

**Draft Report**

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT**

**(ESIA)**

**FOR**

**THE PROPOSED INSTALLATION OF 20" INCH X 80KM GAS PIPELINE  
ORIGINATING FROM OFFSHORE TO THE PROPOSED DE-SADEL  
POWER PLANT IN IBENO LOCAL GOVERNMENT AREA OF AKWA  
IBOM STATE, NIGERIA.**

**By**



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*Submitted to*

**FEDERAL MINISTRY OF ENVIRONMENT, MABUSHI, ABUJA. NIGERIA.**

**AUGUST 2025**

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## LIST OF ABBREVIATIONS AND ACRONYMS

%	Percent
$\mu\text{Sv/yr}$	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
AKSMEnv & MR	Akwa Ibom State Ministry of Environment and Mineral Resources
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
$\text{BTU/ft}^3/\text{hr}$	British Thermal Unit per Cubic Feet per Hour
$\text{BOD}_5$	Biochemical Oxygen Demand
Ca	Calcium
$\text{Ca}^{2+}$	Calcium ion
$\text{CaCO}_3$	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
$\text{CH}_4$	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
$\text{CO}_2$	Carbon Dioxide

COD	Chemical Oxygen Demand
Cond.	Conductivity
CO <sub>x</sub>	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 <sub>2</sub> S	Hydrogen Sulphide
Ha	Hectare
HC	Hydrocarbon
HCN	Hydrogen cyanide
HDPE	High Density Polyethylene
Hg	Mercury
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HMP	Health Management Plan

HNO <sub>3</sub>	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 <sup>+</sup>	Potassium Ion
KCl-	Potassium Chloride
Kg	Kilogram
Km	Kilometer
km <sup>2</sup>	Square Kilometer
kW	Kilo Watt
l/s	Liter per Second
Ltd	Limited
M	Meter
m <sup>3</sup>	Meter Cube
m <sup>3</sup> /d	Meter Cube per Day
m <sup>3</sup> /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 <sup>1</sup>	meters per second
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
NH <sub>3</sub>	Ammonia
Ni	Nickel
NID	National Immunization Day
NO <sub>3</sub>	Nitrate ion
NO <sub>x</sub>	Oxides of Nitrogen
NS	North – South
NE	North East
NESREA	National Environmental Standards and Regulations Enforcement Agency
NTU	Nephelometric Turbidity unit
°C	Degrees Celsius
OHS	Occupational health Safety
Pb	Lead
PM10	Particulate matter that is 10 micrograms per cubic metre or less in diameter
pH	Hydrogen ion Concentration
PO <sub>4</sub> <sup>3-</sup>	Phosphate
PO <sub>4</sub> <sup>3-</sup>	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 <sub>2</sub>	Sulphur Dioxide
SO <sub>2</sub> -4	Sulphate ion
SO <sub>x</sub>	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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## **ACKNOWLEDGEMENT**

De-sadel Limited wishes to express her appreciation to the Federal Ministry of Environment (FMEnv), Akwa Ibom Ministry of Environment and Mineral Resources, all other interested and concerned stakeholders who have contributed to the success of this study. In particular, we are greatly indebted to our consultant, (team of experts) who has demonstrated deep interest and professional competencies to produce this Environmental and Social Impact Assessment (ESIA) Report on the proposed Revitalization and Utilization of 20" Gas Pipeline Project, at Qua Iboe in Ibeno LGA, Akwa Ibom State.

## EXECUTIVE SUMMARY

### ES.1 INTRODUCTION

This report presents the Environmental and Social Impact Assessment for the proposed construction of 20" x 80km subsea Carbon Steel Gas Pipeline from Offshore to supply Gas to the proposed De-Sadel Power Plant to be sited in the vicinity of QIT in Ibena Local Government Area, Akwa Ibom State.

The federal Government through its ministry of power is committed to improving 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 a 20" x 80km subsea Carbon Steel gas pipeline from Oso Platform Gas Transmission Facility (GTF) to the QIT Gas Receiving Facility (GRF) and Power Plant Metering Station belonging to Seplat (formerly ExxonMobil), in Ibena Local Government of 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 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.

### **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 f 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 Organization 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 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 require 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.

## ES.2 PROJECT JUSTIFICATION

To address the problem of power shortage in Nigeria, Gas turbine power plants began to serve as the best option to overcome the electricity crisis because of the presence of large natural gas reserves in the country. More gas turbine power stations were needed because of the abundant gas reserves to power gas turbines and gas turbine burns very clean. The gas turbines can be operated off-grid and features in all the opportunities identified in the power generation sector. The Laying of 20inch diameter, 80km meters in length of Polyethylene Carbon Steel Pipeline to convey Natural Gas from QIT and revitalization of 56 Kilometers Pipeline from Oso Platform to DeSadel Proposed Gas Power Plant at Ibena, Akwa Ibom State. This pipeline is an existing pipeline infrastructure from Oso Platform Gas Transmission Facility (GTF) Station that currently terminates at Qua Iboe Terminal, Ibena, Akwa Ibom State to feed the Gas **Power** Project

- 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 100M) one hundred, fifty-three billion, nine hundred and seventy-five million Naira only (N 153,975,000,000) from procurement and engineering to commissioning. The project shall be funded by De-sadel Limited in partnership with Asian Development and Investment Bank.

### **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.

### **“Site Location Alternative”**

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 Ibena, 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.

## **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 existing Qua Iboe Terminal with assured supply of Gas to the facility.
  - ii) Site accessibility
- a) Road Trucking:** The shortcomings are the specialty is strong, the transportation goods are too specialized, and the transportation items are limited. Poor transportation infrastructure possesses a high risk to the alternative.
- b) Pipelines:** Transmission pipeline industry is an irreplaceable component of our society's infrastructure. The advantages of piping over trucking are: gas can be transported continuously, is not affected by the weather, and has high reliability throughout the day. The pipeline can take shortcuts and the transportation distance is short and the transportation volume is large as well as high environmental benefits and no harmful substances. The energy consumption is small, which is the lowest among various modes of transportation. Safe and reliable, no pollution, low cost while closed transportation can be realized with less loss.

### **ES.3 PROJECT PROCESS DESCRIPTION**

DeSadel Nigeria Limited proposes to construct and operate a gas pipeline close to the existing Qua Iboe Terminal (QIT) Facility and immediately to the North East of Ibena Town along the Qua Ibo Road, in Ibena 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***

#### ***Components***

The scope of work includes Engineering, Procurement & Construction (NGL), and commissioning of the 12" x 56km and 300m Gas Pipeline. The highlights of this scope are;

- Engineering design and procurement of materials/equipment
- Mobilization to site Survey verification
- Right of Way Survey / Clearin.
- Pipeline Stacking and Stringing;
- Trenching;
- Welding and Non Destructive Testing;
- Field Joint Coating;
- Holiday Detection;
- Lowering;
- Horizontal Directional Drilling;
- Backfilling;
- Hydrotest, Cleaning and Drying;
- Nitrogen Purging;
- Paint coating of above ground installation
- Commissioning

## **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 practice.

### **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), its source and its 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, ducts), 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 offsite 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, demobilization 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 simultaneously 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 summarizes 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 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 (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 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.

### **Weather and Climate over Study Area**

Thirty-five (35) years of data was 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 dust 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 Inter-Tropical 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 FMEnv permissible limit. Noise levels were also within FMEnv permissible limit of 70db(A) for 8hourly. Chances of pollutant gases such as CO<sub>2</sub>, CO, NO<sub>2</sub>, SO<sub>2</sub>, H<sub>2</sub>S, CH<sub>4</sub> 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 determines 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 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.

### **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.

### **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 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 *Elaeis guineensis*, *Crytosperla senegalensis*, *Alchornea laxiflora*, *Tectona grandis*, *Griselinia littoralis* and *Anthocleista vogelii*

### **Fauna**

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 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 little of the large mammals been 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), *Osteolea leamus tetraspis* (dwarf crocodile) and many snakes species which include *Dendroaspis angusticeps* (green mamba), *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 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 borehole facility installed in their houses. Therefore, sample of groundwater are sourced from one (1) borehole within the area 90m to the site. The result of physical and chemical parameters of groundwater from the study area showed the analyzed were mild acidic in nature. The mean pH values of the water sample 6.990. mean conductivity value recorded is 585.00 $\mu$ S/cm. The salinity value of the water sample 43.447mg/L; while that of Total Suspended Solids were 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 drained into Qua Iboe River and into the Atlantic Ocean. The river is characterized by brown oily surface. 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).

## **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 dominantly homes of Ibenos 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 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 associated and potential impacts on the environment and Socio-Economic variables within the project location was carried out using 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**

The anticipated associated and potential impacts of the proposed project activities on the biophysical environment were identified based on the interaction between project activities and environmental sensitivities.

### **Significant Positive Impacts**

- Promote the use and commercial capacity of Gas;
- Vegetation clearing will take place and may lead to loss of some vegetation. However, this shall be restricted to the Work, acquired right of way and additional areas essentially needed for the development.
- Biodiversity: The project area is rich in plant and animal life as revealed by the list of species. Some of these organisms will be

displaced or even killed at worst. The overall impact will be minimized by restricting habitat fragmentation and bush clearing to strict dimension. However, none of the species is classified as endangered or rare neither is there any biodiversity Hotspot nor Important Bird Area (IBAs) within the ROW.

- Create employment opportunities at various levels;
- Support significant associated community development projects, offering immediate and sustained benefits to the surrounding communities;
- During construction local spending will increase, thereby benefiting the surrounding communities Negative Impacts
- Land Use: During the pre-construction phase Survey lines shall be selected carefully to avoid social and agricultural resources. Arrangement shall be made to compensate landowners and farmers with agreed sum for both land and economic crops promptly. No community shall be displaced.
- Surface and Ground waters: Rivers may be partially polluted by improperly disposed waste or spill runoff.
- Road Traffic: The total vehicular traffic loading generated by surveying and construction activities will be relatively high and significant. Construction traffic particularly frequent lorry and truck movements may be disruptive and could create significant

environment impact. There may be accidents and traffic disruptions as a result of careless driving, and inappropriate road crossings by trucks, lorries and bulldozers

- Soil: Clearing of the vegetation would cause increase in soil temperature, fluctuating moisture regimes, erosion pattern and topographic changes.
- Air Quality: Short-term air quality degradation may result from construction related operations, and vehicular traffic loadings. Airborne particulates could result from soil disturbance during construction activities. All diesel-powered equipment such as power generators, bull-dozers, trucks and heavy machineries would emit SO<sub>x</sub>, CO<sub>2</sub>, CO, NO<sub>x</sub>, and other hazardous gases. These combustion gases can cause air pollution problems and health related hazards.
- Noise and Vibration: Construction activities and relatively high volume of traffic will generate considerable amount of noise, which may exceed the national exposure limit of 90dB (A) daily for 8- hour working period. Human receptors will be construction crew and nearby communities. Continuous exposure may cause hearing impairment.
- Socio-economic: The project activities will result in significant population increase if most of the personnel recruited are from outside the project area and the underlisted negative impacts may manifest:

## ES.6 MITIGATION MEASURES

Mitigation measures have been developed for the identified negative environmental impacts. Necessary measures shall be put in place during construction phase to ensure health of workers and environmental safeguard and to minimize the risk of possible incident. The slight increase in dust emissions from construction activities will be properly addressed by spraying water in construction sites to reduce powder dispersion. The construction activities will be carried out, also, in accordance with applicable regulations on noise. The major increment in vehicular movements will occur during construction phase, however, the Project will have minor effects on the existing vehicular transit on main road axes. Temporary and occasional impacts on vibrations are expected, but considering the distance between the project site and other premises and nearness to water body there are limited sensitive receptors at risk of project vibrations. Minor impacts on wildlife are expected and time limited, associated to diurnal hours. Current fruition of the existing fauna will not change. Waste production during construction phase will be managed by the regulatory procedures. A negligible population increase by the near host communities associated to the realization of the Project is expected. Dedicated policies and actions will be adopted to safeguard the host communities from impacts due to the influx of workers, however the host communities will particularly benefit of the increase of both direct and indirect employment.

