist of used oils, lubricants, and other hydrocarbons from equipment maintenance. These will be collected in designated containers to prevent leaks and spills, stored in compliance with environmental regulations, and handed over to licensed waste disposal contractors for safe recycling or disposal. Runoff water from cleaning and operational processes will be monitored

for contaminants, treated as necessary, and discharged in line with statutory water quality standards.

Solid waste will encompass a variety of materials, including scrap metals, plastics, wood, machine spares, parts of electrical and armoured cables, empty paint containers, and domestic waste from personnel. These waste streams will be segregated at source into recyclable, non-recyclable, and hazardous categories. Recyclable materials such as metals and plastics will be sent to authorised recycling facilities, while hazardous waste, including empty chemical containers, will be disposed of through certified hazardous waste handlers. Domestic waste will be collected in bins and transported to designated municipal waste disposal sites. The implementation of a Waste Management Plan (WMP) will ensure all waste is managed responsibly, in compliance with statutory guidelines, to minimise environmental impact and support sustainability efforts.

Generic waste streams that can be generated at the power plant site and their treatment and disposal routes can be categorised as presented in Table 3.4.

Table 3.4: Expected Waste Types/Management Strategy during the Operation Phase

Waste Type	Classification	Management Strategy
Empty metal/plastics containers	GEN/REC	Decontamination Recycling via accredited contractors
Metal Scraps Electric cables	GEN/REC	Recycling via accredited contractors
Spent Oil/Lube oil	HAZ	Recycling via accredited contractors
Alkaline-based Chemical	HAZ	Neutralization Pit

cleaning		
Food waste, used cleaning fabrics	GEN/REC	Composting at the approved dumpsite by accredited Waste vendor
Paper waste	GEN/REC	Recycling via accredited contractors
Plastic bottles and sachets	GEN/REC	Recycling via accredited contractors

GEN – General Wastes; REC – Recyclable Wastes; HAZ – Hazardous Wastes

3.7.3 Hierarchy of Waste Management Practices

Each waste stream shall be managed according to the following hierarchy of techniques, in which the technique chosen shall be the first in the hierarchy that is safe and practicable.

- Eliminate (Remove) or minimise (Reduce) the waste stream by choice of procedure or technology
- Recycle or conversion of materials
- Replace unusable equipment or machinery parts
- Repair usable equipment for re-use
- Return used batteries and E-waste to the manufacturer for recycling
- Re-use as a material
- Re-use as a fuel
- Discharge to a receiving water course (application only to wastewater).

The first step of the strategy is to reduce the amount of waste generated. This will be accomplished by:

- Reducing material consumption at all levels (including packaging),
- Reducing the volume of waste and using non-hazardous materials

rather than hazardous ones where practicable. While not affecting the amount of waste, these measures facilitate the management of waste and reduce the risk of impact at disposal.

Wastes will be handled by trained personnel, who will be in charge of the different activities:

- Identification;
- Labelling: waste containers will be clearly labelled to facilitate the safe and appropriate handling of waste. Unidentified wastes will be treated as hazardous.
- Handling;
- Segregation and storage:
  - Different wastes will be segregated, thus requiring segregation areas and appropriate containers (depending on the volume and the typology of the collected waste), designated by a colour coding system and protected from the direct effects of sunlight, wind or rain. This area will be identified taking into account site access and drainage.
  - Hazardous wastes will not be mixed to avoid potential chemical reactions. Hazardous liquid wastes will be stored in bunded areas with a secondary containment capability of no less than 110% of the entire volume of waste stored to reduce the risk of pollution resulting from spillage.
  - All storage areas will be marked to indicate the hazards of the stored waste. Hazardous waste areas will be made secure to prevent unauthorised intrusions. Toxic or very toxic products will be separated from other products and stored in a room or a locked cabinet. Access to these areas will be limited to

trained employees.

- The volume of wastes stored will be kept to a minimum where practicable. Waste will be kept on-site for the minimum amount of time possible, given logistical constraints and stored in a way to prevent scavenging by animals and pests. When containers are ¾ full, the environmental representative must be notified to initiate the collection procedure.
- All waste collection points should have fire-fighting equipment as appropriate. Certain waste collection points may also have areas for washing. Designated areas may be required for storage of non-compliant waste or waste with special handling requirements.

- Transport: only approved contractors (responsible for holding the appropriate operating licenses and regularly monitored) will be used to transport wastes from the collection points to the final disposal site. Additionally, DeSadel Nigeria Limited will require contractors to:
  - Transport wastes in an environmentally safe and responsible manner, using the appropriate level of protection and containment for the wastes concerned.
  - Use appropriate vehicles for transportation with suitable specifications, including compartments or undercover storage to prevent loss of waste.
  - Use designated routes to minimise impact.
  - Use safe loading and unloading procedures to protect the workforce and prevent loss of waste.

- Provide means for emergency response and train employees in spill procedures.
- Ensure wastes and vehicles are labelled accordingly.

Greenhouse Gas Emissions

The greenhouse gas (GHG) emission potential of the CNG plant and associated power generation facility arises primarily from the combustion of natural gas, energy consumption in compression processes, and construction-related activities. These emissions consist mainly of carbon dioxide (CO_2), with smaller contributions from methane (CH_4) and nitrous oxide (N_2O), each varying in its global warming potential.

Operational Emissions

Power Plant Emissions: The on-site power generation plant, fueled by natural gas, emits CO_2 as a byproduct of combustion. While natural gas is a cleaner-burning fossil fuel compared to coal or oil, it still contributes to CO_2 emissions. The magnitude of emissions depends on the plant's operational efficiency, fuel consumption for operation.

Decommissioning Phase

Activities during the decommissioning phase will involve demolition and site clean-up, disposal of waste, demobilisation of the workers, and a final site review. It involves the disengaging and removal of all equipment used in the course of the project's operational life. Decommissioning of the proposed project entails some activities, which include:

- Dismantling of the equipment and
- Transfer of all equipment and accessories to other locations where

they shall be needed.

- Removal of constructed structures (site office building), etc.

Demolition

The main activity under the demolition is the dismantling of the operational and ancillary equipment. The remediation measures that need to be undertaken, therefore, will check the resultant negative impacts of this phase of the project on the environment. The likely impacts will be:

- Physical disturbance arising from equipment removal techniques.
- Waste management problems.

Clean-Up and Waste Disposal

The clean-up process shall involve the removal of the wastes resulting from the demolition of the site at the end of the plant's life. The clean-up process shall be done in compliance with relevant Waste Disposal Guidelines.

Site Remediation Plan After Closure/Decommissioning

- ✓ The following measures shall be planned for implementation after commissioning/closure:
- ✓ All equipment and debris shall be removed from the environment to other locations for use and/or proper disposal as guided by existing regulations.
- ✓ Good waste management plan.
- ✓ Buildings used for administration and residences shall be leased out or used for other purposes.

Post Abandonment Site Review

A post-impact site survey shall be carried out to ensure that no waste or

contaminant is left behind and that the negative impacts on the site are minimised.

3.8 Project Requirement

3.8.1 Personal Protective Equipment (PPEs)

For the process building, raw materials and finished goods storage areas, heat extractors will be wall-mounted along the perimeter of the process building to provide a more conducive environment for the personnel who will be involved in operations. In addition, required Personal Protective Equipment (PPE) will be provided for all employees who will work in the plant. The use of respiratory nose masks, for example, will mitigate the risk of any known respiratory effects of working in an environment with urea or any such materials.

3.8.2 Estimated Project Workforce

In the construction phase, the proposed project will directly employ about seventy skilled professionals as well as about eighty to a hundred unskilled employees; in the operational phase, the project will employ twenty-five (25) skilled professionals and about twenty-five to fifty (25-50) unskilled workers, depending on the number of shifts to be operated. However, during employee recruitment, priority will be given to qualified persons from the host community, followed by those from nearby communities. This will be in accordance with a Local Content Plan to be designed by the contractor and vetted by DeSadel Nigeria Limited, Federal Ministry of Environment. The Local Content Plan will ensure that, whenever possible, qualified, skilled and non-skilled

positions are reserved strictly for people from the project host communities and that on-the-job training is made an integral part of the recruitment policy of the contractor.

3.9 Project Life Span

It is envisaged that with appropriate maintenance operations, this project shall last for 25 years when commissioned for use. During this period, if this technology is not overtaken by a more sustainable one, a general technical assessment of the project shall be carried out, with recommendations for decommissioning.

3.10 Project Schedule

As it is enormous with this type of project, the project proponent had carried out feasibility studies, project analysis, and equipment and material availability and has determined that the project is viable. The project technical design has been completed; site acquisition and consultation also followed the site acquisition till the time of this EIA process. EIA as a frontline activity for this proposed project is scheduled to last for five months, once the project is approved, material procurement shall last for five months, logistic arrangement (movement of materials) shall last for four weeks, site clearance and construction shall last tentatively within period 8 am to 4 pm, Monday to Friday for seventeen months depending on availability of funds for the project, then the project shall be commissioned and demobilization of construction equipment/workers shall follow. The Gantt chart of Table 3.5 is self-explanatory and briefly summarises the project scheduling.

Table 3.5: Tentative Project Schedule

S/N	Activity	Pre-construction Phase	Construction Phase					Operations Phase			
		Duration (timeframe)									
		June 2024 - November 2025	November 2025 - September 2028					November 2028 - 2053			
1.	ESIA Processing and Certification										
2.	Pre-construction activities, including site acquisition, design, permits/approvals										
3.	Construction of buildings and associated structures										
4.	Installation of production equipment and test–running.										
5.	Demobilisation from the construction site										
6.	Operations and periodic maintenance										

CHAPTER FOUR

DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1 Introduction

The existing baseline environmental characteristics around the site for the proposed 750mw Gas-Fired Combined Cycle Power Plant project in Qua Iboe, Ibeno were established through extensive literature research, field sampling/measurements, laboratory analysis, and stakeholders' consultation. These approaches are used for delineating environmentally sensitive areas and for preparing an environmental sensitivity map for contingency planning. The environmental components covered include topography, climate/meteorology, air quality, noise level, wind speed/direction, soil, groundwater and surface water, erosion, vegetation, wildlife, geology, socio-economics characteristic of s communities within the study boundary, health status assessment and waste management. Appropriate measures to mitigate, ameliorate or off-set the project's impact shall be proffered.

4.2 Study Methodology

This environmental and social impact assessment (ESIA) was conducted in line with the EIA guideline by the Federal Ministry of Environment (FMEnv), and follows laid down procedures as highlighted below:

4.2.1 Reconnaissance Survey and Delineation

The reconnaissance survey and delineation of the study area were carried out on the 05th of July, 2024, by the study team and the proponent, De-sadel Nigeria Limited. Site verification exercise was carried out on 06th July 2024, which put together a verification team which comprised of ESIA

consultant, De-sadel Nigeria Limited representative, representative of the Federal Ministry of Transportation, and representatives of the FMEnv and representatives of Akwa Ibom State Ministry of Environment. Visual observations within 2km radius of the proposed project area were made to determine resources, population, landforms, features, ecological characteristics, drainages, and biological and human community.

4.2.2 Consultation with Regulators and Stakeholders

The consultation was held at the Federal, Local and Community Government levels. FMEnv, Akwa Ibom State Ministry of Environment and residents and leaders of Ibeno community were all consulted and briefed about the proposed 750mw Gas-Fired Combined Cycle Power Plant project; and all suggestions, input and contributions made at the consultation meetings were captured and incorporated into the study to aid the project implementation.

4.2.3 Field Visit and Desktop Research

The project area was described by the extent to which the proposed project activities is expected to have influence on the receiving environment; thus, the boundary covered during study stretched through 2km. while one-season (wet season) field data gathering was undertaken between 17th July to 4th of August 2025 for the acquisition of baseline data by a multi-disciplinary ESIA team for which different section of the natural and social environment was covered, secondary data was sourced for dry season from an FMEnv approved ESIA report within the study location (*EIA for the proposed Construction of Odoro Nkit-Okposio Road, Eket-Ibeno LGA, Akwa Ibom State, 2020).* The existing air quality, noise level, soil quality, water

quality, sediment and aquatic life, benthic and benthos, vegetation and wildlife, land use, and socio-economic and health issues within the project environment and host communities. A team of experts and a representative of the FMEnv fully participated in the study field. Field investigations, review of relevant literature, interviews and discussions with stakeholders as well as consultation were undertaken.

Standard methods and procedures for data acquisition, collation, presentation and analysis were strictly adhered to in the course of this study. Quality assurance and quality control (QA/QC) measures were implemented during sample collection, labelling, analyses and data verification. Sample handling, transportation, logging and cross-checking in the laboratory were also implemented. All analyses were carried out in AKS MST-RD Laboratory, located at Ministry of Science & Technology, Uyo, Akwa Ibom State. The methods of analyses used in this study were those internationally accepted analytical procedures, in order to ensure the reliability and integrity of the data obtained.

4.2.4 Sampling design and strategy

The sampling strategy for this study was based on the report of site verification exercise by FMEnv. The strategy consists of the approved number of samples, sampling locations and coordinates (Table 4.1). A total of fifteen (15) sampling points including five (5) control for air quality, noise level, wind speed and direction; eight (8) sampling points for soil and two (2) control point; three (3) water samples and one control and two sediment sampling points were also defined from the surface water body within the study boundary; and two (2) sample from the nearby borehole for groundwater analysis.

Table 4.1 Sample Stations and Coordinates

Air Quality and Noise		Soil		Groundwater		Surface water		Sediment	
Code	**Coordinate Lat N Long E**	**Code**	**Coordinate Lat N Long E**	**Code**	**Coordinate Lat N Long E**	**Code**	**Coordinate Lat N Long E**	**Code**	**Coordinate Lat N Long E**
A/N 01	4.553183° 8.013114°	SS01	4.553159° 8.013241°	GW 01	4.552374° 8.015008°	SW01	4.553630° 8.011912°	SED 01	4.554638° 8.020172°
A/N 02	4.552965°8.015537°	SS02	4.552982° 8.015663°	GW02 Contl	4.561194° 8.016468°	SW02	4.557513° 8.014981°	SED 02	4.555570° 8.030494°
A/N 03	4.553325° 8.018907°	SS03	4.553339° 8.017262°			SW03	4.555193° 8.021738°		
A/N 04	4.554428° 8.018851°	SS04	4.553089° 8.018969°			SW04	4.551404° 8.028087°		
A/N 05	4.554955° 8.017688°	SS05	4.554456° 8.018789°						
A/N 06	4.556005° 8.016161°	SS06	4.555205° 8.016964°						
A/N 07	4.555252° 8.015019°	SS07	4.555098° 8.014948°						
A/N 08	4.554101° 8.014572°	SS08	4.553669° 8.022063°						
A/N 09	4.553206° 8.010669°	SS09 Cntrl 1	4.554311° 8.027590°						
A/N 10	4.552314° 8.007688°	SS10 Cntrl 2	4.554727° 8.030381°						
A/N Cntrl 11	4.553830° 8.022405°								
A/N Cntrl 12	4.554219° 8.025215°								
A/N Cntrl 13	4.558405° 8.013227°								
A/N Cntrl 14	4.558439° 8.016139°								
A/N Cntrl 15	4.558422° 8.019118°								

Key: A, N – Air and Noise, SS – Soil sample, SW – Surface Water, SED-Sediment, GW – Ground Water, Cntrl -Control, RH- Relative Humidity
Source: Field Study, 2025

- *Climate and Meteorology*

Information on the climate and meteorology of the proposed area was obtained from the Nigerian Meteorological Agency (NIMET) of the Federal Ministry of Aviation, Abuja, 2022 and other weather and climate sources. Thirty-five (35) years data (1987-2022) was acquired for rainfall, relative humidity, temperature, wind speed and wind direction. These data were presented and analysed in this report.

- Air Quality and Noise Level

Data on ambient air quality around the proposed area were directly acquired by in-situ measurement. The measurement conducted was to determine the concentration of pollutant gases which includes sulphur dioxide ($SO_{2)}$, nitrogen dioxide (NO_2), carbon monoxide (CO), carbon dioxide (CO_2), hydrogen sulfide (H_2S), suspended particulate matter (SPM), methane (CH_4) and volatile organic compounds (VOC), and analyse their impact on the environment.

- The oxides of nitrogen, carbon, sulphur was measured in parts per million (ppm) using hand-held portable *iBrid MX6 (its* calibration was done using a gas/air mixture forced from a gas cylinder at 1.0 psi*);*
- Particulate matters were measured in mg/m^3 using Konamx Handheld lacer Particle counter
- VOCs were measured using Mini Rae Lite
- Wind speed was measured using an Anemometer vane probe
- Coordinates were taken using *etrex Legend* GPS
- At each sampling point, readings were taken between 9am and 5pm.

To determine noise levels, TES Sound Level Meter was used. Measurement was recorded in dB(A). Wind speed and direction were measured with the aid of Laser Tool 6903 meter, and the values were recorded in meter per second (m/s). Sampling points considered for air quality, noise level, wind speed and direction were georeferenced (Figure 4.1). Plate 4.1 present Air Quality in-situ measurement.

Figure 4.1: Satellite Imagery showing Air and Noise sampling points

Plate 4.1: In-situ measurements of VOCs, SPM, NO, CO_2, CO, SO2, CH_4, H_2S, Noise Level and Wind Speed

Water Sampling and Analysis

Physico-chemistry and Microbiology

Groundwater samples (2) were collected from a borehole at site and one control sample from a reservoir 570m away; while surface water samples on the other hand were collected from the surface water body Adick Mkpank (Douglas Creek) within the study boundary (Figure 4.2). Sterilised 1 litre polyethylene bottles were used for both sample collection, while stainless steel Van-ven grab was used to collect sediments at bottom of the

surface water body. Plates 4.2 and 4.3 present water sampling for groundwater at a borehole and surface water at the creek.

Plate 4.2: Showing a photograph of groundwater sample collection and in-situ measurement

The water samples collected were preserved and transported to laboratory for analysis on parameters that can only be determined in laboratory using the following procedures:

- General physico-chemical parameters: Samples were collected into 1 litre polyethylene bottles and bowl for water and sediment respectively. The bottles were previously rinsed with distilled water and with some portion of the water samples prior to sampling.
- For heavy metals, samples were collected into 1 litre pre-cleaned polythene bottles and preserved by the addition of 2ml concentrated nitric acid.
- For oil, grease and total hydrocarbon content (THC), samples were collected into 1 litre pre-cleaned glass bottles and preserved by the addition of 2ml concentrated sulphuric acid.
- For chemical oxygen demand (COD), samples were collected into pre-cleaned 500ml glass bottle and fixed with sulfuric acid (H_2SO_4).

- For microbiology, samples were collected into 25ml sterilized glass bottles.
- For biochemical oxygen demand (BOD_5), samples were collected into 300ml amber-coloured BOD bottles.

Samples collected were stored at 4^0C on the field with the aid of ice pack before transportation to laboratory for further holding at same temperature. In-situ measurements were conducted for temperature, pH, Electrical Conductivity, Total Dissolved Solids (TDS), Colour, Turbidity, Dissolved Oxygen (DO) on both groundwater samples and surface water sample.

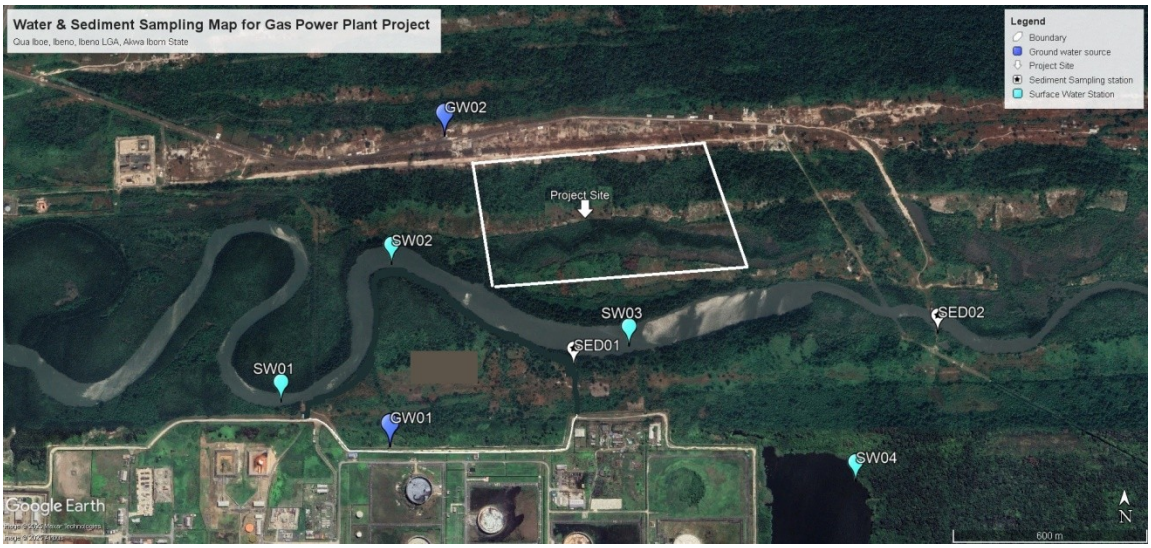

Figure 4.2: Satellite Imagery showing water Study Sampling points.

Phytoplankton and Zooplankton

Planktons (zooplanktons and phytoplanktons) samples were collected by towing plankton net for 5 minutes. During towing, the plankton net sieves the water retaining the plankton inside the net. This allows the planktons to be collected in a 120 ml plastic container bottom of plankton net. The

content of the plastic container beneath the plankton net is transferred into labelled plankton samples container and preserved in 4% formalin. This activity was repeated in subsequent sampling station.

Bottom Sediment

Sediment samples were taken from the bottom of the river using Van-ven grab. A total of two (2) samples were collected for physico-chemistry and kept in polythene bags; samples for hydrocarbon and microbiology analyses were kept separately in aluminium foil, preserved in ice pack and transported to the laboratory for analysis.

Benthic Macro-fauna

The Van-ven grab was used in taking samples of benthic fauna. Grabbed sediment samples were washed with water through a 0.55 µm mesh size sieve. The sieved contents were preserved in 4% formalin in labeled jars for further analysis in the laboratory. The pictures below present surface sampling collection and in-situ measurement.

Plate 4.3: Showing a photograph of surface water sampling and in-situ measurement

Fisheries Study

Fisheries studies investigated fish species composition, diversity, economic importance, harvest methodology, fishing activities and fish sales. These

were carried out through inspection of catches by local fishermen both in the field and in fishing camps, administration of questionnaires, interviews of fishermen in camps regarding catch composition and methodology, survey of the fishes on sale within the area, and interview with the fisheries middlemen about the source of their fishes, landing/income per fishing.

Soil samples

Soil samples were collected at two depths: 0-15cm and 15 – 30cm from three sampling points (Figure 4.3) with the aid of dutch stainless steel hand auger. A total of 20 soil samples including controls (2 samples at each depth from 10 sampling points) were collected at 50 meters intervals within the proposed project boundary. The soil samples were collected in duplicate. Those for physical and chemical analysis were packed in black polythene bags, and those for microbial and oil and grease/hydrocarbon analysis wrapped in aluminum foil. The samples were neatly labeled, preserved and taken to the laboratory for analysis. All in-situ observations for colour, presence of roots and lives were recorded in a field note book. Plate 4.4 is the scene of soil sampling during the baseline study.

Figure 4.3: Satellite Imagery showing soil sampling points

Plate 4.4: Showing a photograph of Soil Sampling within the proposed project environment

Microbiological Analysis

Heterotrophic bacteria and total *coliform* were enumerated by adopting the most probable technique for water samples, while standard spread plate technique was used for soil sample. appropriate dilutions (three-fold) of samples were plated out on nutrient agar plates for bacteria and macconkey agar plates for total *coliform*. The plates were made in duplicate and incubated aerobically at 37^0c for 24hours (bacteria) while that of *coliform* were incubated aerobically at 37^0c, 48hours. at the end of the incubation periods, the number of colonies on the agar plates were counted and enumerated after screening. The relative abundance (i.e., the population density estimate) of the organism were obtained by multiplying the plate count per ml for each organism by the dilution factor used. the growth on the agar plates were noted with regards to the following characteristics: form, pigmentation or colour, texture and elevation. each bacterial culture was identified based on its morphological characteristics using gram reaction as well as confirmatory test.

Flora Study

The flora study of the proposed 750mw Gas-Fired Combined Cycle Power Plant project area was conducted by observation within the study boundary/ environment and using transects. Plants within each transect were identified, those that could not be identified on site were collected and pressed for herbarium. The knowledge of the economic importance of the common plant around the project was obtained from the locals.

Plate 4.5: Showing a photograph of plant identification in the proposed project environment

Fauna Study

Information on the fauna biodiversity of the project area was gotten from residence using interviews, and identification of species from photograph catalogue. Thus, Coloured photographs of West African wildlife species were shown to the locals for easy identification of the wild. Sampling techniques adopted include physical appearance, footprints, sound, burrows, trails, and fecal samples Information on frequency and when last the species were sighted were provided.

Socio-Economic and health

Baseline socio-economic information of Ibeno within the project boundary was acquired during a consultation with the community leadership/members and a community survey. Group consultation, interviews and questionnaire administration were employed to acquire

information which includes traditional governance, demography, education, business activities, social amenities, security situations, and waste management. This information/data was used to analyse the social/socio-economic characteristics of community with the proposed 750mw Gas-Fired Combined Cycle Power Plant project area.

Community health status and presence of healthcare centres were determined by interviews and questionnaire administration to locals and officials of healthcare center's visited.

4.3 Climate and Meteorology over Study Area

The climatic information is based on in-situ data collected from the study area during the field study and analysis of long-term historical data which were collected from the Federal Meteorological Services Department, covering both wet and dry seasons. Akwa Ibom has a Tropical monsoon climate (Classification: Am). The city's yearly temperature is 28.47ºC (83.25ºF) and it is -0.99% lower than Nigeria's averages. Akwa Ibom typically receives about 342.56 millimeters (13.49 inches) of precipitation and has 294.37 rainy days (80.65% of the time) annually. In Ibeno, the wet season is warm and overcast, the dry season is hot and mostly cloudy, and it is oppressive year round. Over the course of the year, the temperature typically varies from *20°C* to *32°C* and is rarely below *17°C* or above *34°C*. Detailed information about the climate and meteorology of the study area is as follows.

4.3.1 Rainfall

There is abundant rainfall with mean annual ranges from 2000mm to 3000mm. The monthly rainfall of the area ranges from 0.0mm to 409.4mm with the majority of the rain falling between June and October. The period

from March to October is the rainy season, with the rainfall accounting for 85% of annual total, and from November to April is the dry season. Construction activities taking place between December and March will have the least pollutant removal by rainfall and very high dust generation due to dry soil conditions.

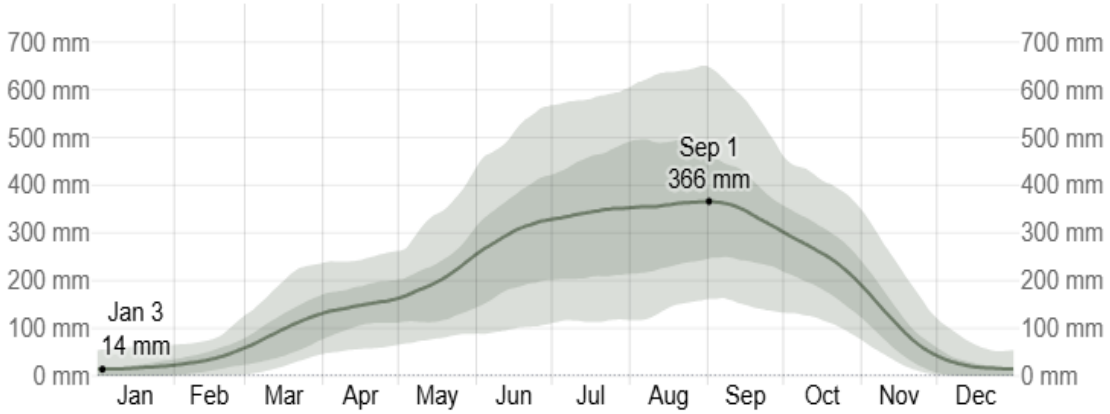

Figure 4.4: Average Rainfall (Millimeter) of the Project Area
Source: Nigerian Meteorological Agency, Abuja and https://weatherspark.com

4.3.2 Temperature

The temperature is usually higher during the dry season and lower during the wet season. The ambient temperature of the area rises gradually in the early morning hours and attains its peak value between 13hrs and 15hrs. The maximum temperature of the area ranges from 28°C to 33°C. Highest values are recorded between December and March which is the end of dry season. The area indicates low temperature from July to September and rises in November to April. The months of April and May in the rainy season are noted to experience the highest temperature ranging between 31°C and 32°C.

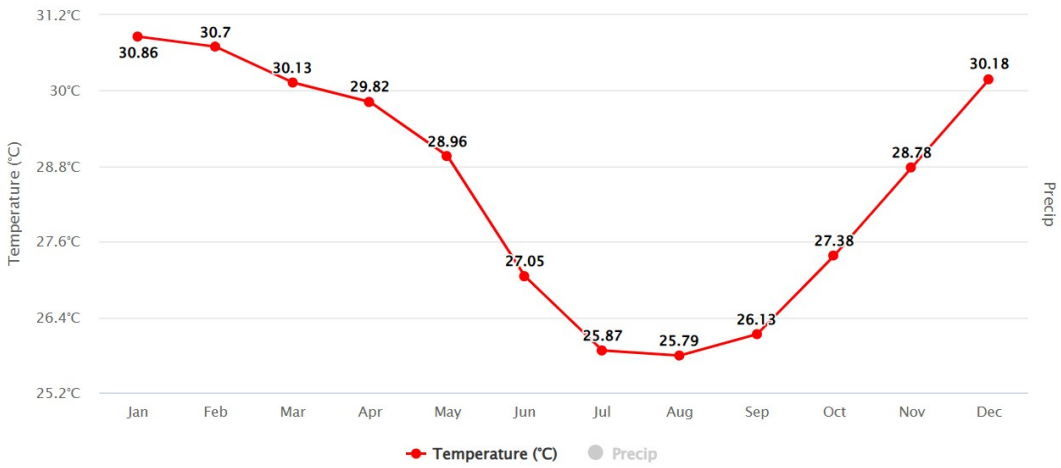

Figure 4.5: Average Maximum Temperature of the Project Area (°C)
Source: Nigerian Meteorological Agency Abuja and https://weatherandclimate.com/

Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	31°C	32°C	32°C	31°C	30°C	29°C	28°C	28°C	28°C	29°C	30°C	31°C
Temp.	26°C	27°C	27°C	26°C	26°C	25°C	25°C	24°C	24°C	25°C	25°C	25°C
Low	20°C	22°C	23°C	22°C	22°C	22°C	22°C	22°C	22°C	22°C	22°C	20°C

Figure 4.6: Average Minimum and Maximum Temperature of the Project Area (°C)
Source: Nigerian Meteorological Agency Abuja and https://weatherspark.com

4.3.3 Relative Humidity

The relative humidity of the area ranges from 9% to 84%, wet season shows the range of 36% to 84% while the dry season showed range 9% to 45%; high values are recorded between June and October ranging from 52% to 84% while lowest values 9% to 45% occurs from November to March. Period of very low humidity of 15% to 29% occurs in January to February during the harmattan spell.

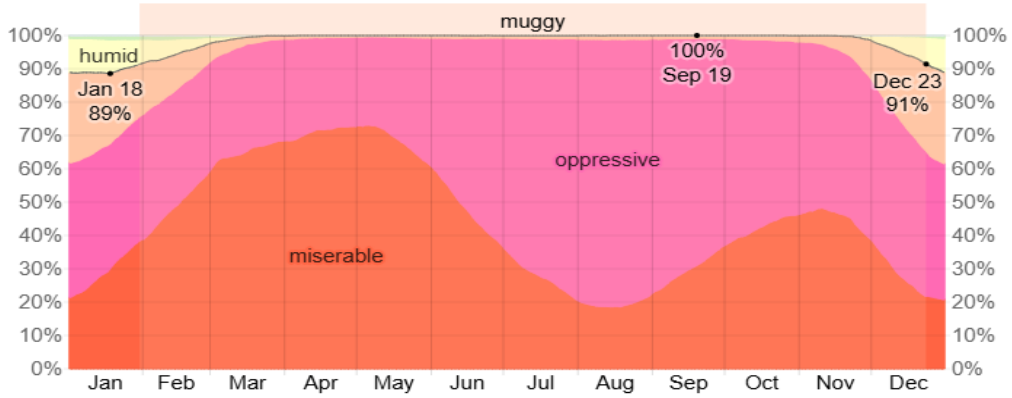

Figure 4.7: Average Relative Humidity of the Project Area (%)
Source: Nigerian Meteorological Agency Abuja and https://weatherspark.com

4.3.4 Speed Wind and Direction

A wind speed that varies between 2.3m/s and 8.1m/s for both dry and wet season was recorded. High wind speed occurs between the months of April and September. Low wind speed occurs at the peak of the dry season and between December and January.

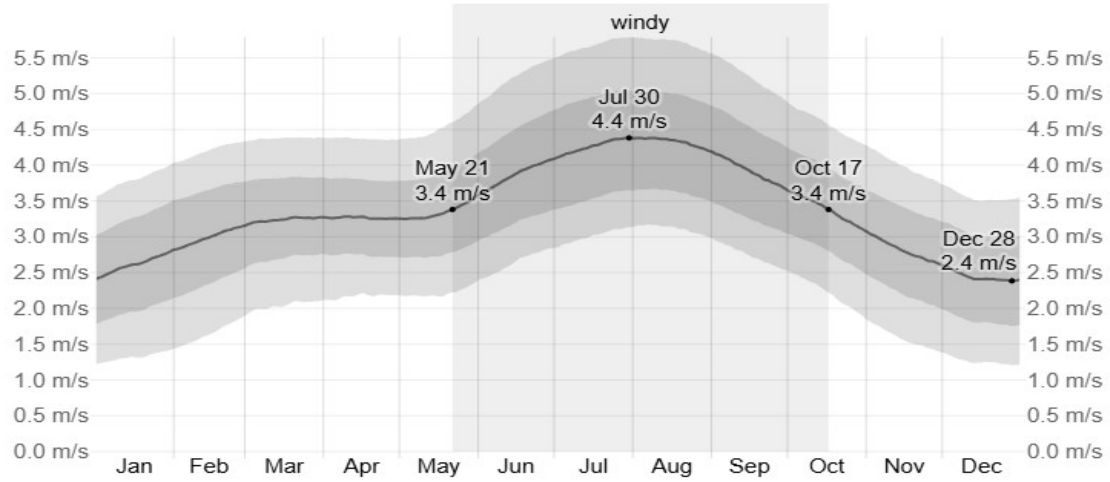

Figure 4.8: Average Wind Speed of the Project Area (M/S)
Source: Nigerian Meteorological Agency Abuja and https://weatherspark.com

Two dominant wind currents prevail in the project area. The winds are the southwest “rain bearing” wind, which reaches the Guinea Coast as a warm, moist wind stream; and the northeast “harmattan” wind, blowing from the Sahara as a hot, dry and often dusty wind stream. For most of the year it is

the warm, moist rain-bearing wind that prevails in the project area, and it is strongest and most persistent during the period from May to September– the peak of the wet season. The wind speeds are more of light breeze (1.6-3.3 m/s) followed by light air (0.3 1.5m/sec. The wind speed of 0.4- 1.4m/s obtained in dry season and 0.4- 2.7 m/s occurred just before heavy downpour during the rainy season (Figure 4.9). The wind directions were generally Southerly (S), Southwesterly (SW), Northwesterly (NW), South-Southwesterly (SSW), North-northwesterly (NNW), West-South-westerly. (WSW) and West-north-westerly (WNW) in the dry and wet seasons. These results indicate that dispersion of atmospheric pollutants will be impeded in the early morning and late evenings due to low temperatures, and very high relative humidity conditions. These conditions will therefore favour the accumulation of atmospheric pollutants within the immediate environment. On the other hand, dispersion and transportation of pollutants will be favoured in the afternoons and evening periods when the temperature value is fairly high and there is prevalence of winds of some magnitude. It should be noted however that wind speeds up to 18 m/s could occur which are mostly Westerlies especially during rainstorm episodes in the rainy season. The wind speed and direction of the Akwa Ibom State for thirty-five (35) years study period is presented in Figure 4.9.

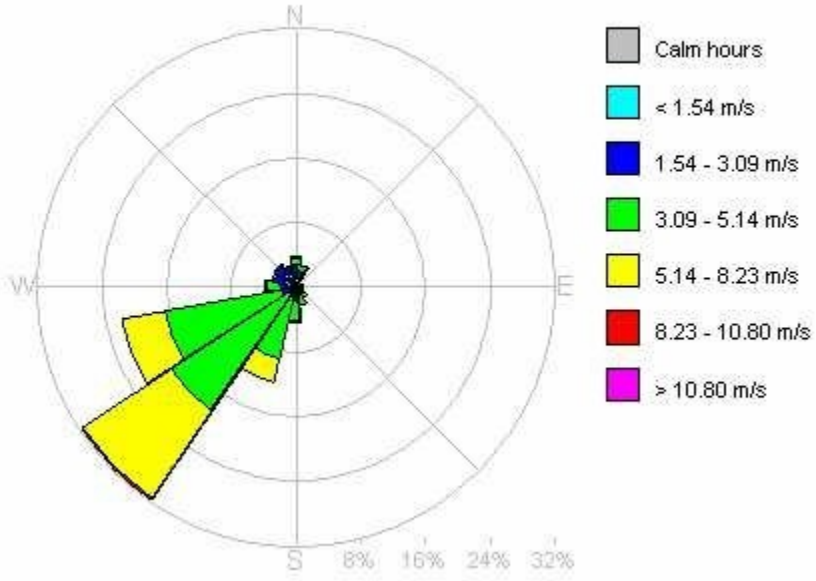

Figure 4.9: Windrose showing wind speed and wind direction of the Project Area

Source: Nigerian Meteorological Agency Abuja and https://weatherspark.com

4.3.5 Sunshine Hours

Only an average of just 121.8 hours of bright sunlight is recorded annually. This gives an average of about 6 hours of bright sky per day. A further assessment reveals that the dullest months are around the peak of rainy season when about 68.2 hours is recorded monthly at an average of less than 4 hours daily. The brightest months are March/April just before the onset of the raining season. It has average of 186 hours for the month, an average of 3.2 hours per day.

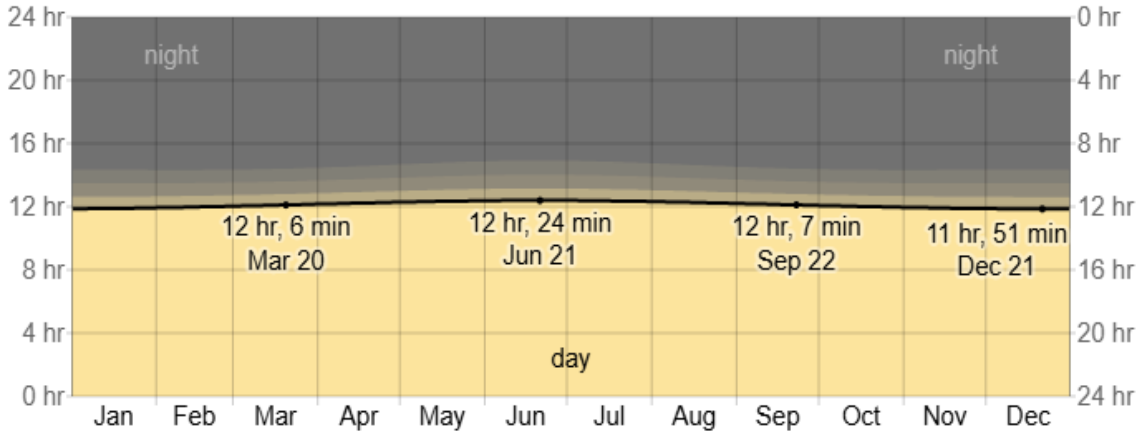

Figure 4.10: Average Sunshine Hours of the Project Area
Source: Nigerian Meteorological Agency Abuja and https://weatherspark.com

4.4 Air Quality and Noise Level Assessment

4.4.1 Air Quality

Assessment of atmospheric air quality was conducted in the course of this study. Owing to observations of several human activities around the proposed 750mw Gas-Fired Combined Cycle Power Plant project area, pollutant gases and suspended particles capable of impacting natural air quality, ecosystems and its biotic components and human health are likely to be emitted. Chances of pollutant gases such as CO_2, CO, NO_2, SO_2, H_2S, CH_4 and particulate matter are being emitted in moderate concentrations even with the notable presence of Oil and Gas companies and the human activity observed within the study boundary; necessitating measurement of these gases (Table 4.2) in the course of the ESIA study.

These pollutants, when present above the permissible levels, are known to affect man and his environment in a number of ways and this will increase over the years. Greenhouse gases (SPM, CO_2, H_2S, and $N0_2$) are likely to be generated in high concentrations in the proposed project area due to Gas flaring thereby impacting atmospheric “greenhouse effect” which will lead

to global warming and climate change. However, an environmentally friendly approach is recommended to be employed during project implementation and operation to ensure protection of the environment.

4.4.2 Noise Level

Noise level of the area was measured (Table 4.2). Noise within the proposed project area is determined by natural (birds) no serious human activities or vehicular movement as the site is dominated by vegetation. Establishment of power project during construction will determines noise level of the area, which in combination can impact on human health and also unbalance the ecosystem, causing migration of wildlife species.

Noise Level Discussion

Noise levels within and around the project site are within the range of 38.9 and 50.8 dB(A), lower than NESREA limit of 70 dB(A) for construction activities and FMEnv permissible limit for hourly of 90 dB(A). The low level of noise may be attributed to nature of the area with minimal commercial activities observed.

Plate 4.6: Photographs of activities around the project site capable of releasing nauseous gases into the atmosphere

Table 4.2: Result of Ambient Air Quality and Noise Level Measurements within the Project area (Rainy Season)

SAMPLE LOCATI	TIME	GE0GRAPHIC LOCATION Lat N Long E	TPS 2.5 (µg/m³)	TPS 10 (µg/m³)	NOISE Level dB(A))		RELATIVE HUMDITY %	WIND SPEED (m/s)		TEMP (^{0}C)	CH_4 ppm	TVOC ug/M³	CO ppm	CO_2 ppm	SO_2 ppm	NH_3 ppm	H_2S ppm	O_2	NO_2 ppm
					Min	Max		Min	Max										
A/N01	10:15am	4.553183° 8.013114°	59	78	41.2	44.7	80.3	0.9	1.1	28.1	0	0.008	**4**	426	0.7	0.003	0.007	20.1	0.3
A/N02	10:30am	4.552965° 8.015537°	48	74	48.6	50.2	80.7	0.8	1.3	28.6	0	0.005	**2**	416	0.02	0.002	0.006	18.8	0.02
A/N03	10:50am	4.553325° 8.018907°	52	76	47.2	49.9	80.0	0.7	1.6	28.1	0	0.024	2	415	0.05	0.003	0.009	20.5	0.02
A/N04	11:10am	4.554428° 8.018851°	49	65	43.1	48.9	81.8	0.6	1.1	29.0	0	0.014	1	413	0.02	0.006	0.006	20.3	0.02
A/N05	11:18am	4.554955° 8.017688°	45	68	45.8	50.8	80.3	0.9	1.7	27.7	0	0.012	1	407	0.02	0.006	0.008	19.7	0.02
A/N06	11:27am	4.556005° 8.016161°	47	61	39.9	41.5	81.4	0.8	1.2	27.8	0	0.009	**2**	401	0.02	0.004	0.002	20.9	0.03
A/N07	11:38am	4.555252° 8.015019°	46	62	41.9	46.0	80.8	0.8	1.0	28.4	0	0.016	1	412	0.02	0.004	0.005	19.1	0.02
A/N08	11:47am	4.554101° 8.014572°	46	61	45.8	49.1	80.0	0.6	1.1	28.8	0	0.026	0	417	0.01	0.004	0.004	20.1	0.02
A/N09	11:58am	4.553206° 8.010669°	51	66	42.5	50.2	80.5	0.6	1.7	28.5	0	0.018	3	422	0.02	0.002	0.003	20.1	0.03
A/N10	12:12 pm	4.552314° 8.007688°	43	62	44.7	46.7	80.0	0.7	1.9	29.6	0	0.024	1	413	0.02	0.003	0.002	19.9	0.02
A/N11 Cntrl	12:23pm	4.553830° 8.022405°	52	74	40.5	46.5	80.3	0.5	1.1	29.8	0	0.012	4	512	0.2	0.006	0.002	19.6	0.03
A/N12 Cntrl	12:34pm	4.554219° 8.025215°	49	71	41.6	44.4	80.0	0.8	1.1	28.1	0	0.024	1	423	0.4	0.004	0.004	20.9	0.02
A/N13 Cntrl	12:43pm	4.558405° 8.013227°	46	63	39.8	45.4	80.3	0.6	1.7	29.5	0	0.004	0	414	0.02	0.002	0.001	20.1	0.02
A/N14	12:54pm	4.558439° 8.016139°	50	64	38.9	43.1	80.6	1.2	2.3	29.1	0	0.019	0	411	0.02	0.004	0.003	20.1	0.02
A/N15 Cntrl	01:07pm	4.558422° 8.019118°	45	67	44.2	48.4	79.4	0.9	1.0	29.3	0	0.028	**1**	419	0.02	0.002	0.004	20.1	0.02
Equipment Detection limit			**0.01**	**0.01**	**30**		**10**	**0**		**10**	**0.01**	0.001	**0.1**	**-**	**0.00**	**0.00**	**0.00**	**1**	**0.01**

												1	1	1		
Minimum value	43	61	38.9	41.5	79.4	0.5	1	27.7	0	0.004	0	401	0.01	0.002	0.001	18.8	0.02
Maximum value	59	78	48.6	50.8	81.8	1.2	2.3	29.8	0	0.028	4	512	0.7	0.006	0.009	20.9	0.3
FMEnv/NESREA Limits	40/250	150/250	70		-	-		<40	-	-	10	-	0.01	0.05	0.05	-	0.06

Key - BDL: Below Detection Limit; AQ: Air Quality; NL: Noise Level; WS: Wind Speed; RH: Relative Humidity

Source: Field Study, 2025

Table 4.3: Result of Air Quality and Noise Level Measurement from secondary data within the Project area (Dry Season, 2020)

Sampling Station code	PM (mg/m^3)					VOCs (mg/m^3)	NO_2 (mg/m^3)	SO_2 (mg/m^3)	H_2S (mg/m^3)	CO (mg/m^3)	CH_4 (mg/m^3)	CO_2 (mg/m^3)
	1	2.5	7	10	TSP							
AQN1	0.001	0.011	0.047	0.165	1.06	0.16	0.001	0.09	0.12	0	1	980
AQN2	0.001	0.01	0.03	0.091	0.483	11	0.03	0.07	0.09	0	0	810
AQN3	0.001	0.021	0.04	0.132	0.5	0.166	0.02	0.01	0.07	0	0	912
AQN4	0.001	0.01	0.04	0.152	0.93	0.231	0.001	0.092	0.09	0	0	850
Mean	**0.20**	**0.51**	**1.43**	**2.11**	**0.74**	**2.89**	**0.01**	**0.07**	**0.09**	**0.00**	**0.25**	**888.00**
Stdv	**0.45**	**1.11**	**3.11**	**4.41**	**0.30**	**5.41**	**0.01**	**0.04**	**0.02**	**0.00**	**0.50**	**74.31**
FMEnv Limits	**0.250 (Daily mean of hourly values)**					**-**	**0.04-0.06**	**0.10**	**0.008**	**10**	**25**	**5000**

Source: FMEnv approved report (*EIA for the proposed Construction of Odoro Nkit-Okposio Road, Esit Eket-Ibeno LGA, Akwa Ibom State, 2020)*

Discussions

Pollutant Gases

Nitrogen dioxide (NO_2) is one of the several nitrogen oxides, a reddish-brown toxic gas characterized by a sharp, biting odour and is a prominent air pollutant. It is known that nitrogen oxides are derived from many sources such as lightning, biological discharges and releases from automobiles (Canter and Hill, 1977). NO_2 occurred minimally within the range of 0.02 to 0.3ppm, above FMEnv permissible limit of 0.06ppm around the gas flaring facility. lower vehicular movement and less commercial and food manufacturing ensured that the area is low of NO_2. However, precipitation is a strong reason for these low concentration obtained during field study. The concentration of NO_2 (Nitrogen Dioxide) gases is higher in the atmosphere during gas flaring, as it is one of the pollutants produced by the combustion process.

Carbon monoxide (CO), is a colourless, odourless, non-irritating but poisonous gas produced from incomplete combustion of fuel such as natural gas, coal or wood. CO emission recorded within the study area ranged between 0 and 4 ppm, lower than FMEnv permissible limit of 10 ppm. No major roads constituting heavy vehicular traffic were observed within the proposed 750mw Gas-Fired Combined Cycle Power Plant project area.

Carbon dioxide (CO_2), a greenhouse gas present naturally in the atmosphere and vital to living organisms, is also generated naturally human and animals that exhales it as waste product, and human activities which primarily are energy production, including burning coal, oil, or natural gas, as well as agricultural activities which includes farm clearing. This gas, when in excess concentration in the atmosphere impact on the greenhouse effect causing Global Warming and Climate Change which further affects the health and wellbeing of all living things, destroys ecosystem, human civilization, and reduce food production through excess heat and flood. This gas occurred between the range of 401 and 512 ppm which is within the excellent region of the CO_2 scale.

Sulfur oxides especially sulfur dioxide, a chemical compound with the formula SO_2. It is produced by various industrial processes. Since petroleum often contain sulfur compounds, their combustion generates sulfur dioxide. Further oxidation of SO_2, usually in the presence of a catalyst such as NO_2, forms H_2SO_4, and thus acid rain. This is one of the causes for concern over the environmental impact of the use of these fuels as power sources. In this study, Sulphur dioxide values in the project area ranged from 0.01 – 0.7 mg/m^3. The standard deviation is 0.04. These values

obtained were below the FMEnv limit of 0.10 mg/m^3 for most of the sampling stations except for point A/N01 and A/N11. At these stations, values exceeded FMEnv limit.

Hydrogen Sulphide (H_2S): Hydrogen sulphide in the project area ranged from 0.001-0.009 mg/m^3 with a mean of 0.04 mg/m^3 with a standard deviation of 0.02. These values obtained were within the FMEnv limit of 0.008 mg/m^3. Hydrogen sulphide is both an irritant and a chemical asphyxia with effects on oxygen utilisation and the central nervous system. Repeated exposure can result in health effects occurring at levels that were previously tolerated without any effects.

Volatile organic compounds (VOC):

VOCs was detected between the range of 0.004 and 0.028ppm within the proposed 750mw Gas-Fired Combined Cycle Power Plant project area. Some VOCs which are organic chemicals that have a high vapour pressure at ordinary temperature and are pollutant compounds that contaminate the air are dangerous to human health as well as the environment.

Suspended particulate matter

Suspended particulate matter across the proposed 750mw Gas-Fired Combined Cycle Power Plant project area is relatively low, ranging between 41.5 and 81.8 μmg/m^3 as against FMEnv permissible limit of 0.25 mg/m^3. Sources of SPM within the project area are flaring activities. Increased levels of fine particles in the air are linked to health hazards such as heart disease, malfunctioning of the lung and lung cancer.

Comparing data obtained for wet season against dry season

Generally, the result obtained from both the primary data in wet season and secondary data obtained in dry season does not show remarkable

variations. However, CO values appear to be high in wet season when compared to data obtained for dry season in 2020. Carbon monoxide was not detected in dry season.This could be attributed to the increased industrial presence in the area in recent years and location difference. Methane was not detected in both seasons. Carbon dioxide concentration values obtained from secondary data within the project area ranged from 712 - 980ppm with a mean of 884ppm in dry season (Table 4.3) and values obtained during wet season are very much lower (Table 4.2).

4.5 Geology and Hydrogeology of the Project Environment

Regional Geology

The project area is in the Niger Delta basin which is situated in the continental margin of the Gulf of Guinea in the equatorial West Africa, between latitudes 3° and 6° N and longitudes 5° and 8° E. It ranks amongst the world's most prolific petroleum producing Tertiary deltas that together account for about 5% of the world's oil and gas reserves, and for about 2.5% of the present day basin area on the earth.

The Niger Delta occupies an area of about 75,000 km^2 with clastic fill of about 12,000m thickness. The structural framework of the Niger Delta is a triple point spreading centre which has resulted in a limited area of basin fill and stacking of deposystem. The Niger Delta extends from Calabar flank and the Abakaliki trough in eastern Nigeria to the Benin flank in the west and it opens to the Atlantic Ocean in the south.

The study of depositional environment and sedimentary facies in the Niger Delta established a lithogenic model that relate facies variation with high energy wave dominated, constructional, accurate lobate

tropical delta as palaeo-environmental, sedimentological and stratigraphic interpretation of the Cenozoic succession in the Niger Delta. It displays a concentric arrangement of terrestrial and transitional depositional environment that can be broadly categorized into three distinct facies belts (Short and Stauble, 1967):

- The Continental delta. “Top facies” - The Benin Formation
- The Paralic delta. “Front facies” - The Agbada Formation
- The Pro-delta Facies - The Akata Formationa.

The Benin Formation is the uppermost unit and extends its limit from West to East side for the whole Niger Delta area and southward beyond the present coastline. This formation, which is of interest to the proposed project, is composed of 90% sandstone with shale intercalations. Its thickness is variable but generally exceeds 1800 metres. The Agbada Formation, which consists of sandstone and shales, underlies the Benin Formation. It consists of an upper predominantly sandy unit with minor shale intercalations and a lower shale unit, which is thicker than the upper one. The Akata Formation consists of mainly dark grey sandy, silty shale with plant remains at the top. This Formation is over 1200m thick and ranges in age from Eocene to Recent. The younger sediments (Holocene) found near the present shoreline consists of barrier beaches, coastal-barrier sands and river mouth sand bars which merge into laminated sandy and silty clays and eventually into fine clays on the continental shelf, edge and continental slope seaward (Allen, 1964, 1965).

4.5.1 Relief and Topography

The project area has relatively flat terrain with no significant elevations. There were also no significant outcrops in the area. The topmost formation (Benin formation) is overlain by various quaternary deposits.

4.6 Soil of the project area

Ibeno Local Government Area, situated on the coastal plain, has soils that are primarily Ultisols, derived from weathered sandy parent materials of the Cross River, Qua Iboe River, and the Gulf of Guinea. These soils are generally characterized by low fertility, high susceptibility to erosion, and low-activity clays. Due to significant oil and gas activities, the soil quality is often degraded, exhibiting pollution from heavy metals like cadmium and copper, and changes in physicochemical properties such as increased acidity from gas flaring. The texture of the soils in the area is generally sandy except in the subsoil of where the texture is sandy loam and clay. The sand content is very high and above 50% in most places sampled while the silt and clay contents are low. The contents of these smaller particles are more in the subsoil (15 - 30cm) than in the top (0 - 15cm) soils. Tables 4.4 and 4.5 show the physico chemical characteristics of soils in the study area during wet season and dry season.

Table 4.4: Physico-chemical Properties of soil Samples at the Project Environment (Wet Season)

S/N	PARAMETERS	FMENV LIMIT	SS1 PP	SS2 PP	SS3 PP	SS4 PP	SS5 PP	SS6 PP	SS7 PP	SS8 PP	SS9 PP Control 1	SS10 PP Control 2
1	P^H	6.5 – 8.5	8.06	7.53	8.22	7.83	8.14	8.22	7.62	8.24	7.87	8.13
2	Permeability %	-	47.3	43.6	38.4	42.8	53.0	46.1	52.4	48.3	50.8	47.3
3	Porosity %	-	52.1	45.2	50.8	40.6	44.9	53.6	48.2	50.6	46.2	52.1
4	Bulk density mg/kg	-	1.43	1.32	1.40	1.82	1.34	1.43	0.93	1.42	153	0.86
5	Sand %	-	46.2	48.6	42.7	40.3	43.8	46.2	40.2	39.8	42.0	37.4
6	Clay %	-	22.5	30.8	32.8	33.0	29.0	28.1	32.4	36.0	30.3	34.8
7	Silt %	-	21.3	20.6	24.5	26.7	17.2	15.2	27.4	24.2	27.7	27.8
8	E. Cond. (µs/m)	1000	82.4	70.4	68.3	72.6	74.1	53.3	82.4	66.9	70.8	68.3
9	Moisture Content %	-	24.38	15.83	28.14	24.65	27.53	17.64	20.82	19.32	22.14	19.72
10	Nitrate (mg/kg)	-	1.083	0.152	1.141	0.258	1.073	1.171	1.148	1.126	1.052	1.130
11	Phosphate (mg/kg)	-	1.618	1.431	1.216	1.134	1.128	0.216	1.211	0.327	1.028	0.162
12	Sulphate (mg/kg)	-	0.342	0.254	1.082	0.813	1.036	0.153	0.715	0.634	0.263	0.214
13	Calcium (cmokg)	-	84	154	128	173	92	138	92	74	108	120
14	Magnesium cmokg	-	26.38	84.36	42.86	94.63	30.86	92.16	30.86	22.63	73.18	87.22
15	Potassium (cmokg)	-	12.34	10.42	9.84	11.63	9.62	12.42	9.52	8.44	10.24	8.63
16	Sodium (cmokg)	-	34.6	32.18	23.4	62.8	64.3	42.6	28.3	44.6	11.6	23.6
17	THC (mg/kg)	50	3.183	2.476	3.251	4.172	3.152	2.817	3.164	2.321	1.974	2.164
18	Vanadium (mg/kg)	-	0.324	1.215	1.032	0.182	0.241	1.043	1.118	0.426	1.204	1.315
19	Nickel (mg/kg)	-	1.218	0.324	1.152	1.050	1.082	1.132	1.125	1.052	0.813	1.038
20	Iron (mg/kg)	-	8.632	6.428	4.321	8.324	6.172	7.631	8.293	6.413	7.453	6.824
21	Lead (mg/kg)	-	1.341	0.974	1.247	0.816	1.304	2.012	1.624	1.052	1.013	1.216
22	Copper (mg/kg)	-	2.652	2.143	2.824	1.934	1.638	2.183	2.014	2.107	1.924	2.153
23	Zinc (mg/kg)	-	15.624	18.251	16.728	14.346	13.183	15.341	18.256	16.314	15.822	14.624
24	THB cfu 1/100g	100	3.0×10^2	2.6×10^2	3.1×10^2	3.4×10^2	3.6×10^2	3.2×10^2	3.6×10^2	3.0×10^2	3.1×10^2	3.4×10^2
25	THF cfu 1/100g	100	2.8×10^2	2.4×10^2	2.6×10^2	2.8×10^2	2.4×10^2	2.6×10^2	2.4×10^2	2.4×10^2	2.4×10^2	2.6×10^2
26	HUB cfu 1/100g	100	2.4×10^2	2.2×10^2	2.4×10^2	2.3×10^2	2.4×10^2	2.4×10^2	2.1×10^2	2.1×10^2	2.1×10^2	2.4×10^2
27	HUF cfu 1/100g	100	2.0×10^2	1.8×10^2	1.6×10^2	1.7×10^2	1.9×10^2	1.8×10^2	1.7×10^2	1.5×10^2	1.5×10^2	1.4×10^2

Key:

mg/Kg = milligram per kilogram
µS/cm = micro-Siemens per entimetre
cfu/g = colony forming unit per gram
NS = Not stated
ND = Not Detected
TNTC = Too numerous to count
Cmol/Kg = centimole per kilogram
THF- Total heterotrophic fungi,
THB- Total heterotrophic bacteria,
HUF- Hydrocarbon utilizing fungi,
HUF- Hydrocarbon utilizing fungi
cfu/g – colony forming unit per gram

Source: ESIA Field Study/lab analysis, August 2025

Discussions

Depth: The soil samples at different sampling locations were taken from topsoil at a depth of 0 -15cm, and 15 – 30cm in each of the sampling points.

pH: The result of the physical and chemical parameters of soil from the project area is shown in table 4.4. The soil pH values recorded from the samples shows that pH decreases with increase in soil depth and all within the range of 7.53, and 8.24. These values show characteristics of alkaline on pH scales. Coastal soils can show diverse pH levels depending on specific geographic and geological factors, such as the type of sand or the influence of nearby sand dunes.

Texture: The soil observed in the project area ranged from sand, silt to clay with the sand fraction varying from 37.4–48.6%. The percentage sand content generally decreased with depth at any particular sampling point. The percentage clay content varied from 22.5– 36.0% while the silt content varied from 19.0– 22.7%.

The texture of a soil determines the water absorption/infiltration rate, the water holding capacity and migration of pollutant down the soil strata (Margesin and Schinner, 2005). It also determines the amount of soil aeration, ease of tilling, and soil fertility (Udoh 1986).

Low clay and high sand soil is porous and will permit easy percolation of nutrients and pollutants to the groundwater table. Other parameters that determine the dynamics of pollutants in soil include bulk density and porosity. The bulk density in particular gives a rough estimation of the aeration and permeability of a soil. The lower the bulk density, the higher is the permeability (Margesin and Schinner, 2005). Bulk density varies with structural conditions of the soil. Therefore, it is related to packing and often used as a measure for soil structure.

Nitrate (NO_3^-): Nitrate from the sampling points varies between 0.152 to 1.171 mg/kg and decreases with increasing soil sampling depth. Nitrates

are highly soluble compounds and as such move readily and available to plant roots at the top soil. Nitrates are also subject to leaching if they move out of the root zone and can eventually cause contamination of groundwater if present in excess. Nitrate is a byproduct of biological decay from the plant and animal matter. High concentrations can be found in rural, farming areas where fertilizers are regularly used. However, due to the absence of heavy farming activities, the value of nitrate from study area may be attributed to natural processes like plant residue decomposition and animal manure on the area.

Hydrocarbon Level in Soil

The summary of results of oil and grease, total petroleum hydrocarbon concentrations measured in the soil samples across the project zone of influence and control stations are presented in Table 4.4. Total hydrocarbon content ranged from 1.974 mg/kg to 4.172 mg/kg. Values lower than these ranges were reported in previous studies carried out in the area in dry season (Table 4.5). The distribution of these pollutants was more or else even across the sampling stations (low coefficient of variation), showing that they are possibly from the same source of which biogenic is most probable.

Soluble Anions

Sulphate (SO_4^{2-}): The concentrations of sulphate ion in the area are in the range of 0.153 to 1.082 mg/Kg. Sulphate is one of the ingredients required for the formation of acid sulphate soil which may affect key environmental values or uses such as aquatic ecosystem, drinking water, recreation and aesthetics.

Phosphate (PO_4^{2-}): Phosphate contents are within the range of 0.162 to 1.618mg/Kg. Just like any other soil nutrient, its concentration decreases with an increase in soil sampling depth. Phosphorus-containing compounds are essential for photosynthesis by plants for energy transformations and for the activity of some hormones in both plants and animals.

Exchangeable Cations: The highest concentration of the cations in the study area is calcium which varies between 74 to 154 mg/Kg, the range of concentration of magnesium is between 22.63 to 94.63mg/Kg while Sodium concentration ranges from 11.8 to 64.3 mg/Kg, the range of concentration of potassium is between 8.44 to 12.42mg/Kg. Exchangeable cations are responsible for nutrient mobility in soil. Calcium and magnesium levels are primarily affected by soil type, drainage and cultural practices. Concentrations of both ions increase with increasing soil pH.

Heavy Metals: The heavy metals tested for in this study include V, Ni, Fe, Pb, Cu and Zn. The concentration of iron detected ranges from 4.321 – 8.632 mg/Kg, Zinc shows a concentration range of 13.183 – 18.256 mg/Kg. Copper shows a concentration range of 1.638 – 2.652 mg/Kg. Lead detected ranges from 0.816 - 2.012 mg/Kg. Heavy metals with severe adverse health effects on human metabolism including (Lead, and Mercury) present obvious concern due to their persistence in the environment as well as documented potential for serious health implications.

Soil Micro-organisms

The microorganisms and macro-fauna work together as a team in organic matter decomposition. The microorganisms of concern in this study were fungi and bacteria and these play important roles in the transformation of

soil nutrients. The pre-dominant heterotrophic bacterial isolates were *Serratia* sp, *Bacillus* sp, *Escherichia* sp, *Pseudomonas* sp, *Vibro* sp, *Flavobacterium* sp and *Alkalegene* sp. Total Heterotrophic Bacterial population varied from 2.6 x 10^2 to 3.6 x 10^2 cfu/g. Total Heterotrophic Fungi population recorded 2.4 to 2.8 x 10^2 cfu/g for all the samples. Hydrocarbon Utilizing Bacteria showed noticeable presence. Their populations varied from 2.0 x 10^2 to 2.2 x10^2cfu/g. The percentage of HUB is indicative of moderate levels of utilization of petroleum products in the study area. Hydrocarbon utilizing fungi population ranged from 1.4 x 10^2 – 1.6 x 10^2 cfu/g. The major fungal isolates are *Pseudomonas* sp, *Candida sp*, *Aspergillus sp* and *Mucor sp*.

Table 4.5: Physico-chemical Properties of Soil Samples from Secondary data within the Project area (Dry Season, 2020)

S/N	PARAMETERS	Soil 1		Soil 2		Soil 3		Soil 4	
		S	SS	S	SS	S	SS	S	SS
1	pH	4.33	5.76	5.02	6.48	5.11	6.92	6.03	7.17
2	Colour (Pt Co)	Light brown	Dark brown	Light brown	Dark brown	Light brown	Dark brown	Light brown	Dark brown
3	THC (mg/kg)	0.198	0.054	0.601	0.214	0.051	0.008	0.464	0.098
4	Nitrate (mg/kg)	46.04	29.19	56.64	43.56	53.32	37.82	21.41	18.94
5	Sulphate (mg/kg)	12.22	9.64	5.40	5.12	9.08	7.26	8.63	5.44
6	Moisture Content (%)	25%	33%	28%	31%	25%	29%	36%	28%
7	Particle Size Distribution (%)	92% sandy 8% loamy	3% Sandy 97% loamy	90% Sandy 10% loamy	6% Sandy 94% Loamy	88% Sandy 12% loamy	15% Sandy 85% loamy	95% Sandy 5% loamy	95% Sandy 5% loamy
8	Vanadium (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
9	Nickel (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
10	Iron (mg/kg)	10.28	7.63	8.33	5.46	11.81	9.02	6.05	4.87
11	Lead (mg/kg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
12	Copper (mg/kg)	<0.001	<0.001	0.021	0.018	<0.001	<0.001	<0.001	0.006
13	Zinc (mg/kg)	0.181	0.190	0.132	0.041	1.872	0.465	0.282	0.014
	Micro – organisms								

14	Faecal Coliform (MPN/100g)	65	75	60	65	75	70	80	70
15	THB ($x10^4$ cfu/g)	3.2	2.8	5.5	3.8	4.2	2.4	5.7	4.0
16	THF ($x10^4$ cfu/g)	2.9	5.1	3.7	3.0	5.6	3.4	2.4	3.8
17	HUB ($x10^4$ cfu/g)	2.6	2.1	4.6	3.2	3.9	1.8	4.1	3.4
18	HUF ($x10^4$ cfu/g)	2.5	4.3	3.0	2.6	4.1	2.9	1.7	3.0

Source: FMEnv approved report **(***EIA for the proposed Construction of Odoro Nkit-Okposio Road, Esit Eket-Ibeno LGA, Akwa Ibom State, 2020).*

4.7 Soil Fauna of the Project Site

The soil macro-fauna identified in the study area include various arthropods (*Myricarid striata, Dorylus fimbriatus, Glomens marginata*), Annelids (Earthworms) and Nematodes (*Acanthamoeba polyphaga, Acrobeloides sp, Porcellia scraber*) (Table 4.6). These organisms are primary consumers; decomposers, mixers and utilizers of energy stored in plants and plant residues, and contribute to the recycling of nutrients. Others are secondary consumers such as centipedes and spiders. These animals consume smaller sized animals and they, also may serve as food for organisms occupying higher levels of the food chain.

Soil fauna are notable and are critical in the biological turnover and nutrients release of plant residues by fragmenting the plant residues, resulting in enhanced microorganism activities and grazing of microflora by fauna. Anderson and Fletcher (1988) noted a symbiotic interaction between earthworm and microorganism in the breakdown and fragmentation of organic matter.

Three genera (*Hyperiodrilus, Ephyriodrilus* and *Eudrilus)* were encountered in the present study. The earthworms were mainly encountered in the moist-wet soils of the Douglas Creek areas. Their populations are said to relatively high during the wet season compared to the dry season.

Table 4.6: Soil Fauna Encountered in soils of the Study Area

Group	Scientific Name
Nematode	*Acanthamoeba polyphaga*
	Acrobeloides sp
	Porcellia scaber
	Phabditis sp
Annelids	*Allolobophora caliginosa*
	Octolasion lacteum
	Eudrilus eugenine
Arthropods	*Myrmicarid striata*
	Dorylus fimbriatus
	Glomens marginata
Myripoda	*Spirotreplus sp*
	Lithobius sp
Arachnida	*Gastrocantha sp*

Source: Field Study, 2025

4.8 Hydrology and Hydrogeology

Fresh water resources are an essential component of the earth's hydrosphere and an indispensable part of all terrestrial ecosystems. The fresh water environment is characterized by the hydrological cycle, including floods and droughts. Global climatic change and atmospheric pollution could also have an impact on fresh water resources and their availability. Water is a vital source of life especially for drinking, input for crop, forage, and fodder growth, input for artisan and industrial activities. Groundwater and surface water are fundamentally interconnected. It is often difficult to separate the two because they feed (complement) each other. The source of groundwater (recharge) is through precipitation or surface water that percolates downward. Hence, one can contaminate the other.

4.8.1 Groundwater Study within the proposed project area

Akwa Ibom State has significant groundwater resources within three main aquifer systems, primarily the shallow unconfined Coastal Plain Sands aquifer, composed of coarse-grained, pebbly sands with clay. This aquifer is widely exploited by the population, with high potential for sustainable use due to high rainfall and recharge rates. However, coastal areas like the project area face the risk of saltwater intrusion, requiring careful monitoring to prevent sea water contamination. Groundwater quality in some coastal areas is poor, showing acidity, salinity, and bacterial contamination, indicating a need for treatment before domestic consumption.

Most residents receive water supply through borehole facility installed in their houses. Therefore, sample of groundwater are sourced from two (2) boreholes within the site and a control point 570m to the site.

Parameters investigated for groundwater in the proposed 750mw Gas-Fired Combined Cycle Power Plant environment are levels of heavy metals: Lead (Pb), Mercury (Hg), Arsenic (as), Fe (iron). Other parameters include pH, Electrical Conductivity, Nephelometric Turbidity Unit (NTU), Alkalinity, Hardness, Chlorine, Total Dissolved Solids (TDS), Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulphate (So_4^{2-}), Nitrate (No_3^-) and oil contamination where relevant. also, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Temperature were analyzed. Microbiology analysis of water sample was also carried out. Table 4.7 presents analysis for groundwater.

Table 4.7: Result of Physico-chemical Analysis of Groundwater sample collected from borehole (Wet Season)

S/N	PARAMETERS	UNIT	FMEnv MAXIMUM PERMISSIBL	WHO MAXIMUM PERMISSIB	GWC2	GW1
					Lat 4.561194°	Lat

			E LIMITS	LE LIMIT	Long 8.016468°	4.552374° Long 8.015008°
PHYSICO- CHEMICAL PARAMETERS						
1	General Appearance		CLEAR	CLEAR	Coloured	Clear
2	Temperature	^{O}C	40	40	27.4	27.6
3	Electrical Conductivity	µS/cm	1000.00	NS	93	106
4	pH		6.0-9.0	6.5-9.0	8.01	7.28
5	Turbidity	NTU	10.00	5.00	26.4	3.84
6	Colour	Pt.co	10.00	5.00	Cloudy	Clear
7	Total Dissolved solid	Mg/L	2000.00	500.00	53	53
8	Total Suspended Solid	Mg/L	NS	NS	1.822	0.008
10	Total Hardness	Mg/L	NS	NS	750	60
14	Salinity	Mg/L	NS	NS	64.32	42.84
ORGANICS						
16	Dissolved Oxygen (DO)	Mg/L	NS	NS	24.8	3.2
17	Chemical oxygen demand (COD)	Mg/L	40.00	60-90	3.14	5.68
18	Biological oxygen demand (BOD)	Mg/L	30.00	30-50	1.62	9.84
ANIONS						
23	Nitrate	Mg/L	10.00	10.00	1.135	0.052
24	Phosphate	Mg/L	5.00	3.50	1.613	0.154
25	Sulphate	Mg/L	500.00	500.00	0.622	0.218
METALS						
27	Cadmium	Mg/L	<1.0	0.00	0.043	0.028
28	Lead	Mg/L	<1.0	0.10	0.531	0.002
30	Iron	Mg/L	0.36	0.5	0.482	0.041
	Zinc	Mg/L	<1.0		2.175	3.428
31	Chromium	Mg/L	0.05	0.20	0.018	0.014
32	Copper	Mg/L	0.01	1.00	0.541	0.638
33	Barium	Mg/L	-	-	0.018	0.014
MICROBIAL PARAMETERS						
40	Total Heterotrophic Bacterial (THB)	cfu/ml	10	10	2.2 x 10	1.6 x 10
42	Total coliform (TC)	cfu/ml	30	30	4	3
43	Feacal coliform	cfu/ml	0	0	10	8

	(FC)					

Key:
mg/Kg = milligram per kilogram
mg/L = milligram per litre
µS/cm = micro-Siemens per entimetre
cfu/g = colony forming unit per gram
NS = Not stated
ND = Not Detected
TNTC = Too numerous to count
Cmol/Kg = centimole per kilogram
Source: ESIA field Study/lab analysis, August 2025

Discussion

pH: The pH values recorded are 7.28 and 8.01. These values are alkaline on the pH measuring scale which falls within FMEnv permissible limit for portable water. pH value expresses the acidity or alkalinity of the water or the concentration of hydrogen ions in the groundwater.

Total Dissolved Solids (TDS): TDS comprises inorganic salts and small organic salts dissolved in water. In this study, total dissolved solids concentration detected is 53mg/L for both samples. This value is within FMEnv permissible limit for groundwater.

Turbidity and Colour: The concentration of turbidity detected is 3.84 NTU and colour is clear for water sample collected from the site, turbidy detected from the water sample at the control point is 26.4 which are far above regulatory limit. The water appears cloudy and coloured. Turbidity describes the cloudiness of water caused by suspended particles such as clay and silts, chemical precipitates such as manganese and iron, and organic particles such as plant debris and organisms (APHA/AWWA/WEF, 2012; Health Canada, 2012).

Total hardness: is the combined amount of calcium and magnesium ions dissolved in water, typically expressed as milligrams per liter (mg/L) or

parts per million (ppm) of calcium carbonate (CaCO3). It's a measure of the water's mineral content and can affect its suitability for various uses. The water analysis indicates value 60 mg/L from the sample taken on site and 750 mg/L from the control source.

Water Anions

Nitrate (NO_3^-): Nitrate and Nitrite concentrations were 0.052 mg/L onsite and 1.135 mg/L for control. Both are within FMEnv permissible limit of 16.8 mg/L. Nitrate is a colourless, odourless and tasteless compound present in groundwater. Too much nitrate in drinking water poses a risk to infants under six months of age as it results to a condition called blue baby syndrome or methemoglobinemia.

Sulphate (SO_4^{2-}): The concentration of sulphate in the sample is 0.218 and 0.622 mg/L for onsite and control sample respectively. This is within FMEnv permissible limit. Sulphate is a substance that occurs naturally in water.

Phosphate (PO_4^{3-}) & BOD: Phosphate concentration is 0.154 and 1.613 mg/L in the sample from the site and the control point respectively. Biochemical Oxygen Demand is 9.84 and 1.62 mg/L for the project site and the control sample respectively. Biochemical Oxygen Demand (BOD) measures the amount of dissolved oxygen consumed by aerobic bacteria to break down organic matter in a water sample. A higher BOD value indicates more organic pollution, depleting dissolved oxygen essential for aquatic life.

Heavy Metals: Heavy metals are persistent pollutants that can accumulate in the food chains becoming increasingly dangerous to humans and Fauna. Heavy metals investigated in the sample include Iron, Copper, Cadmium, Lead, Chromium, Mercury iron and Zinc. Heavy element detected at a low

concentration of Iron 0.041- 0.482 mg/L, Lead 0.002 - 0.531 mg/L, Copper 0.638 - 0.541 mg/L, Zinc 3.428 - 2.175 mg/L, Cadmium 0.028 - 0.043 mg/L and Chromium 0.014 - 0.018 mg/L respectively. Most of the heavy metals were detected slightly above FMEnv/WHO limit.

Total Coliform, Total Bacterial THB, Total Fungi and Feacal Coliform**:** Total coliform counts in the water sample ranged from 3 to 4 MPN/100ml. Total heterotrophic bacteria (THB) in the water samples ranged from 1. 6 x 10 to 2.2 x 10^3 cfu/ml. The predominant genera of bacteria isolated from the water samples were *Bacillus*, *Pseudomonas* and *Enterobacter*. Fungal population density was said to be lower than bacteria population. Feacal coliforms were within the range of 8 to 10 cfu/ml.

4.8.2 Surface Water Study within the proposed Project area

The project area is drained by a surface water body locally called Adick Mkpank (Douglas Creek) that flows 10m Northern axis ward of the project site. The river meanders through the project area and drained into Qua Iboe River and into the Atlantic Ocean. The River is characterized by brown oily surface (Plate 4.7). During the raining season, it volume increases by 40% reach a height almost at the bridge level. The bank of the River has ever green fauna all through the year characterized by Nipa palm (*Nypa fruiticans*) and *Musa species*, ferns and grasses Samples of the water and sediment were taken at three points from the River (Upstream, 200m midstream and 400m downstream). Results of the analysis are presented in Table 4.8 and 9.

Plate 4.7: Photographs of Douglas Creek showing its characteristics

Table 4.8: Physico-chemical analysis of surface water samples collected (Wet Season)

S/N	PARAMETERS	FMENV LIMIT	SW1 PP	SW2 PP	SW3 PP	SW4 Control
1	Temperature ^{O}C	29.0	25.7	26.1	27.4	27.3
2	P^{H}	6.5 – 8.5	8.52	8.34	8.42	8.45
3	Colour	-	Cloudy	Cloudy	Cloudy	Cloudy
4	Turbidity (NTU)	<5	23.82	36.2	51.3	46.3
5	Salinity as Cl^{-} mg/l	250	87.62	44.93	103.62	84.28
6	Total Hardness mg/l	250	1.860	3150	2420	2400
7	E. Conductivity µs/cm	1000	1321	1221	1456	1651
8	Dissolved Oxygen mg/l	>4.0	1.84	1.76	1.93	1.74
9	Biological Oxygen demand mg/l	150	1.68	1.24	1.18	1.32
10	Biological Oxygen demand mg/l	150	3.26	2.88	2.26	2.64
11	Total Hardness Content mg/l	<10	2.154	2.318	1.946	2.634
12	Phosphate mg/l	-	1.813	1.728	1.530	1.524
13	Sulphate mg/l	250	1.528	1.606	1.354	1.812
14	Nitrate mg/l	10	1.274	1.243	1.163	1.214
15	Total Disolve Solid	400	814	576	635	759
16	Total Suspended Solid mg/l	<10	2.613	2.824	3.187	2.421
17	Copper mg/l	0.01	0.648	1.216	0.724	1.316
18	Iron mg/l	0.36	1.251	1.428	1.351	1.243
19	Lead mg/l	<1.0	0.873	1.264	0.793	0.873
20	Zinc mg/l	<1.0	1.654	2.144	2.318	1.647
21	Cadmium mg/l	<1.0	0.413	0.328	0.342	0.218
22	Chromium mg/l	0.05	0.152	0.164	0.154	0.139
23	Potassium mg/l	-	1.821	1.652	1.813	1.711
24	Barium mg/l	-	0.028	0.022	0.030	0.026
25	Faecal Coliform cfu1/100	0	24	18	22	26
26	Total Coliform cfu1/100	0	11	6	8	7
27	Total Heterotrophic Bacteria	100	2.6×10^{3}	2.8×10^{2}	2.4×10^{2}	2.3×10^{2}

Key:
SW = Surface water sample code

mg/l = milligram per litre, µS/cm = micro-Siemens per centimetre,

cfu/ml = colony forming unit per milliliter

TNTC = Too numerous to count

Source: Field Study, 2025

Discussions

The result of physical and chemical parameters of Douglas Creek from the study area is shown in Table 4.8. All the water samples from the River analyzed were within alkaline in nature. The mean pH values of the water samples ranged from 8.34 to 8.52. The values fall within the FMEnv permissible level for surface water.

Electrical Conductivity (EC) is a measure of the ability of a water sample to convey an electrical current and it is related to the concentration of ionized substances in water. The mean conductivity values recorded ranged from 1221µS/cm to 1651µS/cm. This is beyond FMEnv limit. The salinity values of the water sample ranges from 44.93mg/L to 103.62mg/L; while that of Total Suspended Solids were within the range of 2.421 and 3.187 mg/L. The Total Dissolved Solids were within the range of 576 and 814 mg/L. This is above FMEnv limit but lower than the WHO (2011) permissible level of 1500mg/L. The mean colour values recorded ranged between 50 Pt-Co and 60 Pt-Co units. Natural waters can range from <5 in very clear waters to 300 Pt-Co units in dark peaty waters (Chapman, 1996). The mean DO values recorded ranged from 1.174 mg/L to 1.93 mg/L.

The mean BOD @ 20 – 25^{0}C value recorded ranged from 2.26mgl to 3.326mg/L. In the absence of National regulatory limits for these parameters for aquatic life, the EU standard was used. For fisheries and aquatic life, the EU sets a BOD standard of 3 – 6 mg/L (Radojevic and Bashkin, 1999). The mean COD values ranged from 1.18mg/L to 1.68 mg/L.