During operation & Maintenance phase all the necessary measures to ensure health of workers and environmental safeguard and to minimize

the risk of possible incidental will be put in place. No significant effects are expected on air quality during operation phase, since the pollutants concentrations at ground level will be in compliance with air quality regulatory/standards guidelines and with occupational exposure limit values. The initiative will not positively increase air pollutants emissions into the atmosphere likely to negatively affect the existing quality of ambient environment around the complex. The project has a negligible health impacts on host communities. The same population increment by the near host communities will be managed in a proper manner to safeguard the health of host communities deriving from possible exposure to infective/transmissible diseases. Also an acceptable increase of vehicular traffic is expected and will be adequately managed with established Traffic management plan in order to minimize possible socio economic impacts and potential associated hazards.

#### **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 closed and decommissioning on- going. Traffic shall be redirected away from the road. PPE's shall be provided for the decommissioning workers and dust suppression shall be done to reduce particulate emission.

### **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 needs 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 have 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.

DESAD 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 of 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 STD's 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 emergency situations as may be detected near a public or private building or near DESADEL pipeline facility or explosion occurring near or directly involving 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 buried pipeline
- Remediation of all impacted sites in order to restore them to their original condition as far as possible,
- Civil structures shall be broken up and disposed off 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 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 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.

These shall be survey of the site to determine if the site is contaminated, extent of contamination and 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, guideline 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

installation of 20" Gas Pipeline Project in Ibena, Ibena 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 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 accessibility to the district there by reducing the associated difficulties experienced by the residence of the estate. Hence, it is recommended that the necessary approvals be given for the project construction for kick-starting.

## CHAPTER ONE

### INTRODUCTION

#### 1.0 BACKGROUND INFORMATION

This report presents the Environmental and Social Impact Assessment for the proposed Installation of 20"x80km Subsea Carbon Steel Gas Pipeline from Oso Platform Gas Transmission Facility (GTF) to the QIT Gas Receiving Facility (GRF) and Power Plant Metering Station belonging to Seplat (formerly ExxonMobil) at Qua Iboe, Ibena LGA, Akwa Ibom State. The project includes construction 300m pipeline spur from QIPP to the DeSadel Power Plant using existing Right of Way (ROW).

The pipeline project shall supply Natural gas to the proposed 750MW Combined Cycle Gas-Power Station, primarily for 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 project is instigated by DeSadel and the Federal Government of Nigeria to meet the dedicated supply requirement of the HSRS.

The construction work for this project is proposed to span through 48 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 project 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 15<sup>th</sup> August 2025 with the objectives of setting boundaries of the study area and mapping out sampling locations. The data gathering began on 16<sup>th</sup> July and ended on 4<sup>th</sup> 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 safety, 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 require 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.
- 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 Utilization and Construction of 20' Gas Pipeline Project will potentially arise and it was considered imperative to evaluate these likely

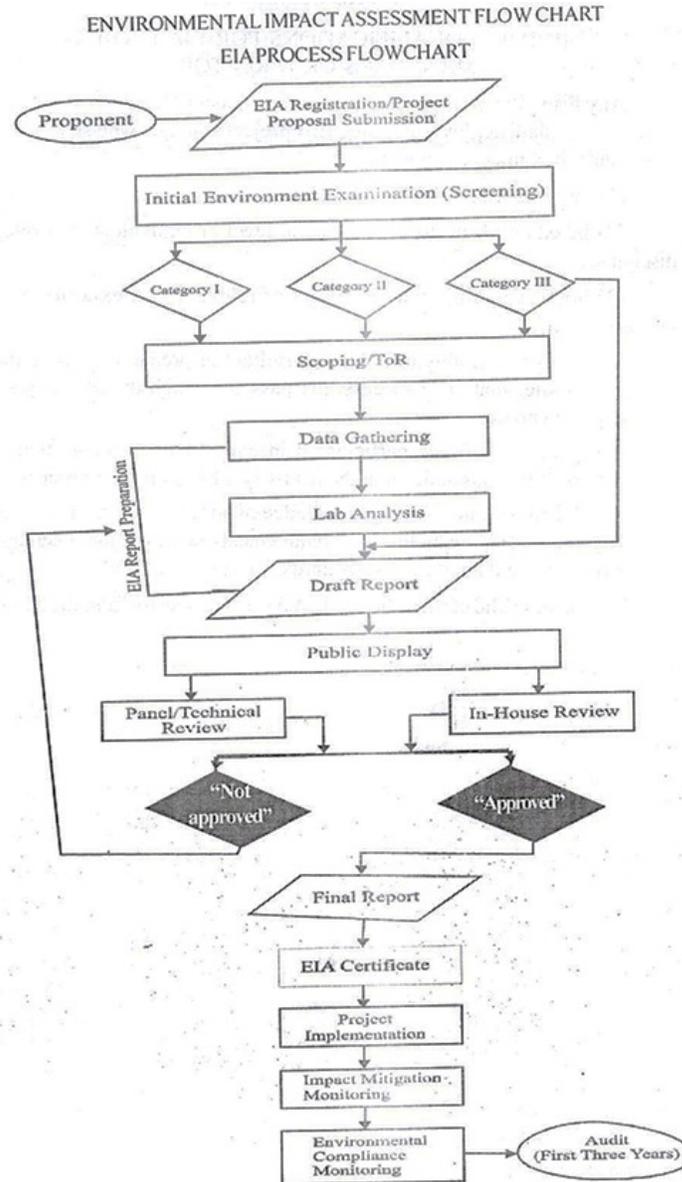
impacts and recommend mitigation strategies and potentially viable alternatives to the proposed project. The scope of work for the proposed Project shall include:

- 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 (FMEEnv)***

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) has 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.

- **S.1.22 National Environmental (Surface and Groundwater Quality Control) Regulations 2011.**

As the title indicates, it is meant to restore, enhance and preserve the physical, chemical and biological integrity of the Nations water (Surface and groundwater) The waters shall be maintained in a safe and satisfactory condition from all manner of industrial and anthropogenic activities such that the water can be used for various uses spanning from industrial, agricultural, recreation, public water supplies, hydro energy etc.

- **S.I.26 National Environmental (Wetlands, River banks and lake shores) Regulations, 2009**

The Regulation amongst other objectives specifically relates to this project by (a) ensuring conservation and wise use of the waterbodies, (b) Control pollution of the river (c) ensure that the wetlands of the community are protected as habitats for flora and fauna species.

- ***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.

### **Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN), 1991 (Revised 2018)**

In 1991, the Nigerian Upstream Regulatory Commission (NURC) formerly Department of Petroleum Resources (DPR) issued the first Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN). These regulations are a comprehensive guide covering all sectors of operation in the oil and gas industry. They have been reviewed and updated since then, with the latest revision published in November 2018.

The DPR Environmental Guidelines and Standards of 1991 (amended 2018) contains in Part VIII (A), sections 3, 4, 5 and 6, the EIA report process, significant effects/impacts, content of an EIA report and environmental screening.

Part VI (A) 3.1 of EGASPIN identifies the sources of wastes associated with pipeline operations, while Part VI (A) 5.1 specifies that licencees/operators shall institute planned and integrated environmental management practices, aimed at ensuring that unforeseen, identified and unidentified issues are brought to an acceptable minimum.

#### **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 Industry 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. Petroleum Pipeline Regulations (under Section 136 and 191)**

The objective of these regulations is to regulate the licencing and operations of Pipelines for natural gas and petroleum liquids (the “Pipeline”) by the Authority pursuant to sections 135 and 190 of the Petroleum Industry Act (the “Act”) Notwithstanding the provisions of these regulations, the provisions of the Oil Pipelines Act and any subsidiary legislation made under it shall pursuant to Sec 311(9)(c) and Sec 310 of the Act continue to be in force mutatis mutandis until revoked or repealed.

(1) An application for a licence to establish a pipeline shall be:

(a) in a form prescribed and upon terms and conditions set out in Guidelines.

(b) in accordance with the provisions of section 111(2&4) of the Act; and

(c) accompanied with an application for permit to survey the pipeline route and a pipeline conceptual plan.

(2) The pipeline conceptual plan shall be prepared in the format prescribed by the Authority and shall include a statement indicating –

(i) the services to be rendered by the pipeline;

(ii) the preliminary specifications of the pipeline;

- (iii) the characteristic of the substances to be conveyed through the pipeline;
- (iv) Financial plan and business case for the development of the pipeline;
- (v) Community development programs; and
- (vi) Local content input for the project.

#### **5. 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

#### **6. National Oil Spill Detection and Response Agency (NOSDRA)**

The functions of the agency as provided in the Act is essentially to coordinate and implement the National Oil Spill Contingency Plan for Nigeria in accordance with the International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC 90). Additionally, the agency is responsible for surveillance/ detection of oil spills in the petroleum sector; monitor reports of oil spillages and co-ordinates response activities throughout Nigeria.

Objectives of the Act relevant to this project include the following:

- to establish an organisation that ensures a safe, timely, effective and appropriate response to all oil pollution as well as hazardous and noxious substances in the petroleum sector;
- identify high-risk areas as well as priority areas for protection and clean up;
- ensure funding and appropriate and sufficient pre-positioned pollution combating equipment and materials, as well as functional communication network system required for effective response to major oil pollution;
- provide a programme of activation, training and drill exercises to ensure readiness to oil pollution preparedness and response and the management and operational personnel;
- co-operate and provide advisory services, technical support and equipment for purposes of responding to major oil pollution incidents;
- develop and implement an appropriate audit system for the entire plan.

## **7. The Petroleum Act CAP P10 LFN 2004**

Section 22 of the Petroleum Act CAP P10 LFN 2004 stipulates that subject to the provisions of all the relevant laws and on such terms and conditions as may be approved by the Minister, the licensee or lessee shall be entitled to such way-leaves for the laying, operation and maintenance of pipelines, telephones and the like through or across the surrendered area or areas as he may reasonably require—

- (a) for the carrying on of operations under the licence or lease; or
- (b) for inter-communication and passage between retained areas (and, in the case of licences or leases in the continental shelf, between retained areas and onshore lands), and any such way-leaves shall

form part or be included in the calculation of the amount of the retained areas.

Section 22 further states that there shall be reserved to the Minister over the retained part such way-leaves, easements or other rights as in his opinion are necessary or desirable for the laying, operation and maintenance of pipelines, telephone lines and power-lines; and any way-leaves or other rights so reserved shall ensure for the benefit of any person or body to whom the Minister may subsequently grant the same to the extent that he may so grant them.

#### **8. Oil Pipelines Act and the Oil and Gas Pipelines Regulations of 1995**

The Oil Pipelines Act and the Oil and Gas Pipelines Regulations of 1995 regulate the right to establish, maintain and operate gas pipelines and ancillary facilities in Nigeria. The Act requires that applications for permit to survey an oil pipeline route be submitted to the Minister for Petroleum Resources. This application shall specify the approximate route or alternative routes proposed for the pipeline to any specified point or destination for purposes connected with petroleum trade or operation. Upon completion of the survey, the holder of a permit to survey may apply to the Minister of Petroleum Resources for an Oil Pipeline License, subject to the payment of the prescribed fees. The license shall entitle the holder and his officers to enter and take possession for use a strip of land of width not exceeding 200 ft (60m) or other such width as may be specified in the license and thereafter to construct, maintain and operate the pipeline and ancillary facilities.

#### **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 (UNFCCC), 1992 and Kyoto Protocol on Greenhouse Gas Emission Reductions	2004
13	IFC performance Standards on Environmental and Social	2012

Sustainability		
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 (UNFCCC), 1992 and Kyoto Protocol on Greenhouse Gas Emission Reductions 2004**

Green Houses Gases (GHG) emissions, particularly of carbon dioxide (CO<sub>2</sub>) 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 Standard 1:** 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 source Natural Gas through the revatilizatization of 20' Gas Pipeline from Oso Gas Platform and construct a 34km spur from Quo Iboe Terminal (QIT) to feed it proposed Combined Cycle Gas Turbine (CCGT) Power

plant with a capacity of 750MW and associated Infrastructure such as the Gas Transmission line and other supporting facilities.