Phosphate values ranged from 1.524 mg/L to 1.813 mg/L. Sulphate values ranged from 1.354 mg/L to 1.812 mg/L. Concentrations in natural water are usually between 2 and 80 mg/L; high concentration (>400 mg/L) may make water unpleasant to drink. Nitrogen compounds are of interest to environmentalists because they are both essential nutrients, beneficial to living organisms, and pollutants with potentially harmful consequences. Nitrate and nitrite are indicators of nitrogen loading of waters. The mean nitrate values recorded in this water sample ranged from 1.163 to 1.274 mg/L.

Heavy metals investigated in the sample include Copper, Iron, Lead, Zinc, Cadmium, Chromium, and Barium. Heavy element detected at a low concentration ranging from 0.648 - 1.316 mg/L for Copper, 1.243- 1.428 mg/L for Iron, 0.793 - 1.264 mg/L for Lead, 1.647 - 2.318 mg/L for Zinc, 0.218 - 0.413 mg/L for Cadmium and 0.139 - 0.164 mg/L for Chromium. The concentrations of heavy metals in the water samples were generally low. However, most were detected slightly above FMEnv limit.

Microbiology

The result of microbial analysis of Douglas Creek from the study area is shown in Table 4.8. Total coliform counts in the water sample ranged from 6 to 11 MPN/100ml. Total heterotrophic bacteria (THB) in the water samples ranged from 2.3 x 10^2 to 2.6 x 10^3cfu/ml. The predominant genera of bacteria isolated from the water samples were *Bacillus*, *Pseudomonas* and *Enterobacter*.

Results Comparison: values obtained at three points around the site exceeded most of the values obtained at the control point except for parameters such as electric conductivity, copper and faecal coliform. The

results of surface water obtained from both seasons shows no remarkable variations. Douglas creek, Mbai and Epeti streams showed similar trend and characteristics. However, Douglas creek had more alkaline and a much higher electric conductivity when compared to the secondary data from dry season.

Table 4.9: Physicochemical properties of sediment samples from Douglas Creek

S/N	PARAMETERS (Units in mg/Kg) accepted stated	SED01	SED02
		4.554638° 8.020172°	4.555570° 8.030494°
A	**PHYSICAL TEST**		
1	Electrical Conductivity	68.3	72.4
2	PARTICLE SIZES/TEXTURE	SAND/SILT/CLAY 54.80/9.0/27.80	SAND/SILT/CLAY 53.60/10.0/24.80
3	pH	8.13	8.15
4	Bulk Density	2.311	2.376
5	Sodium Adsorption Ratio (SAR)	0.044	0.048
B	**MACRO NUTRIENTS**		
6	Total Potassium	8.80	7.15
C	**ORGANICS**		
7	Oil and Grease	0.110	0.112
8	Total Organic Nitrogen	0.027	0.032
C	**ANIONS**		
9	Nitrate	1.130	0.152
10	Phosphate	0.162	0.215
11	Sulphate	0.214	1.082
D	**METALS**		
12	Calcium	120	124
13	Magnesium	87.22	82.40
14	Sodium	23.6	46.3
15	Lead	0.032	0.042
16	Iron	6.824	4.931
17	Chromium	7.265	8.700
E	**MICROBIAL PARAMETERS**		
18	Total Heterotrophic Bacterial (THB)	3.4 x 10	3.0 x 10
19	Total Heterotrophic Fungi (THF)	2.6 x 10	2.8 x 10
20	Total coliform (TC)	2.5×10^3	3.5×10^3

SSource: Field Study, 2025

Discussions

The result of physical and chemical parameters of sediment from Douglas Creek is shown in Table 4.9. The pH was 8.13 and 8.15; The value are alkaline on the pH measuring scale.

Texture: Sediment texture varies from sand, clay and silt with composition were 53.60 to 54.80, 9.0 to 10.0 and 23.80 to 27.80% respectively. The sample texture (or particle size distribution) is a characteristic that influences the physical and chemical properties of the soil along the River. The analyses of texture show that sand dominates the floor of the River.

Anions

Sulphate (SO_4^{2-}): The concentrations of sulphate ion were 0.214 and 1.084 mg/kg. Sulphate is a major ion in the soil area of River courses due to

agricultural activities. However, values obtained are low concentration in the project site.

Phosphate (PO_4^{3-}): Phosphate contents of the sample were 0.165 and 0.215 mg/Kg. Phosphorus containing compounds are essential for photosynthesis by plant along the River course for energy transformations and for the activity of some hormones in both plants and animals.

Exchangeable Cations: The highest concentration of the cations in the sediment samples is calcium which was 120 to 124 mg/Kg. The concentration of magnesium was 82.40 and mg/Kg, the concentration of sodium was 23.6 and 46.3 mg/Kg while potassium concentration was 7.15 and 8.80mg/Kg. Exchangeable cations are responsible for nutrient mobility in the sediment.

Heavy Metals: The heavy metals tested for in the samples include Fe, Pb and Cr. The concentration of iron detected was 4.931 and 6.824 mg/Kg, Lead and Chromium were very small within the range of 0.032 and 0.042 mg/kg, and 7.265 and 8.700 mg/kg respectively.

Table 4.10: Physico-chemical analysis of surface water Samples from secondary data (Dry Season, 2022)

PARAMETERS	Mbai Stream	Epeti Stream	FMEnv Limit
pH	6.14	6.81	6 – 9
Temperature *(°C)*	28.4	29.0	<40
Colour *(Pt-Co)*	Clear	Clear	-
Salinity as Cl- *(mg/L)*	39.34	43.20	600
EC *(µs/cm)*	157.2	220.1	-
Hardness *(mg/ L)*	108.84	79.49	-
Turbidity *(NTU)*	11.52	10.21	10
THC *(mg/ L)*	<0.001	<0.001	-
DO *(mg/ L)*	4.54	5.48	5.0
TSS *(mg/ L)*	13.82	16.40	30
COD *(mg/ L)*	14.42	12.32	50

BOD5 *(mg/ L)*	2.44	2.61	50
Nitrate *(mg/ L)*	3.12	5.13	20
Phosphate *(mg/ L)*	0.35	0.35	5
Sulphate *(mg/ L)*	2.56	4.23	500
Potassium *(mg/ L)*	180	111	-
Copper *(mg/ L)*	0.008	0.007	<1
Lead *(mg/l L*	<0.001	<0.001	<1
Iron *(mg/ L)*	0.056	0.063	20
Barium *(mg/ L)*	<0.001	<0.001	-
Micro-organisms			
Coliform MPN/100m *L*	98	64	-
THB *(x 10^4cfu/ml)*	5.2	4.6	-
THF *(x 10^4cfu/ml)*	5.0	5.9	-
HUB *(x 10^4cfu/ml)*	4.7	3.9	-
HUF *(x 10^4cfu/ml)*	5.0	4.2	-

Source: FMEnv approved report (*EIA for the proposed Construction of Odoro Nkit-Okposio Road, Esit Eket-Ibeno LGA, Akwa Ibom State, 2020)*

4.8.3 Hydrobiology

Hydrobiological investigation of Douglas creek covers the species composition, density, community structure and diversity of the biotic or living components (phytoplankton, zooplankton and benthic invertebrates) of the environment and their interactions amongst themselves and with the abiotic or physicochemical conditions of the environment. The results of field and laboratory investigations of the ecological communities of the study area are presented below. Three sampling stations, upstream, midstream and downstream (200m) were studied. Plankton samples were collected using a 55 µm mesh plankton net, towed via paddle boat for 3 minutes, and preserved in 4% formalin. Samples were analyzed under compound microscope using Utermöhl technique.

The phytoplankton organisms are the basis of aquatic productivity and any alteration in their constitution may have detrimental consequences in the food chain and the entire community structure. The primary trophic roles played by the phytoplankton and zooplankton in the ecology of the aquatic environment cannot be understated. Zooplankton organisms are the various free-floating animals and that plankton is the collective name, zooplankton is extremely diverse consisting of a host of larval and the adult forms representing most of the animals and protistan phyla. Zooplankton further includes those plankton forms that exist temporarily as Plankton. Whereas holoplankton zooplankton are those plankton that spend their entire life as planktonic animals, the Meroplankton zooplankton are those that are found in the plankton spectrum during a cycle of their life, usually the egg or laval stages. Zooplankton based on size can be grouped as larger net zooplankton and smaller microzooplankton. The most abundant of the permanent zooplankton are the copepods.

- **Phytoplankton**

Phytoplankton floras are microscopic chlorophyll containing plants that are found in aquatic ecosystems where they function as primary producers. Majority of phytoplankton have been used for biological monitoring of the environment since they cannot survive in adverse environmental conditions like high turbidity and low nutrient level. Major important members of the phytoplankton group include the divisions *Chlorophyta* (green algae), *Cyanophyta* or *Cyanobacteria* (blue-green algae) and *Bacillariophyta* (diatoms). Table 4.11 present the result of the phytoplankton species observed.

Table 4.11: Result of Phytoplankton

DIVISION	SPECIES

Bacillariophyta	*Achnanthes delicatula,*
	Bacillaria paradoxa
	Chaetocerosmulleri
	Cyclotellaquadricincira
Cyanophyta	*Anabaena cylindrical*
	Chroccocus sp
	Oscillatoria limosa
Dinophyta	*Ceratiumhirudinella*
	Gymnodinum sp
	Peridinium sp
Chlorophyta	*Scenedesmus quadricauda*
	Closterium parvulum
	Volvox Africana
	Volvox aureus
Euglenophyta	*Euglena sp*
	Phacuslongicauda

Source: Field Study, 2025

The species recorded for this plankton analysis are common indicators of freshwater situations. Additionally acidic water conditions are also quite likely as reflected by the bio-indicator species recorded. High levels of nutrients probable in the form of nitrates, phosphates and sulphates (or other nitrogen and phosphorus based compounds) are likely implicated. The high densities of *Aulacoseira granulata* var. *angstissima* and *Aulacoseira granulata* are worthy of note. These species are known indigenous forms of phytoplankton. They have also been previously recorded in our waters before now (Nwankwo 1988, Onyema 2008, Onyema and Ojo 2008). Examples of some indicators of high levels of organic or nutrient pollution recorded for this study include *Euglena, Phacus and Trachemolomonas* (Euglenoids). These species are of

environmental importance and have also been previously recorded in most fresh waters (Nwankwo 1988, Onyema 2008, Onyema and Ojo 2008). These species are also known nutrient pollution tolerant tropical species.

- **Zooplankton Spectrum**

The zooplankton spectrum study recorded 3 (three) groups of species for the zooplankton (Holoplankton and Meroplankton forms). They were Phylum – Arthropoda (class *Crustacea*), Phylum – Rotifera and Juvenile stages. The dominant group of zooplankton was the Phylum – Rotifera, followed by the Phylum – Arthropoda and then the Juvenile Stages. Whereas the Rotifera recorded 50% (6 species), Artropoda recorded 41.7% (Calanoid Copepods, 3 species – 25% and Cyclopoids, 2 species – 16.7%), Juvenile stages reported 8.3%. The juvenile stages were represented by one form namely: Rotiferan egg.

Table 4.12: Zooplankton Composition

Zooplanktonic Group	Species
Rotifera	
Family *Asplanchnidae*	*Asplanchna priodonta*
Family *Brachionidae*	*Brachionus calyciflorus*
	B. caudatus
	B. quadridentata
	Keratella sp

Source: Field Study, 2025

- **Benthic Macro fauna**

The benthos includes a diverse assemblage of animals across almost all the animal phyla. The benthic ecosystem is a very important component of the aquatic ecosystem, because it assists in the degradation of the organic component that sinks to the sediment, as well as indicator for monitoring the condition of the sediment whenever the environment is impacted.

The summary of species composition and abundance of macrobenthic fauna in all sampled stations is presented in Table 4.13. The macrobenthic fauna consisted of 3 taxa belonging mainly to two phyla, viz: phylum mollusca (3 taxa) and insect (1 taxa). The percentage distribution indicated that class gastropoda dominated by 75% followed distantly by class insect (24%) and the least class bivalvia (1%). The dominant species include *Melonoides tuberculata, Chironomus sp.* and *Aloidis trigona* constituting 75%, 24% and 1% respectively of the total individuals sampled.

Species diversity and abundance was generally low across the study area with stations indicating a stressed environment. The dominant species *Melonoides tuberculata* and *Chironomus sp.* in the area are pollution indicators (Edokpayi et al., 2004; Stevens *et al.* 2006 and Bolaji *et al.,* 2012). The collected samples from some stations contained large amount of leaf litter fragment wish might be responsible for the elevated levels of organic matter in sediment as indicated by the high occurrence of the above named species (Ndifon and Ukoli, 1989, Dudgeon, 1989; Gutierrez *et al.,* 1997, Duggan, 2002, Giovanelli *et al.,* 2005).

Table 4.13: Macro-invertebrates Species composition of the Sediment Samples

Group	Species
MOLLUSCA	
Gastropoda	*Littorina* sp

	Neritaglabrata
	Melonoides
	Tuberculata
ANNELIDA: *Polychaeta*	*Capitella* sp
	Nereispelagica
Insecta	*Baetis* sp
	Coenagrion sp
	Chironomus sp

Source: Field Study, 2025

Some important factors governing the abundance and distribution of macro-invertebrate benthic communities includes, water quality, immediate substrates for occupation and food availability (Chukwu and Nwankwo, 2004). Any ecological imbalance arising from any severe alterations of these factors may affect the macrobenthos. The important factors that affects the abundance of macrobenthic fauna in a given community includes: the physicochemistry of the water, immediate substrate of occupation and food availability (Dance and Hynes, 1980).

Dredging and filling activities during the construction phase of the project may introduce a different form of stressors through habitat modification and loss of biological community structures. There is possibility of complete displacement of indigenous species by an invasive or opportunistic species e.g. *Melonoides tuberculata* which is currently one of the dominant species in the area. The operation of a project in the area should be closely monitored to prevent leakage of hydrocarbon compounds into the environment which can lead to loss of benthic community lives. The sedentary organism will be completely wiped out in case of hydrocarbon pollution in the environment.

4.8.4 Fisheries Study

Introduction

The increased concern on the rapid ecological changes in the natural environment has provided major challenges to the scientific community (Chindah 1998). Fishing is one of the major occupations of the people in the project area. Men, women and children alike are involved in this occupation. According to Olaosebikan and Raji (1998) the freshwater food fishes found in Nigeria are about 268 different species. Artisanal or small scale fisheries using dugout canoes with or without motorized engines are the predominant fisheries of creek.

- **Fish/fisheries**

Fishing activities are carried out mostly in the nights, early mornings and evenings, and are generally done from a course of the river Qua Iboe. The fishing gears commonly used include castanets, set nets, drift nets, gill nets and hook-on line as well as fish fence. In terms of species richness, the families *Mochockidae*, *Bagridae*, *Characidae*, and *Cichidae* were dominant. Fish processing within the study area is basically traditional using indigenous technology. Traditional smoking kiln or earthen ovens were a prevalent method of preservation. The smoked fish is consumed within the family unit and/or sold in markets.

The type of boat used in the area are planked and dugout canoe. Out of the 45 canoes counted in the villages around the project area, 80% were planked canoes

Plate 4.8: Planked Canoes at the site and bank of River Qua Iboe

Gymnarchus niloticus (Mormyrid), *Heterotis niloticus* (African bony tongue fish), and *procambarus clarkii* (crayfish) were the most palatable among the fish species. All the fishes examined did not show any physical evidence of parasitic infestation. There was no observation of disease infestation, abnormalities or physical deformities. Below are the different types of fishes seen at community.

Plate 4.9: Showing fish species at fish market

They appear to be minimal fishing activities along Douglas Creek as some of the fishermen interviewed said the water is more polluted than River Qua Iboe. Hence, they tend to explore the river more than the creek. The major fishing problems in the Creek and Qua Iboe River are crab (*Callinectes amnicola*) attack on gillnets, theft of lead sinkers by other

fishermen, net destruction by both inboard and outboard engines used for logging and transportation in the area and water hyacinth (*Echhornia crassipes*) infestation that destroy floating nets.

4.9 Flora Study within the Project Area

Vegetation studies are important in understanding the existing state of the vegetation including the species composition, diversity, and population of plant species as well as their health status (plant pathology). This is useful for assessment of environmental impacts due to the operation of the facility. Cleared vegetation normally leads to environmental impacts, such as loss of ecologically important plant species and habitats for some animals as well as enhancement of soil erosion. The present study has determined the nature of the existing vegetation around the project site.

Generally, the entire project area falls within the coastal swamp forests, mangrove swamps, and brackish water vegetation type with variations in floristic composition. This type of vegetation is common to the southern coastal areas of Nigeria and the Niger Delta region, which are known for their salt-tolerant plants and freshwater and estuary environments. The assessment of the vegetation was done to identify the types of plants, crops, grasses that are found within the study area. This was done through visual inspection and observation along the project area. Inventory of plants species on the project area was taken at intervals. The characterization, identification and classification of the plant species and communities were undertaken both at the field and with reference materials. Generally, the vegetation is thicker along the entire water course of the Douglas Creek dominated by Nipa palm (*Nypa fruiticans*) and climber's as well salt-

tolerant trees and shrubs that grow along intertidal coastlines. The most abundant species across the proposed site include *Elaesis guineensis*, *Crytosperla senegalensis*, *Alchornea laxiflora*, *Tectona grandis, Griselinia littoralis* and *Anthocleista vogelii*. The floristic composition of the study area is diverse. A total of 40 plant species belonging to 27 taxonomic families was recorded in the 5 plots surveyed in the area. Table 4.14 shows the species floristic index and Plate 4.10 is an overview of the three ecological environments within the study area.

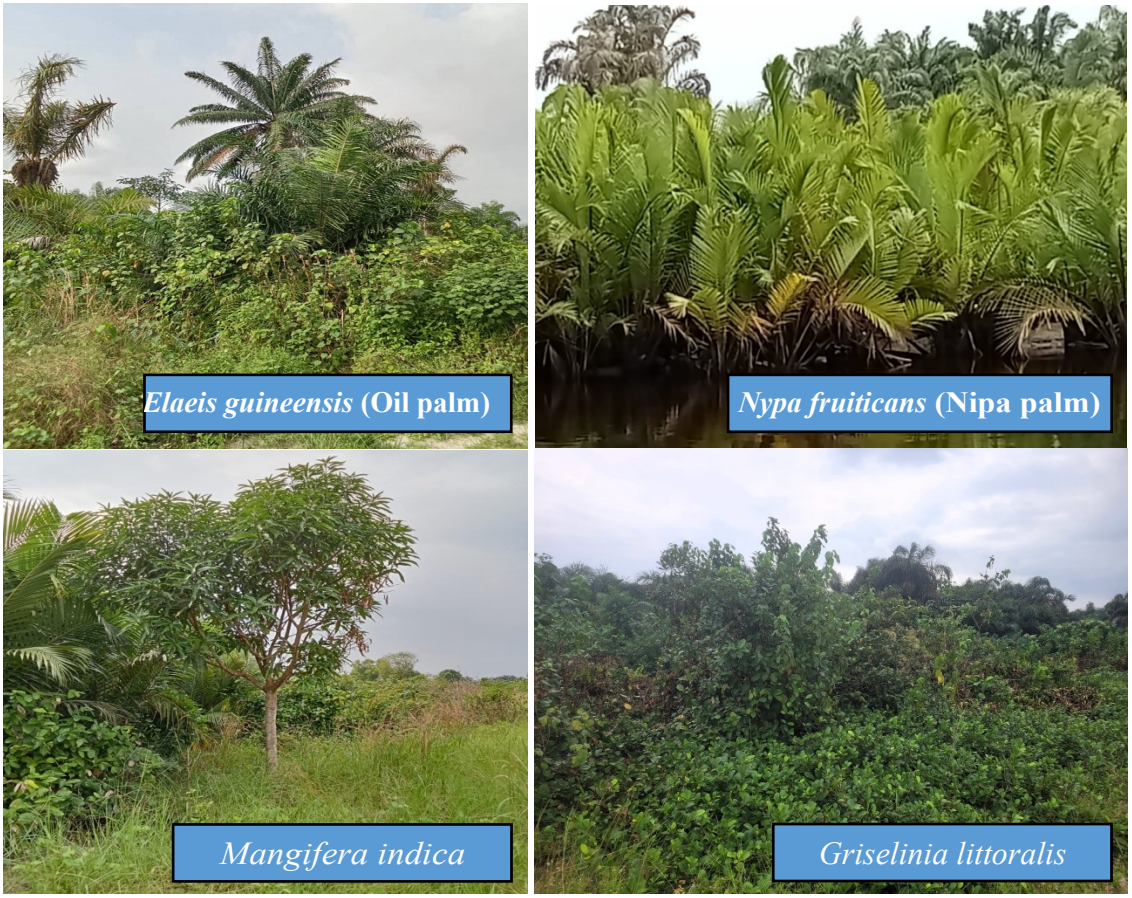

Plate 4.10: Showing vegetation of the project area

Table 4.14: Flora Species Indices and Result

	Floral Features	**Result**
Species attributes	**Species Diversity**	40
	Five most abundant species	*Elaesis guineensis; Crytosperla senegalensis; Alchornea laxiflora; Tectona*

		grandis Anthocleista vogelii; Griselinia littoralis; and Nypa fruiticans
	Five least abundant species	*Berlinia grandifolia ; Anonas comosus ; Cola nigrum ; Gardenia sokotensis and Antidesma lacinatum*
	Shannon Index	3.46
	Five most Abundant Families	Aracaceae , Rubiaceae , Euphorbiaceae; Caesalpinoidea and Papilionoidea
	Five least Abundant Families	Apocynaceae; Cucurbitaceae; Convovulaceae ; Clusiaceae and Mimoisoidea
	Shannon index	3.44

Source: fieldwork, 2025 and secondary data

Species richness for the entire study area has a calculated value of 0.46 while the equitability index was 0.90. Thirty - six species was found to occur per 0.1sqm while the area of land dominated by species (species dominance) was calculated to be 0.59 (59%). The ability of the young plants (wildings) to replace their matured ones (regeneration potential) for the entire study area was calculated to be 51.7%.

Human Activities and Threat to Vegetation

The various anthropogenic activities in the study area include crop farming, fishing logging operation, gathering and collection of non-timber forest products (firewood, leaves, rattan, raffia and palm wine), urban and industrial development. Substantial portion of the forest vegetation has been cleared and converted to oil palm and raffia plantation while other areas suffered slash-and-burn to make way for cultivation of agricultural crops such as cassava, plantain, banana, rice and leafy vegetables for subsistence of the local people. The forest also provide employment and income to other categories of local people particularly young and middle aged women who are actively engaged in gathering of oil palm, *Mitragyna*

Africanus, *Thaumatococcus* leaf and other rattan for sales. The men folks are also actively engaged in tapping the oil palm and raffia for their natural wine for consumption and for sales.

The creeks and other freshwaters that abound in the forests are important habitat for fishing activities which generate substantial daily income for the local people. Notable members of the men in the communities also engage in hunting activities to capture and kill wildlife for consumption and for sales. They are referred to as local hunters and these activities constitute the main stay of their livelihood. The Freshwater swamp forest is highly desirable to commercial timber activities because of their high stocking level of commercially valuable species. Therefore logging activities are notable human engagement in the study area.. The primary threats of the human activities to the vegetation in the study area are deforestation, habitat degradation, loss of plant and animal diversity and change in plant community structure.

Plate 4.11: Fuelwood Harvesting Activities in the Study Area

4.10 Fauna of the Project area

The faunal diversity of the area is categorized on the basis of habitat requirement, niche differentiation and energy pathways (food chain).

The animal communities are important because of their uses as sources of biodiversity conservation and research studies, recreation, and more importantly the provision of protein in the diet of rural communities. An inventory of the terrestrial wildlife fauna of the project area was drawn up from various sources. These included direct sighting of individual fauna, examination of indirect evidence such as faecal droppings, feathers, footmarks and vocal cues, and by interviews with local hunters and residents. The fauna were assessed in accordance with the wildlife census ground and indirect methods of Ayeni et al., (1982).

Ecologically, the animal population plays an important role in the transfer of food energy and cycling of essential elements in the ecosystem. The project area is endowed with a large variety of animal species. They vary from small arthropods like mites and ticks to very large mammals.

The wildlife resources have been grouped under the following major headings: mammals, avifauna, reptiles and amphibians. Wildlife was rare and limited largely to reptiles, birds and mammals. Birds were the most conspicuous form of vertebrate wildlife. The mammalian species were predominantly rodents (small mammals) like *Cricetomys gambianus* (giant rat), *Rattus rattus* (common rat) and *Xerus erythropussp* (ground squirrel) with a little of the large mammals been represented by the monkeys (Family: Cercopithecidae) (Table 4.15). The small mammals have naturally high fecundity as well as adaptability to changing habitat conditions.

The reptiles associated with the study area include *Veranus niloticus* (monitor lizard), *Osteolaeleamus tetraspis* (dwarf crocodile) and many snakes species which include *Dendroaspis angusticepts (*green member)

Python regius (royal python),*Bitis gabonica* (gabon viper) were particularly abundant in the study area.

Birds are one of the best known faunal group in the world (Tvardikova, 2010). They are ecologically highly diverse and inhabit wide range of habitats. They are frequently used taxa to indicate the effects of environmental changes (Carignan *et al*, 2002). Several birds were encountered in the study area. The avifauna was the most conspicuous form of vertebrate wildlife and included weaver birds (Plesiositagra cucullatus), kites (Milvus migrans) and water birds (Halcyon senegalensis).

Plate 4.12: group of birds and their nest found around the study locations

Table 4.15: Fauna Species Observed within the Project area and their Conservation Status

Taxon	Common name	Family
A. *Mammalia*		
Cercopithecus aethiops	Green monkey	Cercopithecidae
Cricetomys gambianus	Giant rat	Muridae
Erythrocebus patas	Patas monkey	Cercopithecidae
Heliosciurus rufobrachium	Squirrel	Sciuridae
Papio anubis	Baboon	Cercopithecidae
Phinolophus sp.	House bat	Scuridae

Rattus rattus	Common rat	Muridae
Xerus erythropus	Ground squirrel	Sciuridae
B. *Aves*		
Accipiter erythropus	Sparrow hawk	Accipitridae
Ardea cinerae	Grey heron	Ardeidae
Ardeola ibis	Cattle egret	Ardeidae
Calidris ferruginea	Curlew sandpiper	Scolopacidae
Ceryl erudis	Pied kingfisher	Alcodinidae
Corvus albus	Pied crow	Corvidae
Halcyon senegalensis	Senegal kingfisher	Alcodinidae
Haliaetus rocifer	West African river eagle	Accipitridae
Milvus migrans	Black kite	Accipitridae
Necrosyrtes monarcus	Hooded vulture	Accipitridae
Plesiosisitagra cucullatus	Weaver bird	Accipitridae
Pycnonotus barbatus	Common garden bulbul	Pycnonotidae
C. *Reptilia*		
Agama agama	Common lizard	Agamidae
Dendro aspisviridis	Green mamba	Elaphidae
Echis carinatus	Carpet viper	Viperidae
Hemidactylis gasciaus	Wall gecko	Gekkonidae
Nerodiaclarkii compressicauda	Mangrove water snake	Colubridae

DS-Direct Sighting, BF-Indirect Evidence (Burrows, Foot Prints, Faeces etc.) Lit- Mentioned in Literature

Source: Fieldwork, 2025 and secondary sources

4.11 Land Use Pattern

. The Land Use Act of 1978 officially regulates land ownership in Nigeria. The law vests ownership of all lands within a state (except those belonging to the Federal Government) to the state government which is applicable to the project area. The area is used for agriculture with the farmers practising subsistence farming; they engage in the cultivation of food crops such as cassava, plantain, banana, rice and leafy vegetables, amongst others. Middle aged women who are actively engaged in gathering of

fishes, *Mitragyna, Thaumatococcus* leaf and other rattan for sales. The men folks are also actively engaged in tapping the oil palm and raffia for their natural wine for consumption and for sales. Livestock production is being practiced by locals. Some of the animals reared include goats and chickens, amongst others.

Plate 4.13: palm nuts harvest in the Project Area

4.12 Socioeconomics

4.12.1 Introduction

The Environmental Impact Assessment (EIA) Act CAP E12 LFN 2004 makes it mandatory for all development projects with potential environmental impacts to undergo an EIA process before approval or commencement. The Act ensures that environmental considerations are integrated into project planning and decision-making. Additionally, the EIA process involves consulting the host community and stakeholders regarding potential project impacts. It is imperative to incorporate community and stakeholders' inputs into the project design, implementation and decommissioning phases so as to achieve project sustainability. Based on this, the project proponents have decided to subject the power plant and pipeline project to full socio economic studies.

Socio-economic Study

The Socio-economic study constitutes a crucial component of environmental and social impact management and is a part of the broader framework for sustainable development. Socio-economic studies in EIA aim to understand and mitigate the potential, social, and economic impacts of a project on the local community and stakeholders.

Study Objectives

The objectives of the Socio-economic study include the following;

- To undertake field studies in the project area to obtain primary Socio-economic data and other related data like the demographic, social, cultural and economic environment, perceptions, fears and concerns of the people.
- Identify potential socio-economic impacts
- Assess how the project might affect local communities, including impacts on livelihoods, health, culture, and economic activities,
- Involve local communities and other stakeholders in the assessment process, to ensure their concerns and needs are considered
- Provide decision makers with a comprehensive understanding of the project's socio-economic implications, to inform project planning and implementation
- Evaluate the impacts and determine the significance of these impacts, considering the local context and stakeholders' perspectives
- Propose measures to minimize negative socio-economics impacts, and enhance positive outcomes for local communities.

Proposed Project Area of Influence

A projects area of influence may be understood as an area potentially impacted by a project. It includes both tangible and intangible interests. It is therefore worthy to note that the location of potentially affected people may not completely align with the geographic boundaries. Also, some project impacts do not necessarily decrease in intensity with distance from the project site. Human beings are connected by a host of linkages and networks. For example, a project may have a long logistics corridor which project activity involves water and air pollution. These may be beyond boundaries determined by technical experts. For the proposed project, the area of influence would be determined through a combination of methods including stakeholder analysis, social mapping and eliciting the changes brought about by the proposed project.

While the project's host community would be established within the immediate footprint of the project, the area of influence will extend beyond the physical boundary.

Study Methodology

Participants who attended the scoping workshop were drawn from the 18 communities in Ibeno Local Government Areas of Akwa Ibom State namely: Mkpanak, Itak Ifaha, Upenekang, Inua Eyet Ikot, Esuk Ikim Ekeme, Itak Abasi, Iwuo-kpom, Atia and Okorutip. Other communities included Ikot Inwang, Okomita, Okposo 1, Esuk Ikim Akwaha, Iwuo-achang, Opolom, Itak Idim Ekpe, Ndito Eka Iba, Okoroitak and Okposo 11.

Sample Procedure and Size.

The choice of participants and respondents for the Consultations and questionnaire response was by purposive sampling technique based on the perceptions of Community leaders as to the people who can provide useful and

relevant information on the current issues in focus. A total of one hundred and twenty (120) questionnaires were administered in different locations based on proportionate population of communities. A total of one hundred and sixteen (116) questionnaires were successfully completed, retrieved and used for analysis.

Field Study Strategy

The field study comprised the following operations:

- Questionnaire production,
- Pre-testing of questionnaires.
- Questionnaire administration and interviews of key informants.
- Focus group discussions.
- Observations
- Photography.

Sources of Data

The survey utilized both primary and secondary sources to gather comprehensive data.

Primary Sources

Administered questionnaires were used to collect quantitative information regarding household and communal characteristics. Direct observation, individual interviews, and focus group discussions were utilized to explore the concerns of community members regarding the social, economic, and health implications of the proposed power plant in their community, as well as their collective expectations from both the proponent and the government.

Secondary Sources

Where primary sources were insufficient to provide the required data, reliance was placed on secondary data sources. Consequently, secondary data was obtained through desk reviews. Additionally, information was sourced from

national data repositories such as the National Population Commission (NPC), the National Bureau of Statistics (NBS), and electronic maps. Secondary data were also sourced from the following:

- Environmental Impact Assessment (EIA) of Ata Field in OML 68 by Tenoil Petroleum and Energy Services (2022)
- Environmental Impact Assessment (EIA) of (Qua Ibo Marginal field in OML 13, Akwa Ibom State by Network Exploration and Production Nigeria Ltd (2023)

Data Management

Data collected through questionnaire administration were analyzed with the use of descriptive statistics and results are presented in tables, charts, figures and photo plates.

4.12.2 Stakeholders Consultation and Engagement

Introduction

This *Section* describes Stakeholders' Consultation/Engagement for the proposed pipeline and gas power plant project. It is designed to conform to the Nigerian Environmental Impact Assessment (EIA) Act CAP E12 LFN 2004, the AfDB's OS 1-10, World Bank's ESS 1 and the IFC Performance Standards It describes the process and means by which Stakeholders were engaged and the outcomes of the engagement activities. It should be noted that stakeholders will continue to be engaged during the implementation of the project.

Various levels of consultations, as typically recognized in the EIA process, were conducted. The emphasis was on engaging the public, host community, and all other stakeholders directly or indirectly affected by the project to participate in assessing its impacts.

The objectives of the consultation process were:

a) Providing communities and stakeholders with early information about the project.
b) Enhancing understanding of potential and associated impacts of the proposed project.
c) Identify and propose mitigation measures proportional to the identified impacts.
d) Incorporating stakeholder views and concerns into the project and EIA execution.

Numerous benefits are associated with stakeholders' consultation for any project. These include:

- Fulfilling regulatory requirements, as community consultation is a prerequisite for an acceptable EIA.
- Providing inputs for further planning by considering critical views and observations crucial to project success.
- Fostering trust, acceptance, and stakeholder buy-in for the project.
- Increasing project success, promoting sustainability, and enhancing accountability.

Identification of Stakeholders

The proposed project would potentially impact individuals, families and communities in the project area. The impacts would vary with different phases of the project from mobilization through construction, commissioning and decommissioning. They could also be beneficial, adverse, negligible, significant, short term or permanent. In consideration of these impacts, it was necessary to ensure participation and integration of various stakeholders

including the local populace (community residents), non-governmental organizations, public agencies, government regulators etc.

Stakeholders consulted and engaged include but are not limited to:

- Akwa Ibom State Government
- Ibeno LGA Council, relevant regulatory agencies.
- Community Leadership, Village Head, Council of Chiefs, Youth Leaders and Women Leaders.
- Local Residents: Directly and indirectly affected community members.
- NGOs and advocacy groups focused on sustainable development.

The stakeholder consultation program involved:

- Consultation with the Paramount Ruler of Ibeno and Council Members on 16th July, 2025.
- Scoping workshop involving community leaders, youth, women leaders, fisher folks and government agencies/regulators on 17th July, 2025
- Consultation with the Ibeno Local Government Chairman on 18th July, 2025.
- Participatory data gathering techniques including Household Questionnaire administration, FGDs, and KIIs employed at the consultation meetings and other locations.
- Community Walk-through and Participatory Rural Appraisal (PRA) for ground trothing with community leaders, youth, women leaders.

The summary of the stakeholder consultation program focusing on target population, type of engagement and issue discussed/decisions reached is presented in Table 4.16 while the minute from the Community consultation with

the Ibeno Paramount Ruler in Council on the 16th of July, 2025 is presented in the Appendix.

Table 4.16: Summary of Consultations with Stakeholders

Date	Participants	Mode of Engagement	Discussions/Decisions Reached
16th July, 2025	Paramount Ruler of Ibeno and Council Members	Meeting	Overview of the proposed project including project design, scope, benefits, potential beneficial and negative impacts/mitigation measures. Overview of the EIA studies and benefits. The People accepted the proposed project emphasizing that a workable MoU will be put in place to take care of issues raised by participants at the meeting.
17th July, 2025	Community Leaders, Men, Women, Youth groups, NGO, Government Regulators, EIA team.	Scoping Workshop	Overview of the proposed project including project design, scope, benefits, potential beneficial and negative impacts/mitigation measures. Request for peace and corporation during project construction and operations by the Project proponent. Overview of the EIA studies, benefits and role of community members during EIA field studies. Interactions and documentation of key issues raised by participant. Feedback from Project Proponent/acceptance to abide by contents of MoU when finally put in place.

Date	Participants	Mode of Engagement	Discussions/Decisions Reached
18th July, 2025	Ibeno Local Government Chairman	Meeting	An overview of the proposed project and the EIA studies. Acceptance of the project by the Chairman and putting forward her requests including: Compensation, Employment of qualified indigenes, Payment of Tenement Rate, Local Content, Meeting the demands of Labour and Revenue Committee.

Below are the scenes of consultation meetings held.

Plate 4.14 a, b, c & d: Consultations with the Paramount Ruler of Ibeno.

4.12.3 Major findings of Socio-economic Characteristics of the Study Area

Ibeno Local Government

Ibeno is in the east of southern Nigeria. It is one of the 31 Local Government Areas in Akwa Ibom State. The sprawling town which consists of over twenty communities lies on the eastern side of the Qua Iboe River and about three kilometres from the river mouth. Ibeno has a long beach which stretches for about 30 kilometres from Ibeno to James Town along the Atlantic coastline of Akwa Ibom State of Nigeria. It occupies the largest portion of the Atlantic coastline out of the more than 129 kilometres of Akwa Ibom State coastline. Located in the mangrove swamp forest, the area has rain most of the year with the peak between June and July. The Ibeno beach is said to be the longest beach in West Africa. With its beautiful coastline, Ibeno provides facilities for tourism. The climatic condition of Ibeno is favorable to fishing and farming. The area has a big fishing settlement which some claim is the largest fishing settlement in West Africa.

The baseline study reported that, Ibeno LGA was carved out of the former Uquo-Ibeno LGA in 1996. It is a riverine area with a network of crisscrossing water bodies. It is made up of 26 gazetted and about 43 un-gazetted communities and settlements.

Ibeno LGA is situated on the lower course of the Qua Ibo River estuary, so that its communities face both the Atlantic Ocean, in the Bight of Bonny and the banks of the Qua Ibo River. Ten villages lie to the Western side of the Qua Ibo River and sixteen villages on the Eastern side, making a total of 26 communities. Ibeno LGA is a petroleum-bearing area and Africa.

The people of Ibeno who are historically related to the Oron People of Akwa Ibom State and the Andoni people of Rivers State. The common dialect of the Ibeno people is the Obolo dialect spoken by them and the Eastern Obolo people of Akwa Ibom State. The people of Ibeno enjoy an active aquatic life using the river as both resource and leisure

History reveals that Ibeno indigenes were migrant fishermen who sojourned from Cameroon around Usak-Edet from about 300AD to 1750AD and later settled at Okoroutip, before their dispersal to various parts of their present abode. Their ancestors were also nick-named as “Salt burners” because of their penchant to burn and treat the saplings of a species of mangrove tree, in order to produce salt. Ibeno has also been acknowledged as a center of early civilization, trading post of early European traders and cradle of Christianity in the region. They are acknowledged as a people whose influence was felt all over the catchment areas of Qua Ibo/Cross River Basin and the Niger Delta region, because of their fishing, trading and social contacts

Population of Ibeno

Nigeria has conducted five national censuses between 1952/53 and 2006. The results from four of the censuses including 2006 were accepted and published. Following 2006 national census, the National Population Commission (NPC), published population figures at national, state and local government levels and did not publish figures of individual communities in the LGAs. The population of Nigeria was estimated to grow at 3.2% annually after 2006 census (NPC Nigeria Demographic and Health Survey, 2008).

At the 2006 Census, the population of Ibeno was 75,380 according to published statistics of the National Population Commission. Out of this total 34,069 are female, whereas 41,311 are male. The Figure 4.33 below shows the gender

distribution of the population of Ibeno Local Government Area at the 2006 census. At that Census, the male population of 41,311 people was 6% more than the female population of 34,069 people. At the Census too, those within the 0-14 age category were 27,335, whereas those within 15-64 Years were 45,510, while those 65 Years and above were 4,995. According to projections made by the National Bureau of Statistics the annual population growth rate for Ibeno LGA, following the 2006 Census is 3.5%. By this projection, the estimated population of Ibeno in 2016 is 105, 100. This projection assumes the same growth rate for all 31 LGAs within Akwa Ibom State. The estimated 2016 population for the entire Akwa Ibom State is 5,482,200, according to published figures of the National Bureau of Statistics. Akwa Ibom State is geographically the 30th largest state in Nigeria, while demographically it is the 15th largest.

Population Structure

Generally, population and a country's level of national income dictates the economic potentials. Large populations present advantages of large market, diverse resource endowment. However, it also creates problems of administrative controls, national cohesion and regional imbalance (Mordi et al, 2006). The population structure of a community can be analyzed based on age-sex distribution and dependency ratios, which are crucial for socio-economic studies. In Akwa Ibom State and Nigeria as a whole, the population predominantly consists of individuals below 25 years of age. This indicates a youthful population, which has implications for dependency on the adult and working-age population. Regarding sex structure, Akwa Ibom State mirrors the national trend, with slightly more males than females in the population put approximately at 51% males and 49% females.