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**

In Nigeria today, the power supply is lower than the demand due to the total installed power is lower than the demand. The endemic power crisis in Nigeria which came as a result of the inability of the existing power plants to meet the ever increasing demands poses as a challenge to the development of the country. Residential homes, office buildings and industries generate their own electricity through alternative sources to make up for irregular power supply. To address the problem of power shortage in Nigeria, Gas turbine power plants began to serve as the best option to overcome the electricity crisis because of the presence of large natural gas reserves in the country. More gas turbine power stations were needed because of the abundant gas reserves to power gas turbines and gas turbine burns very clean. The gas turbines can be operated off-grid and features in all the opportunities identified in the power generation sector. The Laying of 20inch diameter, 80km meters in length of Polyethylene Carbon Steel Pipeline to convey Natural Gas from QIT and revitalization of 56 Kilometers Pipeline from Oso Platform to DeSadel Proposed Gas Power Plant at Ibeno, Akwa Ibom State. This pipeline is an existing pipeline infrastructure from Oso

Platform Gas Transmission Facility (GTF) Station that currently terminates at Qua Iboe Terminal, Ibeno, Akwa Ibom State to feed the Gas Power Project major industries along the row in order to:

- Utilize natural gas to power gas turbine plants constructed by industries and any government around the project area. This will improve power supply in the project area;
- Provide cheaper, cleaner and more efficient fuel for the end users in particular and the country in general;
- Promote the use of natural gas as a substitute for liquid fuel, as well as enhancing environmental status as natural gas is friendly;
- Boost economic activities within the area and country at large;
- Encourage gas utilization culture in Nigeria as fuel-of-first-choice;
- Offer job opportunities in various categories to a number of Nigerian professionals, skilled and semiskilled craftsmen.

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 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**

The development of clean modern energy services is an enormous challenge facing the African continent since energy is fundamental for socio-economic development and poverty eradication. Energy is a foundation stone of the modern industrial economy and provides an essential ingredient for almost all human activities. Modern energy services are a powerful engine of economic and social development and no country has managed to develop much beyond a subsistence economy without ensuring at least minimum access to energy services for a broad section of its population. Energy is a requirement for

industrial development and activity, which without an effective energy supply neither is possible. This is concerning as energy is an essential building block for fighting poverty and promoting sustainable development. The provision of safe and affordable energy is an important, if not vital, condition for their achievement. Access to power expands the number and variety of business and job opportunities available.

Following the realization 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 value of the proposed gas pipeline project is estimated to cost (USD 100m) one hundred, fifty-three billion, nine hundred and seventy-five million Naira only (N 153,975,000,000) consisting of land acquisition, construction, personnel, equipment, approvals, corporate social operation. The project shall be funded by De-sadel Limited in partnership with Asian Development and Investment Bank. A higher percentage of the project amount would be injected into the Nigerian economy through contracts, subcontracts and purchase of construction materials and labour. Consequently, the cost of the gas pipeline and subsequent development of gas turbines will boost industrialization.

### **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 is expected to be technically sustainable because of the proven technology for the pipping and auxiliary facilities being used. Strict adherence to internationally accepted engineering design

and construction standards as well as codes of practice that shall be adopted at all stages of the project are expected to ensure technical sustainability. Innovative technologies that are economically viable and having minimal environmental, social and health impacts shall be utilised in the execution of the proposed project.

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 shall be economically sustainable as there is high demand for power and the Return on Investment (ROI) is surely high. Similarly, the proposed Highspeed rail system will solely depend on electricity which will be supplied by the proposed Combined Cycle Gas Power Plant by DeSadel.

#### **2.4.3 Environmental Sustainability**

The gas pipeline is designed and will be constructed to be eco-friendly based on the concept of building with nature (BWN). The proposed gas pipeline project is environmentally sustainable. In addition, strict adherence to the EMP shall ensure that every aspect of the proposed project is sustainable with minimum impact, especially as it concerns the natural environment and the people who inhabit it. Incorporation of the recommendations of the EIA at the appropriate stages of the project development is expected to ensure that maintenance of the ecosystem such that there are no significant adverse effects to health or social status of life within that ecosystem as a result of the operations of the gas pipeline.

#### **2.4.4 Social Sustainability**

The project has elaborate Social Action Plan and continues consultation with relevant stakeholders throughout the life cycle of the project. A Grievance Redress Mechanism (GRMs) shall be developed and established for the project to forestall any future disagreement between the proponent and the host community. A Grievance Redress Mechanism (GRMs) shall be developed and established for the project to forestall any future disagreement between the proponent and the host community. The social sustainability of the project shall emanate from the extensive consultations, which have been held with host community

and which shall be sustained, are expected to continue to create a good working relationship between DeSadel Nigeria Limited and the project communities.

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

## **2.5 Project Options**

### **2.5.1 Do nothing Option**

It is best practice in Environmental Impact Assessments (EIA) to consider the Do Nothing 'alternative — i.e. where no project occurs. Under a Do Nothing 'alternative, the strategic gas pipeline infrastructure and its associated development would not be constructed. This option would favour the continued reliance on existing inadequate Power Supply and the use of alternative diesel generators. The implications include the fact that land will not be acquired; there will be no disturbance of the people and structures as a result of the decision to maintain the existing power supply of the area as it is presently constituted, which shall also be at variance with the increased demand for energy and vision for sustainable development of the area. The option will reduce and stunt effective social development of the nation. This option was rejected because it under-exploits a proven strategy to empower the people and the nation. The project will have many social, economic and environmental benefits such as jobs creation, revenue generation, social development, reduction in crime etc. This option was rejected because the present power generation in the country cannot meet the energy demand of industries and again, the current cost of diesel fuel is expensive.

### **2.5.2 The 'Delayed' Option**

This option implies that the planned project will be delayed until a much later date. Such option is usually taken when conditions are unfavourable to project implementation such as in war situation, or where the host community is deeply resentful of the project. Also, if the prevailing economic climate is not quite favourable to the project, then delayed project option may be feasible. None of these conditions is applicable. Indeed, the social, economic and the political environment are most favourably disposed towards the project. Therefore, the implication of delayed project option will mean that all the preliminary work and associated efforts/ costs incurred would have come to nothing. Also, because of inflationary trends, such a delay may result in unanticipated increase in project costs, which may affect the final profit from the project. The consequence of these is that it would be a discouragement for private/local investors. In consideration of the above concerns and assessment of the current proposed site the Delayed option of the project is not viable option. These, and other related problems make impracticable to adopt the delayed option. It is therefore unattractive to adopt the “Delayed Project” option.

### **2.5.3 Go Ahead Option**

Gas is readily available in Nigeria, thus the utilization of gas to produce power for electricity is cleaner and more environmentally friendly, than liquid or solid fuels (gas burns effectively and produces very little or no smoke), and will enhance constant power supply to boost production. Transmission pipeline industry is an irreplaceable component of our society infrastructure. These pipeline systems have safely transported products from wells to refineries and ultimately to the necessary markets, including consumers and businesses. Pipelines have historically been the safest means of transporting natural gas and

historically liquids. Considering the economic viability and the numerous advantages of gas utilization as a source of energy to provide constant supply of power for industries in Nigeria, this option was accepted. The option of project development is thus the best of all the possible options considered economically, technologically and environmentally. During the proposed project design development, alternatives were considered in compliance with the requirements of Nigeria's EIA procedures together with international best practices. This is the preferred option.

## **2.6 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.

### **2.6.1 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 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 Ibena, 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 Ibena 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.

## 2.6.2 Transportation Alternative

### Road Trucking

High pressures and explosions make it difficult to transport compressed natural gas in tankers. Due to scientific advancements in the mid-20th century, natural gas can be turned to liquid at extremely low temperatures and transported as liquefied natural gas (LNG). Compared to natural gas, liquefied natural gas spreads to a smaller volume thereby

allowing it to be transported in far distances in a cost-efficient manner. They can even be transported to areas where no pipelines or no natural gas source exist. Similarly, refueling stations by the roadside as well as fuelling equipment need to be suited for cryogenic temperatures. Though this immediately boosts the cost of using natural gas, the latter offers relevant benefits to the environment. Special trailers that can carry liquefied natural gas are able to deliver natural gas from storage tanks to fueling stations. Once delivered, natural gas needs to be stored in insulated tanks at the fueling station. Refueling stations are also necessary along with storage tanks for the cold natural liquid. The shortcomings are the specialty is strong, the transportation goods are too specialized, and the transportation items are limited. Poor transportation infrastructure possesses a high risk to the alternative.

#### Pipelines

Transmission pipeline industry is an irreplaceable component of our society infrastructure. These pipeline systems have safely transported products from wells to refineries and ultimately to the necessary markets, including consumers and businesses. Pipelines have historically been the safest means of transporting natural gas and historically liquids. Pipelines play a very critical role in the transportation process because most of the oil and gas move through pipelines for at least part of the route. Strategic planning involves determining the shortest and most economical routes where pipelines are built, the number of pumping stations and natural gas compression stations along the line, and terminal storage facilities. The advantages of piping over trucking are that:

- It can be transported continuously, is not affected by the weather, and has high reliability throughout the day.

- The pipeline can take shortcuts and the transportation distance is short;
- The transportation volume is large.
- High environmental benefits and no harmful substances.
- The energy consumption is small, which is the lowest among various modes of transportation;
- Safe and reliable, no pollution, low cost;
- Closed transportation can be realized with less loss.

## CHAPTER THREE

### PROJECT PROCESS DESCRIPTION

#### 3.1 Project Overview

This chapter highlights in detail the features of the Project's basic activities, project components, location, layout plan and implementation schedule. DeSadel Nigeria Limited proposes to install 20"x 80km gas pipeline from Oso Platform Gas Transmission Facility (GTF) to the QIT Gas Receiving Facility (GRF) and Power Plant Metering Station belonging to Seplat (formerly ExxonMobil), in Ibeno Local Government of Akwa Ibom State.

The 56km project is onshore which is already constructed with the balance of 34km subsea pipeline to be constructed. This is an existing in part and ongoing facility development with some land acquisition in a brown field which now belongs to Seplat (formerly ExxonMobil). It involves the following:

- Construction of an 20"x 80km Subsea carbon steel, API 5L Grade B (0.500" wall thickness) Gas Pipeline from Oso Platform to QIT power plant to supply gas to QIPP and subsequently to DeSadel Power Plant following a new ROW for 34km fresh acquisition. The width of the new ROW will be approximately 15m.
- Installation of Gas Plant facility and Gas Receiving Facility at QIT and subsequently at DeSadel power plant.

These will enable QIT to:

- Supply over 400MMScfd daily locally within 1 year following the construction of this pipeline.

- Stimulate industrialization of the Nigerian economy with several viable industrial and social projects coming to full realization with an adequate gas supply.
- Aggressively support the Federal Government of Nigeria gas flare out and gas supply to power plants, industrial and domestic markets policies especially the domestic gas obligation policy.

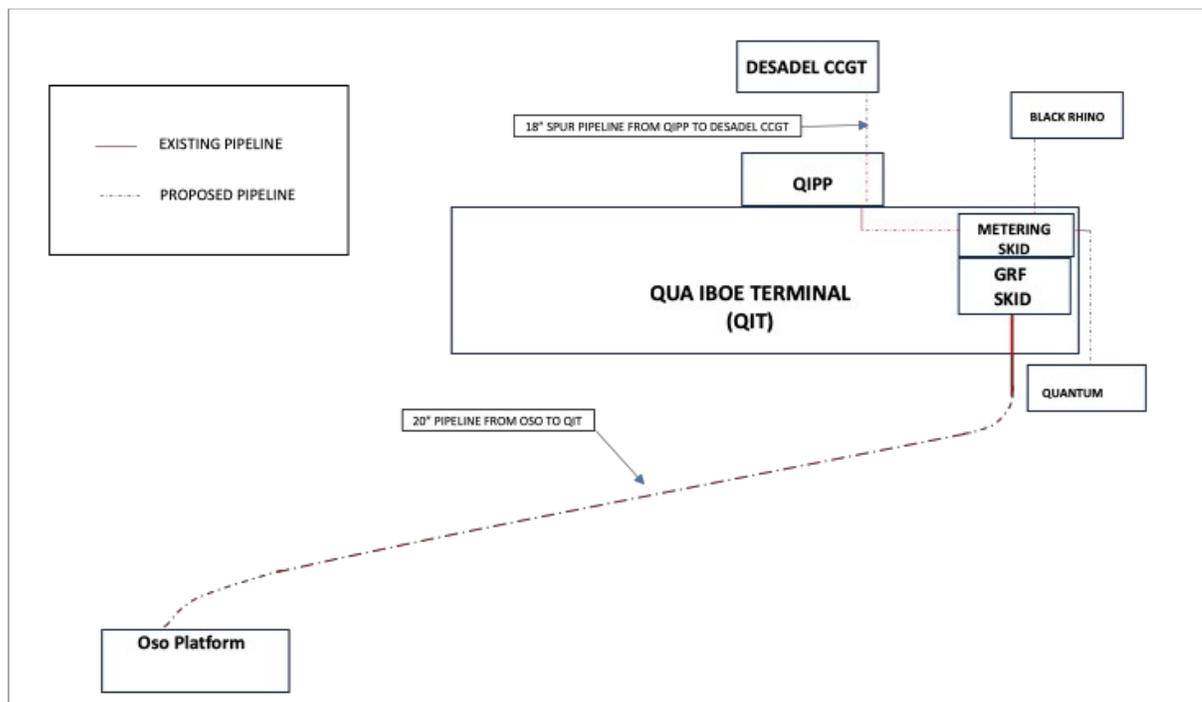


Figure 3.1: DeSadel Gas Supply Provision from QIT

### 3.2 Project Location

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.

The project is located about 300m from existing QIT gas plant. Its micro location is equally within proximity of the existing Qua Ibo Road towards Eket in Akwa Ibom State. The pipeline is to be established to supply gas to the power plant for a base load supply regime. Specifically, the proposed 300m 20' Gas pipeline stretches from QIT on latitude 4.553166°N and longitude 8.020540°E to project site on latitude 4.557101°N and longitude 8.020074°E at an elevation of 7m above sea level. Figures 3.2 show the administrative map of Nigeria and Akwa Ibom State showing Ibeno and the project while figure 3.3 presents satellite aerial view of the project area.



Figure 3.2: Administrative Map of Nigeria indicating Akwa Ibom State hosting the Proposed Project Indicating Ibeno LGA, the Area hosting the Project.



Figure 3.3: Aerial View of the Project Area showing the Proposed Pipeline Route in Red

### 3.3 The Proposed Gas Project Scope

The scope for the project is as follows:

- Construction of 56km ROW for gas supply from the Oso Platform to QIT Metering station and 300m Spur from QIT Metering facility to DeSadel Nigeria Power Plant.
- The volume of gas to be supplied from Oso to QIT would be 400MMScfd gas processing facility.
- The proposed ROW will be existing 56km in length and a new 300m spur .
- Slug catcher and other devices to guarantee quality of product will be constructed and installed next to the GTF and GRF including Metering Station.
- Road crossing where necessary especially, the Qua Ibo road shall be achieved by underground thrust-boring.
- The gas flowing temperature is 35°C, the gas is water-saturated.
- A Gas Receiving Facility (GRF) shall be installed near the gas pipeline interchange and would supply 400MMScfd dew point grade natural gas to the gas fired turbines facility for power generation and other two (2) facilities.
- The Slug Catcher at the Oso-GTF and the Pig Receiver at the QIT-GRF will be capable of handling over 400MMScfd from the 20" gas pipeline. In addition to the Slug Catcher and Pig Receiver, 2 - Gas Filter Separators and 2 - Heaters shall be installed to furnish gas as required to DeSadel power plant. The GRF will be self-sustaining as the power generation required for the facility would be from natural gas fired reciprocation generators near the site.
- The GTF pipeline will be designed with a T-Spur enabling the delivery

of 200MMSCF of gas for the FLNG unit.

- Additional safety and monitoring systems shall be installed for a continual 24/7 operation.
- Multiple Meter Runs with monitoring and proving capabilities shall also be installed for monitoring, testing, and recording all custody transfers of gas from the GRF to the power plant and the other facilities.

### **Standards**

The order of precedence of standards is as follows:

- Nigerian National Standards
- DeSadel Nigeria Limited Standards and specifications
- International standards (e.g. ISO, IEC, etc).

The design philosophy of the pipeline is based on the following rules:

- Power generation and Gas supply is the prime objective of the project
- Non-Associated Gas (NAG) should be gathered and put into economic use and stop gas flaring.

The design life of the pipeline shall be a minimum of 25 years. The maximum life of the pipeline is 30 years.

### **Quality Assurance Design**

In order to ensure that the objectives of the project are realized, DeSadel has specified the following quality objectives for design:

- Compliance with statutory requirements;
- The system must meet performance requirements;
- Production availability;
- Environmental conditions and safety;

- Operability and maintainability;
- Life expectancy;
- Extensibility
- Use of innovative technology

To ensure that the above quality objectives are met, DeSadel intends to adopt time- tested standard pipeline and Gas receiving facility designs, employing new technology where safety and economics dictate.

### **3.4 Design Intent/Technical Specification**

The engineering design, procurement and installation would be in accordance with the latest revisions of the Statutory Codes and Standards, Design and Engineering Practice (DEPs) and DESADEL Standard Facility Design Manuals.

#### **3.4.1 Design Codes, Standards and Regulatory Requirements**

The pipeline system will be designed in accordance with the following code, standards and regulatory requirements:

##### **3.4.1.1 American Petroleum Institute (API)**

- API RP 520 Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries Part 1 — Sizing and Selection
- API RP 521 Guide for Pressure Relieving and Depressurizing Systems
- API 526 Flanged Steel Pressure Relief Valves
- API 5L Specification for Line Pipe
- API RP 1102 Steel Pipelines Crossing Railroads and Highways

- API STD 1104 Welding of Pipelines and Related Facilities
- API RP 5L1 Recommended Practice for Railroad Transportation of Line Pipe
- API RP 5L5 Recommended Practice for Marine Transportation of Line Pipe
- API 600 Steel Gate Valves — Flanged and Butt Welding Ends
- API 6D Specification for Pipeline valves

#### **3.4.1.2 American Society of Mechanical Engineers (ASME)**

- ASME VIII Boiler and Pressure Vessel Code
- ASME B16.1 Cast Iron Pipe Flanges and flanged fitting
- ASME B16.5 Steel Pipe flanges and flanged fittings
- ASME B.16.9 Factory made wrought Steel Butt welding fitting
- ASME B31.3 Chemical Plant & petroleum Refinery Piping
- ASME B31.8 Gas Transmission and Distribution Piping System

#### **3.4.1.3 Det Norske Veritas (DNV)**

- DNV-RP- E305 On-Bottom Stability Design of Submarine Pipeline
- DNV-RP- F105 Free Spanning Pipelines

### **Codes and Standards**

- **Electrical**
- IEC60826-2003: Design criteria of overhead transmission lines.
- IEC 61865: Overhead Lines-Calculation of the electrical component of distance between live parts and obstacles-

Method of calculation.

- IEEE C2-2012: National Electrical Safety Code (NESC).
- IEEE 516-2009: IEEE Guide for Maintenance Methods on Energized Power Lines.
- **Civil Work**
  - ASCE 7-05: Minimum Design Loads for Buildings and Other Structures
  - ASCE 10-97: Design of Latticed Steel Transmission Structures
  - IEEE Std 691<sup>TM</sup> 2001: IEEE Guide for Transmission Structure Foundation Design and Testing American concrete institutes (ACI).
- **Material**
  - IEC61 089: Round wire concentric lay overload electric standard conductor.
  - IEEE 812: Definition of terms relating to the fiber optics.
  - IEG 60120: Dimensions of ball and socket coupling for string Insulators.
  - ISO 898: Mechanical properties of fasteners made of carbon steel and alloy steel.
  - ASTM: American Society for Testing and Materials.
  - GB/T 700-2006: Carbon structural steels.
  - GB/T 1591-2008: High strength low alloy structural steels.
- **Tower Code for Design**
  - ASCE 7-05 for load computation.

- ASCE 10-97 for tower design.
- **Structure Code for Design**
- IEEE Guide for Transmission Structure Foundation Design and Testing (IEEE Std 691TM 2001)
- American concrete institutes (AC1318)
- American Society for Testing and Materials (ASTM).

### **Pipeline Materials Selection**

The materials selection study for the project was based on the detailed corrosion prediction study/analysis for the Nigerian Gas Company main lines, flow lines and Gas Plant sales gas. Duplex (22Cr) has been proposed for the gas pipeline materials stemming from the results of the corrosion prediction analysis so far carried out. The choice of duplex stems from the following:

- High corrosion rates predicted due to the presence of CO<sub>2</sub> and free H<sub>2</sub>O (approx. 5mm/year at the inlet and decreasing to about 2mm/year).
- High corrosion rates suggest use of corrosion resistant material or corrosion inhibition system with allowable corrosion allowance (CA) — 8mm maximum as per STEP 99-5661.
- High corrosion rates suggest unacceptable CA for carbon steel and Inhibitor System Availability requirement is above 90% - historically a big challenge.
- All lines are critical for achieving the overall project objective

of providing gas to the client.

- Carbon steel with inhibition seems unsuitable for this service.
- Although duplex has the higher initial CAPEX, its lifecycle cost is only marginally above that of carbon steel, even though it is assumed that the carbon steel pipelines will not be replaced within the 20 years under consideration. In addition, duplex offers better corrosion resistance, reliability and guarantee for integrity over the design life.

## **Corrosion Protection**

### **(a) Internal Corrosion**

To minimize threat of internal pipeline corrosion an inhibitor may be injected into the pipeline. Furthermore, pigging of the line will prevent the accumulation of debris which is a known contributor to internal corrosion. The low concentration of sulphate in the pipeline will minimize the activity of sulphate reducing bacteria and consequently eliminate the risk of corrosion and hydrogen induced cracking from this source.

### **(b) Cathodic Protection**

Cathodic protection is based on galvanic and impressed current. The efficiency of the Cathodic protection will be greatly improved through the use of impressed electric current. The design of the cathodic protection scheme would be determined by the findings of the corrosion survey, the pipeline diameter, wall thickness and coating material, and

application quality.

The long-term cathodic protection system would be designed to provide an adequate pipe-to-pipe negative potential for the expected operational life of the pipeline. A direct current electricity supply will be obtained by conversion from the main electricity. The choice of one deep well ground bed is based on soil resistivity measurements and Cathodic Protection design. The effectiveness of the cathodic protection system will be monitored throughout the life of the pipeline. To facilitate monitoring, a number of above ground test points will be installed along the pipeline route.

### **3.5 Project Component and Site Layout**

The components and information for the gas pipeline project are as follows:

- Gas Supply facilities
  - Pressure reduction and metering system (PRMS)
  - 2 Gas booster compressors and panel
  - Internal Gas pipeline System
- Water supply and distribution network
  - Borehole point
  - Water pump

A preliminary site layout based on a 4 units of turbine is shown below in figure 3.4.