Table 4.17: Age and Sex Structure of Akwa Ibom State

Age group (yrs)	Males (%)	Females (%)	State-wide (%)
Less than 15	32.22	33.34	32.77
15-24	26.12	25.42	25.78
25-34	14.52	15.80	15.15
35-44	9.88	13.21	11.52
45-54	9.71	9.02	9.37
55-64	5.22	2.27	3.77
65 and above	2.32	0.94	1.64

Source: AK-BASES (2005)

Ethnic Composition

The proposed project communities have a combination of indigenous and non-indigenous residents. Indigenous residents are the Ibenos who form the dominant population, accounting for more than 69% of the local population. There are other Nigerians from various ethnic groups residing in Ibeno. These include Ibibios, Annangs, Oron, Ekid etc. There are also, residents in Ibeno from the State. These include Igbo, Yoruba, Hausa, Ijaws, Andoni, Ilajes, Ghanaians and Ijaws among others. Some of these are public and private sector workers in the employment of Local, State and Federal Governments, oil and gas industry workers, traders, artisans, and various entrepreneurs. The communities do not have any known socio-cultural practices that limit or forbid interactions between residents of different ethnic backgrounds and religious orientations. Ethnic and religious tensions between community members and workers on the proposed project are therefore not expected.

Language and Communication

Ibeno people are basically of the Obolo/Andoni origin. Their common dialect is Ibeno dialect of the Efik-Ibibio language. They also speak Obolo language of their neighbouring Eastern Obolo people. Other indigenous languages Ibibio, Annang, Oron etc and English are used commonly in communication in the study

community. Apart from the indigenous languages, more than 80% of residents are able to communicate in English and Pidgin English.

Dependency Ratio

The dependency ratio reflects the proportion of the economically dependent segment of the population (children aged 0-17 years and the elderly aged 65 years and above) in relation to the economically active segment (those aged 18-64 years). It serves as an indicator of the burden placed on the economy in providing for dependents. The assumption is that the economically active population (those aged 15-64 years) bears the economic responsibility for the dependents. A higher dependency ratio indicates a lower labor input per capita.

Dependency ratio for Akwa Ibom State is reported as 72.2% (GlobalData Lab, 2022). This ratio signifies a substantial economic burden, suggesting that a significant portion of the community's resources should be allocated to caring for children and the elderly. Typically, this would necessitate considerable investments in education, healthcare, social welfare, and other essential services required by these demographic groups. The higher ratios imply that more resources are committed to the care of children and the elderly in households in the LGA. A youthful population tends to reduced labour input and income per capita and leads to high dependency ratios. These are characteristic of under-developed economies

Life Expectancy

Life expectancy estimates for Akwa Ibom State align with national figures. According to national estimates from the National Bureau of Statistics (NBS) in 2013, the life expectancy for women was 56 years and 53 years for men. However, more recent data from NBS in 2022 indicates that Akwa Ibom state-wide estimates have plateaued at 55.1 years for male and female life expectancy at 57.2 years.

Migration status

There are no formal records and specific figures regarding migration in the studied communities making it challenging to ascertain precise statistics. However, through informal discussions, many residents indicated that they were born in the community and have resided there for over ten years. Human migration is an important demographic variable that requires frequent review. Migration in the study area is a common phenomenon considering the settlement history and resource abundance of the communities. In the project communities, the rate of immigration (movement into the communities) on average is more than emigration (movement out of the communities). This is as a result of the economic activities in the project communities. FGD session revealed that, in the past two decades, the communities have experienced more of an influx of people due to economic and explorative activities within the area. The non-indigenes have migrated to the area due to business interest or employment and a majority of them are with their families. They profess that the host communities are hospitable and their norms and traditions are very accommodative. For the indigenes, the most common motivations for relocation included educational pursuits and employment opportunities. Those who migrated out, it was

gathered, relocated primarily to urban centers such as Eket, Calabar, Lagos, and Uyo, the state capital.

Characteristics of Respondents

Age Distribution

Figure 4.11 shows the age distribution of respondents of the sample communities in Ibeno.

Table 4.18: Distribution of Respondents by Age

Age (Yrs.)	Frequency	%
26 -35	11	9.5
36 – 45	35	30.3
46-55	52	45.2
55 and above	18	15
Total	**116**	**100**

Source: Fieldwork 2025

The age distribution of respondents indicates that most of them are head of households. A total of 45% of the respondents are between the ages of 46-55, which is almost half of total respondents. Then the age group of 55 years and above make up 15% total respondents while respondents who are between the ages of 26 - 35 make up 9.5 % of respondents.

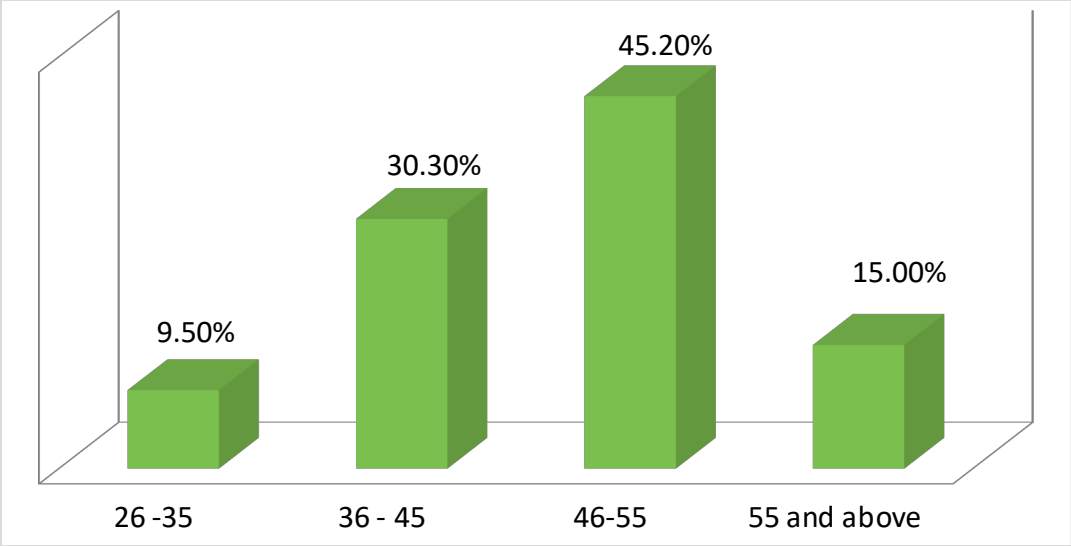

Figure 4.11: Sex Distribution of Respondents

Figure 4.12 shows the gender distribution of respondents in this study. The respondents in the study were predominantly male. A total of 86 men representing 74% and 30 women representing 26% participated in the study.

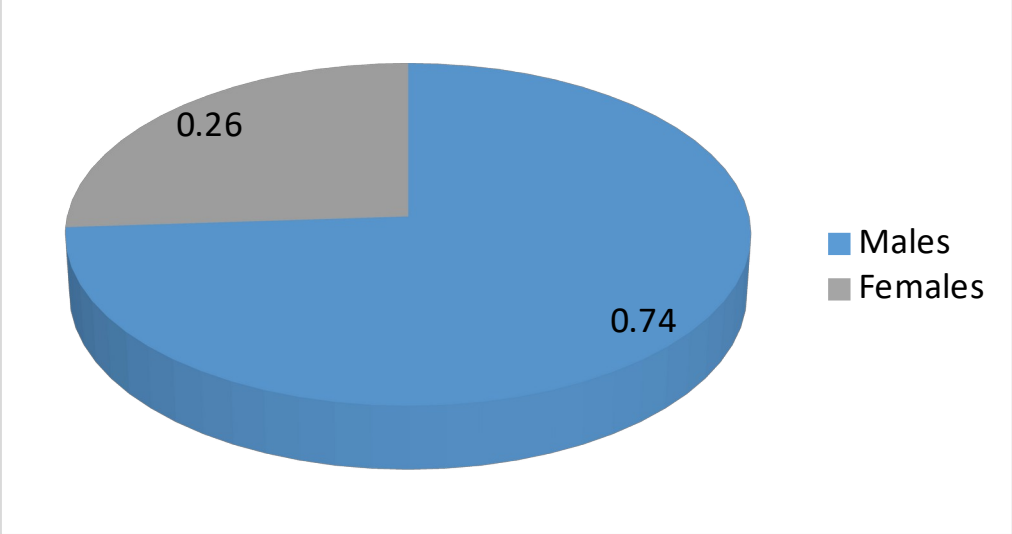

Figure 4.12: Gender Distribution of Respondents

Marital Status of Respondents in the Study

Responses from the administered questionnaires revealed that 12 (20.7%) of the respondents were single while more than half of the respondents 42 (72.4%) were married. While there were no reported cases of divorce and separation. Over two-thirds of the married male respondents (83.4%) married one 17 % were polygamists Polygamy may be practiced by those engaged in agricultural activities as many hands are usually needed to make up for the household labour. Polygamy also features where there is pronounce preference for male children. There was no respondent with more than two wives.

Table 4.19: Distribution of Respondents by Marital Status

Marital Status	Frequency	%
Single	24	20.7
Married	82	72.4
Divorced	0	0
Widowed	8	6.9
Others	2	4.1
Total	**116**	**100**

Source: Fieldwork 2025

Educational Level

The study identified four primary categories of educational attainment within the project area: individuals with no formal education, those with primary education, those with secondary education, and those with post-secondary education. Results presented in Table 4.20 indicate that about 15.5% of the respondents had no formal education, approximately 31% had attained primary education, 44.8% had completed secondary education, and 8.7% had achieved post-secondary education.

Educational attainment is a critical socioeconomic variable that reflects a population's literacy level. It is commonly used as an indicator of a country's

socioeconomic development. Moreover, educational attainment influences reproductive health, behavior, and morbidity and mortality rates. In Nigeria, various government policies and programs have been implemented since 1976 to address education, including the 6-3-3-4 education system, which entails six years of primary education, three years of junior and senior secondary education, and four years of tertiary education.

Table 4.20 Distribution of Respondents by Educational Status

Educational Level	Frequency	%
No formal education	9	15.5
Primary education	36	31.0
Secondary education	51	44.8
Post- secondary education	10	8.7
Total	**116**	**100**

Source: Fieldwork 2025

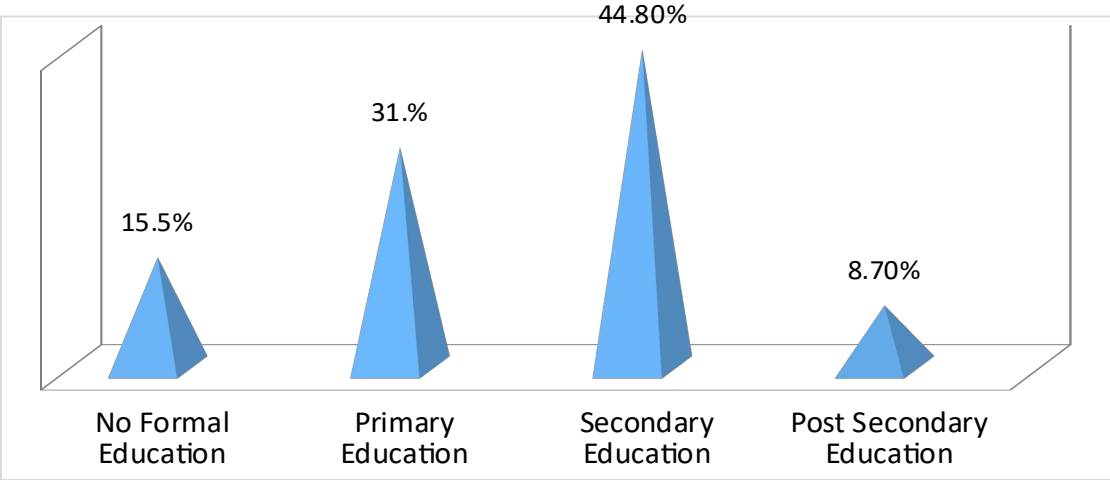

Figure 4.13: Graphical Representation of Educational Status Respondents

Household Composition and Size

In the study area, a typical household unit comprises a head and multiple members. Often, the head of the household is the father, and members include his wife, children, and relatives. These relatives may be children of brothers,

uncles, or even friends, and they are typically provided for and supported using the household's resources. According to the accommodating nature of African families, household members may not always be biologically related.

According to questionnaire responses, the household size in the surveyed communities ranged from 1 to 11. Table 4.21 below depicts the distribution of household sizes in the study area. Families with 6-10 members comprised 44.8% of respondents, making it the most common category. The category with family sizes of 4-5 followed with 35.5%. Families with 11 members and above accounted for 5.2%.

Table 4.21: Distribution of Household Size in the Study Area

Family size	Frequency	%
1-3	18	15.5
4-5	40	34.5
6-10	52	44.8
11 and above	6	5.2
Total	116	100

Source: Fieldwork, 2025

Occupational Distribution

Traditionally, the prevalent occupation among people in the study communities is fishing. Ibeno is has a long coast near rivers and sea. As such, there is a setting and inclination to engage in fishing and fishing related activities such as fish/crayfish drying and fish selling. However, the review of the questionnaire responses reveals that trading is dominant. This may not be unconnected to the fact that the fisherfolks were out for business as the study proceeded.

During interactions, it was noted that some people have other primary occupations but also engage in recreational and or subsistence fishing. Other occupations, apart from trading and fishing include employment in government

establishments and private companies, farming, provision of personal services, artisanship etc.

Table 4.22 Distribution of Respondents by Occupational Status

Occupation	Frequency	%
Artisanship	17	15
Services	14	12
Trading	32	28
Fishing	19	17
Farming	13	11
Public service/Company	10	8
Unemployed	11	9
Total	**116**	**100**

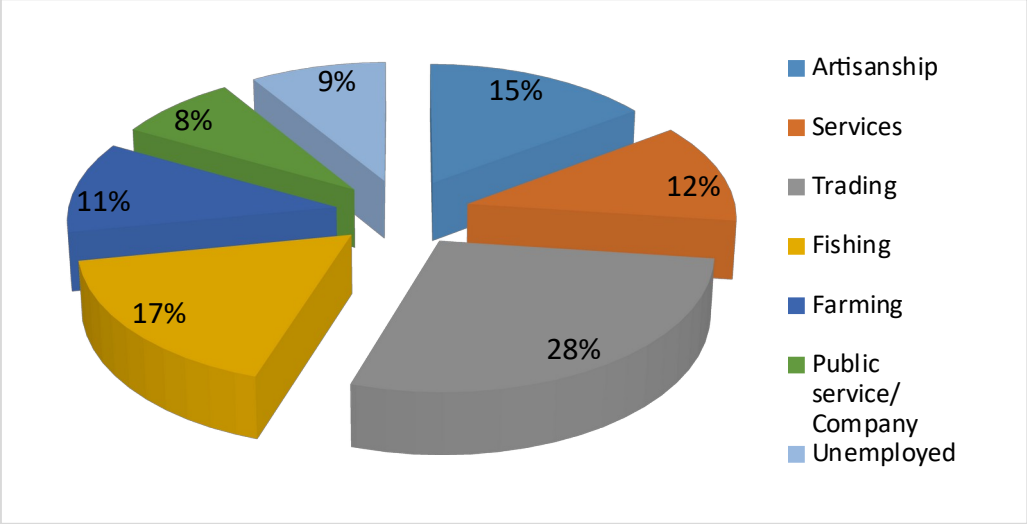

Plate 4.14: Distribution of Respondents by occupation
Source: Fieldwork 2025

Income Status of Respondents

Disposable income to a large extent determines household consumption, savings and investment expenditure. It is one of the variables that measure the welfare of households. It influences socio-economic status of individuals and its distribution pattern has the potential of influencing other demographic variables

including nutrition and health seeking behavior. Income distribution in the proposed project communities is presented in F**igure 4.15.**

Result shows that on average, more than 62.3% of households earn between ₦ 61,001 – ₦ 90,000 per month, about 19.2% earn below ₦ 60,000 per month. About 18.5% earn ₦ 90,001 and above. Analysis reveals that, income earners within ₦ 61,000 - ₦90,000 are predominantly businessmen and traders while those in the income brackets of ₦ 90,001 and above are those with specialized skills working in oil companies, civil/public service, or contractors etc. Findings also reveal that personal income levels of self-employed rural households are difficult to assess because many rural households do not keep records of their income.

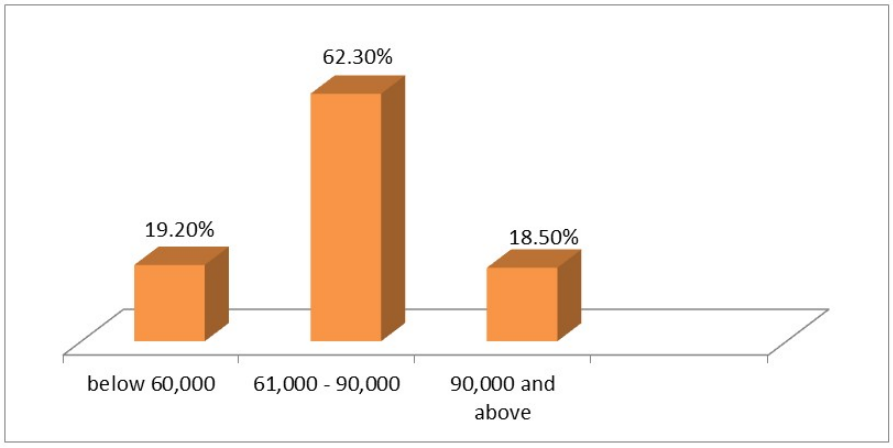

Figure 4.15: Distribution of Respondents by Income Level
Source: Fieldwork 2025

Household Expenditure pattern

The number and quality of goods and services available for household consumption depends solely on income disposition of the households.

Analysis of household's expenditure pattern in the study area is presented in Figure 4.16. It reveals that household expenditure on food, education and accommodation represents 52%, 14% and 10%, respectively. Expenditure on transportation and healthcare and others is 9%, 8% and 6%, respectively. This

reveals that, households in the project communities' embraces education as a growth path to sustainable development. During interaction sessions, respondents affirmed that educational infrastructure provided by government and the private sector, although not adequate have helped in a large extent to enhance the education of their wards.

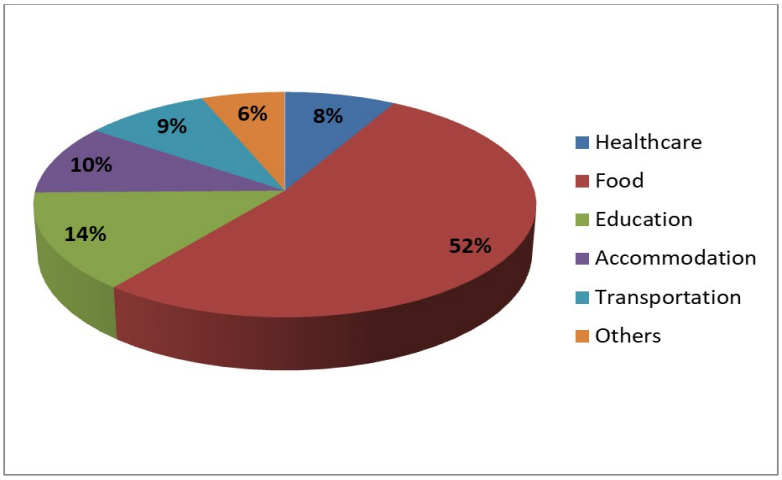

Figure 4.16: Distribution of Respondents by Expenditure Pattern
Source: Fieldwork 2025

Leadership Structure in the Study Area

There are two systems of leadership in the study area- formal (political) governance and traditional administration. Under the formal administration, the communities fall under the jurisdiction of Ibeno Local l Government Area of Akwa Ibom State, with established executive, legislative, and judicial functions. Currently, Ibeno Local Government Council is led by an elected Executive Chairman, Hon. Deaconess Glory Ekah Effiong and supported by appointed Supervisory Councilors. The Legislative arm of the LGC comprises Councilors elected from political wards in the LGA. The tenure of the elected officers is 3 years.

The communities' administrative structures are a testament to their balanced approach to governance. It has distinct traditional administrative structures, including the Paramount Ruler, Clan Head, Village Head (Eteidung), Family (Compound) Heads, Community Youth President, and Women Leader. These traditional organs work in close collaboration with formal government institutions for community welfare. Committees may also be constituted periodically to address emerging issues, further highlighting the communities' collaborative governance model. The traditional governance of the studied communities' is characterized by its inclusivity and the diverse contributions of its members.

The entire Ibeno Local Government Area has ethnic affinity and a single "Paramount Ruler" who is His Royal Majesty Owong (Prof.) Effiong Bassey Archianga. He is traditionally the Akwaha Owong, Ibeno and Udammung. This ruler is the traditional head of Ibeno which consists of places like Okposo, Atarikang, Ukpenekang, Ikot Akpabin, Mkpanak, Ntafre, and OPolom. Itakitaha, Okposo I, OkposoII, Ikot Inwang, Itak Abasi, Atia, Esuk Ikim Akwaha, Iwuokpom Okpolum., Nta-Ajri, Nto Eka Iba, Itak Idim, Inua Eyet Ikot, Okoritak, Itia etc.The respective villages have their Village Heads. The Village Heads are involved in such matters as settlement of disputes. Certain disputes are handed locally by the Village head and his Council Chiefs. Disputes of more gravity like those involving different communities are addressed by the Paramount Ruler and his Council of Chiefs. However, criminal cases are handled by government security agents.

Religious Affiliations and Practice

Christianity is widely practiced in the project area. The influence of modernization and the evangelical movement has led to a decline in the number of individuals practicing traditional African religions.

According to the questionnaire responses, approximately 97% of the population in the study area identify as Christians.

The remaining 3% adhere to other belief systems and there were no reports of conflicts between religious groups. Prominent denominations present within the communities were evidenced by churches such as Full Gospel Assembly, The Apostolic Church, Living Faith (Winners Chapel), and Methodist Church, Qua Iboe Church, Assemblies of God, Sure Foundation, Faith Tabernacle, Mount Zion Lighthouse, Mount Horeb, Faith and Works etc. The Qua Iboe Church in Nigeria was founded in Ibeno 1887. Interactions revealed no known communal restrictions on religious beliefs and practice. Residents are at liberty to pursue their religious interests.

Plate 4.16: A Place of Worship in the Study Area (Qua

Archeological Heritage and Resources

Archaeological heritage and resources encompass the material remains of past human activity, including sites, objects, and landscapes that hold historical, cultural, and scientific significance. These resources provide valuable insights into the lives, cultures, and histories of past societies. The Qua Iboe Church, founded in 1887 in Usiakifia community, Ibeno LGA, can be considered an archaeological heritage and resource, particularly for its historical and cultural significance. The church represents a pivotal moment in the spread of Christianity in Nigeria, impacting local communities and shaping the region's religious landscape.

Festivals/Cultural Activities

The culture of Ibeno people is exemplified in their folk songs, music and lyrics, parables (adages, wise saying or proverbs), dressing, craftsmanship and marriage rites and ceremonies. Their culture is manifested in Ekpe masquerade and in traditional dances, storytelling and plays. These plays include: Ekpe, Ekong, Obon, Ekong isong, Nyoho, Akata, Ntok Odio Odio, Atia Ata, Ebre Ikara. Ibeno people are rich in cultural heritage. The people have many age-long traditional institutions like Ekpe, Obon, Uke, Ekong, Akata, Eka-Ebitu, Ubom Isong, Oluo, Ikini and the age-grade system (Nka) which is highly recognized and practiced in Ibeno. The people of Ibeno have an annual Festival called "*Beach Day*" which is celebrated every 26th December yearly. The carnival nature of the celebration attracts people from all walks of life. Traditional festivals in Ibeno include the Akata, Ulok Ulok and the Ekpe festivals. The Akata festival involves dances in colourful costumes, masquerade appearance and performance as well

as activities like wrestling matches among youths. These festivals are celebrated in November and December every year.

Value system/ Taboos

Previous studies chronicle the value systems of the surveyed communities and reported that, there are well organized community set of value systems across the study area. There is a hierarchical order, with similar culturally prescribed roles and status targeted at ensuring the maintenance of social control and social order The people are essentially strong willed and perceptive. They also exhibit a mentality and behaviour that is strongly linked with their cultural background. For example, fishers may refuse to fish on Sundays and so-called evil days on the sea (25th December and 1st January). Interactions also revealed that Ikot Inwang fishers prefer to dry harvested fish in the day time, while crayfish is dried overnight. The belief is that smoked crayfish never gets dried in the day time, no matter the strength of fire applied to it. It was also revealed in Ibeno that only few women are involved in smoking of water produce. Commercial fish/shrimp drying operation is performed by hired male hands and non- native females (especially of the Andoni stock) in Ibeno.

There are some age long norms which are meant for the collective security and harmonious coexistence of community members. Violating them according to gathered information may result in dire consequences, such as the performance of expensive appeasement and cleansing rituals.

This underscores the seriousness of the community's rules. Notably, there are no communal restrictions on religious beliefs and worship, allowing residents to pursue their spiritual and economic interests without hindrance. Generally, Ibeno people do not eat or kill the reptiles, snake and crocodile. Other taboos include, stealing and killings. Adhering to these taboos enhances community's well-being.

Livelihood Activities

Fishing and fish related activities are the traditional and main source of livelihood in the study communities. Other sources of livelihoods among residents include trading, farming, artisanship practices and employment in the public and companies operating in the area.

Artisanship practices in the study communities include phone repairs, auto mechanics, electricians, panel beating, welding, electrical and electronic installations, carpentry and furniture while personal service provision include fashion design, barbing, hair dressing, pedicure and manicure, food service, among others.

Fishing, the major occupation of the people in the community is reported to be facing serious challenges ranging from declining fish catch, spending many nights per fishing expedition before getting a reasonable fish catch, high-cost fishing gears and fuel for operating the fishing boats, attack and kidnapping of fishermen and stealing of their fish boats, outboard engines, fish catch and cash by sea pirates. These have resulted in great losses causing many fisher folks to abandon the business, leading to loss of employment and sources of livelihood. These problems have also affected fish processors and marketers as they cannot find enough fish to process and market. The business is also experiencing higher

investment cost which many cannot afford, leading to many person wishing to discontinue with the business

Settlement Pattern

The study area exhibits a mix of rural characteristics, with both linear and nuclear settlement patterns. Linear settlements are concentrated along the main streets and lanes, while nuclear settlements are formed by clustered houses. These clusters often represent family lineages and kindred groups. The spacing between houses varies significantly, ranging from one or two meters to about ten metres.

Plate 4.18: Linear Settlement Pattern in the Study Area

Housing Structure

A diverse range of designs and construction materials are used in the houses. Houses were mostly single family bungalows. The number of bedrooms range from three to eight. In most of the houses, kitchens, toilets and bathrooms were located outside the houses. Materials used in construction include mud, cement blocks, thatch and corrugated iron sheets. In terms of ownership, it was found that about 95% of the houses are owner-occupied. Most houses (61.4%) are

bungalows built by affluent community members. Following this, approximately 27% of respondents indicated living in houses with mud walls and corrugated iron roofing. Other types of houses were those constructed with thatch, nylon and wooden materials.

Plate 4.19: Housing Types in the Study Area

Land Ownership and Tenure

Land is one of nature's free gifts, and it possesses unique characteristics of immobility that make it distinct. Its uses span a wide range, including both agricultural and non-agricultural purposes. In Nigeria, land serves social, economic, and developmental purposes. The way land is acquired, owned, used, and passed on to successors is called the land tenure system.

Land ownership, acquisition and resettlement in Nigeria is provided for in the Constitution of the Federal Republic of Nigeria (1999) and the Land Use Act CAP 202 LFN 2004. The Act recognizes the State Government's ownership of all lands and it provides the framework for payment of compensation for land acquisition for development purposes. This provision has not been well received by most communities in Nigeria. The reason for this may not be far from the fact that land is regarded as a key livelihood assets and generational inheritance. Consequently, in spite of the law, the communities still practice their traditional land ownership systems which vests ownership of lands in extended families. The families allocate, sell or lease parts of their lands to individuals and private organizations as occasions demand. Such lands can be put to any use including housing, infrastructural and industrial development. Family lands are managed by males in the family. The major land uses in the communities include housing, industrial and infrastructural development, and agriculture. These account for more than 85% of land use.

Sources of Energy

Figure 4.17, presents the sources of power supply for lighting in the households. 80% of the respondents claimed to be connected to the National Grid, 15% use generator and 5% use kerosene lamp/after NEPA. However, though majority is connected to the National Grid, they complained of frequent shortage of power

supply and reliance more on generator use. Interactions also revealed a lot more people use a combination of the sources.

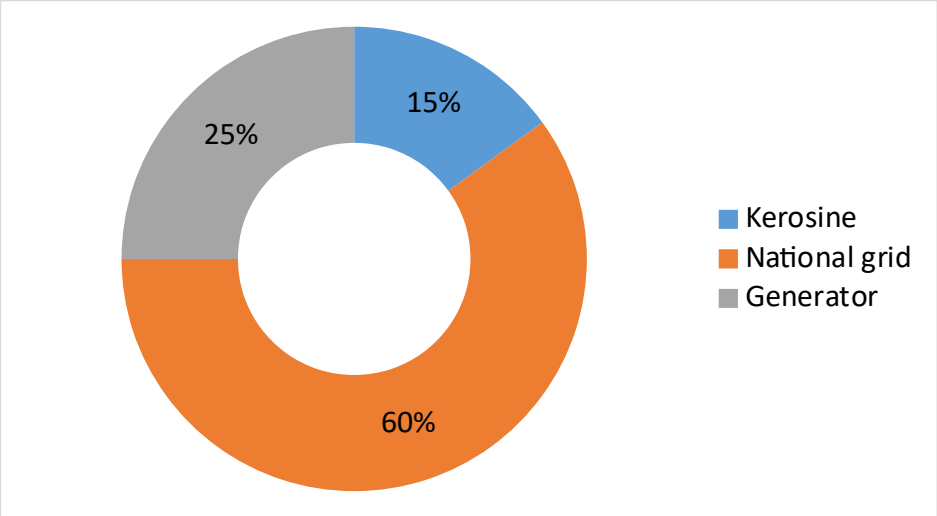

Figure 4.17: Sources of Light in the Study Area

Sources of Energy for Cooking

Figure 4.18 shows the sources of energy used for cooking in households. 42% of respondents use firewood for cooking and fish processing (drying). 35% of the households use gas as their source of energy for cooking, while 23% use kerosene stove. The high prevalence of usage of firewood is occasioned by its use as the main fuel for fish/crayfish drying. The mangrove forests provide the sources for firewood. Environmentally, high firewood usage can lead to deforestation.

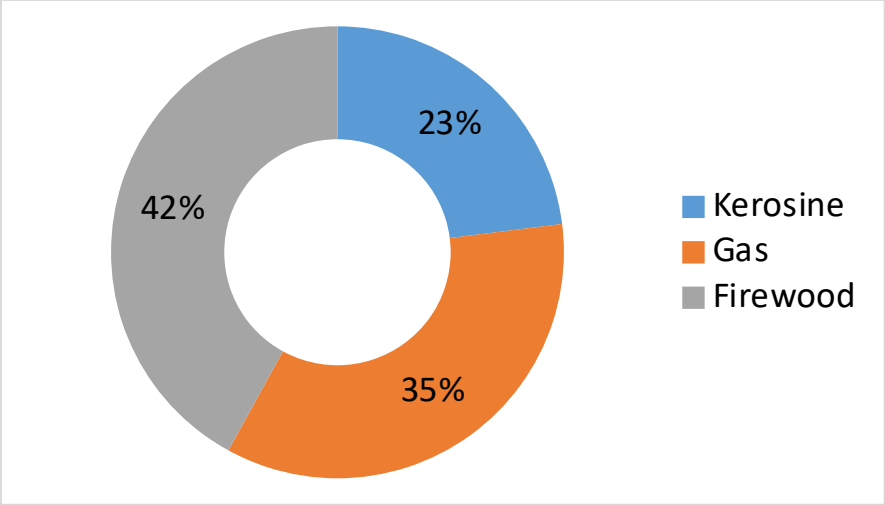

Figure 4.18: Distribution of Respondents by Energy Source

Water Supply and Waste management

There is inadequate access to drinking water in the host communities. With inadequate supply of public provided borehole systems, the other alternatives for accessing water are privately owned boreholes, rain water, streams/rivers, sachet water and bottled water. Residents of the host communities also use hand dug wells as water source. Unfortunately, most of these sources often lack treatment, and their chemical characteristics are unknown, posing serious risks of waterborne diseases. Moreover, water scarcity amplifies hygiene and sanitation challenges, leading to a surge in water-related illnesses such as skin and eye infections. It is imperative to address this issue promptly, as access to safe drinking water can significantly reduce disease burden. It is factual that the people in the Ibeno communities are much aware of the challenge of potable water availability and affordability. For these communities, the provision of clean, safe water is a very crucial need.

Infrastructure

Infrastructure plays a crucial role in shaping the quality of life within communities, directly impacting residents' willingness to reside there and affecting various socio-cultural and economic factors. Idachaba (1985) proposed a three-fold classification of infrastructure encompassing physical, social, and institutional components. Physical infrastructure includes transportation facilities such as roads, railways, bridges, ferry services, canals, and footpaths, as well as storage facilities like silos, warehouses, and open-air facilities. Additionally, it comprises processing facilities such as machinery, equipment, and irrigation systems, along with soil conservation and water resource development facilities.

Social infrastructure encompasses housing, leisure and recreational facilities, and health facilities, including hospitals, dispensaries, health centers, and educational facilities ranging from primary schools to vocational and adult educational institutions. Utilities like electricity, water supply, and sanitation facilities also fall under this category.

Information from the study revealed that basic infrastructural necessities in the communities are lacking.

Roads/Transportation

The study communities have a mixture of tarred and earth roads. Upgrading some of the earth roads to tarred roads would improve the connectivity of the various parts of Ibeno. Modes of transportation in the area include boats, motorcycles, tricycles and cars. Short distances are covered on foot.

Educational Facilities

Public and private nursery/ primary schools abound in the study area. Public schools in the area do not have sufficient facilities. Due to the inadequacy of schools, children trek long distances to acquire secondary education. Mkpanak has a Primary School that is Government owned, but there is no Public Secondary School in the communities. There is neither public primary nor secondary in Inua Eyet Ikot. The challenge of educational facilities in the study area is both for quantity as for quality. With increasing population, there is need to provide more educational facilities with schools provided with adequate staff, books, and equipment for the people.

Markets

There are no daily markets in some of the communities under study. In such communities, residents transport their goods to markets in Mkpanak and other markets. However, kiosks within the community facilitate daily sales, ranging from petty trading to shops stocked with various goods. There is a big market in Mkpanak which is growing bigger because of the increasing number of both sellers and buyers. At the market many fish and fish products are traded including fresh fish, smoked fish, crayfish and shrimp. Aside the fishing products, fishing gears and household provisions and items are also commonly sold at the market

Plate 4.22: A Section of Mkpanak Market in

Electricity

Most of the communities are linked to the national grid but the supply is reported to be erratic. The electricity in Mkpanak is free as donated to the community by Exxon Mobil. With the high cost of petrol and kerosene, the people have been forced to depend on torchlight and candles to illuminate their home. Lack of electricity supply is impacting local businesses and artisanship such as welding, barbing, metal fabrication etc.

Water

Potable water supply is inadequate in the study area. They rely on private boreholes, streams, and wells and rain water for consumption and domestic use.

Plate 4.23: A Private Water Facility in the Study Area

Telecommunication

The major telecommunication networks links are available in the study area. However, reception is poor in some locations that are far away from telecommunication masts.

Recreational Facilities

Ibeno LGA is an emerging tourist attraction. It has religious, cultural and environmental dimensions. Some people in the area and visitors to the project

communities' area are involved in swimming for recreation. This, they do in the Atlantic Ocean by Ibeno beach. It is important to note that Atlantic coastline stretches 129km from Oron in the east to Ikot Abasi in the west and is the longest shoreline / beach in Nigeria, with Ibeno being the only LGA having the longest shoreline / beach in Akwa Ibom State starting from Mkpanak to Okposso 11. This serves as a recreational centre for many local and visiting tourists. The Ibeno beach recreational center serves a variety of cuisines and other entertainments to tourist mostly during festive seasons like Christmas and Easter.

Plate 4.24: A Swimming pool at the Beach

Plate 4.25: Ibeno Beach and the Atlantic Ocean Shoreline

Plate 4.26: An Entertainment Arena at the Ibeno Beach

Security

Apart from Upenekang, police stations are not available in the other project villages. However, interactions with residents suggest a relatively secure environment for both lives and properties. The communities rely on vigilante groups made up of youths from the communities. They conduct patrols to deter criminal activities and maintain law and order. The traditional administration administers justice and refers criminal cases to the police. As a result of these efforts, there have been no reported cases of communal conflicts in the area, underscoring the effectiveness of collaborative security measures in promoting peace and safety within the communities. However, reports of piracy were reported along the water routes during interactions.

Role of Youth in the Study Area

The youth is made up of males and females in their 20s and 30s and they are traditionally responsible for ensuring internal security, enforcing and maintaining law and order, and mobilization for community sanitation. They are also key participants in community liaison with companies and other organizations that have any business in the communities. They exert their influence and play their roles through their youth organization. The youth executive has three year tenure and a new executive is put in place through elections. They have a slogan “Build the youth, Build the Nation”.

Roles of Women in the Study Area

Traditionally, women play very important in the family and society, including supportive roles in traditional administration, social mobilization, and initiation and ownership of developmental projects and programmes. They are also important in attending to welfare needs and conflict management, especially as this concerns their members. The women contribute to household income as they work and invest in livelihood activities. They are important in the upbringing of children and community development. In the different communities, they are led by the Community Women leader who happens in most cases to be the wife of the Village Head.

Female Gender Issues

The communities in the studied communities reflect deep patriarchal structures where authority and decision-making power are predominantly vested in male heads of households. Women in the community have limited ownership rights over major properties such as land and houses, and their participation in decision-making processes is minimal. This lack of inheritance rights and property ownership contributes to their marginalized status within the community. However, gender norms, while deeply entrenched, do not diminish the resilience of women in the communities. Despite their responsibility for domestic chores, farming, and small businesses; women continue to bear the burden of unpaid domestic work, including fetching water, firewood, food preparation, and involvement in economic activities. This unequal distribution of labour, rather than breaking their spirit, fuels their determination to overcome the level of poverty they face.

While the barriers women face in accessing education, training opportunities, and appropriate technologies are significant, they are not insurmountable. The

patriarchal nature of the family and community structures may reinforce gender-based inequalities, but it also presents an opportunity for change. By challenging these norms, advocating for women's rights to property ownership and decision-making and implementing initiatives to enhance women's access to education, training, and resources, the government can pave the way for a more equitable future in the project communities.

While women may face systemic barriers to full participation in decision-making and economic activities, their role within the household is indispensable and valued by both men and children. Efforts to mobilize women into cohesive, action-oriented groups present an opportunity for promoting gender equality and empowering women. Women's social orientation and propensity for collective action, as evidenced by their involvement in church-oriented groups and pre-cooperatives, can be harnessed to drive positive change within the community. Encouraging women to organize and advocate for their rights can lead to greater recognition of their contributions and increased access to resources and opportunities.

Vulnerable Groups

Several vulnerable groups within the community are likely to be disproportionately affected by the proposed project, primarily due to their inability to adapt to potential societal and economic changes. Such groups include children, adolescents and youths, with distinctions between males and females.

The elderly constitute a vulnerable group lacking access to essential social services like healthcare and welfare due to insufficient facilities in the study area. Children in the communities face the risk of accidents while travelling to

school during project mobilization to site and construction as a result of increased vehicular movements. Male adolescents may face the temptation to abandon education and seek casual employment at the project site. On the other hand, teenage girls may grapple with managing their sexuality amidst exposure to sexual advances from older, more experienced male workers at the project site. This may increases the risk of school dropout and teenage pregnancy, which can lead to societal stigmatization and hinder future academic pursuits.

The gender biased allocation and management of family land by males may disadvantage female family members and widows. Widows and single mothers, particularly, may struggle to support their households amidst the presence of rich individuals who may migrate to the area for different business as the gas plant project commences. This economic disparity further exacerbates their vulnerability

It is envisaged that movement of equipment and vehicles will increase with project construction phase. Residents and frequent users of the roads would be vulnerable to disruptions of traffic and complete closure of portions of the road during the project construction phase. Potentially vulnerable groups include physically challenged residents, children and the elderly.

Community youth will be another vulnerable group. There could be agitations and restiveness if desire for employment is not met due to limited opportunities in the project. The youth are also very energetic and impressionable which could lead to several other vulnerabilities associated with social vices. If drug abuse and commercial sex activities increase in communities in the area due to project activities, the youth would be most vulnerable to the influence of these activities. These vices could have long lasting impacts on morals and life of the youth. Addressing the needs and challenges of these vulnerable groups is crucial for

ensuring equitable development and minimizing adverse impacts of the project on the communities.

Environmental Problems

The major environmental problems experienced in the communities are:

- Acid rain corroding roofs of houses
- Deforestation of mangrove forests
- Declining fish catch
- Nypa palm invasion of Mangrove forests
- Flooding
- Air pollution
- Erosion
- Frequent oil spills from existing oil facilities in the area
- Water pollution
- Vibrations, shaking of building foundations and cracking of walls as a result of seismic operations by oil exploration companies
- Light pollution from gas flaring

Socio-Economic Problems

- Lack of employment/ empowerment
- Lack of potable drinking water
- Lack of educational facilities
- Insecurity
- Lack of skills acquisition centres
- Inadequate of health facilities
- Declining fish catch
- Drug abuse

Host Communities expectations from the Project Proponent

The following items are the expectations from the proponent:

- Provision of potable water.
- Supply of electricity to the communities.
- Employment of trained indigenes.
- Financial support for business capital
- Payment of adequate compensation.
- Support for the construction, equipping /operation of health facilities
- Provision of skills acquisition centers for the youth
- Provision of classrooms blocks and things needed to boost education.
- Proponent to put in place and implement MoU

4.13 HEALTH IMPACT ASSESSMENT

Introduction

The proposed gas pipeline and power plant project is expected to have both positive and negative impacts in all its phases. Some of the impacts are presumed to have negative effects on human health within the influence of project location and operations. This informed the conduct of the Health Studies as part of the total ESIA. This section documents the Health Study conducted in the project's study area.

The health status of Ibeno people was assessed as part of the Field Data Gathering Exercise. The Health Assessment questionnaires and Interviews and observation sessions were used to collected data on relevant health parameters.

Aim and Objectives of the Health Study

The overall aim of the health study for the proposed project was to determine the baseline health status of the people within the project area, and evaluate the possible impact of the project on community and environmental health.

The specific objectives of the study were to:

a. Identify and enumerate available health facilities, and assess the quality and access to healthcare
b. Identify and document the types and pattern of common diseases prevalent in the project community.
c. Identify peculiar health problems, hazards and potential health hazards within the project area.
d. Identify and document the available indices of environmental health significance in the project community.
e. Identify knowledge, attitude, practice and behavior on health in the project area.
f. Develop and provide necessary recommendations.

Major findings of Health Study of the Study Area

Health Facilities/Infrastructure

A number of health facilities are available to provide the health needs of the people within the study area. These facilities include: The Cottage Hospital, Upenekang, Ibeno; Health facilities at Iwuachang, Iwuokpom, Iwuokpom Opolom, Ntafre, Atabrikang, Itak Abasi, Opolom, Atia, Ndito Eka Iba, Inua Eyet Ikot, Okoroutip, and Mkpanak. These Health Centres are helpful in the sense that they bring basic health services closer to the people, especially the vulnerable segments of women and children. They also provide more affordable services than private hospitals. From the above, it shows that it is not every community that has a facility. The Health Centre at Inua Eyet Ikot and another facility opposite it , all near the Ibeno Beach Resort, said to have been provided by an Oil Company were seen abandoned during field data gathering. Therefore, the people of these and others with poor access to healthcare areas left with the options of

services provided by the patent medicine store, the TBAs and traditional medicine

practitioners. For the available facilities, their challenge is that is that they lack equipment, drugs and personnel. Many of the health centres do not have doctors, so it becomes challenging when a patient's case demand doctor consultation. In terms of equipment, the health centres lack laboratory equipment. They also do not have enough qualified health care workers.

Plate 4.27: Cottage Hospital, Ibeno

Disease Trend/Risk Factors

Formal records of diseases in the communities were not available during the time of study. However, the prevailing health problems in the area were identified through discussions, interviews and field diagnosis. Ailments and health conditions identified by the people as common in their community include malaria, typhoid fever, skin diseases, respiratory diseases, coughs, heart diseases, hypertension, stroke, prostate problems, diabetes and malnutrition among children. These are experienced throughout the seasons. The most common amongst these and which poses the greatest threat to the community are Malaria

and Typhoid fever. The table below shows the common diseases in the area and their predisposing factors.

Table 4.23: Common Diseases / Predisposing factors in the Study Area

S/No.	Disease	Risks/Predisposing factor
1.	Malaria	Water logs due to poor drainage, Bush patches close to homes
2	Typhoid fever	Unsafe source of drinking water Poor sanitation
3	Respiratory Tract Infection (Coughs)	Air pollution
4	Malnutrition	Diet/food choices
5	High Blood Pressure	Stress, age Excessive alcohol consumption
6	Stroke	Poor sanitation; unsafe source of drinking water
7	Skin Infections	Occupational exposure (farming, fishing). Bush patches close to homes Unsafe source of drinking water
8	Diabetes	Age, genetics

Source: Fieldwork 2025

Mortality

Formal records of births, deaths and illnesses in the project area were not available at the time of survey hence accurate indices could not be ascertained. However, information gathered from discussions and interviews, based on the discussants' knowledge of their communities, provided some qualitative data. High birth cases were indicated in the project area. This could be due to behavioural and other social factors in a largely youthful population that characterizes the communities, among others. At peak, traditional birth attendants in the community could see up to five expectant mothers in a week;

although this does not translate to 5 deliveries per week. There is a locally held notion that identifies high birth cases with riverine dwellers, supposedly owing to the cold environment that conjures strong sexual desires among couples, resulting in a high rate of pregnancies. According to Michael, *et al*., 2024, behavioural and biological factors such as exposure and deliberate and natural marital fertility, are the contributing factors to high fertility in Nigeria.

While child mortality was adjudged low, more people died in the project area in the last one year.

According to 2023 statistics, Nigeria's Fertility Rate (total births per woman per 1000 population) was put at 4.5, representing a record low from previous years; and the Crude Death Rate (number of deaths in a given period divided by the population exposed to risk of death in that period) was 12 (World Bank, 2025).

Community members blamed remote cause of death amongst the adult population on poverty; while immediate causes were identified as ailments such as heart diseases, hypertension/stroke, prostate cancer and diabetes. Child deaths were blamed chiefly on the lack of healthcare. The World Health Organization (WHO) identified Malaria and lower respiratory infections as the leading causes of death in Nigeria (WHO, 2024).

According to World Bank, 2025, National figures for the year 2023 show Nigerians' life expectancy at birth as 54 years (male) and 55 years (female).

Morbidity

The predominant diseases in every community sampled include malaria, typhoid, diarrhea, dysentery, anemia, respiratory tract infections, parasitic worm infections, sepsis, and skin diseases/fungi infections. From the various sources, the top five causes of illness in the communities are as follows:

- Malaria
- Water-Borne diseases
- Respiratory diseases
- Accidents
- Non-Communicable Diseases

This categorization of diseases includes segments of the population like Pre-School children, School Aged children, Pre-Teen Children, Teenage Age Children, Young Adult Male, Young Adult Female, Middle-Aged Male, Middle Aged Female, Elderly Male and Elderly Female. Malaria is the most common disease among all these segments of the population. Then the next prevalent are that water borne disease like dysentery, diarrhea, schistosomiasis, and other worm infections. Respiratory tract infections are another prevalent disease group. This includes diseases like pneumonia, common cold, bronchitis, cough and asthma. Respiratory tract infection like pneumonia has high prevalence among Pre-School Children and even accounts for death among them. Traffic includes boat accidents, injuries from occupational, domestic or leisure mishaps, and injuries from fights and violence. Accidents are mostly prevalent among mostly adult males. Non-communicable diseases refer to conditions like hypertension, stroke and diabetes which affect older people more.

Water Supply

The study area has poor access to safe drinking water. The major source of drinking water supply available is borehole. This is acquired by those who can afford while other purchases same. Community members also buy drinking water in sachet commonly known as “pure water”. The people of the project area also

obtain water for washing and cleaning from hand-dug wells and the rivers. The wells are not protected, thus exposed to contamination; and the water supply from them contains excessive concentration of ferrous iron, which shows in brick red colour of the water on exposure; and often, oil sheens, obviously due to groundwater contamination by crude oil. The river is predominantly polluted by oil and domestic and human wastes.

Rainfall is another source of water for the people, accessible to 100% of the population, but not readily available as it is seasonal. It is prone to contamination by particulate matter and gaseous pollutants that cause acid rain; and also exposed to contamination during collection and storage. Going by what is available to them, it is obvious that the community lacks access to basic drinking water, which refers to water from an improved source, provided collection time is not more than 30 minutes for a round trip. Improved water sources include piped water, boreholes or tube wells, protected dug wells, protected springs, and packaged or delivered water (World Bank, 2023). The lack of safe water is a major public health issue. National statistics show that 70% of the population has access to basic water services, but more than 50% of these water sources are contaminated (UNICEF, 2021).

Sanitation

Sanitation refers to the provision and availability of facilities and services for maintaining personal and public hygiene. Hence access to sanitation is measured by the percentage of the population which has access and are using improved sanitation facilities, such as flush or pour-flush toilet/latrine (to piped sewer system, septic tank, pit latrine), ventilated improved pit (VIP) latrine, pit latrine

with slab or composting toilet (CDC, 2022). Toilet facilities common in the study area are the water closet toilet, pit toilet and open defecation.

The water closet is obviously the more common toilet type used in Mkpanak and Iwuo-Achanag. In Mkpanak and Iwuo Achang. From field observation, it was gathered that this type of toilet is sometimes shared by two or more households in a building or compound. Similarly, some more rudimentary houses have only the pit latrine which is often situated at some distance away from the living building. Then due to their proximity to rivers, some residents still cater for their toilet needs around the river bank and bushes. Some use the pier toilet located on platforms in shallow waters or they just openly defecate on the shore or in the bushes. This major source of fecal pollution of surface water and river banks in the area and constitutes a significant public health concern in the study area. The provision of sanitation/ toilet facility in areas so described is what the Project Proponent can explore in terms of supporting community health infrastructure as part of Corporate Social Responsibility. Reducing open defecation and providing standard toilet facilities is critical to maintaining individual and community health. Open defecation contributes to polluting the streams and rivers which households rely on.

Waste Disposal

Waste disposal is generally inefficient in Nigeria whether in the rural, semi-rural, semi-urban and urban communities of Nigeria. One critical problem with waste disposal is lack of standard infrastructure for proper waste management and waste disposal. As a result, people in towns and villages use indiscriminately waste disposal methods like open dumping, open burning, bushes and dumping into stream/ river channels.

The study communities in Ibeno as in many communities in Nigeria at large, do not have a central or coordinated waste disposal or waste management system. In the study communities, waste disposal is arbitrary. People use the disposal methods mentioned above. The outcome of indiscriminate dumping is that in some of the areas, these heaps smell and they pose a potent contamination hazard. Vectors thrive and spread from these refuse heaps and contaminants from these heaps pollute the water body.

Housing

Housing serves as a major index for assessing the health and wellbeing of a people. This applies to the building structure and the indoor and outdoor dwelling conditions associated with it. The dominant housing structures in the study area those of block wall with zinc roof (65%). Others are mud wall/zinc roof (15%), aluminum/tarpaulin wall/zinc roof (10%), and mud wall/thatch roof (5%), thatch

Plate 4.28 a & b: Housing Types in the Study Area

wall/thatch roof (all-thatch) (5%).The settlement pattern in the area is linear, nucleated; and a reflection of communal habitation.

Housing condition is fair in block-walled houses; most of such structures have ample ventilation, with mosquito net-screened windows. Mud-walled/aluminum sheet/thatch houses lack good ventilation and ample comfort; rather they have open eaves, which give access to disease vectors such as mosquitoes and other pests.

The status of house occupancy, indicated in context by the number of persons that sleep in a room) in the community is poor, with more than 3 persons sleeping in a room, especially in the low housing structure accommodations. This is an indication of inadequate housing, which is the sole cause of congestion in living houses. Congestion can enhance communal transmission and spread of contagious and airborne infections.

Hygiene

One of the factors affecting the hygiene status of any people is its location. Aside the marine environment of the project area, the area is located within the geographic influence of oil and gas industry activities on land and offshore, where some major and marginal operators operate. Hence, the community is exposed to environmental pollution due to gas flaring and oil spillage. The significant impacts from environmental pollution in the area include acid rain, destroying roofs, and surface/ ground water pollution. Additionally, pollution of surface water by human waste due to open defecation is another major concern in the communities. During high tide, the surging water carries all forms of wastes including human waste along its courses into the community marshes and some living surroundings; leaving beaches and other areas littered with wastes when the water recedes.

Nutrition

Nutrition refers to the intake of food, considered in relation to the body's dietary needs. The Ibeno people have a comparative advantage over sea food by virtue of its geographical location, the dominant occupation of fishing which engages more than half of the working population. While fish and other forms of sea food, such as shrimps, etc. constitute the major source of animal protein, their diet comprises chiefly of starchy staple derived from cassava-based products. Their major food types include garri, yam, *fufu*, cocoyam, rice and plantain; with a variety of local vegetables and common fruits. There are no food taboos.

The availability and abundance of seafood should critically enhance the nutrition of people, especially children; however, the nutritional status of the community appears poor. The nutritional condition of children reflects the community's status. A few malnourished children were observed during the survey. Malnutrition may adversely affect child growth and development in the community. According to UNICEF (2023), malnutrition is a direct or underlying cause of 45% of all deaths of children under five years of age; and about 2 million Nigerian children are affected by severe acute malnutrition.

Disease Vectors/Pest

Mosquitoes, sandflies, houseflies, cockroaches, and rats, the study area's most common insects and pests, pose significant health risks. Their prevalence is primarily due to the proximity of bush patches to homes and the cultivation of water-holding plants like plantains, cocoyams, and pineapples around houses, which create ideal breeding grounds for disease vectors such as malaria-carrying mosquitoes. Despite some awareness of mosquito nets as a preventive measure, most houses are not equipped with screened windows or mosquito nets, leaving

the community vulnerable to these health hazards. Animals like cats, dogs, goats, and chickens were encountered in the communities. Some households commonly keep domestic animals as pets or for commercial purposes. The villagers lack knowledge about zoonotic diseases, which are diseases that can be transmitted from animals and humans. This lack of awareness means that domestic animals are not perceived as potential sources of danger, highlighting the need for awareness and prevention.

Occupational Health Risks

The people of the project area are engaged in various livelihood activities which exposes them to many occupational health risks. Fishing is the traditional and prevalent occupation in the area. Trading is carried by others while farming is done at a very low level for subsistence. Some indigenes are engaged in various capacities in the available oil and gas companies onshore and offshore. The major occupational health risks are the inherent risks associated with the occupations as shown in Table 4.24.

Table 4.24: Health Risk and Predisposing Factors.

S/No	Health Risk	Predisposing factor
1	Drowning	Fishing/Offshore engagements
2	Pneumonia	Cold/fishing
3	Rheumatism	Work fatigue
4	Insect bite	Fishing, farm work
4	Snake bite	Farm work
5	Burns	Fish processing
6	Falls	Construction/oil and gas

Source: Fieldwork 2025

Lifestyle/Habits

Common habits and lifestyle were examined to determine the inclinations of the people. These include alcohol consumption, tobacco smoking, and personal

hygiene. Alcoholic drinks include beers, wine, brandy, whiskey, gin and local brews like palm wine and ogogoro. These sorts of drink are freely and widely consumed in the Niger Delta communities, towns, and cities. Ibeno, the study locality, is a place where leisure activities are common. Apart from tourists and visitors who come to the area to enjoy the beaches and local cuisines, residents also engage in active leisure and nightlife. People in Ibeno consume alcohol widely. Among respondents, 80 % said they take alcohol, whereas 16% said they smoke tobacco. Apart from leisure drinking, alcohol is also a component of traditional ceremonies like marriage, burial, masquerade, and dance festivals. During ceremonies like these alcoholic drinks are served and consumed. Alcohol impinges on both individual and social health. But no data from field studies suggest a regular occurrence of alcohol related health issues.

Hand washing is a common practice in both community; and is has been recorded as an indicator of positive health awareness.

Healthcare Needs

The people of the project area welcomed and accepted the proposed pipeline and gas power plant project describing it as a welcome development. The people in addition requested the following from the Project:

- Provision of Potable Water
- Provision of Toilet Facilities
- Building and Equipping of Health centres where none existed.
- Implementation of mitigation measures to reduce pollution to the barest minimum.

CHAPTER FIVE

5.0 POTENTIAL AND ASSOCIATED IMPACT ASSESSMENT

5.1 Introduction

The key objective of an ESIA is to predict changes (adverse or beneficial, whole or partial) in the ecological and socio-economic environment resulting from a proposed development project or activity, as well as recommend mitigation measures to minimize, eliminate or offset those aspects that will adversely impact on the environment.

In pursuance of its policy on the environment and in compliance with relevant national and international laws, conventions and acceptable industry standards, the management of **DeSadel Nigeria Limited** has embarked on this impact assessment for the project. The study is intended to predict, identify, interpret and communicate the impacts of the various phases of the project on the environment. This Chapter, however, evaluates the potential impacts of the various project activities of the proposed Gas Power Plant project on the environment. The assessment approach generally involves matching the various activities of the proposed project (as described in Chapter 3 of this report) with the components of the existing environment. Consequently, the interaction may lead to changes in or impacts on the environment, hence, mitigation measures are proffered in order to reduce, offset or ameliorate such changes (See Chapter Six). The assessment of the potential and associated impacts of the proposed Construction of 750mw Gas-Fired Combined Cycle Power Plant, Qua Iboe, Ibeno LGA, Akwa IbomState, is presented hereunder.

5.2 Impact Assessment Methodology

The guidelines of ISO 14001 were used for impact prediction and evaluation. This allows for interactive and descriptive analysis of relationships between the proposed project activities and the various environmental components (biophysical, health and social). The pathway followed in the identification/ assessment and evaluation of the potential and associated impacts of the proposed project is illustrated in the Figure 5.1.

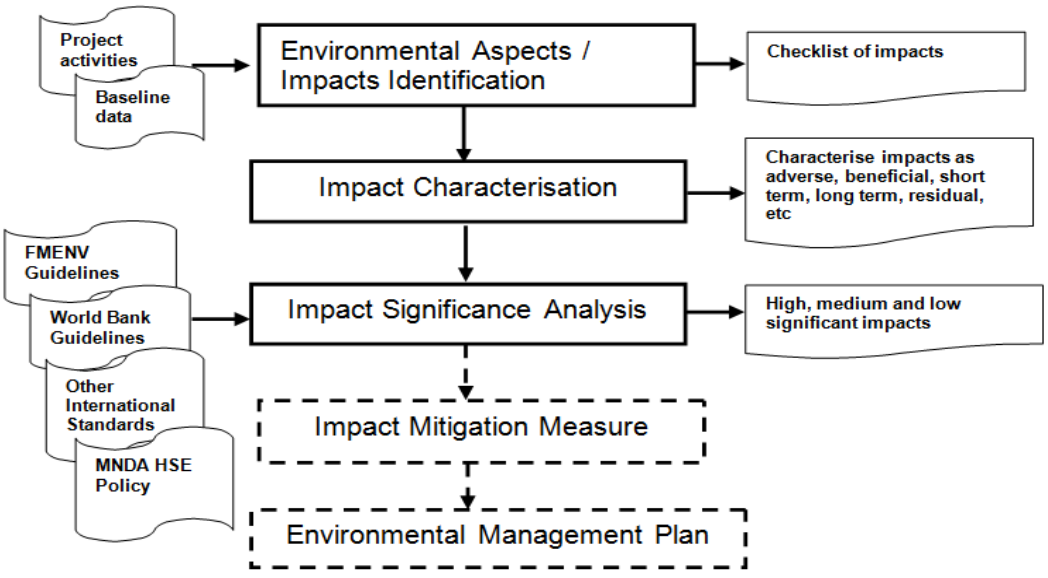

Figure 5.1: Impact Assessment Pathway

Details of the process are discussed in **sections 5.2.1 – 5.3** while the results are presented thereafter in **Table 5.2**.

5.2.1 Impact Identification

The environmental aspects of the proposed project were teased out from the planned project activities description (**Chapter 3**). These aspects were then matched with the existing baseline description of the project environment (**Chapter 4**) and used to develop a checklist of potential and associated impacts of the proposed project (**see Table 5.2**). The development of the checklist was carried out using the FMENV EIA Sectoral Guidelines for Power Generation Projects, the World Bank Environmental Assessment Source Book, Volume 111 (Guidelines for Environmental Assessment, 1991).

Other source references include DeSadel Nigeria Limited HSE Policy and other relevant international standard codes used such developmental projects.

5.2.2 Environmental Impact Indicators

The environmental impact indicators are easily observable parameters that will indicate change/deviation, which can be used to monitor the various environmental components, as presented in Table 5.1.

Table 5.1: Environmental Components and Potential Impact Indicators

S/N	Components Of Environment	Impact Indicators
1.	Climate	Humidity, Temperature, Rainfall, Wind
2.	Air Quality	Particulates, NO_X, SO_X, CO_2, THC, H_2S etc.
3.	Water Quality	Solids (TDS, TSS), Turbidity, Toxicity
4.	Hydrology	Drainage/Discharge, Hydrologic Balance, Sedimentation, Shoreline Erosion
5.	Hydrogeology	Groundwater level and Quality
6.	Soil/Land Use	Erosion, Farming, Hunting, Recreation
7.	Ecology	Diversity and abundance of Aquatic and Terrestrial Flora &Fauna
8.	Fisheries	Productivity, Diversity &Abundance
9.	Archaeology	Cultural relies, sites
10.	Noise &Vibration	Night-time disturbance, hearing loss, communication interference
11.	Socio-economic	Population, income, settlement pattern, health, safety and security
12.	Wildlife &Forestry	Conservation areas, habitats and sensitive areas

5.2.3 Impact Characterization

The identified impacts of the proposed project were further characterized as explained below. The characterization was based on the nature, characteristics and duration of the various project activities on the ecological components of the environment as well as human health and safety as necessary.

Table 5.2: Impact Characterization

Impact Characterization	Definition

Beneficial Impacts	Impacts that would produce an overall positive effect on the well-being of the people as well as the environment.
Adverse Impacts	Impacts that may result in: • Irreversible and undesirable change(s) in the biophysical environment. • Decrease in the quality of the biophysical environment. • Limitation, restriction or denial of access to or use of any component of the environment to others, including future generations and • Sacrifice of long-term environmental viability or integrity for short term economic goals
Direct Impacts	Impacts resulting directly (direct cause-effect consequence) from a project activity
Indirect Impacts	Impacts that are at least one step removed from a project activity. They do not follow directly from a project activity.
Normal Impacts	Impacts that will normally be expected to follow a particular project activity
Abnormal Impacts	An impact is considered to be abnormal when it follows a project activity as against sound predictions based on experience
Short-term Impacts	Impacts that will last only within the period of a specific project activity.
Long-term Impacts	Impacts whose effects remain even after a specific project activity.
Reversible Impacts	Impacts whose effects can be addressed on application of adequate mitigation measures
Irreversible Impacts	Impacts whose effects are such that the subject (impacted component) cannot be returned to its original state even after adequate mitigation measures are applied
Cumulative Impacts	Impacts resulting from interaction between ongoing project activities with other activities, taking place simultaneously
Incremental Impacts	Impacts that progress with time or as the project activity proceeds.

Residual Impacts	Impacts that would still remain after mitigation measures have been applied

5.2.4 Impact Evaluation

At this stage, the potential and associated impacts identified and characterized in the previous stage of the assessment process (**sections 5.2.1 – 5.2.3**) were evaluated. The evaluation which was based on clearly defined criteria (legal/regulatory requirement, risk, frequency of occurrence, importance and public Interest/concern) was used to determine the significance or otherwise of the impacts. The criteria and weighing scale adopted for the evaluation are described below.

Legal/Regulatory Requirements (L)

Here, the proposed project activities that resulted in impacts were weighed against existing legal/regulatory provisions to determine the requirement or otherwise for permits prior to the execution of such activities. Such legal/regulatory requirements were identified from the laws/guidelines, which have been reviewed in opening chapter of this report, as well as those guidelines in the source references relating to the proposed project activity as presented in **section 5.2** and **subsections 5.2.1 – 5.2.2**. The weighting scale used was as follows:

Table 5.3: Legal/Regulatory Requirements Criterion

Condition	Rating
No legal / regulatory requirement for carrying out project activity	**Low =1**
Legal / regulatory requirement exist for carrying out activity	**Medium =3**
A permit is required prior to carrying out project activity which may result in impact on the environment	**High =5**

Risk Posed by Impact (R)

The health, safety and environmental risks associated with each impact were assessed and ranked as “low”, “medium” or “high”, using the Risk Assessment Matrix (RAM). Reference was also made to the source

references listed in the previous sections. Three criteria (consequence, probability of occurrence and severity) were used as basis for ranking the risks of the impacts. These were determined using the RAM as shown in Table 5.4.

Table 5.4: Risk Assessment Matrix (RAM)

Probability

Consequences

Probability Category	Definition
A	Possibility of Repeated Incidents
B	Possibility of Isolated Incidents
C	Possibility of Occurring Sometime
D	Not Likely to Occur
E	Practically Impossible

Table 5.4: continued

Consequence Category	Considerations			
	Safety / Health	**Public Disruption**	**Environmental Aspects**	**Financial Aspects**
I	Fatalities / Serious Impact on Public	Large Community	Major/Extended Duration/Full Scale Response	**High =5**
II	Serious Injury to Personnel / Limited Impact on Public	Small Community	Serious / Significant Resource Commitment	**Medium =3**
III	Medical Treatment for Personnel / No Impact on Public	Minor	Moderate / Limited Response of Short Duration	**Low =1**
IV	Minor Impact on Personnel	Minimal to None	Minor / Little or No Response Needed	**None**

The risks (measure of the likelihood and magnitude of an adverse effect) associated with such project operations were evaluated in terms of:

- Risk to human health.

- Risk to asset (commercial and economic risk).
- Risk to the biophysical environment and
- Risk to the proponent's reputation.

Based on the matrix above, the weighting used was as follows:

Table 5.5: Risk Criterion

Risk	Attribute – Environmental, Human Health, Safety and Reputation
1= Low	• This means that no further mitigation may be required
3= Medium	• This means that the impact can be mitigated with additional controls and modifications
5=High	• This means that the impact requires avoidance or major control/mitigation

Frequency of Impacts Occurrence (F)

Evaluation of the frequency of occurrence of each impact was also carried out. Frequency of occurrence was rated as "high", "medium" or "low" based on the historical records of accidents/incidents, consultation with experts and professional judgment. The frequency criterion is summarised below.

Table 5.6: Frequency Criterion

Frequency	Attribute – Environmental, Human Health and Safety
High = 5	• Major degradation in quality in terms of scale (>1% of study area or habitat within the study area), appearance, duration (beyond duration of project) • Irreversible or only slowly recoverable (change lasting more than 1 year) degradation of environmental ecosystem level (population, abundance, diversity, productivity) • High frequency of impact (occur continuously and almost throughout the project execution period (< 4months) • Geographic extent of impact (e.g. encompassing areas beyond study area)
Medium =3	• Degradation in quality in terms of scale (>0.1% of study area, habitat), appearance, duration (a few months)

	• Effect beyond naturally occurring impacts variability • Slow reversibility (change lasting a few months before recovery), lasting residual impact • Potential for cumulative impact • Intermittent frequency of impact (occur in only a few occasions during the project execution period) • Limited geographic extent of impact (large area within study Area)
Low = 1	• Minor degradation in quality in terms of scale (<0.1% of study area, habitat, very localized), appearance, duration (a few days to a month) • Effect within range of naturally occurring impacts, changes, dynamics • Rapid reversibility (change lasting only a few weeks before recovery), no lasting residual impact of significance • No potential for significant cumulative impact • Low frequency of impact (occur in just about one occasion during the project execution period) • Only very localized geographic extent of impact (e.g. not more than a few meters from impact source point)

Importance of Impact (I)

The importance of target environmental component in respect of identified potential impact was also determined and rated as “high”, “medium” or “low”. The ratings were based on consensus of opinions among consulted experts, including project engineers and other stakeholders in the proposed project. The importance criterion is summarized below.

Table 5.7: Importance Criterion

Importance	**Attribute – Environmental, Human Health and Safety**
High = 5	• Highly undesirable outcome (e.g., impairment of endangered, protected habitat, species) • Detrimental, extended flora and fauna behavioral change (breeding, spawning, molting) • Major reduction or disruption in value, function or service of impacted resource • Impact during environmentally sensitive period • Continuous non-compliance with international best practices
Medium =	• Negative outcome

3	• Measurable reduction or disruption in value, function or service of impacted resource • Potential for non-compliance with international best practices
Low =1	• Imperceptible outcome • Insignificant alteration in value, function or service of impacted resource • Within compliance, no controls required

5.3 Result of Impact Assessment

The results of the impact assessment exercise as discussed in the previous sections are presented in Table 5.8. The various project phases, planned project activities, the environmental aspects of the proposed project, as well as the identified associated and potential impacts are reflected in Table 5.8. Also included in Table 5.8 are impact significance evaluation criteria:(legal/regulatory requirements (**L**), risk posed by impact (**R**), frequency of occurrence (**F**), importance of affected environmental component (**I**) and public perception (**P**). In addition, the overall ratings of impact significance (**High** or **Medium** or **Low**) of each impact considered have been included. The overall significance ratings were based on the following considerations:

High = (L+R+F+I+P) ≥ 15 or (F+I) ≥ 6 or P = 5

Medium = (L+R+F+I+P) ≥ 9 but < 15

Low = (L+R+F÷I+P) <9.

Table 5.8: Potential impacts Identification, Ranking and Quantification

Project Phase	Project Activity	Description of Impact	Impact Qualification						Impact Quantification						
			Adverse	Beneficial	Short term <3 months	Long term >3 months	Reversible	Irreversible	L	R	F	I	P	F+I+P	Overall Ranking (High/ Medium/ (Low)
Mobilization	- Movement of goods, workers, equipment, etc.	Increase in road traffic volume and risk of accidents/injury	-		S	L	R	I	3	3	1	3	5	9	M
		Increase in noise nuisance	-		S		R		3	3	1	3	3	7	M
		Reduction in air quality	-		S		R		3	1	3	1	1	5	L
		Increase in respiratory diseases	-		S		R	I	0	3	3	1	1	5	L
		Movement of heavy equipment of worksite which may pose danger to public	-		S		R		3	3	3	3	3	9	M
		Increase in community unrest	-		S		R		0	3	3	3	3	9	M
		Pressure on existing infrastructures e.g. roads	-		S		R		0	1	3	1	3	7	M
Construction	Land clearance Foundation Piling Excavation Compaction Fuel consumption Waste generation Transportation	Reduction in biodiversity/ Loss of Flora and Fauna	-			L		I	3	3	1	3	5	9	M
		Influx of people	-	+		L	R	I	5	5	3	5	3	11	H
		Increase in cost of living/inflation	-			L		I	0	3	5	5	5	15	H
		Job creation		+		L	R		3	5	5	5	5	13	H
		Business opportunity/ Economic enhancement		+		L	R		0	5	5	5	5	15	H
		Improvement of existing infrastructure		+		L	R		3	5	3	5	5	13	H
		Alteration of natural soil profile	-			L		I	3	3	1	3	5	9	M
		Skills acquisition		+		L	R		3	5	3	5	5	13	H

		Increase in community unrest	-			L	R		0	3	3	3	5	11	H
		Increase in road traffic volume and risk of accidents/ injury	-		S		R		3	3	3	3	5	11	H
		Soil Degradation and Soil/ Groundwater Contamination	-			L	R		3	3	1	3	3	7	M
		Pollution of water bodies	-			L	R		3	3	1	3	3	7	M
		Increase in noise nuisance	-			L	R		3	3	1	3	5	9	
		Increase in social vices	-			L	I		3	3	3	5	5	13	

Project Phase	Project Activity	Description of Impact	Impact Qualification						Impact Quantification						
			Adverse	Beneficial	Short term <3 months	Long term >3 months	Reversible	Irreversible	L	R	F	I	P	F+I+P	Overall Ranking (High/ Medium/ (Low)
		Injury / fatalities in workforce/communities	-			L	R		3	5	5	5	5	15	H
		Pressure on existing infrastructure	-			L	I		3	3	3	5	5	13	H
		Reduction in air quality	-			L	R		3	3	1	3	3	7	M
		Shift in traditional occupation	-			L		I	0	3	1	3	5	9	M
		Stress on existing security structures	-			L	R	I	5	5	3	5	3	11	H
		Increase in communicable diseases (Including STIs)	-		S	L		I	3	3	3	5	3	11	H
		Increase in local population	-		S		R	I	0	5	5	5	3	13	H
		Increase in respiratory diseases	-		S	L		I	0	5	3	3	3	9	M
		Loss of farm land	-			L	R		0	1	1	1	5	11	H
		Reduction in population		+	S		R		0	1	1	1	1	5	L
Operation	- Selection and engagement of qualified staff - Running and maintenance of staff accommodation - Operation and maintenance of the plant to generate electricity - Waste generation Selection of other staff	Emotional disturbance	-			L	R	0	0	3	3	5	1	9	M
		Increase in revenue to Government and DESADEL		+		L	R	3	3	5	3	5	5	13	H
		Increase in efficiency of gas use and electricity generation		+		L	R		3	5	3	5	5	13	H
		Improved management of facilities		+		L	R		3	5	3	5	5	13	H
		Exposure to emerging international utility management techniques		+		L	R		0	5	3	5	5	13	H
		Reduction in gas flaring		+		L			5	3	3	5	5	13	H
		Injury/ fatalities in workforce/ communities	-			L	R		3	5	3	3	3	9	M
		Increase in community unrest	-			L		I	0	5	5	5	5	15	H
		Increase in cost of living / inflation	-			L			0	1	5	5	5	15	H
		Loss of employment during staff disengagement after construction activities	-			L	R	I	3	3	3	3	3	9	M
		Business opportunities / Economic enhancement		*		L	R	I	0	3	3	1	5	9	M
		Pollution of water bodies	-		S		R	I	3	3	1	3	3	7	M
		Increase in respiratory diseases	-			L	R		0	5	3	3	3	9	M
		Increase in road traffic volume,	-			L	R		3	3	3	3	3	9	M

		accidents/injury														

project Phase	Project Activity	Description of Impact	Impact Qualification						Impact Quantification						
			Adverse	Beneficial	Short term <3 months	Long term >3 months	Reversible	Irreversible	L	R	F	I	P	F+I+P	Overall Ranking (High/ Medium / (Low)
		Improvement of infrastructure		+		L		I	3	1	1	5	5	11	H
		Increase in noise nuisance	-			L		I	3	3	3	3	3	9	M
		Reduction in air quality	-			L		I	3	3	3	3	3	9	M
		Soil Degradation and soil/ground water contamination	-		S		R		3	3	3	3	3	7	M
		Risk / Exposure to electric shock	-			L	R	I	0	5	1	3	3	7	M
		Increased period of brightness	-			L		I	0	1	3	1	1	5	L
		Increase in local population	-			L	R		0	3	3	3	3	9	M
Demolition	- Equipment dismantling - Structures dismantling - Waste Disposal - Removal of contaminants - Soil remediation	Business opportunities / Economic enhancement		+		L	R	I	0	3	3	5	5	9	M
		Job Creation		+		L	R		3	5	5	5	5	13	H
		Increase in cost of living/inflation	-			L		I	0	1	3	5	5	15	H
		Increase in noise level and dust generation.	-			L	R	I	3	3	5	5	5	13	H
		Increase in community unrest	-			L		I	0	5	3	5	5	15	H
		Injury / fatalities in workforce/ communities	-			L	R		3	5	3	3	3	9	M
		Stress on existing security structures	-			L	R		5	3	3	3	3	9	M
		Increase in respiratory diseases	-		S	L	R	I	0	5	1	5	3	11	H
		Alteration of soil fauna community	-			L	R	I	0	3	1	3	1	5	L
		Alteration of natural soil profile	-			L	R		3	1	1	3	1	5	L
Handover	- Assessment of facility - Restoration - Staff movement	Job creation		+		L	R		0	5	1	3	5	9	H
		Emotional disturbances	-			L	R		3	5	1	5	5	11	H
		Stress on existing security structures	-			L	R		0	3	3	3	3	9	M
		Change in economic conditions	-	+		L	R		0	3	1	3	3	5	L
		Community unrest / agitation	-		S		R		3	5	1	5	5	11	H
		Loss of employment after construction and decommissioning activities.	-			L		I	3	3	1	5	5	9	M

5.4 SIGNIFICANT POSITIVE IMPACTS

Job Creation

Baseline:

Unemployment rate is currently very high in the project area, standing at 60% for males, and 35% for females.

Potential impacts

During mobilization, and construction, the bulk of the jobs will be created that locals and nationals will be expected to take advantage of and there will be opportunities for the acquisition of new skills.

During the operation & maintenance as well as the demolition phases, jobs are expected to be available for locals and nationals even if at a lower rate than during the construction phase.

Business Opportunities / Economic Enhancement

Baseline:

The local economy is currently dominated by hunting and farming with minor emphasis on ginneries and garri processing. Such off-farm activities as sale of provisions in stores and petty trading on various kinds of farm produce (cassava, yams, fruits, groundnuts etc) as well as cottage industries such as bicycle repairing, carpentry, welding, GSM calls, motor-cycle commercial business and phone repairs etc is done within the communities.

Potential impacts

Movement of the workforce during the mobilization phase will trigger an increase in local economic activity especially for food vendors, retailers, landlords, transporters, etc. This will promote economic empowerment of the local populace.

In particular, it is estimated that the incoming workers and followers have the potential to increase the population of Ibeno by up to 4%. The local economy will enjoy a "boom" that is expected to last throughout this phase and even slightly beyond. But during the operations phase, when most of the workers have been demobilized, the local economy will suffer a "bust", as demand levels will drastically drop. This will mean considerable loss of income for many locals, with the attendant adverse social repercussions.

There will be no road diversion of the existing road and no impact is envisaged to be generated as a result of minor upgrade of the access road leading to the project site. As is common in communities such as this, development will shift towards the road upgrade area and the economic activities will thrive very well.

5.5 SIGNIFICANT NEGATIVE IMPACTS

Increased potential for road traffic volume and risk of accidents/ injuries

Potential impacts

It is anticipated that road traffic will increase by 10% during mobilization of personnel and equipment to site, throughout the construction phase, which is expected to last for about two to three years, and by 5% during the decommissioning phase.

Given the present condition of the road, these increases in volume of traffic have the potential to increase the risk of accidents/injuries on this road.

Influx of People

Alteration of the age-sex distribution

Baseline

In the study area, there was a relative preponderance of persons in the younger age cohorts. For instance, those aged 20 to 40 years for Nigeria as a whole as at

the 2006 census accounted for 27.8% of the total population while in the study area people within that age bracket accounted for 39.3%. In the study area there were 106 males for every 80 females and the dependency ratio averaged 80%.

Potential impact

During various phases of the project especially during mobilization and construction, influx of workers and followers totaling about 1,500 persons at the peak construction period, will consist of mostly young males and females but predominantly the former. This could serve to alter the age ratio loading more people in the 20 — 44 age groups, thus further increasing the noted concentration in this age bracket.

Similarly, since the immigrants will mostly be males, the sex ratio will be altered in favour of males.

Pressure on existing infrastructure

Baseline

The study area has limited physical, social and economic institutional infrastructure.

Potable water, recreational facilities, clinics, banks and post offices were available but not sufficient, except for few communities which had electricity and potable water supplied by the influential individuals in the area. Thirty-three percent (33%) of the housing stock was rated as “good” (need no repair); 32% as “fairly good” (need minor repair), 25% as “bad” (need major repair), and the rest (10 %) as “very bad” (beyond repair).

Potential impact

Influx of people mostly during the mobilization and construction phases will put more pressure on the already noted deficient physical social and economic institutional infrastructure.

Increase in communicable diseases (including STIs)

Baseline:

Survey data show

(a) A preponderance of the younger, sexually active age groups;

(b) A general low level of knowledge of STI transmission routes;

(c) Low availability and use of protective mechanisms;

(d) Practice of keeping multiple sexual partners;

(e) High morbidity and mortality from communicable diseases, especially malaria, respiratory tract infections and diarrhea);

(f) Very few health facilities with low capabilities and; Poor housing.

Potential impact:

The influx of a largely youthful, sexually active people, many of who are likely to be either single or who their families is anticipated to increase the potential for casual sex and the transmission of STIs. Experience from past projects indicates that commercial sex workers often constitute a significant proportion of camp followers and if the same occurs for this project, is likely to increase the risk of contacting STI given the baseline circumstances.

The workforce from outside the area (both national and expatriate) and their camp followers may also import some communicable diseases such as malaria, tuberculosis, etc. Many camp followers are expected to live in poor housing conditions with over-crowding and inadequate sanitation. These conditions are favorable for the spread of communicable diseases such as respiratory diseases and diarrhoea.

Increase in cost of living/Inflation

Baseline

Although, the inflation figure for the specific study area is not available, the Central Bank of Nigeria puts national inflation rate currently at 13%.

This can be extrapolated to the study area. Actual inflation figures in the study area are not available.

Potential impact:

Any significant increase in movement of people to an area, especially those expected to be economically stronger than the local population usually triggers an increase in cost of living, and therefore inflation. This is due to the increased demand for accommodation, food items and services

Inflation is likely to commence during the mobilization phase as people and equipment begin to move in. It will reach a peak during the construction phase, when there will be more intense site activity over a relatively prolonged period of time, during which most of the workers will be resident in the project area. The inflation rate is expected to drop off during the operations phase, when the bulk of the construction workers should have been demobilized and most of them have moved out of the area.