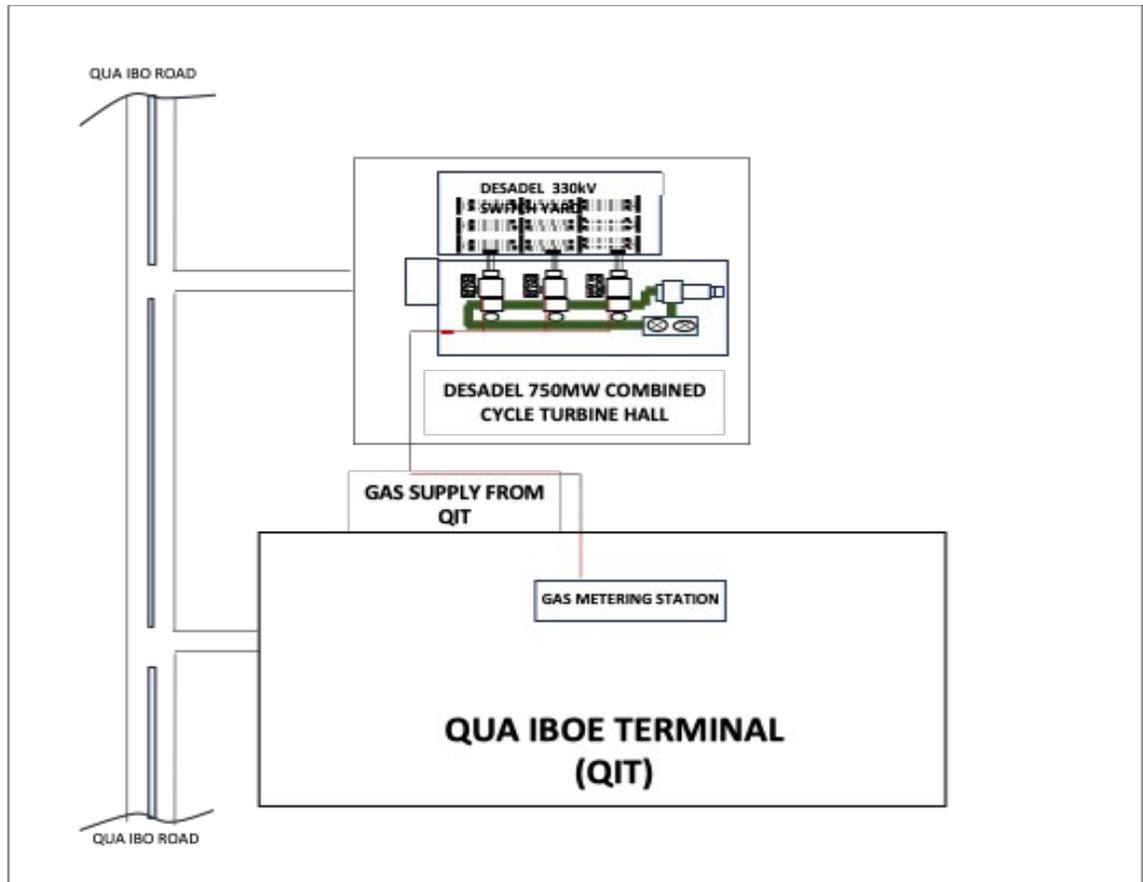


Figure 3.4: Desadel Proposed CCGT Lay Out with QIT Gas Supply

### 3.5.2 Technical Layout

The incoming gas supply requirements at the above battery limit are as follows:

- Maximum Flow 57,921Nm<sup>3</sup>/hr (@ Base load and ambient temp of 18<sup>0</sup>C)
- LHV 48 786kJ/kg
- Pressure (Design) 35.0bar(g)
- Pressure (Max) 30.0bar(g)
- Pressure (Min) 25.0bar(g)
- 
- Temp (Design) 80°C
- Temp (Max) 50°C

- Temp (Min)18 °C

An above ground 12inch (300mm) gas pipeline is routed from the battery limit, via the gas receiving station, to the gas turbine area, where it is branched to provide fuel gas to the gas turbines. Provision has been made in the design to allow for any secondary items of equipment and associated piping to be taken out of service for maintenance, purging or flushing without shutting down the turbines. For reliable operation of the gas turbines, it is essential that the fuel gas be supplied at constant pressure and acceptable quality.

The fuel gas receiving system currently in operation is very basic and consists of a pressure regulating station with by-passes and a small gas scrubber. The gas pressure regulating valves shall maintain a proper pressure of the outgoing gas. The main gas line contains an active pressure regulating valve in addition to isolating valves. A by-pass line with a stand-by manual pressure regulation and isolating valves is provided.

### **Tie-in Requirements**

#### **Gas**

Table 3.1 specifies the allowable limits for the fuel properties and constituents.

**Table 3.1: Gas Composition Requirements at Tie-in and allowable limits**

<b>Fuel Properties</b>	<b>Maximu</b>	<b>Minimu</b>	<b>Notes</b>
Gas Fuel Pressure	30 barg	25 barg	
Gas Fuel Temperature, oC	50 oC	18 oC	
Lower Heating Value. Btuscf	None	100 –	

Modified Wobbe Index (MWI)	54 + 5%	40 – 5%	
- Absolute Limits - Range Within Limits			
Flammability Ratio	none	2:2:1	
Constituent Limits, mole %	100	85	% of reactant species
Methane	15	0	% of reactant species
Ethane	15	0	% of reactant species
Propane	5	0	% of reactant species
Butane + higher paraffins (C4+)	Trace	0	% of reactant species
Hydrogen	Trace	0	% of reactant species
Carbon Monoxide	Trace	0	% of reactant species
Oxygen	15	0	% of reactant species
Total Inerts (N <sub>2</sub> +CO <sub>2</sub> +Ar)	Report	0	% of reactant species
Aromatics (Benzene, Toluene etc.) Sulfur	Report	0	% of reactant species

Source: Manufacturers Manual

## INSTRUMENTATION AND CONTROL SYSTEM

The instrument control and installation philosophy shall be:

- Local Control Loops (pressure, level & temperature control) – The process will be locally controlled on the skids by pneumatic control loops.
- Tank Condensate Level and Export Pump Control – PLC shall be used with analog level transmitters at the required storage tanks. Monitoring and control from the HMI located in operator’s office.
- Metering and Export Compressor Control – PLC shall be used with analog transmitter. Separate PLC’s for each compressor. Monitoring and control from the HMI located in operator’s office.
- Safety/ESD System – A separated independent PLC (certified as an ESD/SI system) shall be used. Monitoring and control from the HMI located in operator’s office.

An API-14C SAFE (Safety and Function Evaluation) Chart analysis shall be conducted to determine all necessary safety devices and shutdowns

during the FEED. Initiation of an ESD shall be possible from different locations, i.e. from:

- Manual push button located in site office (24h manned)
- Two manual ESD push buttons (under protective glass): at the control room  
and next to the pumps
- IRR sensors for fire detection near rotating equipment will automatically cause an ESD
- After an ESD had been initiated the SDV valves (fail-close type) will shut in and the PSVs open to the flare to de-pressurize the process equipment.

At the wellheads the equipment will be operated by instrument gas taken at the wellhead. The ESD system shall be hardwired. Two levels of ESD are provided. A level 0 ESD is the highest and safest level of ESD. When activated it automatically closes in the SSV and the SSSCV, and vents down the process module. A level 1 ESD automatically closes the SSV and SSSCV will be part of the detail design. Gas detection devices shall be installed inside the containers for alarm only.

## **EQUIPMENT DESCRIPTION**

The gas receiving facilities equipment for the selected concept will essentially consist of the following

- Slug catcher
- Inlet filter separators
- Line heaters
- Pressure reduction and fiscal gas metering station
- Fuel gas scrubber

- Slop tank
- E&I system
- Utilities

All equipment shall be delivered on skids. The skid units shall be supplied as self-supporting units on steel support structures (skirt, skid, construction etc.) for installation on concrete foundations at site.

### **Utilities**

The following Utilities will be needed.

- ☺ Fire Fighting Equipment
- ☺ Water system
- ☺ Instrument Air System
- ☺ Chemical Injection System
- ☺ Drain System

### **Gas Export Pipeline**

The recommended gas pipeline is 18"x0.500" wall thickness. Table 3.2 shows the required entrance pressure for 10" through 20" lines and the gas pipeline capacity.

The basic design data are as follows: Basis: 1,440 psi DWP

### **106MMScfd Capacity**

0.05" corrosion allowance

450 psi required at power plant

Code: ANSI B31 B31.8, Design Factor 0.72 – Sparsely Populated Area

Panhandle A with Efficiency Factor = 0.90

Length =0. 5km

**Table 3.2 Gas Export Pipeline sizing summary**

Nominal Size (")	Wall Thickness	ID (")	Area (ft <sup>2</sup> )	MAWP (psi)	Required Entrance Pressure	Line Velocity
10	0.500	9.750	0.518	2,344	2,780	130.6
14	0.375	13.250	0.957	1,350	1,357	70.7
16	0.438	15.124	1.247	1,380	1,027	54.3
18	0.500	17.000	1.575	1,400	722	43.0
20	0.625	18.750	1.917	1,575	704	35.3

### 3.5.3 LAND ACQUISITIONS

Generally, construction easement widths would normally be a strip of land 15m in width for a single pipeline located approximately 6m from one easement boundary limit. The proposal for this project is to minimize land use by installing pipelines in common corridors which reduces corridor widths. During detailed design phase, a constructability study will be carried out to consider the stringing, trenching, welding, laying, backfilling, and reinstatement of the pipelines. In addition to the construction easement, temporary additional workspace may be necessary for laydown areas at road crossings and areas with side slopes. The pipeline is only 300m and, as much as possible, shall be routed on a straight course from the QIT power Plant metering station to the Gas Receiving Facilities at the DESADEL IPP.

#### **Permanent ROW**

After the pipeline construction is completed, the need for wide construction corridors is replaced by a lower requirement to gain access for maintenance and repair. In open farmland/swamp terrain, this permanent ROW can be reduced to a 10m strip centered on the pipeline centerline (i.e. 5.0m either side). Any conditions or restrictions contained

in the ROW shall be incorporated in the design and construction of the line.

### **Permits**

Environmental permits will be required for new or modified facilities. DESADEL will liaise for each applicable permit to fulfill the statutory Nigeria compliance. Land use permits are normally required when the pipeline crosses State lands and roads etc. the design and installation of the pipeline would be in compliance with the specific permit requirements. Any conditions or special requirements would be indicated on the design drawings, or in the contract documents.

### **Design Data**

All design data listed in this document is taken from the latest revision of the FEED for DESADEL Plant Concept Study unless noted otherwise. The minimum design life of the pipeline system is 25years.

## **3.6 Proposed Project Activities**

The activities to be carried out for the Gas Pipeline Project will include the following aspects

- o Land acquisition for 300m ROW
- o Land and Marine transportation of heavy equipment
- o Piling of civil foundation for new facilities for the Gas receiving facility at the IPP
- o Lifting of equipment and materials during construction
- o Excavation on the ROW for lying pipelines
- o Welding, minor fabrication and testing at site

These activities can be grouped into four phases namely;

- i. Pre-construction and site preparation (pre-developmental)
- ii. Construction and commissioning (Developmental)
- iii. Operation and Maintenance (Operational)
- iv. Decommissioning / Abandonment

### **3.6.1 Pre-construction Activities (Site planning and preparation)**

These include the following:

- ≡ Conceptualization of the DeSadel Gas pipeline project designs;
- ≡ EIA;
- ≡ Detailed gas pipeline development Project.

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.

### **3.6.3 Construction Overview**

#### **General**

The pipeline and facilities, which shall be designed have a life of 25 years, shall be constructed in accordance with DeSadel's standard construction specifications and relevant government and other regulatory standards. Innovative technology that will reduce negative impact of pipeline and facilities construction on the environment shall be utilized during the construction phase. All wastes generated during construction shall be disposed in accordance with approved industry regulations. Emissions to the atmosphere and noise pollution shall be

minimized to acceptable regulatory limits. All the facilities shall have in-built special containment facilities for hydrocarbon spills, if any. Prior to the construction team mobilization to site, a camp site that will house about 100 persons will be constructed near the DeSadel Power plant including a logistic base. The choice of this location was due to availability of a fabrication workshops and jetty that were used during the construction of ExxonMobil pipelines that are available for lease. Journey to and from construction sites and other areas will be managed using DeSadel Journey Management Procedure.

### **Procurement of Permits and Licenses**

Appropriate permits, licenses and approvals shall be obtained from Government Authorities for the preparation of excavation and construction works. Such permits shall be renewed as required during the course of the job.

### **Site Preparation Activities Equipment/Personnel to be deployed to the Work**

The following equipment will be deployed for the work:

- ⇒ Surveying equipment- Theodolite and leveling instrument.
- ⇒ Excavators
- ⇒ Dry plants made up of Bull dozers, Front end loaders, Trucks etc
- ⇒ Small personnel carriers such as motor cars.
- ⇒ Staff strength of the work is about 40 people as the job is equipment driven.

The likely spills during the project execution will be engine oil, diesel and petrol, in very small quantities.

### **Mobilization to site**

The selected DeSadel IPP Contractor shall mobilize all equipment and material to the site, ready to start work after necessary medical certification for fitness. The site can be accessed by land.

### **ROW Survey**

The boundaries of all sites be indicated by mean of coloured survey pillars. The DeSadel shall open the site boundaries and stay within the boundary lines and avoid causing any damage to, or placing any obstruction upon the survey pillars and third party property outside the boundaries.