Increase in Social Vices

Baseline:

Currently, about 21% and 5% of males and females respectively, use alcohol regularly.

The corresponding figures for cigarette smoking are 4.5% and 0.5%. From participatory research, it was found that, in the project area, known commercial sex workers (CSWs) are denied accommodation by landlords. Therefore, although

the exact figures are not available the number of CSWs in the area at the present time can be assumed to below.

Potential impact:

The influx of people into the area (both the workforce and the followers), starting from the mobilization phase, will mean that mainly young men of different lifestyles will migrate into the area. The presence of such people could lead to various social pathological conditions such as increase in crime rate, fraud, prostitution, drug and alcohol abuse, etc.

As has been the case elsewhere in the area, it is expected that there will be a significant influx of commercial sex workers (CSWs) to take advantage of construction workers, many of who will come without their families. Although this trend will begin to be noticeable during the mobilization phase, it is during the construction phase that it will attain its peak, dropping off during the decommissioning phases.

Injury/Fatalities in Workforce/Communities

Baseline

The major industrial activity in the area is the Ibeno Power Plant, the Qua Iboe terminal and other oil and gas companies. There is also the gas line from Oso platform. There are minor household based industries such as garri processing, motorcycle repairing, palm oil processing, etc. Current records on injury/fatalities in the workforce and communities arising from these activities are not available.

Potential impact:

During construction, operation, and demolition, activities could lead to increased work related injuries/fatalities. Additionally, major plant upsets and work related accidents occurring off-site might also lead to injuries for some community members.

Increase in Respiratory Diseas*es*

Baseline:

Based on survey results, morbidity from respiratory diseases accounted for 31.5%, 7.4% and 61.1% in under 5years, 6-15years and those above 15years respectively. The peak flow rate measurement in the communities revealed less than optimum lung function in all the age groups. The proposed project has the potential to release emissions to air (SPM, COX, and NOX etc)).

Potential Impacts

The emissions have the potential to lead to a reduction in air quality and cause an increase in respiratory diseases and worsen existing cases such as chronic bronchitis and asthma.

Health impacts from asbestos fibers are usually associated with long-term exposure over many years and hence affect workers. If not handled and disposed of correctly there exists the potential for the exposure of workers to these fibers especially during the periods of decommissioning and demobilization.

Loss of Farmland

Baseline:

At present farming is an important economic activity in the area, with 31% of female and19% of males engaged in it. Five families typically farm one hectare of land and have other agro-based activities on the side (fishing, palm fruit processing, etc).

Potential impact:

The various types of construction activity envisaged during the construction phase will entail loss of some land areas (about 12 ha) currently used for farming purposes. Since the locals are predominantly farmers, this will mean loss of

livelihood for the affected families and will probably necessitate some occupational re-adjustment for those who cannot obtain land elsewhere. This also has implication on nutrition due to reduced access to farm produce.

Loss of Employment

Baseline

At commencement of construction activities, there will be requirement for permanent and contract staff to be employed by company. The other significant employer in the area are the Delta Glass Company, the Qua Iboe terminal and other oil and gas companies as well as the gas and crude transmission lines right of way (ROW).

Potential impact

During operations, because of high automation, only about 50 permanent staff will be needed plus possibly another 20 contract staff. Therefore, it is expected that there will be a job loss at the plant of the order of 60%.

Increase in Noise Nuisance

Baseline

The baseline study noted that ambient noise levels in the proposed power plant area are made up predominantly of noise from the Qua Iboe Terminal and traffic noise from motorists and okada riders as well as generating sets. At night when the effect of other sources such as traffic noise is reduced, the power plant is the only significant source of noise. The baseline survey determined that noise levels ranged from 32.6dB(A) to 43.1 dB(A) for daytime noise measurements.

The measurements taken by the boundary of the power plant was 46.3dB(A). These results are used as a guide to the current occupational noise exposure. The background noise levels in the communities are within the World Bank Guidelines (Leq 1 hour db (A)) for residential, institutional and educational

receptors. The noise standard proposed by the Federal Environmental Protection Agency (FEPA) (now the Federal Ministry of the Environment (FMENV)) relate specifically to on-site occupational noise exposure. It contains no off-site exposure levels. The noise level within site was 39.8dB(A).

Potential impact

During mobilization and construction, the machinery and vehicles are likely to create high noise levels within the site. These may impact receptors on the existing site, and the nearest sensitive receptors off–site.

Reduction in Air Quality

Baseline

The principal source of industrial emission is the existing Qua Iboe Terminal. Baseline study indicated that the only significant air pollutants observed were suspended particulate matter (35 to 67 $\mu g/m^3$) and nitrogen dioxide (0.00 to 0.03$\mu g/m^3$). Although present in this environment, the concentrations of these pollutants are below the Nigerian Ambient Air Quality Standards recommended by the Federal Ministry of Environment.

Traffic along the Ibeno - Eket road is relatively light in the vicinity of the Qua Iboe and as the baseline study shows, this has not resulted in poor air quality at distances within a radius of 2km of the plant and especially at distances of more than 100m on either side of this road.

The major sources of emissions would be from the existing Qua Iboe Terminal and other gas facilities (NOx, SPM, steam) as well as during construction activities (dust and particulates)

Potential impact

The smallest dust particles i.e. those with a diameter of less than 10 microns are most likely to be deposited in the lungs and therefore have the greatest potential

for causing health impacts. The dust particles that may be emitted during construction will be of large diameter (50-200 microns) and will therefore tend to settle on the ground within 100 to 500m of the site.

Approximately, 70percent of the dust will generally settle out of the atmosphere within 200m of the source and less than 10 percent could be expected to remain at a distance of 410m. Thus, most of the dust would settle on the surrounding vegetation.

The combustion of natural gas results in the emission of flue gas containing carbon dioxide, water vapor, oxygen, nitrogen, carbon monoxide, oxides of nitrogen and traces of sulphur dioxide. The last depends on the level of sulphur in the fuel. Because the initial analysis of gas in the Ibeno area suggests negligible levels of sulphur and the gases are not odorized with methyl mercaptans (which can be sources of sulphur in the odorized natural gas) emissions of sulphur dioxide from the power station are, therefore, unlikely to be significant.

Combustion in gas turbines is conducted at high excess air rates, typically 200-300 percent excess air. There are therefore very low levels of carbon monoxide, un-burnt carbon (i.e. particulate matter) or un-burnt volatile organic compounds when burning gaseous fuels.

Reduction in Biodiversity/Loss of Flora and fauna

Baseline

Baseline studies show that the general project area lies in the swamp rainforest/coastal vegetaion where the vegetation has been cleared for farming purposes. The hinterland area contains a large diversity of flora and fauna, although few species of wildlife have been identified as nationally endangered or threatened, though not within the proposed project area.

The main occupations of the local people are farming, fishing and to a lesser extent hunting and so majority of the population rely on the flora and fauna of the region frothier livelihood.

Potential impact

A total of about 30 hectares will be acquired for the construction of the power plant and link road. The project activities during construction will result in a loss of habitat and an alteration of the flora and fauna ecosystems, during site preparation.

The most significant impact will be the loss of economic and medicinal plants, the loss of non-timber forest products and the displacement of wildlife into surrounding areas. The area bordering the proposed location has lost many of its forest wildlife species (such as duiker, Chimpanzee, Buffalo, etc) over the years and the extinction process is continuing, by all local accounts. However, it is expected that any disturbance in the area will most likely displace any mammals within the area into the tropical rainforest and derived savannah forests bordering the project site. The displacement may be significant for nursing female species that may not migrate easily with their young ones.

Site preparation (clearing & excavation) removes the vegetation cover over the soil leading to increased evaporation that dries the soil (mainly due to increased exposure to the sun). This drying may make the soil less favorable for the fauna of the soil.

Soil degradation and Soil/Groundwater Contamination

Baseline

In the baseline survey for this study, condensate spillage, used oil disposal and management of clean oil products were not identified as major concerns at the Power Plant area although petroleum contaminated soils were reported in a

previous study. Perhaps the only known case of oil pollution in the piece of land behind the project site occurred when a truck conveying diesel fell down and spilled the area.

The baseline data indicate that the soil adequately supports normal agricultural activities. The waste management programme of the Power station shall be effectively enforced. There were no visible wastes at the proposed site for now. Most of the refuse generated in the study area especially during construction and mobilization included both degradable and non-degradable types. Most of the degradable wastes were mainly kitchen waste, which included food wastes or remnants (garbage), papers etc. The non-degradable wastes will mainly be plastics, bottles, polythene bags, ashes, cans/tins etc.

The major refuse disposal methods seen within the communities were open dumping, burning and dumping into shallow pits beside the house. Pit latrine is the most commonly used human waste disposal method. There is no deliberate waste management practice in place.

Effluents from the proposed power plant facilities will be discharged into Douglas Creek via a pipeline after conventional treatment to meet regulatory limits before discharge, a distance of approximately 50m via a channel. A state-of-the art water treatment plant will also be constructed to handle waste water before disposal.

Potential impact

Construction equipment generates large volumes of waste oil. Its proper handling is critical because improper discharge and/or storage, and leakage can result in the contamination of soils, surface water and underground water. Oil products can also lead to contamination of surface and underground water if there is a lack of a controlled fuelling, maintenance and servicing protocol for construction machinery at worksite.

There is the potential for soil loss by erosion from increased surface run-off (especially during high rainfall). The consequence of the erosion of land is likely to be a change in the land use pattern of the area and increase sediment load on downstream water bodies especially the pond.

As part of the pre-treatment/conditioning of the incoming fuel gas (condensate), and the generation of electricity, minor quantities of hydrocarbon liquid shall be separated from the fuel gas prior to combustion by the slug catcher from the metering station. Improper handling, storage and accidents could cause soil contamination with negative consequences.

CHAPTER SIX

6.0 MITIGATION MEASURES AND ALTERNATIVE MEASURES

6.1 Introduction

Project activities evaluated in Chapter 5 show that the various components of the environment will be impacted positively or negatively. This chapter of the report presents the mitigation (preventive, reduction and control) measures and alternatives considered to ensure that the associated and potential impacts of the proposed construction of the 750mw Gas-Fired Combined Cycle Power Plant Project in Ibeno, Ibeno LGA, Akwa Ibom State, on the ecological and socio-economic environment are eliminated or reduced to as low as reasonably practicable (ALARP) thus preserving the ecological integrity of the existing environment. Also, stated here are details of the control technology and compliance with health and safety hazards requirements including a table showing the potential impacts of the proposed project with their proffered mitigation measures (Table 6.1).

6.2 Approaches to Impact Mitigation

The approaches to the mitigation measures include enhancement (for the positive impacts), prevention, reduction, avoidance and compensation (for the significant negative impacts). The mitigation measures for each (significant and adverse) impact of the proposed project activities were generally identified based on the associated effect to the environment and human health/safety. The significance of the impact, probability or likelihood that the impact would occur and the severities of its consequence (as determined from the risk assessment matrix) were indices used for determining the mitigation requirements as illustrated in Figure 6.1. Subsequently, the specific mitigation

measures satisfying the mitigation requirement were established putting into consideration available resources and competencies, on-site conditions, public concerns and technology.

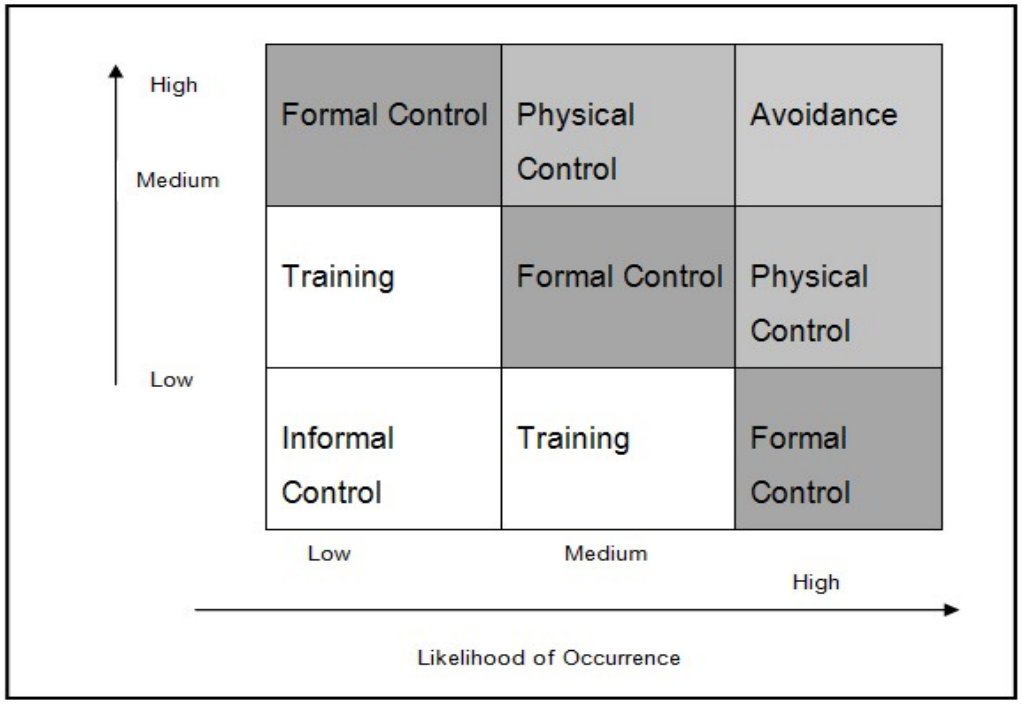

Figure 6.1: Matrix for Determination of Mitigation measures

The definitions of the various approaches to impact mitigation considered are presented below.

Enhancement: These are measures proffered to ensure that significant beneficial impacts of the existing facilities and proposed project are encouraged.

Prevention: These are measures proffered to ensure that significant and adverse potential impacts and risks do not occur.

Reduction: These are measures proffered to ensure that the effects or consequences of those significant associated and potential impacts that cannot be prevented are reduced to a level as low as reasonably practicable.

Formal control: This involves the application of documented policy, process or procedure in mitigating the impacts of the project activities.

Informal Control: This involves the application of sound judgment and best practice in mitigating the impacts of project activities.

Physical control: This involves the application of physical processes or instruments (pegs, flags, signage), not necessarily requiring any special technology, in order to mitigate the impacts of a project or impacts.

Avoidance: This involves the modification of plans, designs or schedules in order to prevent the occurrence of an impact or impacts.

Training: This involves personnel awareness in specific / specialized areas.

6.5 Management Procedure for Mitigation Measures

The management procedures employed for the establishment of mitigation measures for the identified impacts is presented in Figure 6.2. Mitigation measures were subsequently proffered for adverse significant potential impacts. These measures (prevention, reduction, control strategies) were developed for the adverse impacts through review of industry experience (past project experience), consultations and expert discussions with multi-disciplinary team of engineers and scientists.

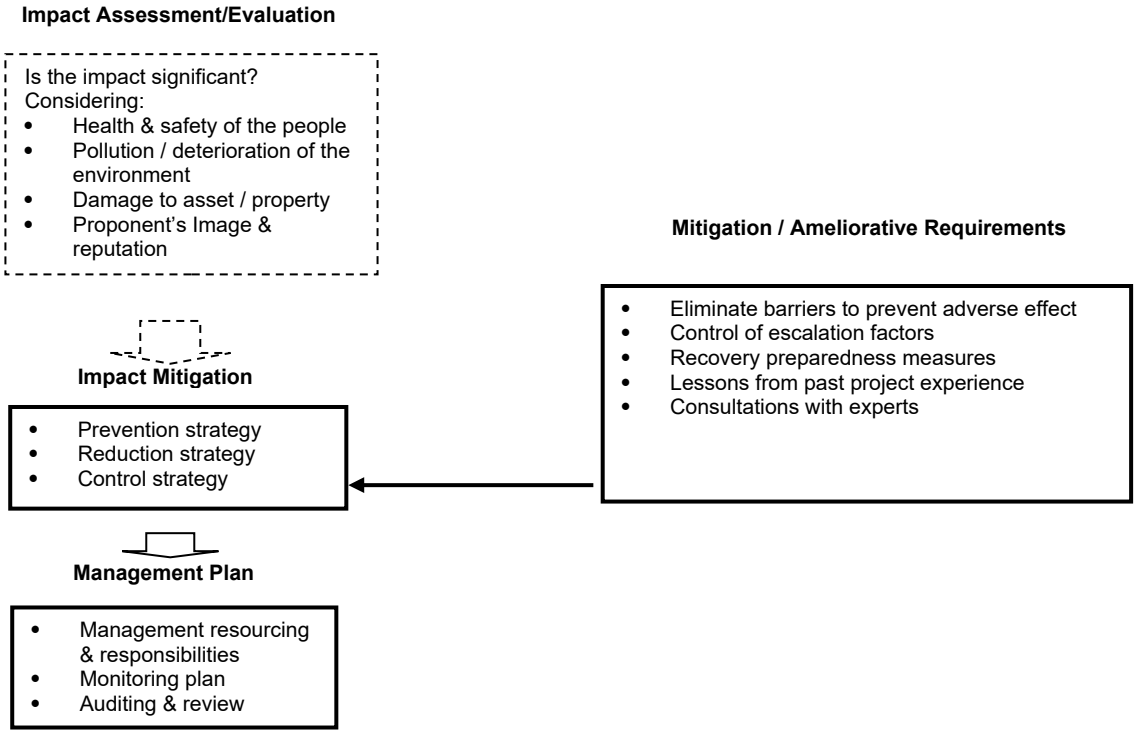

Figure 6.2: Management Procedure for Mitigation Measures

6.6 Proffered Mitigation Measures

Accordingly, this section presents the mitigation measures proffered for the significant (medium and high) adverse impacts of the project. These cost-effective measures have been proffered with reference to best industry practice and HSE considerations.

Based on the impact assessment matrix in the previous section, the overall ratings of impact significance **High** or **Medium** or **Low** was established for each identified impact. The proffered mitigation measures and the expected final residual impact rating for the identified potential significant impacts are presented in the **Table 6.1.**

Project Phase	Project Activity	Description of Impact	Significance Rating before Mitigation	Mitigation	Significance Rating after mitigation (Residual Impact Rating)
Mobilization	Movement of goods equipment etc	Increase in road traffic Volume and risk of accidents/ injury	Medium	DESADEL shall • ensure pre-mobilization inspection of all vehicles • Visible warning signs shall be placed on roads and vehicles • Speed breakers shall be installed at sections of the road traversing communities. • Ensure Pedestrian friendly roads. • Defensive driving course for DESADEL and contractor drivers shall be enforced. • Large and slow moving vehicles shall be scheduled during off-peak periods. • Vehicle monitoring device/DESADEL Journey Management Policy/Night driving and alcohol policy shall be enforced by the EPC contractor. • Raise community awareness of unusual activity via the HSE team shall be maintained. • Compulsory medical fitness test for all	Low

				DESADEL and contractor/ drivers shall be enforced. • Ensure apprpriate maintenance of the road network. • First Aid boxes in vehicles shall be implemented by DESADEL • Emergency/Medevac procedures as they apply in DESADEL shall be put in place. • Ensure upgrade of existing medical/ clinic to include emergency unit.	
Project Phase	**Project Activity**	**Description of Impact**	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual Impact Rating)**
		Increase in noise nuisance	Medium	Night driving policy of DESADEL shall be enforced by EPC contractor. Contractor shall plan activities such that World Bank limits shall not be exceeded at the nearest community (ies) especially at night. Key communities shall be consulted prior to periods of expected peak noise levels.	Low
		Movement of heavy equipment to worksite which	Medium	Visible warning signs shall be placed on roads and vehicles. Large and slow moving vehicles carrying	Low

		may pose danger to public		heavy equipment shall be scheduled during off-peak period (i.e. nights with increased security) DESADEL shall raise the awareness of the communities along the route of unusual activity via the HSE team. Much of movement of heavy equipment to site shall take place at night (with increased security), thus avoiding the daytime peak traffic periods, and reducing possible danger to road users. Times of movement of heavy equipment shall be advertised, so that road users can reschedule their trips on the major road and/ or use alternative routes. DESADEL shall contact Government traffic police to ensure more traffic control on the relevant road(s) during periods of movement of heavy equipment, thus reducing danger to the general public. Heavy truck drivers shall be specially counselled to be careful while in transit to reduce danger to the general public.	
Project Phase	**Project Activity**	**Description of Impact**	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual**

					Impact Rating)
				Transportation of heavy equipment to the site shall be accompanied by public warning and precautions such as labels; sirens, etc	
		Increase in community unrest	Medium	DESADEL shall maintain established channels of communication with communities along the route during this phase of the project. DESADEL shall listen sympathetically to the needs of the host communities with a view to assisting, whenever possible.	Medium
		Pressure on existing infrastructure e.g. roads	Medium	DESADEL shall ensure appropriate maintenance of the existing road with a view to improving its functionality. The new road diversion shall also serve to reduce stress on the Eket—Ibeno road.	Low
		Influx of people	High	EPC Contractor shall make available a detailed housing plan to the DESADEL project manager prior to mobilization.	Medium
		Increase in cost of living inflation	High	DESADEL shall support skill development and enhancement of the local communities through training and complemented by cooperative and micro-credit schemes in Ibeno. EPC contractor shall submit a catering plan to the DESADEL Project manager for approval	Medium

				prior to mobilization.	
		Alteration of natural soil profile	Medium	DESADEL shall ensure that EPC contractor minimises topsoil removal so that quarried laterite brought in from another location does not tremendously alter the natural soil profile of original location.	Low
Project Phase	**Project Activity**	**Description of Impact**	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual Impact Rating)**
		Soil Degradation and Soil/Groundwater contamination	Medium	DESADEL shall ensure that EPC contractor provides containment for chemicals and liquid discharges. DESADEL waste management policy shall be enforced in cases of domestic rubbish/trash, scrap metals, non-plastic combustible packaging materials, plastic packing materials, drums and containers as well as medical wastes. DESADEL shall ensure that a controlled fuelling, maintenance and servicing protocol for construction machinery at worksite is established and followed. DESADEL shall ensure that a liquid (condensate) knock out facility is installed in	Medium

				the gas supply system and that approximate means to store and dispose of this liquid is provided in the design and construction of the plant.	
		Pollution of Water bodies(underground water)	Medium	DESADEL shall ensure that EPC Contractor provides containment for chemicals and liquid tdischarges. DESADEL shall ensure that clearing is during dry season to minimise run-off into water bodies. DESADEL waste management policy shall be enforced.	Low
		Increase in noise nuisance	Medium	The proponent shall plan activities such that World Bank limits shall not be exceeded at the nearest communities (ies) especially at night. Communities shall be consulted prior to periods of expected peak noise levels.	Low
Project Phase	**Project Activity**	**Description of Impact**	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual Impact Rating)**
		Increase in social vices	High	Intensive enlightenment campaign and health education for the abatement of abuse of drugs, alcohol in the communities and among	Medium

				workers throughout the life of the project shall be carried out vigorously. DESADEL shall ensure that EPC contractor enforces the alcohol & drug policy for staff. DESADEL shall encourage EPC contractor to support sporting activities. DESADEL shall support public health lectures with emphasis on common communicable diseases such as malaria, TB, STIs including HIV/AIDS. DESADEL shall engage and support local security systems. Provision of condoms for construction workers shall be encouraged. DESADEL shall ensure that EPC contractor implements social and health awareness programs for all workers at induction and on a continuous basis throughout the life of the project.	
		Increase in communicable diseases (incl. STIs)	High	DESADEL shall supportimmunization in collaboration with Ibeno Local Government for workers and community members. DESADEL shall train traditional health practitioners and village health workers to strengthen primary health care in the project area. DESADEL shall undertake community based	Low

				training on the prevention of common communicable diseases, water protection/ purification techniques and basic sanitation. DESADEL shall upgrade and support existing health services and facilities at the project site. DESADEL shall enforce expatriate malaria policy and immunization status. DESADEL shall support activities of the National Action Committee on Aids (Akwa Ibom State) at Ibeno area to reduce the incidence of HIV/AIDS. DESADEL shall distribute Insecticide Treated Nets (ITN) to children in host communities as part of malaria control. DESADEL shall support the routine and emergency reporting of diseases at the clinic using the 001 and 002 forms of the health authority.	
		Injury / fatalities in workforce / communities	High	Compulsory medical fitness test for all DESADEL and contractor personnel shall be maintained and implemented. First Aid training of workforce (i.e. 1:50) shall be carried out on routine basis. Upgrade of existing clinic shall be done to include emergence unit Emergency response procedures shall be put in place and enforced.	Low

				Safety awareness training for workforce and selected representatives of main community (Ibeno).	
		Pressure on existing infrastructures	High	Existing infrastructure (e.g. Ibeno road, Clinic and school, etc) shall be maintained with a view to improving their functionality.	Low
		Reduction in air quality	Medium	DESADEL shall ensure that all mobile and stationary internal combustion engines are properly maintained; DESADEL shall ensure that water is sprayed to reduce dust in air during construction in the dry season.	Low
		Stress on existing security structures	High	DESADEL shall ensure that both contractor and DESADEL personnel develops a high level of security consciousness both within and outside the work area. Daily security reports shall be called for, received and reviewed by the DESADEL Project manager.	Medium
				Special security force shall be established and deployed for the project. This shall include deploying some of DESADEL security to strengthen security in the area. DESADEL shall ensure that a liaison to foster partnership with the community so as to guarantee security for the project is established and sustained.	

				In order to beef up security for the project, DESADEL shall contact government authorities to improve the strength of the security force at the area and shall consider assisting with equipment, e.g. patrol vehicles, to ensure improved security. DESADEL shall ensure that safety workshops to identify, evaluate and recommend contingency plans for all security risks are regularly organized.	
		Change in local population	High	Prior to commencement of the construction phase, DESADEL shall advertise construction jobs that will be available. This will, hopefully, discourage unqualified personnel from moving into the project area, thus reducing the rate at which population will grow.	Medium
		Description of Impact	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual Impact Rating)**
		Increase in road traffic volume and risk of accidents/injury	High	Pre-mobilization inspection of all vehicles shall be carried out. Visible warning signs on roads and vehicles shall be conducted.	Medium

				Speed breakers at sections traversing communities and major roads shall be placed. Defensive driving course for DESADEL and contractor drivers shall be carried out. Large and slow moving vehicles shall be scheduled during off-peak periods. Vehicle monitoring device/DESADEL Journey Management Policy/ No night driving policy shall be enforced. Raise community awareness of unusual activity via the HSE team shall be encouraged and implemented. Compulsory medical fitness test for all DESADEL staff and contractor/ drivers shall be done. DESADEL shall ensure appropriate maintenance of Ibeno- Eket road network	
		Increase in respiratory diseases	High	Nose masks shall be worn by site workers during (dusty) operations. Water shall be sprayed on construction site to reduce dust levels especially during dry season. Pre-mob inspections and regular maintenance of equipment shall be conducted. Upgrade and support of existing health services and facilities shall be carried out. DESADEL guide for health shall be implemented. Construction workers shall be compelled to wear PPEs equipment.	Low

		Description of Impact	Significance Rating before Mitigation	Mitigation	Significance Rating after mitigation (Residual Impact Rating)
		Increase in Community unrest	High	DESADEL shall maintain established channels of communication with host communities throughout the duration of the project. DESADEL shall require contractors to hire local labour where feasible as required by law. DESADEL shall support local capacity building. As is normal practice in Nigeria, EPC contractor shall undertake and agree on an MOU with the local communities. The contractor shall honour this MOU.	Medium
		Shift in traditional occupation	High	DESADEL shall support traditional occupations through extension services. The Health Management Committee shall ensure the monitoring of anthropometric indices in children less than five years old at the clinic.	Low
		Loss of farmland	High	DESADEL shall pay adequate compensation to affected Landowners. DESADEL shall increase productivity of remaining farmers through provision of farming support facilities e.g. fertilizers and	Low

				improved varieties of seedlings. EPC contractor shall support training schemes for skills acquisition. DESADEL shall utilize unused portions of acquired land as demonstration plots for farming.	
		Description of Impact	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual Impact Rating)**
		Reduction in biodiversity Loss of flora and fauna	Medium	DESADEL shall limit cleared area to what is required Site clearing shall commence from developed (e.g. roads) to undeveloped areas to provide escape routes for wildlife. DESADEL shall encourage the EPC contractor to educate construction workers and locals on the sensitive nature of the biodiversity of the area and the need for conservation. Hunting by employees of EPC/other Contractors shall be prohibited. DESADEL shall support local capacity building through skills enhancement to facilitate occupational re-adjustment. DESADEL shall encourage the EPC contractor to re-vegetate land cleared for temporary use	Low

				where feasible.	
		Increase in noise nuisance	High	DESADEL shall ensure that EPC contractor enforces existing night driving policy of DESADEL. EPC contractor shall plan activities such that World Bank limits shall not be exceeded at the nearest community (ies). Communities shall be consulted by the EPC contractor prior to periods of expected peak noise levels.	Low
		Injury / fatalities in Workforce/ communities	Medium	Compulsory medical fitness test for all DESADEL and contractor personnel. Shall be enforced First Aid training of workforce (i.e. 1:50) shall be conducted. Upgrade of existing clinic to include emergence unit. Emergency response procedure shall be put in place and administered. Safety awareness training for workforce and selected representatives of main communities (Ibeno) shall be carried out seriously.	Low
		Description of Impact	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual Impact Rating)**
		Increase in cost of living	High	DESADEL shall support skill development & enhancement of the local communities	Medium

		/ inflation		through training and complemented by	
				cooperative and micro-credit schemes in Ibeno. EPC contractor shall submit a catering plan to the DESADEL project manager for approval prior to mobilization. DESADEL shall ensure that feeding of project perrsonnel is done in the project camp to reduce demand for local food items, thus helping to stern inflation. With the introduction of the housing plan, it is envisaged that there shall be minimal demand for accommodation within the communities by the project workforce who shall reduce possible rise in cost of rental accommodation.	
		Loss of employment (during project construction completion)	High	DESADEL shall encourage and to provide counselling services to staff not selected but who may have desired to stay at Ibeno; DESADEL shall ensure that O & M contractor adopts a transparent approach in the selection of staff to be maintained after construction activities are completed. Criteria for staff selection shall ensure that those staff not retained or redeployed promptly receives adequate severance benefits.	

		Description of Impact	Significance Rating before Mitigation	Mitigation	Significance Rating after mitigation (Residual Impact Rating)
		Pollution of Water bodies especially the Douglas Creek	Medium	DESADEL shall ensure that waste water and other effluents discharged into the Ibeno pond are treated to meet FMENV and World Bank guidelines for new plants especially where initial mixing with the pond takes place. Potentially contaminated storm water collected from roads shall be routed to a buffer tank and oil separator. All chemically contaminated effluents shall be routed to a neutralization pit where they will be neutralized/treated and routed to a balancing tank from where they shall be routed to the common discharge. DESADEL waste management policy shall be enforced.	Medium
		Increase in Respiratory Diseases	Medium	Nose masks shall be worn by site workers during (dusty) operations. Water shall be sprayed on construction site to reduce dust levels.	Low
				Pre-mob inspections and regular maintenance of equipment shall be conducted. Upgrade and support of existing health services and facilities shall be carried out. DESADEL guide for health shall be	

				implemented. Construction workers shall be compelled to wear PPEs equipment.	
		Increase in road traffic volume and risk of accidents/ injury	Medium	Pre-mobilization inspection of all vehicles shall be enforced and carried out. Visible warning signs on roads and vehicles shall be carried out. Speed breakers at sections traversing communities shall be placed and monitored. Defensive driving course for DESADEL and contractor Drivers shall be enforced.	Low
		Description of Impact	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual Impact Rating)**
		Increase in road traffic volume and risk of accidents/ injury	Medium	Large and slow moving vehicles shall be scheduled during off-peak periods. Vehicle monitoring device/DESADEL Journey Management Policy/ No right driving policy shall be enforced. Raise community awareness of unusual activity via the HSE team shall be encouraged and maintained. Compulsory medical fitness test for all DESADEL staff and contractor drivers shall be enforced. Ensure appropriate maintenance of the road network shall be given a high priority.	Low

		Increase in noise nuisance	Medium	Enforcement of no night driving policy shall be implemented. O&M contractor shall plan activities such that World Bank/FMENV limits shall not be exceeded at the nearest community (ies) Communities shall be consulted by the O&M contractor prior to periods of expected peak noise levels. DESADEL shall control the area situated outside the plant fence to prevent permanent settling of people in an area where the World Bank guidelines may be exceeded.	Low
		Reduction in air quality	Medium	DESADEL shall ensure that all mobile and stationary internal combustion engines are properly maintained.	Low
		Soil Degradation And Soil/ Groundwater contamination	Medium	Provide containment for chemicals and liquid discharges shall be carried out effectively and efficiently; DESADEL waste management policy shall be enforced.	
		Risk/ exposure to electric shock	Medium	DESADEL shall ensure that O&M contractor staff strictly adhere to known safety procedures, when work is in progress.	Low
		Description of Impact	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual Impact Rating)**
		Emotional	Medium	DESADEL shall adopt transparent selection	Low

		disturbance		criteria for staff that shall be retained after construction activities is completed. DESADEL shall counsel workers before redeployment. DESADEL shall monitor payment of redeployment/ compensation entitlements with a view to ensuring fairness to staff. DESADEL shall encourage O&M contractor to provide psychological services as part of occupational health requirement. Hospital services shall be available to disengaged staff over a transition period.	
		Increase in Community unrest	High	In addition to the mitigation measures outlined for community unrest during construction: O&M contractor shall abide by all agreements reached with communities. O&M contractor shall source all unskilled labour from within the communities. Preference shall be given to qualified skilled labour from the communities. Contractor shall encourage recreational activities within the communities. DESADEL and O&M contractor shall maintain dialogue with the host communities.	Medium
		Description of	**Significance**	**Mitigation**	**Significance**

		Impact	Rating before Mitigation		Rating after mitigation (Residual Impact Rating)
		Increase in dust generation	High	Demolition contractor shall take inventories of all materials that are likely to be encountered. Positively identify and categorize all waste types shall be done; Establish a procedure to manage the dislodgement process shall be carried out Put a waste management plan in place shall be done with the HSE Manager supervising; Ensure that demolition process shall be subject to regulatory approval of FMENV and Akwa Ibom State Ministry of Environment; Ensure that adequate emergency response procedures shall be put in place; Ensure proper use of PPE by site workers.	Low
		Injury/ fatalities in workforce communities	Medium	Compulsory medical fitness test for all DESADEL and contractor personnel shall be enforced. First Aid training of workforce (i.e. 1:50) shall be carried out. Upgrade of existing clinic to include emergency unit shall be done.	Low

				Safety awareness training for workforce and selected representatives of main communities (Ibeno) shall be carried out.	
		Description of Impact	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual Impact Rating)**
		Stress on existing security structures	Medium	DESADEL shall ensure that both contractor and DESADEL personnel develops a high level of security consciousness both within and outside the work area; Daily security reports shall be called for, received and reviewed by the Project manager; Special security force shall be established and deployed for the project. This shall include deploying some of DESADEL security to strengthen security in the area; DESADEL shall ensure that a liaison to foster partnership with the community is established and sustained so as to guarantee security for the project. In order to beef up security for the project, DESADEL shall contact government authorities	Medium

				to improve the security situation at the communities and shall consider assisting with equipment, e.g. patrol vehicles, to ensure improved security. DESADEL shall ensure that safety workshops to identify, evaluateand recommend contingency plans for all security risks are regularly organized.	
		Increase in respiratory diseases	High	Demolition contractor shall establish occupational health monitoring for site workers; Enforce use of nose masks and other PPEs shall be pursued; Provide special training for those handling asbestos and other hazardous substances shall be conducted.	Low
		Description of Impact	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual Impact Rating)**
		Loss of employment	Medium	O & M contractor shall provide severance package in line with conditions of service and Nigerian labour laws; DESADEL shall investgate the possibility of staff retention by new operator in handover	Low

				agreement; O&M contractor shall provide counselling for staff in preparation for the handover and management process of the plant; DESADEL shall ensure that the O&M contractor adopts a transparent approach towards staff on all handover matters; DESADEL shall ensure that the O&M contract for employment of staff shall include information on the date of handover to new operator.	
		Emotional disturbance	Medium	DESADEL shall adopt transparent selection criteria for staff to be retained. DESADEL shall counsel workers before Redeployment and lay off. DESADEL shall monitor payment of redeployment/ compensation entitilements with a view to ensuring fairness to all staff. DESADEL shall encourage O&M contractor to provide psychological services as part of occupational health requirement. Hospital services shall be available to disengaged staff over a transition period.	Low
		Description of Impact	**Significance Rating before Mitigation**	**Mitigation**	**Significance Rating after mitigation (Residual**

					Impact Rating)
		Stress on existing security structures	Medium	Daily security reports shall be called for, received and reviewed by the Project manager; Special security force shall be established and deployed for the project. This shall include deploying some of DESADEL security to strengthen security in the area. In order to beef up security for the project, DESADEL shall contact government authorities to improve police force at Ibeno, and shall consider assisting with equipment, e.g. patrol vehicles to ensure improved security. DESADEL shall ensure that safety workshops to identify, evaluate and recommend contingency plans for all security risks are regularly organized.	Medium
		Community unrest	High	DESADEL and O&M contractor shall honour all obligations	Low

6.7 Residual Impacts

Residual impacts are those that remain after all feasible mitigation and preventive measures have been implemented. For this project, they include unavoidable changes such as permanent land take for the facility, alterations to site topography, and the long-term visual presence of the power plant. All residual impacts have been identified for each project activity and their significance levels clearly indicated. Most are of low to moderate significance and are not expected to pose any threat to human health or the biophysical environment. These residual effects will be subject to ongoing monitoring to ensure they remain within acceptable limits throughout the project lifecycle.

6.7.1 Increase in community unrest

The presence of a large number of vehicles and unusual movements is likely to create unease among the communities. As a mitigation measure, DeSadel Nigeria Limited shall maintain and establish channels of communication and inform communities in advance of this important phase of the project.

Community unrest stems, amongst others, from (a) intra- and inter-community chieftaincy tussles; (b) perceptions of DeSadel Nigeria Limited failure to deal even-handedly with all strata of community stakeholders; and (c) claims of infrastructural deprivation. This situation may continue during the project. In order to deal with this, DESADEL shall establish channels of communication with the communities during all phases of the project.

Furthermore, the proponent shall hire local labour force where feasible, and to honor all MOU's requirements with the local communities. Following the foregoing, the impact rating should drop from *high* to *medium*, rather than *low* because many causes of community unrest are due to lack of proper consultation or by dealing with few and avoiding others.

In some communities for example, youth restiveness is synonymous with community unrest. This is currently high because of joblessness, high expectations, complaints of broken promises, infrastructural deprivation, lack of contract awards etc. This condition could be exacerbated by the project especially during construction, operation and handover of the facilities. During construction due to the pressure of employment, operation because of selection of workforce from elsewhere and from the communities, the anxiety which may follow as a result; during the handover of the power plant and there deployments/redundancies at this moment. As mitigation, DeSadel Nigeria Limited shall abide by all agreements reached with the communities; unskilled labour shall be drawn from the community; preference shall be given to qualified skilled labour from the project area; the proponent shall encourage recreational activities; and maintain regular dialogue with the host communities. DeSadel Nigeria Limited shall not play favoritism in the communities. It is important that the proponent ensures that the workforce adopt

transparent approaches in matters regarding to employment even for the unskilled labour,

The criteria for selection of skilled staff must be advertised and DESADEL shall ensure that those not retained or redeployed receive adequate and prompt severance benefits. The impact rating is expected to drop from *high* to *medium* significance, but not too *low*. This is because the measures to be undertaken by the proponent cannot adequately address all or even most of the reasons for community unrest, but efforts shall be put in place to create a conducive and harmonious working relationship with the host communities to curtail un-rest and other negative vices.

6.7.2 Increase in Cost of Living / Inflation

Inflation will cut across three phases (mobilization, construction, operations) and, to a lesser extent, the handover phase. To mitigate inflation, DESADEL shall support skill development and economic enhancement of the local communities through training especially at Ibeno and the environs.

After construction, there is expected to be an economic “bust” as opposed to the “boom”of the construction period. Most of the unskilled construction workers are likely to leave at Ibeno area for other areas where their services may be needed. The micro-credit schemes shall be expanded to include seminar sessions on economic

planning and judicious use of the resources acquired during the boom period.

Inflation is of *high* significance and after mitigation it will only drop to *medium* and not althea way to *low* because once prices go up it is difficult for them to go down.

Furthermore, inflation is a national phenomenon and responds to other factors that originate outside the project area. Inflation will cut across three phases (mobilization, construction, operations) and, to a lesser extent, the handover phase. To mitigate inflation, DESADEL shall support skill development and economic enhancement of the local communities through training at Ibeno and the environs.

6.7.3 Increase in Social Vices / Awareness

Social vices such as drugs and alcoholism may be mitigated through sustained awareness campaigns so as to achieve behavioral modification. To this end, DESADEL shall carry out intensive enlightenment campaigns before the commencement of construction activities, with follow up campaigns on a quarterly basis. DESADEL shall also enforce the alcohol and drug policy of the company at all her worksites. In addition, DESADEL shall support sporting activities in the area with a view to channeling the energies of youths away from vices to more productive and rewarding pursuits. The rating after mitigation will drop to *medium* and not all the way to *low*

because the proposed mitigation measures cannot extinguish all the reasons for deviant behaviour.