### **Site Clearing and De-stumping**

Bush clearing and de-stumping shall be limited to the area, which is absolutely necessary and shall be carried out only by DeSadel certified bush cutters. Bush clearing involves the felling of all trees and clearing bush within the pegged areas and the removal of all stumps. Debris shall be piles next to, but within, the boundaries of the area of ROW (15m). Appropriate construction equipment, namely – bulldozer, crawler/payloaders, excavator, and or any other DeSadel approved equipment shall be used for bush cutting and de-stumping.

### **Pipeline Construction**

#### **Soil Excavation**

The proposed site is currently bare. During ground breaking, excavation of the top soil shall be done to pave way for the construction. 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 Douglas Creek causing siltation. The excavated soil will be used to backfill and any remainder shall be disposed 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.

During excavation and pipe laying activities in the field, the following would be observed:

- The pipe trench shall be 3.75-600mm for the 300m new acquisition;
- The trench shall be excavated to minimum widths in relation to pipe sizes of usually 1-1.5m depth depending on the terrain and at road thrust boring locations;
- Mechanical equipment shall be used for the excavation;
- The finished trench shall be free of roots, stones or other hard objects, which may damage the pipe or pipe coating;
- Provision shall be made for dewatering, as may be required;
- The pipe shall be lowered into the trench such that it lies naturally, and is continually supported along its entire length in the bottom of the trench. Where the floatation method is used, the pipe shall be floated into position and lowered into place with adequate floats or pontoons as necessary;
- After laying the pipe in position, the floats shall be carefully removed to prevent damage to the coating, and
- The pipe shall be filled with filtered, clean water for flushing and pressure testing. In each stage of the main teamwork, construction is by

“cut and fill” process generally involving the stages below:

- ≡ Top soil removal
- ≡ Ditching involving subsoil removal
- ≡ Pipe laying
- ≡ Cleaning
- ≡ Welding
- ≡ Inspection
- ≡ Hydrotesting
- ≡ Coating
- ≡ Backfilling
- ≡ Soil Management/Reinstatement

### **Topsoil Removal**

The topsoil would be stripped from the working width and stored in an earth bound, which runs continuously parallel to the trench on one side of the working width.

### **Pipe Laying**

Pre-coated pipes would be delivered from the pipe yard in the nearest DESADEL base. After inspection, the welds and any other area of bare pipe would be coated with “serviwrap” PVC tape and concrete-coated so as to form a continuous protective coating. The pipes would then be laid on stands along the trench. Once a section has been completed, the trench profile is checked, the stands removed and the pipeline is settled on the bottom on the trench.

### **Backfilling**

The working procedures for backfilling are determined by the nature of soils of the area and the mode of construction. In general, the first stage

will be to return materials excavated from the trench in a reverse order.

### **Pressure Testing**

The internal part of the pipeline will be cleaned using two wire brush pigs propelled through the line by compressed air. A gauging pig will then be installed and propelled through the pipeline with water. The gauging pig will identify any deformities in the pipeline shape. The water pressure will be increased and the line hydrostatically pressure tested. Once up to full test, the pressure will be monitored for 24 hours to ensure pressure maintenance. If pressure drops, it may indicate a leak and further inspection will be required.

### **Re-Grading**

Once hydrostatic tests have been completed, the working area will be re-graded with topsoil and appropriate cultivation undertaken, where necessary, by the restoration contractors. The returned soil is graded so as to allow settlement. The soil would be spread evenly over the working width to ensure maintenance of the working width bank.

### **Specialist Team**

In addition to the main construction spreads, there will be specialist teams that precede the main spread. These are specialists on road crossing, reinstatement topography and erosion. Works in some cases will require the use of special vehicles (tractor and trailer).

### **Restoration/Reinstatement**

Correct construction techniques will be employed to guard against any long-term restoration problem, i.e. soil erosion. The success of any restoration process is measured by the similarity of the vegetation and firmness of the soil on the restored land to that of its surroundings.

### **Utilities, Infrastructure and Logistics during Construction Activities**

Items of utilities, infrastructure and logistics, as applicable to the gas pipeline construction from QIT Power plant to DeSadel IPP Project, are described below.

**Power Generation and Distribution:** Diesel generating set(s) of adequate capacity (minimum of 70KVA depending on Contractors requirement) shall be installed, to provide required electricity/energy during construction. Noise and emissions shall be managed to stay within the allowable limits and DeSadel shall ensure contractor's compliance, through effective supervision and audits.

**Supplies to the Construction site:** Supplies of food, materials, consumables, fuel, water etc shall be by road. The intention is to minimize disruption and nuisance to social life in the project area.

### **Materials for Pipeline Construction**

#### **Line Pipe**

Material for construction of the pipeline shall be Carbon steel, API 5L Grade B. A corrosion allowance of 0.05" has been prescribed in accordance with the project Basis for Design for Gas Flow.

#### **Bends**

For Carbon steel pipe, the use of field bends is assumed at road and pipeline crossings, although the use of pre-formed induction bends can be considered.

Cold formed field bends shall be made using a hydraulic bending machine with mandrel and shall have minimum radii in accordance with ASME B31.8 for gas lines. The induction bends shall use a minimum radius of 5D for all above ground and buried lines. The wall thickness for

induction formed bends may require increasing to allow for thinning of the bend during fabrication. This shall be accounted for in estimating wall thickness of mother pipes from which bends shall be formed. Alternatively, bends could be ordered to the wall thickness of line pipes from specialist bend Manufacturers. Tangent lengths will be required to all fabricated bends.

Where possible, changes in direction along the pipeline route shall be made using elastic bends (i.e natural allowable radius of curvature). The pipeline elastic bending radius will be calculated and may require a wider ROW as changes in direction along the route. The minimum elastic bend radius shall be calculated based on the maximum permissible combined stress in accordance with the method described in ASME B31.8. where, route considerations require cold field bending, alternative methods of concrete weight coating for buoyancy control may have to be considered. After bending, technical solutions and supporting calculations shall be prepared during FEED. The maximum cold bend angle will be calculated from the appropriate ASME design code.

### **Pig Traps**

Pig traps shall be fitted on the gas pipeline. Where fitted, they will be designed to accommodate the longest proprietary intelligent pigs which will allow the passage of all industry standard inspection equipment. The pig traps will be designed as

100% carbon steel and laid to a fall to allow complete drainage of all residual products. Interlocks and inherent safety devices shall be incorporated to prevent the trap door being opened when pressurized.

### **Pipeline Operating Philosophy**

The gas shall be supplied from the QIT Power plant Gas metering station at a pressure set to maximize the fluid flow rate. Low flow and High Pressure Alarms shall be provided.

### **Pipeline Pressure Protection**

The pipeline is fully rated at 1440 psi DWP from the anticipated maximum sales pressure required by existing and future customers.

### **Emergency shut- down valves**

The DESADEL IPP pipeline shall have ESD valves installed at each end which may be activated from a local emergency console or from the control room in the event of a site emergency or pipeline failure due to a pressure drop as a result of gas leakage.

## **PIPELINE DESIGN REQUIREMENTS - Pipeline Loading Cases**

### **General**

All pipeline design is in accordance with ASME B31.8. Evaluation of combined stresses on the pipeline shall be carried out for the assurance of the mechanical strength in conformance with the relevant code. In addition, detailed stress analysis shall be carried out during the detailed design phase.

To analyze the pipeline systems, the following loads will be taken into consideration as a minimum:

- ⇒ Internal pressure loads (hoop stress).
- ⇒ Sustained Loads (soil loads, soil frictional force, self-weight)
- ⇒ Live Loads (vehicle traffic)
- ⇒ Thermal Loads (changes in operating/installations temperatures)
- ⇒ Test Loads (hydrostatic testing)

⇒ Hydrodynamic Loads (wave and current induced loading) – for the river crossing sections (which is not applicable in this project).

### **Stress Conditions**

The following stress conditions have been considered for the design of the pipelines:

- o Circumferential stresses due to internal pressure and external sustained and live loads
- o Expansion stresses for restrained and unrestrained portions of the system due to internal pressure and thermal loads.
- o Longitudinal stresses for unrestrained pipeline sections, due to pressure, weight and other sustained loadings
- o Longitudinal stresses for restrained pipeline sections, due to pressure, weight and other sustained loadings, considering the frictional restraint of the soil
- o Longitudinal stress produced by internal pressure, live and dead loads.
- o Circumferential and longitudinal stresses induced during hydrostatic testing.

### **Combined Loads**

For combined loading cases on the pipelines, ASME B31.8 shall be used to provide more detailed guidelines.

### **Hydrotest Loads**

Calculations of any hydrotest induced loads and the proposed method to cater for them shall be developed in accordance with ASME B31.8

### **Road Crossings**

Though the project is located in a lowland terrain, the pipelines will be subjected to additional loading at road crossings due to the weight and frequency of traffic. All pipeline road crossings shall be designed to conform to API RP 1102 and where application. Where a temporary diversion road cannot be constructed around a proposed pipeline crossing a trunk road carrying commercial traffic, thrust bore methods shall be considered to avoid vehicular disruption.

### **Pipeline Expansion and Flexibility**

The length of welded sections of pipeline prior to ditching shall be restricted to 0.2km and the temperatures at which the buried pipelines are tied in shall be maintained within 10<sup>0</sup>C of the normal ambient temperatures in order to maintain pipeline stability.

Pipeline expansion before ditching will be analyzed to ensure that unacceptable stresses are avoided during construction. Anchor blocks may be installed at the ends of the buried pipeline in order to limit expansion and prevent the pipe being overstressed at end or branch connections to piping, cause any external soil disturbance and prevent pipeline coating damage. In calculating maximum allowable thermal stress, both the short-term expansion, immediately after start- up and the long-term friction relaxation shall be considered.

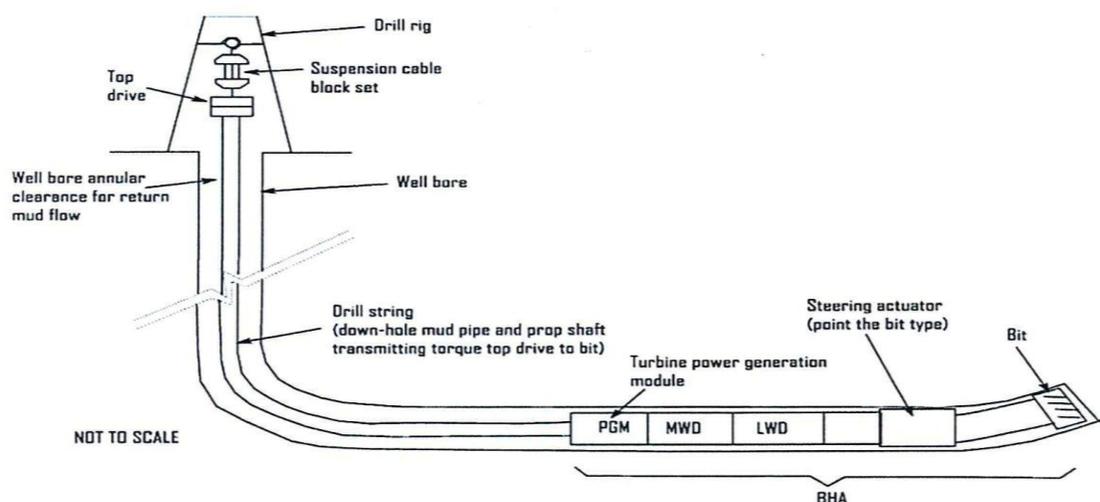
The buried sections of the pipeline system covered by this specification shall be designed to be fully restrained by soil friction, as defined by ASME B31.8. During detailed design, the minimum depth of cover will be assessed to determine if it is sufficient to prevent the pipeline from suffering upheaval buckling due to expansion forces which shall meet applicable DeSadel approved standards. All buried connections shall be

located within the restrained region of each pipeline. Where the connections are not in the restrained regions they shall be relocated or have above ground expansion legs incorporated. Anchor blocks may be avoided if the stress analysis simulation shows the pipeline is operating in stable conditions. Should the pipeline operating conditions change in the future and show significant fluctuation in operating temperature conditions, the decision will need to be revisited and requirement for anchor blocks evaluated. All pipeline and above ground piping shall have a detailed stress analysis completed using a Principal-approved software package during the detailed design.

### River Crossing

River crossing is a specialized pipeline construction technology that avoids open trenching of pipeline across rivers. It is done with a technology known as HDD: Horizontal Directional Drilling (HDD). Figure 3.2 describes the various components of HDD.

**Figure 3.5: A typical HDD Components**



Most of the pipeline designed will be laid across 46km subsea from Oso

Platform to QIT. The balance of 8km is already laid across the beach to the QIT Gas Receiving Facility. There will be a river, stream or creek crossing involved in the pipeline spur across the Douglas Creek. Adequate measures will be taken to adhere to all requirements regarding the above.

### **Pigging**

The 20" Gas pipeline will be designed as fully piggable with permanent pigging facilities. Typically, intelligent pig manufactures declare that equipment can pass bends as low as 3D, however 5D bends are preferred to minimize the risk of sticking pigs. The use of aluminum gauging plates may be acceptable when carried by polymer cup pigs which maintain the gauging plate centrally in the line.

### **Cathodic Protection**

The external corrosion protection of the Gas Project pipeline shall be provided by a combination of polyethylene (PE) coating and cathodic protection around the QIT metering station Gas Plant and the Gas Receiving Facility at the DeSadel IPP. The DeSadel requirements for the design of an Impressed Current (IC) cathodic protection system on buried pipeline systems shall be adhered to.

### **Venting**

The system will incorporate installation of Blow-down assemblies to allow for the evacuation of gas from the pipeline under emergency conditions or for scheduled maintenance operations. The blow-down assembly shall be sized to ensure minimum blow-down (venting) time and quantity of vented gas. The blow-down assembly will be part of the

pig launcher skid.

### **Pressure/Temperature Regulation and ESD Systems**

Pressure would be regulated using automatic pressure control valves (PCVs). Multiple trains of active and monitor PCVs (160 MMScfd) would be required to achieve the desired reliability of supply. Quick acting /slam shut and relief valves will be incorporated to achieve satisfactory over-pressure protection of low-pressure pipeline and facilities. Temperature would also be regulated using temperature control valves (TCVs). Provision would be made for Emergency Shut Down (ESD) for protection against system malfunction and isolation of station from gas source in case of fire outbreak.

### **Testing, Pre-Commissioning and Commissioning**

The gas pipeline will be hydrostatically tested in accordance with the minimum code requirements. In line with applicable codes, the hydrotest pressure for each pipeline shall be selected to be 1.25 times the design pressure or that which impose a stress level equal to 90% SMYS in the pipeline.

### **Landuse Optimization**

The option of using new ROW and already existing ROW was given a high priority to reflect the 'lean and green' approach, involving minimum land take, which is favoured by DeSadel with least environmental effects. The option of using the existing ROW was weighed to have more environmental consequences due to the distance and the possible structures and facilities that would be passed through. The majority of the surface locations in the proposed route can accommodate the proposed new facilities for installation, Gas Receiving

Facility and Pigging facilities for the pipeline). This will minimize land acquisition costs, and elaborate location preparation cost. Moreover, the attendant environmental impact of new acquisitions will be minimal.

### **3.6.4 Operation and Management Phase**

#### **Maintenance Philosophy**

##### **a. Upkeep of Structures**

Maintenance and inspection activities, based on periodic inspection to determine the condition of structures and performance of their protection system include refurbishment activity to restore the integrity of structures, replacement of and coating system applied to structures based on time maintenance schedule.

##### **b. Containment of Hydrocarbons**

Periodic (monthly) inspections will be carried out to determine the condition of all elements of the process fluid containment envelope as well as any protective coatings applied thereon. Inspection programmes for certifiable pressure vessels, pressure/vacuum relieving devices will be carried out to meet the requirements of the Minerals Oils (Safety) regulations of Nigeria. Refurbishment activity to restore the integrity to the envelope will be based on their condition. Where appropriate, economic systems to mitigate the effects of corrosion shall be put in place and their effectiveness routinely monitored.

##### **c. Control and Protection**

Control and protection system, will be based on periodic inspections / calibration / testing both their input and output functions as detailed in the Routines Job Maintenance. Non – availability of hydrocarbon

production caused by such inspection/calibrations/test will be accounted for in the production plan. Change of set points will be controlled by the plant change procedure.

## **Maintenance and Inspection**

### **a. Gas Pipeline**

Regular surveillance of the pipeline route and associated structures will form an integral element of the integrity monitoring system and will seek to:

- ⊗ Detect and locate any activity which may interact with the pipeline including unauthorized third-party activity.
- ⊗ Locate any local changes or ground conditions which may threaten the pipeline including areas of ground erosion, movement or subsidence.
- ⊗ Detect any leakage from the pipeline and its facilities.

To reduce the risk to the pipeline from third party activities, most often due to unauthorized building and construction work, valves and alarms shall be incorporated into the design and construction. As part of the operational integrity monitoring, the following inspection procedures will be introduced:

- ⊗ Initial inspection of the pipeline coating to cover routine surveillance aided by the presence of marker posts at all major road crossings and field boundaries. The pipeline route will be inspected at monthly intervals. Block valve stations will be regularly visited.
- ⊗ Close liaison with all communities along the route will be maintained.
- ⊗ Induced current density readings will be recorded and analyzed to identify any areas where it is indicated that cathodic protection is not at the required level.

### **Pigging Operations**

The pipeline system is provided with “pig” launching facilities. These enable various pigs to be sent down the pipeline for commissioning, maintenance and inspection purposes. Pigs fulfill a number of roles; they

- o Clean the line of unwanted debris
- o Check the pipeline for signs of damages or deformity
- o Detect areas of corrosion

The frequency of pigging operations will be determined by operational circumstances.

#### **3.6.5 Decommissioning of Affected Existing Facility**

The pipeline and Gas Receiving Facility (GRF) at QIPP and DeSadel Power Plant have a life expectancy of about 25 to 30 years, a comprehensive decommissioning and restorative plan would be finalized and reviewed with the relevant authorities. These would involve

- i. Demolition and site cleaning which will entail removal of surface and sub-surface structures, backfilling of all pipelines and trenches.
- ii. Disposal of wastes.
- iii. Rehabilitation of site comprising of re-vegetation of all bare surfaces. This will involve a provision in the decommissioning and restorative plan as well as a post decommissioning monitoring plant in consultation with the regulatory authorities, host communities and available resources.

The demolition exercise will be carried out with skill and diligence to

avoid spill of hazardous liquids and damage to the environment. At the end of demolition, various solid wastes shall be segregated according to their types and then disposed of according to DeSadel waste disposal guidelines.

Experience has shown that a phased approach to decommissioning, remediation and reclamation is the most practical and cost effective. This phased approach allows the level of investigative and remediation effort to be tailored to the size and complexity of the problem. The required level of effort for decommissioning, remediation and reclamation is dependent on the type, size and age of the sites, historical waste management practices, the environmental and regulatory setting, and the proposed future use of the property.

### **3.7 Project Waste Management Plan**

Any development project involving bush clearing and excavation in an environment such as the pipeline construction area between QIT power plant and DeSadel Nigeria IPP is bound to encounter waste management problems which need to be handled in compliance with the Petroleum (Drilling & Productions) Regulations, 1969, Sections 25, 36, 49 and (b), (c) and (d), which stipulate *inter alia*:

“The licensee or leasee 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, banks or shoreline or which might cause harm or destruction to fresh water or marine life, and where any such

pollution occurs or has occurred, shall take prompt steps to control and, if possible, end it;"... etc.

It is, therefore important that an effective waste management scheme be in place to avoid contravening the above regulation and the DeSadel HSE policy.

### **3.7.2 Waste Management Strategies**

Wastes anticipated from the project belong to the following broad categories:

- (a) Solid wastes
- (b) Clean and dirty location run-off water
- (c) Domestic and sanitary waste
- (d) Gaseous emission and discharges

The following strategies of waste management shall be adopted:

- Reduce the volumes of wastes generated through appropriate technology.
- Recycle and re-use wastes where feasible.
- Treat hazardous wastes and make them inert before disposal.
- Ensure safe and responsible collection, segregation, storage and disposal of all wastes.
- Keep auditable records of all waste streams.
- Monitor waste disposal activities in order to prevent future liabilities.
- Reduce the negative impact of site preparation and operations on the environment.

All chemicals used by DeSadel and their contractors would be handled

and ultimately disposed of according to the requirements of DeSadel Safe Handling of Chemicals (SHOC) system. Records of all chemicals stored on site, shall be maintained identifying their Health, Safety and Environmental implications.

Regular checks would be made by DeSadel staff to ensure that records are maintained and storage facilities are in good handling practices. Solid wastes would be disposed of in the following manner:

- Plastic containers depending on their size will either be returned to the supplier, cleaned for reuse or crushed.
- The disposal of industrial wastes would be conducted in designated areas in accordance with DeSadel waste management procedure.

### **3.7.3 Waste Materials**

#### **(a) Solid wastes**

Anticipated solid wastes include cleared vegetation, domestic refuse, unused pipes, pipe off-cuts, scrap metals, welding torches and spent welding electrodes, filters, hand gloves, pigging thrash, etc. Trees would be felled along the ROW and cut into useable lengths. All these shall be segregated at source and trucked back to waste re-cycling depot at Contractor's yard or DeSadel's Facilities for subsequent trucking to re-cycling vendors.

#### **(b) Liquid Wastes**

##### **Hydrotest water**

Prior to operation, the pipeline will be pressure-tested using fresh water from the environment. The water in the environment has been

confirmed to be sea water; as a result addition of inhibitors will be necessary in the hydrotesting process. The need for corrosion inhibitors have risen because the water had not been fresh. Since inhibitor is involved, disposal of the hydrotest water into the environment will require appropriate treatment to guard against any harm to the environment. However, DeSadel shall take the additional precaution by analyzing water, treating the water if contaminated and piping the water directly into a flowing water body at a controlled rate. The period for which the hydrotest would be undertaken is short (24 hours) and therefore does not require the use of an inhibitor. The source of water for the hydrotesting will thus be the River Creeks in the study area. The nearby water body will serve as the recipient water bodies.

**(c) Diesel/Oil/Condensate**

These wastes would emanate from working equipment such as welding machines, excavators, bulldozers etc. These wastes shall be scooped, contained and disposed in designated sites. Liquid condensate from pigging operation shall be reclaimed and sent to fuel depots/refinery for recycling or taken to QIT for treatment with the Thermal Desorption Unit (TDU).

**(d) Human Waste and domestic Waste (Black and Grey Water)**

During the pipe laying activities, all human wastes (sanitary sewage) will be contained in a septic tank and treated on site using in-built domestic sewage treatment plants at campsites. Other human-associated wastes, including empty water bottles, food packs, and other used consumer goods wrapping, shall be segregated and packed on site, and

subsequently conveyed to Government approved dump sites at Ibenor for handling.

**(e) Gaseous Emissions and Discharges**

The atmospheric emissions principally associated with gaseous discharges during the construction activities are: Carbon Dioxide (CO<sub>2</sub>) Carbon monoxide (CO), Methane (CH<sub>4</sub>), oxides of Nitrogen (NO<sub>x</sub>) and Sulphur Dioxide (SO<sub>2</sub>). The levels of these emissions shall be monitored during construction and operational phases of the project.

**Table 3.3: Waste Streams from the gas pipeline Project**

Project Stages	Types of Wastes to be Generated
Preconstruction	Domestic waste Packaging materials (papers, nylons and pallets).
Construction	Vegetation wastes /off cuts Excavated soil Concretes (leftover) Metal pipes and Cement Papers Wood Used for foundation constructions Oil from equipment service Packaging materials (papers, nylons and pallets). Reels (used for wire winding) Domestic waste
Operational stage	
Abandonment	Oil from heavy duty vehicles Scrap metal from pipes

**3.7.4 Description of Material Input/Output and By-Products**

### **(a) Gaseous emissions**

Exhaust fumes from heavy machinery, transportation vessels and power generators are likely to introduce pollutants into the atmosphere during construction. Fume catalysers will be employed, where practicable. The pipeline sparing philosophy shall ensure the availability of adequate quantities of spares to maintain the line integrity.