6.7.4 Increase in Local Population

It is estimated that the incoming workers and followers have the potential to increase this population of these settlements near the site by up to 30% especially during the construction phase. This increased in population has the potential of increasing the stress on existing infrastructure, particularly housing. Currently, there few houses on the area hosting the sites, the impact will be transferred to Ibeno main town and subsequently increase its population even though insignificant.

Baseline information indicated that there was scarcity of decent accommodation in the project area to house operational staff of the power plant. Permanent accommodation for O&M staff is likely to be provided outside of the host village 'housing. This is therefore expected to minimize the stress on existing housing within the communities during the operational phase of the project.

6.7.5 Stress on existing Security Structures

DESADEL shall ensure that a high level of security consciousness is maintained by both workers and DESADEL personnel. To enhance security in the area, it may be necessary to establish and deploy a special security force while fostering a closer working relationship between the Nigerian Police in the area and the community.

6.7.6 Increase in Road Traffic Volume and Risk of Accidents / Injury

In order to mitigate the anticipated increase in road traffic during all phases of the project, DESADEL shall undertake appropriate maintenance of the Ibeno Road and ensure that the road is pedestrian friendly. Furthermore, in order to reduce traffic congestion and discomfort to road users, especially during the mobilization and construction phases during which at least 10% increase in traffic is expected, movement of large and slow-moving vehicles shall be scheduled during off-peak traffic periods. If these mitigation measures are put in place, the impact significance rating shall drop from medium to low significance.

6.8 ENHANCING POSITIVE IMPACTS

6.8.1 Job Creation

This project is expected to create jobs during different phases. During mobilization, and construction, the bulk of the jobs shall be created that locals and nationals shall be expected to take advantage of. Because the plant is highly automated, the labour force required to operate the plant, is likely to be less compared to other power plants that were existing in the Country. Nevertheless, there shall be opportunities for the acquisition of new skills.

So as to ensure enhanced job creation opportunities throughout the life of the project, DESADEL shall ensure that all Personnel for supplies and minor repairs are reserved for qualified contractors

from the host communities in the first instance. The surveys of the Ibeno revealed many workers with some skills, which may not meet the required standards for the project. The proponent shall suggest to the EPC & O&M contractors that such persons and local contractors from these communities could formally register with a skills' registration centre, which could be established for the project so that initial considerations shall be given to them for employment and contracts.

6.8.2 Business Opportunities / Economic Enhancement

As part of sustainable approach to community interaction, DESADEL under its community development programme (CDP) shall embark on the necessary support, which shall include micro-credit schemes, to the communities such that they take advantage of the business opportunities available at Ibeno as a result of this project.

Movement of the workforce during the mobilization phase will trigger an increase in local economic activity especially for food vendors, retailers, landlords, transporters, etc. This shall promote economic empowerment of the local populace.

The local economy shall enjoy a "boom" that is expected to last throughout this phase and even slightly beyond. But during the operations phase, when most of the workers have been demobilized, the local economy will suffer a "bust", as demand levels shall

drastically drop. This will mean considerable loss of income for many locals, with the attendant adverse social repercussions.

DESADEL shall organize workshops and seminars to point out to the members of these communities the desirability to apply/invest the credit and the extra income of the boom period in projects in which they have interest or in which they are more likely to acquire the necessary expertise, keeping their agro-based nature in view.

6.8.3 Increase in efficiency of gas use and electricity generation

DESADEL intends to generate 750 MW from this project increasing the power generation capacity in Nigeria by more than 25%. The amount of gas slated for use and the planned power generation capacity represent a potential for significant improvement over existing historical data on gas use and power generation at Ibeno. This power station shall be operated for 25 years and proper maintenance shall ensure breakdown of the plant is avoided and output is maintained. Guaranteed electricity output shall improve industrial and domestic activities within the country.

Given the history of successful private sector participation in business which DESADEL is expected to bring into the power sector, the plant is most likely to be run better, hence, efficiency of gas use and power generation will increase.

To enhance this positive impact, DESADEL shall explore the possibility of entering into this or other types of agreements with government so that more gas can be utilized to generate more electricity in other parts of the country while exploring the possibility of expanding the facilities at Ibeno axis to generate more electricity.

6.8.4 Increase in Revenue to Government and DESADEL

For this project, DESADEL shall generate electricity for sale to PHCN, while PHCN distributes via the national grid and collects revenue generated from the sale of the electricity to customers. Based on this, revenue shall accrue to DESADEL by way of an energy tariff (cost of gas + cost of processing gas to energy), and/or capacity tariff (when energy is generated but not dispatched). Thus, both DeSadel Nigeria Limited and government shall generate revenue from this project.

Given the rate of population growth in Nigeria (2.8% annually for the national population and 5% for urban areas), there is likely to be a steady increase in energy demand in Nigeria in the foreseeable future. This will create the opportunity for increased revenue for both DESADEL and Government, especially if facilities are expanded and more power generation carried out as stated earlier.

6.8.5 Improvement of Infrastructure

The project shall usher in improvement in existing infrastructure, for example, rehabilitation of Schools and clinic, widening and upgrading of the existing access to Ibeno village etc. These obviously

constitute positive project impact, which shall be enhanced by extending this programme on facilities improvement to some communities

6.8.6 Skills acquisition

Technically, for this project, proven technologies shall be applied in the design, construction and operation of the facilities. Training of selected staff and other qualified Nigerians in acquiring new skills for the operation and maintenance of the turbines shall be done. Also, some qualified community indigenes that shall work on this project would also gain experience during construction, operation and maintenance of the power plant. Opportunities for turbine-related technology training shall be extended to some locals and nationals who would not be hired for the project but could put their newly acquired training and experience to good use in appropriate locations elsewhere in the country given the proposals by PHCN and other bodies to build more power plants

6.9 STAKEHOLDER PERCEPTIONS

Because of the perceived socioeconomic transformation which this project is likely to engender coupled with its impacts on the surrounding communities through disturbance during construction and operation (e.g. noise, traffic, dust, emissions, etc) and through the influx of workforce, public interest in this power development project is expected to be high.

As the preceding discussions on mitigation and enhancement measures have shown, effective and realistic measures to mitigate/enhance these impacts have been proposed. Nevertheless, stakeholder perceptions such as:

- damage to structures due to vibration
- increase in hearing impairment due to increase in noise are likely to persist. This power development project shall employ and sustain dialogue as well as involve the communities and other stakeholders in all phases of the project in the spirit of securing the social license to operate. In particular,
- DESADELL shall ensure that the O&M staff fully involves stakeholder communities in the environmental monitoring and management plan for this project.
- Use of exhaust gas emissions monitoring and other test results as evidence of good environmental practice and performance shall be enforced during the operations of the power plant.

CHAPTER SEVEN

7.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

An Environmental Management Plan (EMP) is the essential and stand-alone component of an EIA that provides the assurance that the mitigation measures developed for reducing the effects of adverse and associated potential impacts to as low as reasonably practicable (ALARP) as well as those proposed for enhancing beneficial impacts are implemented and maintained throughout the project lifecycle. The EMP for the proposed Power Project, which outlines the strategies for managing hazards, associated and potential impacts and their effects on the environment, is presented in this chapter.

7.1 THE OBJECTIVES OF THE EMP

The objectives are:

- To demonstrate that a systematic procedure ensuring that all project activities are executed in compliance with applicable legislations and DESADEL policies on Health, Safety, Environment, Security and Community Relations have been established for the project;
- To show that mitigation measures for all impacts and effects have been established and shall be maintained throughout the project life cycle, so that impact risk levels will remain ALARP;
- To demonstrate that emergency response measures will be in place. This will ensure that adequate responses in case of emergency have been established for the project; and
- To set out the structure that will ensure compliance by DESADEL and

its contractors, with the EMP.

7.2 MANAGEMENT ORGANIZATION

DESADEL shall retain the primary responsibility of ensuring that environmental Commitments are met throughout the life cycle of this project. The company shall establish a schedule for responsibility and training on matters relating to the environment. Environmental issues shall be a line responsibility for which all levels of personnel are accountable. Top management shall ensure that all environmental considerations are integrated into project execution. The Environment Unit of DESADEL shall offer expert advice on protection measures and shall assist to monitor performance.

DESADEL shall appoint an Environmental Monitoring Team (EMT) to ensure effective implementation of the recommendations of the EIA and its management plan. This team shall be made up of representatives of the project team, HSE and other Departments. The project HSE Team Leader shall additionally provide leadership to the EMT. However, final environmental responsibility lies with the Project Manager. The EMT shall liaise at a predetermined interval with contractors, engineers, quality assurance officers, supervisors and relevant DESADEL departments on all environmental matters. The HSE Team Leader within the project, assisted by the EMT shall be the focal point for all environmental matters relating to detailed design and monitoring of construction, operation, and handover of facilities to the operating and maintenance teams. The EM Team shall verify the effectiveness of the EMP implementation in liaison with Regulators and other stakeholders as appropriate.

Notwithstanding, all action parties within the project team shall demonstrate compliance directly from their line through to the Project manager.

In this way, DESADEL shall take responsibility for all environmental matters and ensure that both the EPC and O&M contractors comply with all applicable environmental laws, regulations and policies as they apply to this Power Plant project. In principle, the EPC Contractor shall be responsible for implementing those aspects of the EIA recommendations that pertain to the engineering, procurement and construction phase of the project. Similarly, the O&M contractor(s) shall be responsible for the implementation of the recommendations of those aspects of the EIA recommendations that are relevant to them during the operations and maintenance phases of the project.

The EPC and O&M contractors shall be required to submit, for approval, their proposal to manage HSE inherent in their contract execution. The EM Team through the HSE- Team Leader will operate in an advisory capacity in all matters; the approval responsibility lies with the Project Manager.

7.2.1 Use and Maintenance of the EMP

The EMP shall remain a dynamic working tool and will be owned by the Power project team. DESADEL HSE Manager is, however, the custodian of the document and may exercise auditing role to verify compliance by the project. The EMP shall be updated and revised periodically, throughout the project's life span to incorporate improved technologies, better

environmental regulations, management systems, guidelines and policies. Constructive suggestions by users (contractors, management, line and operating personnel) shall be assessed by the EM Team and integrated into the EMP.

7.3 REGULATORY COMPLIANCE

All environment-related regulations as they apply to the proposed Power Project have been documented and described in this EIA. DESADEL management shall ensure compliance with these regulations throughout the project's lifecycle in line with measures inherent in the Engineering Project Management Guide (EPMG).

7.4 DETAILED DESIGN GUIDELINES

Health, Safety and Environmental (HSE) Premises that cover the minimum performance standards for HSE critical elements to be applied to the design of the power plant have been established as part of the Front End Engineering Design (FEED) phase of the proposed Power Plant project.

These standards and criteria are meant to ensure that the design of the Power Plant is in line with currently accepted HSE principles and policies as they apply to this project. In particular, the HSE Premises has steered the design towards the goal of preventing/minimizing injuries, ill health, and damage to assets and the (natural and social) environment, to avoid/eliminate liabilities in the future. In the design of the Power Plant, efficient use of natural resources and energy sources as requirement has been taken into account.

This is aimed at resource conservation and the protection of the environment through prevention/minimization of discharges that have

adverse effects on the environment.

The HSE Premises is flexible enough to permit refinements and extensions arising from formal HSE deliverables that are likely to be produced during successive project development phases. The driving force for the design is the reduction of risks to people, assets, reputation and the environment in compliance with the principle of As Low as Reasonably Practicable (ALARP). Any residual risks/effects after the application of the ALARP principle shall be managed through continuous improvement of the design of the station.

7.5 IMPLEMENTATION OF MITIGATION AND ENHANCEMENT MEASURES

The mitigation measures proposed for the significant negative impacts and the measures proposed to enhance the significant positive impacts presented in Chapter 5 have been developed into an EMP that provides a detailed action plan with roles and responsibilities for their implementation. Working through the EM Team, the HSE Team Leader shall ensure that these measures are complied with.

7.6 TRANSPORT OPERATIONS

The project shall manage all transportation operations in line with the following guidelines in order to forestall accidents/incidents.

Pre-mobilization of Vehicles

All vehicles to be used for transportation of equipment, materials and personnel shall be pre-mobilized. The pre-mobilization shall be conducted to confirm that the vehicles are fit for purpose and that the driver of the vehicles as well as their assistant(s) has the necessary competencies needed

for the journey. It shall also be confirmed during the pre-mobilization exercise that a job hazard analysis (JHA) has been conducted for the trip and that all recommended precautions (mitigation measures) have been adopted.

Journey Management Plan

In liaison with the HSE Team Leader, the contractors for this project shall manage their day-to-day transportation needs within a framework of controls that ensures compliance with DESADEL's standards.

Journey management shall include the following:

- Planning takes place before travelling;
- Distances travelled are minimized;
- Unnecessary journeys are avoided;
- Transport tasks are combined, e.g. unused cargo space and empty seats;
- Right vehicle and driver for the job are selected; and
- The safest times and routes are selected.

7.7 PREVENTION OF ACCIDENTS/INCIDENTS

Prevention of workplace accidents and incidents during the proposed project shall be achieved using the JHA tool and written work instructions (WIs).

Consequently, the HSE Team Leader shall arrange for JHA to be conducted for all HSE critical activities. Written and explicit work instructions from such activities shall be developed.

Compliance to regulatory standards, operations/maintenance codes and specifications as well as HSE guidelines shall form the basis for the execution of the proposed project. However, emergency situations could

still occur as a result of equipment failure, weather, negligence and/or sabotage. Consequently, a contingency plan shall be developed as back up to other containment systems put in place to handle such occurrences. As a minimum, the contingency plans that shall apply to both DESADEL and contractors, shall address the following emergency situations.

- Fires and Explosions;
- Electrocution
- Serious injury or illness;
- Uncontrolled gas leaks and hydrocarbons/chemical spills;
- Weather related disasters; and
- Land vehicle mishaps.

The HSE Team Leader shall ensure that adequate security arrangements are put in place. Such plan shall have inputs from host communities.

The team shall also identify, evaluate and manage the risks to personnel and property arising from malicious practices, crime, civil disorder or armed conflict.

The security activities shall be co-coordinated from a common view point by all stakeholders and be in line with DESADEL's security guidelines.

In addition, each contractor shall be required to prepare a project security plan and community involvement strategy and summit to DESADEL for a review and approval. As part of the Environmental Management Plan and with the approval of the DESADEL power plant Project Manager, the HSE Team Leader shall organize security workshops to identify, evaluate and recommend contingency plans for all security risks associated with the Power Plant project.

7.8 TRAINING AND AWARENESS

In order to assure competence and awareness amongst EPC as well as Operation & Maintenance (O&M) staff and contractors, the project management shall establish, maintain and operate a training and awareness programme on health, safety and environmental issues. A great deal of attention shall be devoted to the locals in the contractors' teams. The training shall include accident-emergency practices, basic First Aid, the use of Personnel Protective Equipment etc. Environmental Induction Course and subsequent refresher course relating to the project shall be organized for all work forces. The objective of the courses would be to develop environmental awareness and sensitivity amongst the personnel. The training and awareness programme shall be reviewed periodically by top management and shall include but not restricted to the following aspects;

- HSE induction course,
- Emergency response drill,
- Community interaction and relations management,
- Basic First aid for all and more in depth training for selected personnel,(numbers as required by DESADEL's policy),
- Defensive driving,
- Permit to Work System, and
- HSE on site

Certificates of attendance shall be issued to successful participants. DESADEL shall also conduct HSE awareness campaigns for the host communities and general public with the aim of sensitizing them to the

potential impacts and hazards associated with its operations and the appropriate response to accidents/incidents. The public awareness campaigns shall be conducted periodically and the proceedings documented for subsequent audit.

7.9 MAINTENANCE PROGRAMME

The maintenance officer to be employed by the contractors for the project shall develop a comprehensive maintenance programme. The maintenance schedule contained in the programme shall be designed in line with manufacturer's specifications for each of the equipment. A maintenance logbook shall also be operated and it shall be regularly audited/checked by the HSE Team Leader. In addition, the maintenance status (last and next service dates) shall be displayed at appropriate and clearly visible points on each equipment and machine.

7.10 CONSTRUCTION GUIDELINES

7.10.1 Site Preparation/Clearance

Site preparation/clearance works shall be carried out within defined perimeters and only when necessary. The maximum permissible time lapse between site clearing and initiation of construction operations shall be reduced to the barest minimum necessary to permit safe operations. Areas cleared in excess of operational requirements shall be reinstated with indigenous topsoil and vegetation.

During construction, acquired land not used shall be fenced off and left fallow until use for the land is required. As an additional measure to mitigate reduction in biodiversity, approved clearing of land for

construction activities shall commence from the road into the bushes. This is to give any animals present in the area to be cleared the opportunity to move away.

7.10.2 Use of Public Rights of Way

All transportation and construction works shall be executed in such a manner that will ensure that interference with the use of public highways and access roads is minimal. However, if operational safety demands that public highways or roads be blocked, then the DESADEL's Project Manager may approve such action only when temporary traffic control and diversion arrangements have been provided.

Dumping or storage of litter/debris, tools and equipment in public or private highways and roads shall be prohibited. The proponent shall develop highway android clearing strategies to ensure that public roads and highways are kept clear, safe and passable.

7.10.3 Archaeological/Heritage Sites

Contractors and all DESADEL personnel working at the sites shall preserve the cultural heritage of the host communities by clearly demarcating and avoiding all known existing sites of heritage or cultural value. If there is need to relocate any such site, definite agreements shall be reached between members of the affected community and DESADEL prior to relocation.

7.10.4 Health and Safety of Workers

Throughout the project development HEMP (*Hazards and Effects Management Process*) shall be applied and shall consist of identifying, assessing and controlling hazards, and putting in measures to recover from

the consequences of hazards if the controls fail. An early part of this is the HAZID (Hazard Identification). The project's Combined HAZID Study, which identified the potential hazards associated with the health, safety and environmental aspects of the project and the HSE Premises for this plant, which sets out the minimum standards and guidelines that should be met by the project, have set the stage for project execution which aim to design, construct and operate the plant in a sustainable manner.

Operations at all work sites shall be subject to government, industry and DESADEL HSE policies and guidelines. All DESADEL and contractor staff shall be well informed and trained on the HSE policies and guidelines. All facilities shall also be designed to enhance safety planning and activities shall be executed within the confines of relevant legislation and stakeholders' interests.

The proponent shall provide adequate health services as well as site first aid services for its workforce. The first aid services shall be extended to visiting personnel and casual workers. All construction activities shall be properly managed through careful planning and the application of relevant HSE policies including the following:

- Use of Permit to Work (PTW);
- Job Hazard Analysis and toolbox meetings;
- Use of PPE in designated hazard areas;
- Prohibition of alcohol during work hours and at work sites and facilities;
- Prohibition of use of petrol engines for operations;
- Regular emergency drills;
- Prohibition of smoking in fire hazard areas.

7.10.5 Emergency Response

The following equipment shall be provided as minimum requirements for emergency response action.

- Safety showers at locations in the plant where accidental spillage of chemicals could occur. Supply shall be taken from the firewater system;
- Self-contained (storage type) eye wash units shall be provided at battery rooms;
- Safety signs and notices shall be provided throughout the plant in accordance with DESADEL requirements and standards;
- Walkways across pipes and working platforms on vessels and equipment shall be provided with non-slip surfaces;
- Hot surfaces (>70^{-0}C) likely to be accessible by personnel, shall be lagged or caged;
- A general alarm system shall be provided, capable of giving an audible alarm in all areas of the plant and visual display in areas of high background noise;
- Portable flammable gas detectors shall be provided, stored in the control room, to enable personnel to check gas levels after failure of the gas detection system or total shutdown of the plant, or where abnormal gas accumulations have occurred, and to assure safety during maintenance/repair activities;
- Two sets of personnel breathing apparatus shall be provided in each control building to allow rescue activities to be performed in smoke conditions.
- Safety mats in areas where there is the possibility of electrocution
- Emergency response procedures shall be put in place for snakebites,

electrocution, road traffic accidents, medevac/medial rescue and gas leaks.

7.10.6 Pollution Control

i) Air Pollution

In operating equipment, DESADEL shall utilize all practical methods and devices available to control, prevent and otherwise minimize atmospheric emissions or the discharge of air contaminants. Good engine efficiency of equipment and vehicles shall be maintained. Indiscriminate burning of materials resulting from clearance of trees, bushes and combustible materials shall not be permitted.

Field measurements of air pollutants to determine the air quality in the communities around the Power Plant was undertaken as part of the baseline surveys.

ii) Water and Soil Pollution

a) Wastewaters: Pollution of surface water by project-related waste including wastewater shall be prevented by proper management practices. Contaminated or potentially contaminated plant area run-offs shall be collected and treated by the proponent to meet regulatory requirements before discharge.

b) Soil: DESADEL shall ensure that all construction activities are performed by methods that will prevent pollution of the soil media by accidental spills of contaminants, debris, and other objectionable pollutants. In the event of a significant spill, relevant spill control measures shall be applied and contaminated soil shall be cleaned as appropriate. Regular checks shall be conducted on equipment to minimize minor lube oil and combustible leaks from engines.

iii) Noise Pollution

DESADEL shall comply with all requirements for noise control and with regulatory standards. For example, DESADEL shall ensure that contractor plans activities such that World Bank Guidelines shall not be exceeded at the nearest communities especially at nights. All equipment shall be maintained at optimal working conditions and recommended work practices shall be employed to minimize noise. Night operations shall be avoided except when absolutely necessary. In such instances, adequate measures shall be taken to reduce the noise involved and keep working hours to a minimum. Earmuffs shall be provided for all workers and any other person present in the vicinity of high noise generating equipment or operations.

If noise levels at any time give rise to public complaint, the issue shall be treated as public nuisance and DESADEL shall take appropriate measures to resolve the problem with the appropriate authorities. In any case, communities shall be consulted prior to periods of expected peak noise levels. Safe separation distances and buffer zones shall be established between facilities, work sites and host communities to reduce the impact of high noise levels from the facilities. The possibility of encroachment up to the fence line is taken into account in the design of noise reduction measures.

7.10.7 Prevention of Erosion

During construction, the proponent shall where necessary ensure that

surface water flow on land or swamp areas are controlled and if necessary channeled into temporary discharge pits. Such pits shall be located, designed and constructed in a manner that will minimize the potential threat of erosion. Muddy water and surface runoff from work sites shall be drained into suitable silt traps before discharge into the environment and the adjoining Douglas Creek. The silt trap shall be of adequate size and regularly de-silted. Excessive site clearing shall be avoided and exposed surfaces shall be re-vegetated as soon as practicable to minimize erosion.

For environmental accountability and sustainability, the areas that are prone to degradation around the Power Plant where there are possible erosion has sites have been noticed and shall be reconstructed if necessary. Proper channels for the flow of run-off water into the receiving environment shall be constructed where required. These are aimed at preventing further erosion of land behind the power plant.

7.11 OPERATIONAL GUIDELINES

As part of the development of the project, a set of minimum standards and guidelines were developed and agreed upon by the project managers. This is the HSE Premises document. These include numerical limits (e.g. for noise, air emissions) as well as commitment to certain policies, systems and actions. The relevant sections and commitments from the project HSE Premises document shall be translated to contractual requirements of the contractor(s).

It is known that when power plant is operating at below approximately 50-70% rated capacity, NOx emissions rise significantly because the Dry Low NOx (DLN) burner system cannot operate at these lower loads and the

burners switch (automatically as determined by the manufacturer) to a different mode.

For this reason, a manual of permitted operations (MOPO) shall be developed and implemented for the project. This (MOPO) shall establish:

(i) The limits within which the plant will be allowed to operate and

(ii) The required level of supervisory intervention when operating outside the optimal design envelope.

Other than during start-up and rectification of system upset periods, the facilities shall be operated in compliance with project environmental standards.

To assist in maintaining the technical integrity of the facilities, a well-defined maintenance management system, which shall be approved by the HSE Team Leader, shall be used to ensure compliance with DESADEL's maintenance policies. The maintenance system shall include plans and procedures for:

- Normal maintenance (routine and breakdown maintenance performed by the various disciplines will be judiciously adhered to;
- Preventive maintenance (activities carried out at pre-determined intervals);
- Predictive maintenance (as initiated by facility condition monitoring and assessment);
- Inspection (in accordance with a pre-defined programme and based on statutory and company requirements);
- Production and maintenance personnel shall be properly selected and trained to ensure safe and effective job performance. Ongoing competence training shall be undertaken.

Inspections shall be carried out to comply with statutory and company

requirements and shall be based on “Risk Avoidance” rather than “Risk Management”. The principle of risk-based inspection shall be adopted. Routine maintenance and inspection activities shall also be carried out for all project facilities and on-line condition based performance monitoring shall be applied.

7.12 SITE INSPECTION PROCEDURES

The EM Team and representatives of regulatory bodies throughout the project life shall carry out regular inspection of sites and facilities. The main objective of such inspections shall be to assess compliance level with mitigation measures and recommendations of the EIA. When the HSE Team Leader requests such inspection, the site shall therefore be made accessible to such inspectors upon authentication of identity to:

- Examine and inspect all equipment that could cause pollution;
- Collect samples of any atmospheric emissions, effluent discharges or solid waste deposition for analyses and interpretation;
- Examine all construction and operation logbooks for environmentally related issues.

After each inspection, the Team shall compile a site inspection report detailing the:

- Specific facilities or areas inspected,
- Details of project activities, and
- Highlights of any observed non-compliance/persistent negligence.

In case of non-compliance the O&M contractor shall be requested to take appropriate measures. The inspection procedure shall be repeated after implementation.

7.13 AUDIT PROGRAMME

Environmental suitability studies shall be conducted at the project site before mobilization and during operation. Mobilization is to commence only after the DESADEL Project Manager on the advice of the HSE Team Leader has provided authorization. Construction activities will be subject to regular audits after mobilization. The audit process shall be used to assure that the equipment used for construction and the operations of the Power Plant meet the requirements and specification outlined in the EIA and also to assess its environmental performance during these phases of the project. This will ensure that environmental protection and management procedures are being enforced.

7.13.1 Objectives

In implementing the audit programme, facilities on the plant perceived as having high environmental risks shall be thoroughly investigated. The audit programme shall:

- Examine compliance with regulatory requirements;
- Examine line management systems, plant operations, monitoring practices etc.;
- Identify current and potential environmental problems especially during the various phases of the project.
- Assure implementation of recommended practices and procedures; and
- Make recommendation for the improvement of the management system of the power plant operation.

After every audit exercise, the environmental auditor shall produce an Environmental Audit Report (EAR), which shall be submitted to DESADEL and the plant-operating Manager as well as the Federal Ministry of

Environment who is the apex regulatory body on environmental matters in Nigeria. This regulatory and facility audit shall be conducted three years after the commencement of operations of the power plant.

7.14 ENVIRONMENTAL MONITORING PLAN

The overall objective of (performance) monitoring shall be to identify any unanticipated changes to the biophysical, health and social environment brought about by the Power Project. Baseline information against which development and post development impacts and mitigation measures can be measured and compared has been established. DESADEL shall ensure that deviations from the baseline beyond reasonable limits shall trigger corrective actions so that monitoring becomes a dynamic activity as opposed to passive collection of data. This Environmental Monitoring Plan has been formulated with the aim of ensuring that all the identified significant impacts from the project are mitigated to as low as reasonably possible and that key performance indicators are monitored periodically to track how effectively mitigation measures are implemented. It specifies the mitigation measures, monitoring requirements, duration and frequency of the monitoring, and the action parties to manage the biophysical, social and health environment at the various phases of the project. The implementation of the EMP shall be monitored by FMENV during their impact mitigation monitoring visits that would be periodically scheduled over the project's life cycle.

Table 7.1 presents the impact management and mitigation plan at the various stages of the power development project. In formulating this plan,

care has been taken to ensure that DESADEL complies fully with FMENV regulatory control measures; international best practice and self imposed standards (DESADEL HSE Policy). In addition the plan also provides for measures to mitigate indirect impacts of the project that may result from influx of people into the project area as well as practical proposals for the enhancement of significant positive impacts. It is recognized that many of the host communities lack basic infrastructure and have needs that though unrelated to the project, have generated concerns from stakeholders. These and related issues have been considered in a separate section on Community Development.

Inspections of the site and surrounding areas will generally be made on a weekly basis and these inspections will be formally reported monthly.

For air quality, the nature of the atmosphere is very random. For this reason, it is not common, in good practice, to install off-site air monitoring equipment in an effort to determine the impact of a single source such as a power plant (Wark and Warner, 1976: De Nevers, 1995). The plume from the stack will move around in path determined by wind speed and direction prevailing at the time. This plume will be spread over a very wide area. Monitoring at a single or a few points for a few days or weeks is unlikely to “find” the plume and hence the air quality measurements will reflect the overall background concentrations or perhaps the impact of a nearby source like a busy road.

Some monitoring, especially that which requires the use of instrumentation (e.g.noise, water quality) will be undertaken on a different frequency as indicated in the following table. For NOx, off-site ambient air

measurement shall be done once before construction begins, once during peak construction and once after full operation, in the same places as done for the baseline. These data will be reported either in the monthly report or a 6-montly report as appropriate.

Once this proposed Environmental Monitoring Plan has been accepted, it will be used as the basis for developing a detailed plan to manage the impacts and enhance the benefits of the project during its lifecycle. This detailed plan will be updated as results of monitoring determines the efficacy or otherwise of the proposed and implemented mitigation/enhancements.

The detailed plan will also be reviewed in the light of prevailing circumstances, environmental regulations, guidelines and policies (including those of DESADEL).

Details of the Impact Management and Monitoring Plan (EMP) follow up process covering the project phases are presented in the following tables.

Table 7.1: Impact Mitigation and Management Plan – Mobilization

Project Activity	Impact (positive or negative)	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter for monitoring	Frequency of inspection/ monitoring	Frequency of formal reporting	Action party
Movement of goods, workers, equipment, etc.	Increase in road traffic volume and risk of accidents/ injury	DESADEL shall ensure pre-mobilization inspection of all vehicles	Proponent	Pre-mob certificate and statistics	Weekly	Monthly	DESADEL and FMENV
		Visible warning signs shall be placed on roads and vehicles	Federal traffic regulations, VIO's and Traffic wardens	No. and adequacy of signs and speed breakers	Weekly	Monthly	DESADEL Civil Engineering Dept/FMENV.
		Speed breakers shall be installed at sections of the roads traversing communities	DESADEL HSE policy	No. of speed breakers	Weekly	Monthly	Traffic dept.
		Defensive driving course for DESADEL and contractor drivers shall be enforced	DESADEL HSE policy	Driving permits and statistics	Weekly	Monthly	DESADEL and relevant Govt. Agencies
		Large and slow moving vehicles shall be scheduled during off-peak periods	DESADEL HSE policy	Records of schedule	Weekly	Monthly	EPC Transport supervisor
		DESADEL shall ensure that vehicle monitoring devices/ Journey Management Policy/Night	DESADEL HSE policy	Journey management record; night driving permit	Weekly	Monthly	DESADEL/EPC HSE Adviser

		driving and alcohol policy is implemented by EPC Contractor		and statistics			
		Raise community awareness of unusual activity via the HSE team	DESADEL HSE policy and Business Ethics	Records of awareness sessions	Weekly	Monthly	DESADEL CLOs and EPC contract
		Compulsory medical fitness test for all DESADEL and contractor drivers	DESADEL HSE policy	Medical certificates and statistics	Weekly	Annually	DESADEL and Consultant
		DESADEL shall ensure appropriate maintenance of all road network around project location	None	Road maintenance records	Weekly	Monthly	DESADEL Civil Engineering Dept.
		First Aid boxes in vehicles shall be implemented by DESADEL	DESADEL and international standards	First Aid boxes in vehicles and their contents	Weekly	Monthly	DESADEL and Consultant
		Emergency/ Medivac procedures as they apply in DESADEL Policy shall be put in place	DESADEL standard	Inventory of required materials	Weekly	Monthly	DESADEL and EPC HSE Adviser
Project Activity	Impact (positive or negative)	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter for monitoring	Frequency of inspection/ monitoring	Frequency of formal reporting	Action party
	Increase in noise nuisance	DESADEL shall ensure that DESADEL's night driving policy is enforced by	DESADEL HSE policy	Night driving permit and statistics	Weekly	Monthly	FMENV,DESADEL and EPC

		contractors					Transport supervisor
		DESADEL shall ensure that Contractor plans activities such that World Bank Guidelines shall not be exceeded at the nearest communities.	World Bank Guideline/FMENV	Noise levels at selected sites as per baseline	Monthly for 2 consecutive nights and as necessary in response to complaints	Quarterly	FMENV, DESADEL and EPC Contractor.
		Key communities shall be consulted prior to periods of elevated noise levels especially when occurring at night (eg concrete pouring)	DESADEL HSE policy	Records of consultation	As required	Monthly	FMENV,DESADEL, CLOs & EPC Contractor
	Movement of heavy equipment to worksite which may pose danger to public	Visible warning signs shall be placed on roads and vehicles	Federal Traffic regulations, VIO's, Traffic wardens and FRSC	No. and adequacy of signs and speed breakers	Weekly	Monthly	DESADEL Civil Engineering Dept.
		Large and slow moving vehicles carrying heavy equipment shall be scheduled during off-peak periods.	DESADEL HSE policy	Records of schedule	Monthly	6-monthly	DESADEL and EPC Transport supervisor
		DESADEL shall raise the awareness of the communities along the	DESADEL HSE policy and Business Ethics	Records of awareness sessions	Monthly	6-monthly	DESADEL and EPC CLOs

		route of unusual activity via the HSE team.					
		Times of movement of heavy equipment shall be advertised, so that road users can reschedule their trips on the major road and/ or use alternative routes.	DESADEL HSE policy	Public advert via radio and television	Monthly	6-monthly	EPC HSE Adviser
Project Activity	Impact (positive or negative)	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter for monitoring	Frequency of inspection/ monitoring	Frequency of formal reporting	Action party
		DESADEL shall contact Government traffic police to ensure more traffic control on the relevant road(s) during periods of movement of heavy equipment, thus reducing danger to the general public.	FGN and State traffic controllers	Records of such contact	Monthly	monthly	DESADEL, FRSC, VIO and External Affairs
		Heavy truck drivers shall be specially counseled to be careful while in transit to reduce danger to the general public	DESADEL HSE policy	Records of such counseling	Monthly	-Monthly	DESADEL, FRSC, VIO and EPC HSE Advisers
		Transportation of heavy	DESADEL HSE	Labels on heavy	Monthly	-monthly	DESADEL, FRSC,

		equipment to the site shall be accompanied by public warning and precautions such as labels; sirens, etc.	policy	vehicles and outriders following			VIO and EPC HSE Advisers
	Increase in community	DESADEL shall ensure that contractors	Contractual	Compliance with MOU	Monthly	-monthly	DESADEL,
	unrest	honour the MOU that DESADEL agree with the local communities.		items			Communities and Observers
		DESADEL shall maintain established channels of communication with host communities during all phases of the project.	DESADEL policy	Records of meetings	Weekly	Monthly	DESADEL Manager
		DESADEL shall require contractors to hire local labour where feasible as required by law.	Nigerian labour laws	Staff statistics	Monthly	6-monthly	DESADEL and EPC Contractor
		DESADEL shall support local capacity building.	None	Training records	Monthly	6-monthly	DESADEL and EPC Contractor
		DESADEL shall listen sympathetically to the needs of the host communities with a view to assisting, whenever possible.	DESADEL policy	Records of needs communicated to DESADEL	Monthly	6-monthly	DESADEL Project Manager

	Pressure on existing infrastructure, e.g., roads	DESADEL shall ensure appropriate maintenance of the existing road with a view to improving its functionality.	None	Road maintenance	Monthly	6-monthly	DESADEL Civil Engineering dept.
Project Activity	Impact (positive or negative)	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter for monitoring	Frequency of inspection/ monitoring	Frequency of formal reporting	Action party
All activities requiring workers	Increase in jobs in the local area	Use of local staff shall be maximized and in compliance with the Nigerian policy on local content both for skilled and unskilled staff.	DESADEL Local Content Policy	Proportion of workers from local area	Monthly	Annually	DESADEL, Communities and Contractors
		Training shall be provided to facilitate the use of local people	DESADEL local content policy	Proportion of workers from local area	Monthly	Annually	DESADEL and Workers
All activities	Economic enhancement	Where possible and agreed (eg as part of local content plan, housing plan and catering plan) use and procurement of local facilities, contractors and resources shall be maximized.	DESADEL policies and plans	Spend in the local community	6-Monthly	Annually	DESADEL, Communities and Contractors
	Living conditions of EPC contractor staff	DESADEL shall ensure EPC Contractor makes	Public Health Law (Cap 103)	Monitor living conditions of	Weekly	Monthly	DESADEL and EPC Contractors

		available a detailed housing plan to the DESADEL Project manager for approval prior to mobilization.	building regulations code	staff			
	Increase in cost of living / inflation	DESADEL shall support skill development and enhancement of the local communities through	None	Training, Micro-credit and cooperatives statistics	Monthly	Annually	DESADEL, Community representatives
		training and complemented by cooperative and micro-credit schemes in Ibeno					and Sustainable Development Unit
		DESADEL shall ensure EPC Contractor submits a catering plan to the DESADEL project manager for approval prior to mobilization.	DESADEL standards	Statistics of catering services health certification of food handlers inspection records of food & food premises	Weekly	Monthly	DESADEL CLO& EPC contractor.
Project Activity	Impact (positive or negative)	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter for monitoring	Frequency of inspection/ monitoring	Frequency of formal reporting	Action party
	Alteration of natural soil profile	DESADEL shall ensure that EPC contractor minimizes	DESADEL Policy and	Soil profile at work locations	Every two-Months	Annually	FMENV, AKSMENV & MR,

		topsoil removal so that imported laterite or other fill material does not tremendously alter the natural soil profile of original location.	internationally accepted standards				LGA and DESADEL HSE
	Soil Degradation and soil/ groundwater contamination	DESADEL shall ensure that EPC contractor provides containment for chemicals and liquid discharges.	DESADEL Policy	Physical Assessment	Weekly	Monthly	DESADEL, FMENV, AKSMENV & MR ,LGA and EPC contractor
		DESADEL waste management policy shall be enforced in cases of domestic rubbish/trash, scrap metals, non-plastic combustible packaging materials, plastic packaging materials, drums and containers as well as medical wastes.	FMENV and DESADEL Policy	Waste collection records and chain of custody transfer	Weekly	Monthly	FMENV, AKSMENV & MR, LGA and EPC contractor
		DESADEL shall ensure that a controlled fuelling, maintenance and servicing	DESADEL Policy	Fueling, maintenance and servicing	Weekly	Monthly	DESADEL and EPC contractor

		protocol for construction machinery at worksite is established and followed.		protocol record.			
		DESADEL shall ensure that a liquid (condensate) knock-out facility is installed in the gas supply system and that approximate means to store and dispose of this liquid is provided in the design and construction of the plant.	Good engineering practice	Functionality of the knock-out and storage/disposal facilities.	Weekly	Monthly	DESADEL,NGC and EPC contractor
	Pollution of Water bodies	DESADEL shall ensure that clearing is during dry season to minimize run-off into water bodies.	Compliance with NIWA Regulations	Site clearing records	Monthly	Annually	DESADEL, FMENV, AKSMENV & MR, LGA and EPC contractor
		DESADEL waste management policy shall be enforced.	FMENV and DESADEL Policy	Waste collection records and chain of custody transfer	Weekly	Monthly	DESADEL, FMENV, AKSMENV & MR, LGA and EPC contractor
		Provide containment for the chemicals and liquid discharges shall be carried	DESADEL Policy	Physical Assessment	Weekly	Monthly	FMENV, AKSMENV & MR, LGA

		out					and EPC contractor
	Increase in social vices	Intensive enlightenment campaign and health education for the abatement of abuse of drugs, alcohol and tobacco in the communities and among workers throughout the life of the project shall be enforced.	Law against smoking in public places and NDLEA Act	Enlightenment campaign/health education statistics records of cases of abuse in the workforce.	At least three months before commencement of activities then 6-monthly thereafter.	Annually	DESADEL, CLO, Communities& EPC contractor
		DESADEL shall ensure that EPC contractor enforces the alcohol and drug policy for staff.	DESADEL Policy	Records of violation	Monthly	Annually	DESADEL and EPC contractor
		DESADEL shall encourage EPC contractor to support sporting activities.	None	No. of EPC contractor sponsored sporting activities.	6-monthly	Annually	DESADEL& EPC contractor
		DESADEL shall support public health lectures with emphasis on common communicable diseases such as malaria, TB, STIs including HIV/AIDS	None	Statistics of health awareness lectures	1-3 months before mobilization and then quarterly	Annually	DESADEL and LGA

		DESADEL shall engage and support local security systems.	None	Records of DESADEL support	6-monthly	Monthly	DESADEL,LGA and Communities
		DESADEL shall ensure that EPC contractor implements social and health awareness programs for all workers at induction and on a continuous basis throughout the life of the project.	None	Statistics of social & health awareness programmes	At induction and quarterly thereafter.	Annually	DESADEL and EPC contractor
		Provision of condoms for construction works.	DESADEL Policy	Statistics of condom use	Monthly	Annually	DESADEL, Communities and EPC contractor
	Increase in communicable diseases (incl. STIs)	DESADEL shall support immunization in collaboration with Akwa Ibom State Ministry of Health and Ibeno Local Government for workers and community members.	National Health policy	Immunization statistics	Monthly	Annually	DESADEL, AKSMH, LGA.
		DESADEL shall train traditional health practitioners and village health workers to	DESADEL policy	No. of village health workers trained	6-Monthly	Annually	DESADEL, AKSMH and LGA

		strengthen primary health care in the project area.					
		DESADEL shall undertake community based training on the prevention of common communicable diseases; and water protection/ purification techniques and basic sanitation	DESADEL policy	Number of commercial sex workers (CSW) statistics on HIV/AIDS prevention session by NACA; No. of community members trained.	6-Monthly	Annually	DESADEL, AKSMH, LGA and Local NACA Offices
		DESADEL shall support activities of the National Action committee on Aids (Akwa Ibom State) at Ibeno area to reduce the incidence of HIV/AIDS.	DESADEL policy	Condom use statistics; sex education programme conducted	Monthly	Annually	DESADEL, AKSMH, NACA and LGA
		DESADEL shall distribute Insecticide Treated Nets (ITN) to children in host communities as part of malaria control.	DESADEL policy	Recent statistics	6-Monthly	Annually	DESADEL, AKSMH and LGA
		DESADEL shall enforce malaria policy and immunization status.	DESADEL policy	Statistics of compliance	Monthly	Annually	DESADEL, NPI Office, AKSMH and LGA
	Injury/ fatalities in	Compulsory medical	DESADEL	Medical reports	Monthly	Annually	DESADEL

	workforce/ communities.	fitness test for all DESADEL and contractor personnel shall be enforced.	Policy				
		First Aid training of workforce (at least 1:50) shall be ensured	DESADEL policy	Training records	Monthly	Annually	DESADEL and LGA
		DESADEL shall ensure contractor clinic on site and retainer clinic shall be properly equipped for emergencies.	DESADEL minimum health standard	Monitor clinics in line with NHIS	6-Monthly	Annually	LGA and DESADEL Occupational Health Unit
		Emergency response procedure shall be put in place and administered.	DESADEL minimum Health standard	Records of such procedures.	6-Monthly	Annually	DESADEL Safety Unit.
		Safety awareness training for	DESADEL Policy	Training records and	Monthly	Annually	DESADEL, FRSC and
		workforce and selected representatives of main communities shall be carried out		statistics.			other safety recognized companies
	Pressure on existing infrastructures	Existing infrastructures shall be maintained with a view to improving their functionality.	None	Maintenance records	Weekly	Monthly	DESADEL Civil Engineering Dept.
	Reduction in air quality	DESADEL shall ensure that all mobile and stationary	Nigerian vehicle	Inspection for visible smoke	Weekly	Monthly	FMENV and EPC contractor

		internal combustion engines are properly maintained.	emission standards				
		DESADEL shall ensure that water is sprayed to reduce dust in air during construction in the dry season.	None	Inspection	Weekly	Monthly	FMENV and EPC Contractor
	Stress on existing security structures	DESADEL shall ensure that both contractor and DESADEL personnel develops a high level of security consciousness both within and outside the work area.	None	Statistics of security breaches	Weekly	Monthly	DESADEL, Nigerian Police Force and EPC Contractor
		Security reports shall be received and reviewed by the Project manager.	DESADEL Policy	Security reports	Monthly	Monthly	DESADEL, NPF and EPC contractor
		Special security force shall be established and deployed for the project. This shall include deploying some of DESADEL Securities to strengthen security in the area.	DESADEL policy	No. of special security personnel on site.	Weekly	Monthly	DESADEL, NPF and EPC contractor
		DESADEL shall ensure that	DESADEL	DESADEL-	Monthly	Monthly	DESADEL, LGA,

		a liaison to foster partnership with the community so as to guarantee security for the project is established and sustained.	Policy	Community security meetings			Communities and EPC contractor CLOs
		In order to beef up security for the project, DESADEL shall contact government authorities to improve the strength of the police force at the communities and shall consider assisting with equipment, e.g. patrol vehicles, to ensure improved security.	DESADEL Policy	Deployment of police personnel and records of security equipment	Monthly	Annually	DESADEL,NPF and EPC contractor
	Change in local population	Prior to commencement of the construction phase, DESADEL shall advertise construction jobs that will	None	Records of applicants at employment office and copy of	Weekly	Monthly	DESADEL and EPC contractor
		be available. This will, hopefully, discourage unqualified personnel from moving into the project area, thus reducing the rate at which		advertisement			

		population shall grow.					
	Increase in road traffic volume and risk of accidents/ injury	Speed breakers shall be strategically placed at all locations to safeguard the road and if necessary road diversions shall be constructed	FRSC, VIO	Present levels of records and statistics shall be accessed.	Weekly	Monthly	FRSC, VIO and EPC Contractor
	Increase in respiratory diseases	Nose masks shall be worn by site workers during (dusty) operations	DESADEL Policy	SPM and records of respiratory diseases	Daily	Monthly	DESADEL, FMENV,AKSMENV & MR, LGA and EPC Contractor
		Water shall be sprayed on construction site to reduce dust levels especially during dry season.	None	Inspection	Daily	Monthly	DESADEL, FMENV, AKSMENV & MR, LGA and EPC Contractor.
		Pre-mob inspections and regular maintenance of equipment shall be conducted.	None	Maintenance and pre- mob records	Monthly	Annually	DESADEL and EPC contractor
		Support of health services and facilities shall be carried out (EPC, O&M contractors)	DESADEL minimum health standards	Monitor facilities	6-monthly	Annually	DESADEL and EPC Contractor
		DESADEL guide for health Services shall be	DESADEL Policy	Monitor implementation	6-monthly	Annually	DESADEL,LGA and EPC

		implemented.					Contractor
		Construction workers shall be compelled to wear Personal Protective Equipment (PPE)	DESADEL Policy	Monitor compliance	Daily	Monthly	FMENV, DESADEL and EPC contractor
	Increase in community unrest	An MOU shall be signed between the communities and the Company	Labour Law requirements	Monitor implementation	Monthly	Annually	DESADEL, LGA, AKASG and the communities
	Shift in traditional occupation	DESADEL shall support traditional occupations through extension services	DESADEL Policy	No. of beneficiaries	Monthly	Annually	DESADEL, AKASG, LGA
		The Health Management Committee shall ensure the monitoring of anthropometric indices in children less than five years old at contractor clinic	None	Wasting and stunting rates	Monthly	Annually	DESADEL, AKSMH, LGA and EPC Contractor
	Loss of farmland	DESADEL shall pay adequate compensation to affected landowners	DESADEL Policy	Compensation records	6 months before construction		DESADEL, AKASG, LGA and Communities.
		DESADEL shall increase productivity of remaining farmers through provision of farming support facilities e.g.	DESADEL Policy	Records of supportive actions	6 monthly during construction		DESADEL, AKASG, LGA and Communities

		fertilizers and improved varieties of seedlings.					
		DESADEL shall ensure that the EPC contractor supports training schemes for skills acquisition	DESADEL Policy	Training records	6 monthly	6 Monthly	DESADEL,LGA and Communities
		DESADEL shall utilize unused portions of acquired land as demonstration plots for farming.	None	Land use records	Annually	Annually	DESADEL,LGA and communities
	Reduction in biodiversity / loss of flora and fauna	DESADEL shall limit cleared area to what is required.	DESADEL Policy	Area cleared during construction	Once during construction		DESADEL Site Engineer, FMENV, LGA, Communities and EPC Contractor
		Site clearing shall commence from developed (e.g. roads) to undeveloped areas to provide escape routes for wildlife.	DESADEL Policy	Mode of clearing	Once during construction		DESADEL, FMENV, AKSMENV & MR and EPC Contractor
		DESADEL shall encourage the EPC contractor to educate construction workers and locals on the sensitive nature of the biodiversity of the area	DESADEL Policy	Records enlightenment	Monthly	Annually	DESADEL, FMENV, AKSMENV & MR, LGA.

		and the need for conservation.					
		Hunting by employees of EPC and sub contractors shall be prohibited	DESADEL Policy	Plans for enforcement and records of penalties for violations	6 Monthly	Annually	DESADEL, EPC Contractor and the host communities.
		DESADEL shall support local capacity building through skills enhancement to facilitate occupational re-adjustment.	None DESADEL Policy	Records of capacity building sessions Monthly	Monthly	Annually	DESADEL, AKASG, LGA
		DESADEL shall encourage the EPC contractor to re-vegetate land cleared for temporary use where feasible.		This shall be carried out to limit or minimize wildlife migration			FMENV, AKSMENV & MR, LGA and EPC Contractor
	Increase in noise nuisance	DESADEL shall ensure that EPC contractor enforces existing no night driving policy of DESADEL	DESADEL Policy	Night driving permit and statistics	Daily	Monthly	DESADEL Transport supervisor
		DESADEL shall ensure that EPC contractor plans activities such that World Bank Guidelines/FMENV are shall not be exceeded	World Bank Guidelines/FMENV Guidelines	Noise levels at selected sites within 1km band	At specified times as agreed	As agreed	FMENV, AKSMENV & MR, LGA and EPC HSE Adviser

		at the nearest community(ies)					
		DESADEL shall ensure that communities are consulted by the EPC contractor prior to periods of expected peak noise levels.	DESADEL HSE policy	Records of consultation	As required	Monthly	DESADEL, AKSMENV & MR, LGA& EPC CLOs
Project Activity	Impact (positive or negative)	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter for monitoring	Frequency of inspection/ monitoring	Frequency of formal reporting	Action party
All activities requiring workers	Increase in jobs in the local area	Local empowerment shall be enhanced as well as the purchasing power of the communities	DESADEL Policy	Rate of employment	Quarterly	Annually	DESADEL,DTSG,LGA and Communities
Power Generation by Gas	Better quality if life/ economic enhancement	DESADEL shall ensure that the O&M contractor is incentivized to maintain the plant and meet demands for power.	DESADEL Policy	Power plant availability	Continuous	Monthly	DESADEL/O&M Contractor
		DESADEL shall ensure that the O&M contractor is incentivized to operate the plant in open cycle mode as much as possible.	O&M Agreement	Proportion of power generated in SCGT mode	Continuous	Monthly	DESADEL/O&M Contractor
	Injury / fatalities in workforce/ communities	Compulsory medical fitness test for all DESADEL and contractor personnel	DESADEL HSE policy	Medical certificates and statistics	Monthly	6-Monthly	DESADEL and LGA Health officials

		shall be enhanced.					
		Emergency response procedure shall be put in place and administered	DESADEL minimum health standard	Records of such procedures	6-monthly	Annually	DESADEL and EPC Contractor
		First Aid training of workforce shall be prioritized	DESADEL standard	Pre-mob certificates and statistics	6-monthly	Annually	DESADEL, O&M and EPC Contractor
		EPC and O&M contractor retainer clinic to include emergence Unit shall be enhanced	DESADEL Health Management System	Monitor facilities in line with NHIS	6-monthly	Annually	DESADEL Occupational Health Unit
		Safety awareness training for work force and selected representatives of main communities shall be encouraged	DESADEL policy	Training records and statistics	6-monthly	Annually	DESADEL and EPC Contractor
	Increase in community unrest	Preference shall be given to qualified skilled labour from the communities.	None	Employment records & statistics	Monthly	Annually	DESADEL,EPC and O&M Contractor
		The proponent shall encourage recreational activities within the communities	None	Records of supportive action by contractor	Monthly	Annually	DESADEL, EPC Contractor and O&M Manager
		DESADEL shall ensure that feeding of project personnel is done in the	None	Meal schedules Menus feeding statistics	Monthly	Annually	DESADEL and EPC contractor

		project camp to reduce demand for local food items, thus helping to stem inflation. With the introduction of the housing plan, it is envisaged that there shall be minimal demand for accommodation within the communities by the project workforce who shall reduce possible rise in rental accommodation.					
	Loss of employment	DESADEL shall encourage disengaged workers to provide counseling services to staff.	None	Records and statistics of counseling sessions	Once before selection and redeployment		DESADEL and EPC Contractor
		DESADEL shall ensure that O&M contractor adopts a transparent approach in the selection of Workers.	DESADEL standards	Selection process	Once before selection		DESADEL and EPC Contractor
		Criteria for staff selection shall be advertised prior to the exercise and DESADEL shall ensure that those staff not retained or redeployed promptly	Labour laws	Record of advertisement Records of severance benefits	Once before selection		DESADEL and Media Houses

		receive adequate severance benefits					
	Pollution of Douglas Creek	DESADEL shall ensure that wastewater and other effluents discharged into water bodies are treated to meet FMENV and World Bank Guidelines for new plants especially where initial mixing with Water bodies takes place.	DESADEL Policy	Physico-chemical assessment	-Monthly	6-monthly	FMENV, AKSMENV & MR, LGA and the EPC contractor
		All chemically contaminated effluents shall be routed to a neutralization pit where they will be neutralized/ treated and routed to a balancing tank from where they will be routed to the common discharge	DESADEL Policy	Request of records and physical assessment	2-monthly	6-monthly	FMENV, AKSMENV & MR, LGA and EPC contractor
		DESADEL waste management policy shall be enforced.	DESADEL policy	Inspection	Monthly	Quarterly	FMENV, AKSMENV & MR, LGA and EPC Contractor
		Potentially contaminated storm water collected from roads shall be routed to a	DESADEL policy	Inspection	Monthly	Quarterly	FMENV, AKSMENV & MR, LGA and EPC

		buffer tank and oil separator.					Contractor
		Identity cards shall be visibly displayed within the plant site.	DESADEL policy	Inspection	Weekly	Monthly	DESADEL and O&M Manager
	Increase in Respiratory tract diseases	See in the beginning of the table					
	Increase in road traffic volume and risk of accidents/injury	See in the beginning of the table					
	Increase in noise nuisance						
		DESADEL shall control the area situated outside the plant fence to prevent the permanent settling of people in an area where the World Bank Guidelines may be exceeded.	World Bank Guidelines/FMENV Guidelines	Ambient Noise levels at fence line	6-monthly for the first 3 years then annually	Annually	FMENV, AKSMENV & MR, LGA and the O&M Manager
	Reduction of air quality	DESADEL shall ensure that all mobile and stationary internal combustion engines are properly maintained.	World Bank Guidelines/FMENV Guidelines	Maintenance records SPM at selected sites around area	Monthly	Annually	FMENV, AKSMENV & MR, LGA and DESADEL Engineers Unit
	Soil degradation and soil/	DESADEL shall ensure that a liquid (condensate)	Good engineering	Functionality of the knock-out	6 monthly	Annually	FMENV, AKSMENV & MR,

	groundwater contamination	knock-out facility is installed in the gas supply system and that appropriate means to store and dispose of this liquid is provided during the operation of the power station.	practice.	and storage/ disposal facilities			LGA,DESADEL and O&M Contractor
	Emotional disturbance	DESADEL shall ensure O&M contractor adopts transparent selection criteria for staff.	None	Documented evidence of use of selection criteria	At least 3 months before staff selection		DESADEL and EPC Contractor
		DESADEL shall counsel workers before disengagement.	None	Records of counseling sessions.	At least 3 months before staff selection		DESADEL and EPC Contractor
		DESADEL shall monitor payment of disengaged staff/ compensation entitlements with a view to ensuring fairness to staff	Contractual and in line with DESADEL's Policy	Compensation and entitlement records	At least 6 months.		DESADEL Transition committee
		DESADEL shall encourage O&M contractor(s) to provide psychological services as part of occupational health requirement.	None	Records of services	Monthly	Annually	DESADEL Medical personnel
		Clinical services shall be	None	Records of	Monthly	Annually	DESADEL

		available to disengaged staff over a transition period		beneficiaries	during transition period		Medical personnel
Project Activity	Impact (positive or negative)	Mitigation/Enhancement	Compliance Requirement (if any)	Parameter for monitoring	Frequency of inspection/ monitoring	Frequency of formal reporting	Action party
All activities requiring workers	Increase in jobs in the local area	See table above.					
All activities	Economic enhancement	See table above.					
Equipment dismantling Structures dismantling -Waste disposal Removal of contaminants Soil remediation	Increase in dust generation during decommissioning	Decommissioning contractor shall take inventories of all materials that are likely to be encountered.	None	Records of materials	Once before demolition		DESADEL and Contractor
		Positively identify and categorize all waste types shall be carried out	FMENV and World Bank Guidelines	Records of waste types	Once before demolition		FMENV, AKSMENV & MR, LGA and Contractor
		Establish a procedure to manage the dislodgement process shall be enforced	FMENV and World Bank Guidelines	Written procedure	Before demolition		FMENV, AKSMENV & MR, LGA and Contractor
		Put a waste management plan in place with effective monitoring shall be done	FMENV standards	Waste management policy	Once during demolition		FMENV, AKSMENV & MR, LGA and

							Proponent
		Ensure that demolition process is subject to regulatory approval and procedure shall be enforced.	FMENV standards	Approval from FMENV	Once before demolition		FMENV, AKSMENV & MR, LGA and Proponent
		Ensure that adequate emergency response procedures shall be put in place	DESADEL standard	None	None		FMENV,EPC Contractor and O&M Manager
		Ensure proper use of PPE by site workers shall be fully enforced.	DESADEL policy	Physical observation	During demolition		FMENV, AKSMENV & MR, LGA and DESADEL
	Injury/ fatalities in workforce/ communities	See tables above					
	Stress on existing security structures	DESADEL shall ensure that both contractor and DESADEL personnel develops a high level of security consciousness both within and outside the work area.	None	Statistics of security breaches	Weekly	Monthly	DESADEL and demolition contractor
		Security reports shall be received and reviewed by the Project manager	DESADEL Policy	Security reports	Weekly	Monthly	DESADEL and demolition contractor

		Special security force shall be established and deployed for the project. This shall include deploying some DESADEL security to strengthen security in the area	DESADEL policy	No. of special security personnel on site	Weekly	Monthly	DESADEL and demolition contractor
		DESADEL shall ensure that a liaison to foster partnership with the community is established and sustained so as to guarantee security for the project.	DESADEL Policy	DESADEL - Community security meetings	Monthly	Annually	DESADEL, Communities and demolition contractor CLOs
		In order to beef up security for the project, DESADEL shall contact government authorities to improve the police force at Ibeno LGA and Ibeno and shall consider assisting with equipment, e.g. patrol vehicles, to ensure improved security	DESADEL policy	Deployment of police personnel and records of security equipment	Monthly	Annually	DESADEL and demolition contractor
	Increase in respiratory diseases	Provide special training for those handling	World Bank/FMENV	Record of training	Once during demolition		DESADEL and Decommissioning

		asbestos	Guidelines				contractor
Assessment of facility Restoration Staff movement	Loss of employment	DESADEL shall ensure that the O&M contractor(s) provides severance package in line with conditions of service and Nigerian labour laws.	Nigerian labour laws	Record of beneficiaries	Once before handover		DESADEL and Demolition contract holder
		DESADEL shall investigate the possibility of staff retention/agreement during O&M activities.	None	None	Once before handover		DESADEL and EPC contract holder
		DESADEL shall ensure that the O&M contractor(s) provides counseling for staff in preparation for the Disengagement.	None	Records and statistics of counseling sessions.	Once before handover		DESADEL and O&M ,Manager
		DESADEL shall ensure that the O&M contractor(s) adopts a transparent approach towards staff on all matters.	DESADEL standards	Records of communication with staff	Weekly during disengagement	Monthly	DESADEL and O&M Manager.
		DESADEL shall ensure that the O&M contract for employment of staff shall include information on the date of handover to new operator.	Contractual	Employment agreement	Once during employment		DESADEL and EPC contract holder.

	Emotional disturbance	DESADEL shall adopt transparent selection criteria for all staff.	None	Documented evidence of use of selection criteria.	At least 3 months before staff selection		DESADEL,EPC and O&M Managers
		DESADEL shall counsel workers before Disengagement.	None	Records of counseling sessions	At least 3 months before staff redeployment		DESADEL, EPC and O&M Managers
		DESADEL shall monitor payment of disengaged staff/ compensation entitlements with a view to ensuring fairness to all staff.	Contractual and in line with DESADEL's Policy	Compensation/ payment records	At least 6 months before disengagement.		DESADEL Transition committee
		DESADEL shall encourage the O&M contractor(s) to provide psychological services as part of occupational health requirement.	None	Records of services	Monthly	Monthly	Head of medical services for DESADEL. Clinic
		Clinical services shall be available to disengaged staff over a transition period.	None	Records of beneficiaries	Monthly during transition period	Monthly	DESADEL Medical personnel
	Stress on existing security structures	Daily security reports shall be called for, received and reviewed by the Project manager.	DESADEL Policy	Security reports	Weekly	Monthly	DESADEL and O&M contractor(s)

		Special security force shall be established and deployed for the project. This shall include deploying some of DESADEL Security to strengthen security in the area.	DESADEL Policy	No. of special security personnel on site.	Weekly	Monthly	DESADEL and O&M contractor(s)
		In order to beef up security for the project, DESADEL shall contact government authorities to improve police force at Ibeno LGA and Ibeno, and shall consider assisting with equipment, e.g. patrol vehicles to ensure improved security.	DESADEL Policy	Deployment of police personnel and records of security equipment.	Weekly	Monthly	DESADEL and O&M contractor(s)
	Community unrest	DESADEL and O&M contractor(s) shall honour all obligations.	Contractual	Compliance with MOU items	Once during handover		DESADEL and CLO Unit

7.15 MANAGING STAKEHOLDER PERCEPTIONS

Public interest is expected to be high. The project will have impacts on the surrounding communities through disturbance during construction and operation (e.g. noise, traffic, dust, emissions etc) and through the influx of workforce. Effective and realistic measures have been put in place to mitigate these impacts.

Nevertheless, stakeholder perceptions are bound to persist. These perceptions include:

- damage to structures due to vibration
- increase in hearing impairment due to increase in noise

This project shall manage these perceptions by employing and sustaining dialogue as well as involvement of the communities and other stakeholders in all phases of the project. In particular,

- The proponent shall ensure that the O&M Engineers(s) fully involves stakeholder communities in the environmental monitoring and management plan for this project.
- Use exhaust gas emissions monitoring and other test results as evidence of good environmental practice and performance.

7.16 EMP AND COMMUNITY DEVELOPMENT

The EMT shall ensure that this EMP does not conflict with the community development programmes of government authorities, NGOs and aid agencies for around the Power Project area. The EMT shall integrate the Community Development/Assistance aspects of this development project with the community development programmes of external bodies.

7.17 PARAMETERS TO BE MONITORED

The environmental aspects to be monitored are: Air quality, Noise level,

wildlife and vegetation, Effluent (wastewater) quality, and receiving body of water, underground water quality, soil characteristics and solid waste management. These parameters are summarized on Table 7.2.

Table 7.2: Parameters for Monitoring and their frequencies

MEDIUM	PARAMETERS	
Air Quality	Total particulate ; Respiratory particulate ; Nitrogen (IV) oxide Sulphur (IV) oxide ; Carbon (IV) oxide ; Carbon II oxide Ozone ; Ammonia; Hydrocarbons	
Liquid Effluent Quality	- General Appearance - Colour - Temperature - pH at 25 ^{O}C - Total Suspended Solid (TSS) - Total Dissolved Solids (TDS) - BOD_5 at $20^{O}C$ - COD - Dissolved Oxygen (DO) - Detergent - Fat/oil/grease - Phenol, Total - Phosphate, Total - Nitrogen - Sulphite	- Sulphate - Chloride - Manganese - Cadmium - Copper - Lead - Mercury - Zinc - Chromium - Arsenic - Total Iron - Total Coliforms - Faecal coliforms - Cyanide - Toxic materials
Effluent receiving River Quality	- General Appearance - Colour - Temperature - pH at 25 ^{O}C - Total Suspended Solid - Total Dissolved Solids - BOD_5 at 20oC - COD - Dissolved Oxygen (DO) - Detergent - Grease/fat/Oil - Phenol, Total - Phosphate, Total - Nitrogen - Sulphite	- Sulphate - Chloride - Manganese (Mn) - Cadmium (Cd) - Copper (Cu) - Lead (Pb) - Mercury (Hg) - Zinc (Zn) - Chromium (Cr) Hexavalent - Arsenic (As) - Total Iron (Fe) - Total Coliforms - Faecal coliforms - Cyanide (CN) - Toxic materials
Soil Quality	- Texture - Moisture - Total Hydrocarbon - PH - Conductivity - Exchangeable cations & anions - Phosphorus, Nitrogen	- Sulphate - Phosphate - Chloride - Nitrates - Heavy metals (Cr, Cu Cd, Fe, Mn, Ni, Pb, Vn, Hg and Zn.)
Solid Waste (including sludge) Quality	- Total hydrocarbon - Moisture Content - PH - Ignitability - Reactivity - Corrosivity - Heavy Metals (Cu, Cr, Cd, Pb, Hg, Vn, Mn, Zn).	- Sulphate - Phosphate - Chloride - Nitrates

7.18 MONITORINGFREQUENCY

As outlined in Table 7.2 above, the following are the monitoring frequencies for the above identified environmental medium:

i) Air quality- Will be conducted quarterly and the results made available to the regulatory agencies.

ii) Liquid effluent quality- This will be monitored every two weeks since there will be a laboratory within the premises of the brewery and the results will be forwarded to FMENV and AKSMENV.

iii) Effluent receiving Stream- The pond water and sediments shall be sampled weekly to determine the effluent characteristics and to validate whether it meets regulatory requirements before being discharged. It is envisaged that the effluent shall be treated before being discharged into the receiving stream.

iv) Soil quality- This will be monitored every quarter

v) Solid waste (including sludge) - This shall be monitored weekly and wastes that can be recycled shall be sorted out and transported to all the necessary vendors for handling.

vi) Underground water- This shall be monitored every year to determine whether the activities of the company are causing pollution on the underground water.

Vii) Noise- Noise level shall be measured every two months to determine whether the facility is in tune with the regulatory limit of 8 hour operation at 90dBA.

7.19 REMEDIATION PLANS AFTER DECOMMISSIONING/ CLOSURE

Power Plants especially Gas Turbines by their nature usually have a very long life span. In Europe, there are power plants that have lasted up to 40 years old. The DeSadel Nigeria Limited is proud that it will be generating power in this country for the future. We anticipate that the plant will still be in operation in 50 years from start-up operation after modifications and improvement in engineering design.

Over this period, the generating turbines will continue to be modernized in apiece-meal.

In the event of a catastrophic down-turn in the economy, which might lead to unexpected bankruptcy of the industry, however, all that would happen is a dismantling and environmentally friendly disposal of the equipment, and the conversion of the premises to other use.

If and when this happens, and the gas turbines stops generating power, the effluent generation will cease. There will be no solid wastes and less gaseous emissions, and there will be no hazardous leakages and discharges to the environment.

During decommissioning and abandonment phase, the regulatory bodies such as FMENV, AKSMENV and the Ibeno LGA shall be contacted and various guidelines that stipulate the guidance of demolition and dismantlement shall be strictly adhered to.

The site shall be restored back to its pristine stage by environmental restoration and remediation and the site handed over to the communities or LGA for other uses.

7.20 ENVIRONMENTAL MANAGEMENT PLAN FOR GAS PIPELINE ROW

7.20.1 Introduction

The project specific Environmental Management Plan is one of the key components within company's Environmental Management System that clearly defines the proposed project initiatives to ensure protection of the environment and all affected stakeholders from the construction and operational activities. The programme will form the key reference document for ensuring that environmental issues addressed and should be fully communicated to all project staff, and contractors involved in the project.

1. Project Environmental Impacts/Mitigation Plan; Potential project environmental impacts have been identified in this EIA along with mitigation measures through engineering design or by site management during construction and commissioning/decommissioning activities have been identified.
2. Project Environmental Monitoring Plan for identified impacts provided

3. Measures to mitigate identified impacts proffered
4. Social & Health Management plan identified
5. Noise control plan
6. Waste management plan
7. Contingency plan
8. Audit plan
9. Training plan
10. Abandonment & Rehabilitation Plan

Detailed environmental procedures will be developed as the project progresses from design through construction to operation. The plans and procedures should be coordinated by the environmental advisor or HSE Manager and distributed to the engineering team. Best practices to protect the environment will be adopted. During the construction, operational and decommissioning phases of the project the detailed environmental plans will form the basis against which audits will be conducted on the field.

7.20.2 Demonstrable Management Leadership, Planning Commitment and Review Management and supervision shall be regarded as being fully committed to HSE by all staff and contractors. They are to be seen as providing a leading role towards constant improvement through leadership and action planning. Management shall regularly review the suitability and effectiveness of the system.

7.20.3 Policy and strategic Objectives

Contractors involved in the project shall have a written HSE policy, covering the DESADEL QHSE Policy elements as a minimum.

HSE objectives shall be challenging, and understood by all and consistently incorporated in policies.

In setting objective, management shall consider the overall risk levels its activities and identify those critical operations and installations which require a full documented demonstration that risks have been reduced to as low as reasonably practicable (ALARP).

7.20.4 Organization and Responsibilities

The organization and resources available within DESADEL and other interest groups shall be adequate for its purpose. Responsibilities at all levels shall be clearly described, communicated and understood. Staff shall be developed following structured competency assessment and training systems.

7.20.5 Hazards and Effects Management Process

The process for these critical operations and installations shall include:

- An inventory of the major hazards to the environment and to health and safety of people of all the activities, materials, products and services.
- An assessment of the related risks, implementation of measures to control these risks and to recover in case of control failure.

Health risk assessment shall address physical, chemical, biological, ergonomic and psychological health hazards associated with work.

Environmental Impact Assessment (including a consideration of social impacts) shall be conducted prior to all new activities and facility developments, or significant modifications to existing ones.

Product stewardship shall be applied at all stages of product life cycle relevant to the company's activities.

7.20.6 Standards, Procedure and Document Control

Adequate standards and procedures shall be in place and understood at the appropriate organizational levels. Preparation, review and distribution of all key reference documentation shall be adequately controlled.

Emergency response procedures (including medical emergencies) shall be regularly tested.

7.21 Environmental Management Plan

The objectives of the Project Environmental Management Plan are to:

1. Minimize the negative impacts and enhance the positive impacts on the environment.
2. Ensure compliance with all relevant regulatory requirements,
3. Enhance social acceptability of the proposed project by all stakeholders.

7.22 Social Management Plan

This is essentially concerned with the social action plan (SAP) for the host communities. SAP consists of measures designed to mitigate the adverse social impacts of projects. Among other things, SAP lists mitigation measures, the means by which the measures shall be implemented; the time schedule for the implementation, as well as the implementing agency. SAP is therefore based clearly identified mitigation measure. These measures are usually designed in collaboration with host communities in order to engender a sense of ownership. This can be achieved by holding wide-ranging discussions with cross sections of the communities. This is necessary for the success of the measures.

Mitigation

It is clear from literature and from experience that development projects do generate some adverse social impacts, in addition to other positive effects. Mitigation measures are therefore designed to address the adverse impacts. The mitigation measures for the respective adverse social impacts were spelt out in the previous chapter. On the basis of the proposed mitigation measures, a proposed SAP is provided in Table 7.3.

Table 7.3: Proposed Social Action Plan

Goals	Actions	Implementing Agency	Time Frame/Phase
1. Stem population growth due to in-migration	a. Initiate skill acquisition programme for the	Personnel Department in conjunction with local organizations	Site preparation, construction and pipe laying

	locals b. Recruit and train locals for project jobs.		
2. Minimize the depletion of the farming population and agricultural production	a. Meet with farmers or farmer's groups. b. Assist with agricultural extension service, c. Subsidize agricultural inputs	Community Relations Department, AKSMENV and LGA	Site preparation construction and pipe laying
3. Ensure the availability of commodities and curb inflation	a. 2a. b and c above b. Facilitate the transportation of goods and services	Community Relations Department	Site preparation construction and pipe laying
4. Ease pressure on local infrastructure	a. 1a and b above b. Expand or improve existing infrastructure (e.g water supply) c. Provide infrastructure for project staff	Personnel Department Community Relations Department	Site preparation construction and pipe laying
5. Minimize disruption of means of live hood	a. Relocate farms and farmers where necessary b. Pay compensation where necessary	Community Relations Department	Site preparation construction and pipe laying
6. Curb deforestation due to demand for fuel wood	a. 1a and b above in order to minimize additional demand for fuel wood b. Initiate reforestation programme	Community Relations Department/Akwa Ibom State Forestry Dept.	Site preparation construction and pipe laying
7. Curb possible sexual laxity	a. 1a and b above in order to minimize social disruptions due to the influx of non- locals. b. Promote health education and public enlightenment concerning STDs.	Community Relations Department/NACA/LGA	Site preparation construction and pipe laying
8. Reduce the potentials for youth militancy and disruptive activities	a. 1a and above b. Facilitate the establishment of strengthening of public safety institutions. c. Cultivate good community relations	Community Relations Department HSE Department, AKSMENV, LGA	Site preparation construction and pipe laying

Location

The Location of the activities should depend on the nature of the activity in question.

For 1 (a) and (b), recruitment shall be coordinated at the District or Local Government Headquarters, while training can either take place in the Headquarters or wherever DESADEL has the facility, depending on the level of training required.

2 (b) and (c) should be coordinated in the District or Local Government Headquarters.

3 (a) and (b): Same as (ii) above. The activity may involve upgrading or rehabilitation of roads.

4 (a) and (b): To be coordinated at the District Headquarters and Local Government Headquarters. Work on infrastructure shall be in all sizeable host communities.

5 (a) and (b): To be coordinated at the District Headquarters and Local Government Headquarters. Relocation and compensation shall take place in that affected host communities.

6 (a) and (b): To be coordinated in the District Headquarters and Local Government Headquarters. Reforestation shall take place in that affected host communities.

7 (a) and (b): To be coordinated in the District Headquarters and Local Government Headquarters. The health education programme shall take place in all the host communities.

8 (a) and (b): To be coordinated in the District Headquarters and Local Government Headquarters.

8 (b) to take place in local police stations.

Monitoring and Auditing

The monitoring and Auditing of the activities can be handled by the

same team. The auditing functions shall consist of examining the number, state and efficiency of the activities, while they are being put in place. On the other hand, the monitoring function will involve periodical checks to ensure that the activities/facilities are working properly. The monitoring and auditing programmes should involve visits to activity sites/host communities, in conjunction with local/community leaders.

Monitoring is particularly necessary in the case of youth militancy and disruptive activities, the experience in other parts of the country, particularly the Niger Delta is a clear indication.

CHAPTER EIGHT

REMEDIATION PLANS AFTER DECOMMISSIONING

8.1 Introduction

Projects are normally designed to serve a planned lifespan, after which they shall be decommissioned and replaced or phased out. The decommissioning and phase-out plan is based on what will happen to the structures at closure. This involves activities that result in the stabilization and restoration of unneeded projects to a more natural state. For this project, DeSadel will 'return' the project site to its initial and unblemished natural state, through rehabilitation and enhancement, as prescribed by the environmental statutes and in recognition of the multi-stakeholder's decision.

Decommissioning of the project shall be given utmost priority as DeSadel believes in leaving the environment in its project sites as close to how it was before operations began. To this end, all activities related to decommissioning shall be initiated ahead of time, before the cessation of project activities. Considerations will be given to ensuring the safety of navigation taking into cognizance all appropriate regulatory and company requirements. In addition, the removal of all structures shall be carried out with due regard for the protection of the environment and the rights and duties of the government.

Prior to the actual decommissioning activities, a plan shall be drawn. The plan will discuss the effects of the closure and decommissioning on other stakeholders of the project and the economy of Nigeria in general. Decommissioning of the structures and abandonment is the reverse of

construction and commissioning. Therefore, detailed HSE studies, engineering and decommissioning plan must be carried out before implementation. Consultations and negotiations with stakeholders, particularly the host communities, employees and regulatory agencies must commence early and be concluded before commencement of the execution of the decommissioning plan. The Federal Ministry of Environment EIA Division, NESREA and the Akwa Ibom State Ministry of Environment and Mineral Resources shall be informed about the plan. Furthermore, guidelines for site restoration and remediation prevailing at time shall be used.

Before decommissioning, DeSadel will develop plans that include the following:

- Identification of components of the project that will be removed.;
- The choice of environmentally sound methods for removal, re-use, recycling or disposal of special wastes that may arise from the decommissioning process e.g. Asphalt, liaison with FMEnv.
- Expressly outline the time frame/schedule for the decommissioning and post-decommissioning process, and communicate the same to FMEnv and other relevant regulatory agencies as well as the affected or concerned persons and groups.
- Proper rehabilitation, decommissioning process.
- Appropriate site rehabilitation, remediation and enhancement techniques and technologies and
- There shall be post-decommissioning assessments to compare ameliorated project-related impacts, relative to the baseline conditions.

The content of the plan will take into consideration the extent of the decommissioning (temporary or permanent, partial or complete shutdown), plans for future use of the site, and the condition of the site and environment at the time of decommissioning. A detailed post-operational study of the impact of the project on the environment will be conducted to determine an appropriate restoration and remedial measures.

In general, however, decommissioning activities will be conducted in compliance with applicable regulations and guidelines, including FMEnv or any other regulations that are in force at the time of decommissioning. The plans will also include regulations and a risk and cost analysis of the various options.

8.2 Consultation

The project decommissioning and abandonment plan will include consultation with various stakeholders including employees from various departments. The decommissioning team will include competent personnel from various departments of DeSadel as well as the regulatory authorities.

8.3 Decommissioning of WTE and Ancillary Facilities/Equipment Re-Use

At the end of the project and its ancillary facilities utility, the project and all ancillary facility will be decommissioned. All installed facilities on the project site will be adequately dismantled and removed to allow for proper remediation of the project site. DeSadel Health Safety and Environment Management Systems will be implemented to assure safety of personnel and the public during decommissioning as well as minimize negative environmental impacts. Particular attention will be paid to the following:

- Protection from air pollutant emissions.
- Protection from noise and

- Waste handling

The process of decommissioning will involve:

- Blockage of entrance to site
- Decontamination of contaminated spots
- Re-vegetation and Watering
- Removal of fills and culverts
- Establish drainage ways and remove unstable road shoulders
- Full obliteration, recontouring and restoring natural slopes.

All the components that can be used or recycle will be identified and quantified. Cleared locations will be re-vegetated using fast growing native plant species, which can either be purchased from a nursery plantations/farms or nursery of these seedlings will be developed by capable agronomists contracted by DeSadel. Disturbed areas on the facility will be identified and restored using native species.

8.4 Reporting

As required by regulations, a post-decommissioning report will be prepared and submitted to the FMEnv. The report will include the following details:

- Overview of decommissioned 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
- State of the surrounding environment
- Waste Management Plan

- Plans for restoration/ remediation where necessary.

Recommended Mitigation Measures for Decommissioning Phase

Some basic mitigation measures that will be required to be undertaken once all operational activities of the project have ceased. The necessary objectives, mitigation measures, allocation of responsibilities, time frames, prevention, minimization and monitoring of all potential impacts associated with the decommissioning and closure phase of the project

8.5 Decommissioning and Abandonment Plans

8.5.1 Decommissioning of Existing Facilities

Decommissioning of the project is not foreseen, however, decommissioning of related facilities especially project site offices or equipment area is inevitable. Further, decommissioning of quarries and borrow sites will be done upon completion of construction works. The proponent will prepare a written abandonment plan within 30 days of determining decommissioning. The Plan will detail how the decommissioning will be carried out.

The abandonment plan will be subject to approval by FMEnv/NESREA. An Rehabilitation Plan will be prepared prior to implementation of this plan, to assess and minimize potential environmental and social impacts arising from the abandonment operations. This abandonment Study will be submitted to FMEnv/NESREA for consideration. Upon completion of the abandonment operations, an assessment of contaminated land will be prepared recording the final contamination status of the location of the

project facilities. This assessment will be subjected to FMEnv/NESREA for approval.

8.5.2 Products, By-Products and Waste

The construction of the project will generate inert, non-hazardous and hazardous waste over the period of construction. Operation of the station will result in relatively small volumes of routine waste generation for the life of the project. Maintenance and repair activities conducted during the operational lifetime of the project may generate limited volume of waste.

8.6 The Federal Ministry of Environment's guideline shall be invoked and the step-by-step decommissioning procedure shall be implemented fully.

CHAPTER NINE

9.0 CONCLUSION AND RECOMMENDATIONS

The Environmental and Social Impact Assessment of the proposed construction of the 750mw Gas-Fired Combined Cycle Power Plant, Qua Iboe, Ibeno LGA, Akwa Ibom State, in accordance with the EIA Act Cap E12 LFN 2004. This has afforded a critical review of the anticipated impacts of the development project considering its adverse and beneficial effects. Measures to be put in place in off-setting the negative impacts have been outlined in the report. However, the potential and associated impacts of the proposed project on the socio-economic environment of the area are beneficial because it will increase electricity accessibility to the area and Nigeria at large as well as power the high-speed rail way system, hence, it is recommended that the necessary approvals be given for the project construction to commence.

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