### **(b) Vegetation clearing**

The proposed sites for the construction including the work camps and excavation sites will be cleared, which could result to the destruction of indigenous plant communities. These could lead to death and permanent loss of vegetation (medicinal/economic plants) within the proposed work camps and excavation sites. The vegetation cleared outside the required project areas shall be re- vegetated with indigenous species.

### **(c) Night Time Operations**

There might be some night time activities during construction at work camps such as welding operations and this would basically reduce the construction time. DeSadel has a “no night sailing and driving policy”; hence the night operations would be restricted to DeSadel facilities. The impact would be localized and of short term, since the construction would be for a short term.

### **(d) Noisy Operations**

Noise would be generated during the pipe laying and facility construction/ operations. This will be managed by installation of noise mufflers on noisy machinery, where practicable. The undesirable effects

of noise on personnel will be managed using barriers such as earmuffs.

**(e) Risk of Accidents resulting in Pollution or hazards**

Pipeline leaks/ruptures could result in environmental pollution. This could be as a result of sabotage, operational failure, corrosion, etc. Surveillance methods/ integrity checks shall be applied to prevent/minimize/manage spill and gas leak incidents/emergencies. DESADEL emergency contingency plan shall be fully adhered to.

**(f) Traffic Generation**

There would be increased land logistics supplies during the proposed pipe laying and facility construction activities, since materials and workers would be moved to and from site as operations demand. The land traffic shall be minimized by embarking only on approved journeys in line with DESADEL journey management guidelines.

**(h) Gas handling**

The Federal Government is committed to elimination of routine flaring as a means of disposal of associated gas and to a continuous reduction in the proportion of gas flared as a result of operational or equipment failures in line with the gas flare-out objective of the Federal Government and to accommodate more AG from the development wells.

**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

that 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 of such materials.

### **3.8.2 Estimated Project Workforce**

Construction of the project would require at least one prime contractor and multiple subcontractors. The project contractor will work closely with the traditional administration to identify and maximize sourcing of skilled, semi-skilled and unskilled workers from the communities where the proposed transmission line will traverse. Approximately 50 workers would be employed during the peak of the construction period which is expected to last about 12 months. The construction workforce would include transmission line construction, ROW access, logging, environmental compliance and quality assurance. Local unskilled labour and skilled out of town labour factors would depend on local labour market condition, contractor's labour force availability, construction status and time of year. Local unskilled labour could be between 30 — 40 % of the total workforce and skilled out — of town labour would comprise the rest of the workforce. The contractor shall adopt the option related to worker housing of housing the work force in nearby Ibeno and transport them to the jobsites against erecting temporary camps at strategic locations along the selected route. The contractor would provide and maintain a detailed schedule throughout the construction period with construction of the project progressing either in an orderly fashion from one end of the project to the other,

with each activity taking place sequentially or more likely it would progress in a rather random pattern around numerous obstacles. Some of the factors that would determine the flow of work include weather, soil conditions, access, seasonal environmental restrictions, avoidance of sensitive resources and the contractors' available resource.

### **3.9 Project Life Span**

It is envisaged that with appropriate maintenance operations, this project shall last for 25 - 30 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 simultaneously 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 3.4 is self-explanatory and briefly summarizes the project scheduling.

**Table 3.4: 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 equipment and test –running										
5.	Demobilization from 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 Installation of 20" Gas Pipeline project at 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 05<sup>th</sup> of July, 2024, by the study team and the proponent, De-sadel Nigeria Limited. Site verification exercise was carried out on 06<sup>th</sup> 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 20" Gas Pipeline 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 17<sup>th</sup> July to 4<sup>th</sup> 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 eight (8) sampling points including two (2) control for air quality, noise level, wind speed and direction; two (2) sampling points for soil and one (1) 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	4.553152° 8.013386°	SS01	4.553231° 8.014453°	GW 01	4.552374° 8.015008°	SW1 PP	4.553630° 8.011912°	SED 01	4.554638° 8.020172°
A/N 02	4.553257° 8.015278°	SS02	4.553545° 8.018413°	GW02 Cntl	4.561194° 8.016468°	SW2 PP	4.557513° 8.014981°	SED 02	4.555570° 8.030494°
A/N 03	4.553855° 8.017138°	SS03 Cntl 1	4.554265° 8.030138°			SW3 PP	4.555193° 8.021738°		
A/N 04	4.553573° 8.019209°					SW1 PL	4.551404° 8.028087°		
A/N 05	4.556878° 8.016295°								
A/N 06 Cntrl	4.554133° 8.024194°								
A/N 07 Cntrl	4.546526° 8.025515°								
A/N 08 Cntrl	4.542823° 8.023156°								

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<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), hydrogen sulfide (H<sub>2</sub>S), suspended particulate matter (SPM),

methane (CH<sub>4</sub>) 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<sup>3</sup> 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 geo-referenced (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<sub>2</sub>, CO, SO<sub>2</sub>, CH<sub>4</sub>, H<sub>2</sub>S, 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 called 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<sup>0</sup>C 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 6 soil samples including controls (2 samples at each depth from 3 sampling points) were collected at 100 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<sup>0</sup>c for 24hours (bacteria) while that of *coliform* were incubated aerobically at 37<sup>0</sup>c, 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 20" Gas Pipeline 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 20" Gas Pipeline project area.

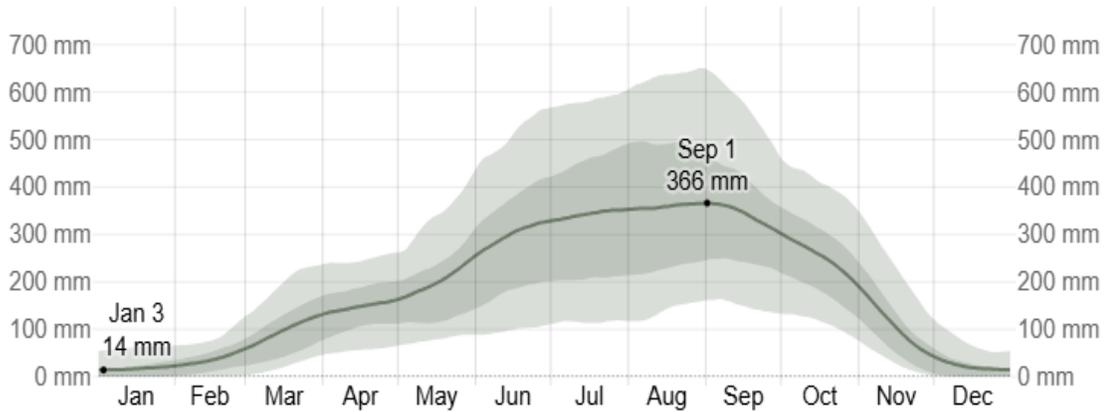
Community health status and presence of healthcare centres were determined by interviews and questionnaire administration to locals and officials of healthcare center's visited.

### **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 28.47°C (83.25°F) 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.

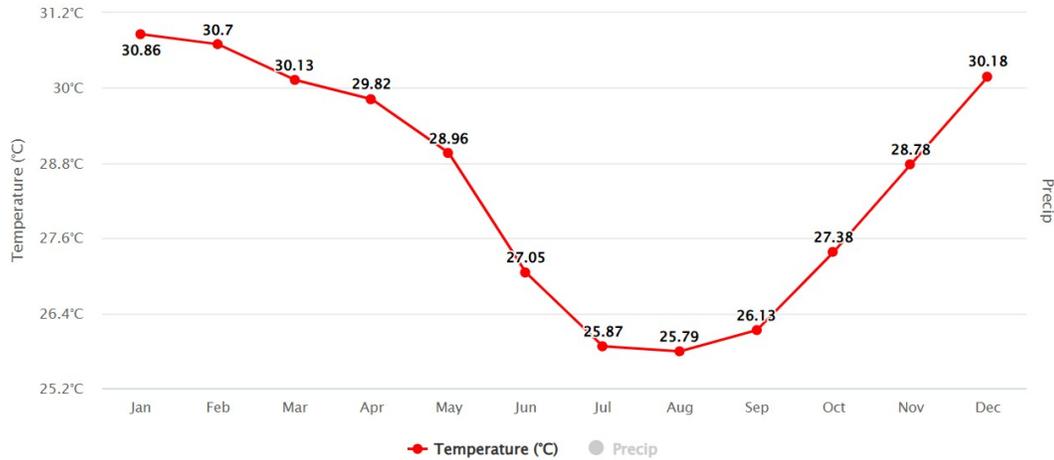


Figure 4.5: Average Maximum Temperature of the Project Area (°C)

Source: Nigerian Meteorological Agency Abuja and <https://weatherandclimate.com/>

Average Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

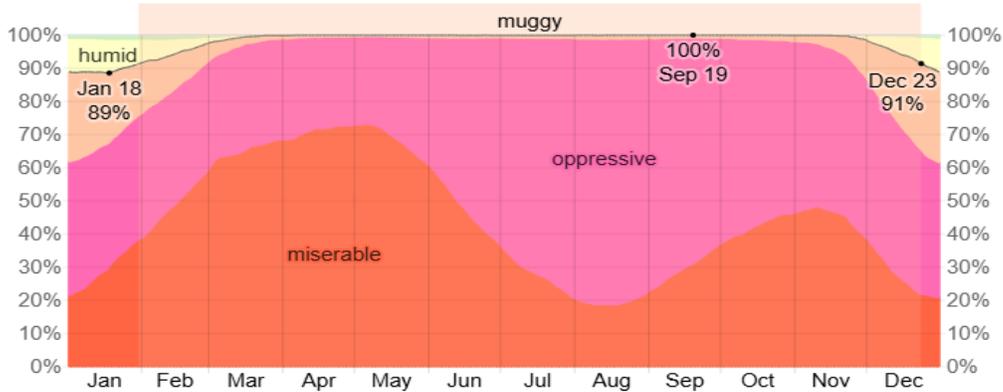
Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	31°C	32°C	32°C	31°C	30°C	29°C	28°C	28°C	28°C	29°C	30°C	31°C
Temp.	26°C	27°C	27°C	26°C	26°C	25°C	25°C	24°C	24°C	25°C	25°C	25°C
Low	20°C	22°C	23°C	22°C	20°C							

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.

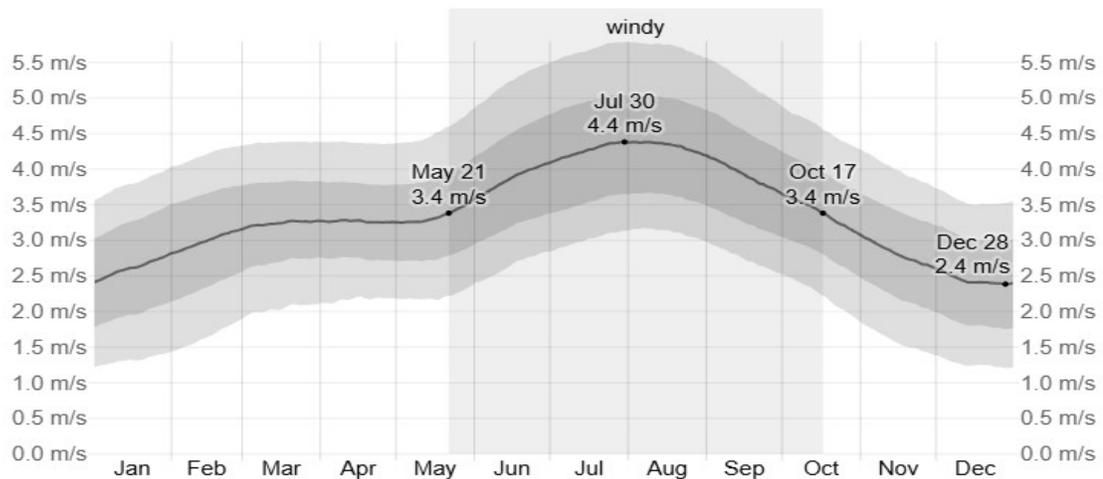


**Figure 4.7: Average Relative Humidity of the Project Area (%)**

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.

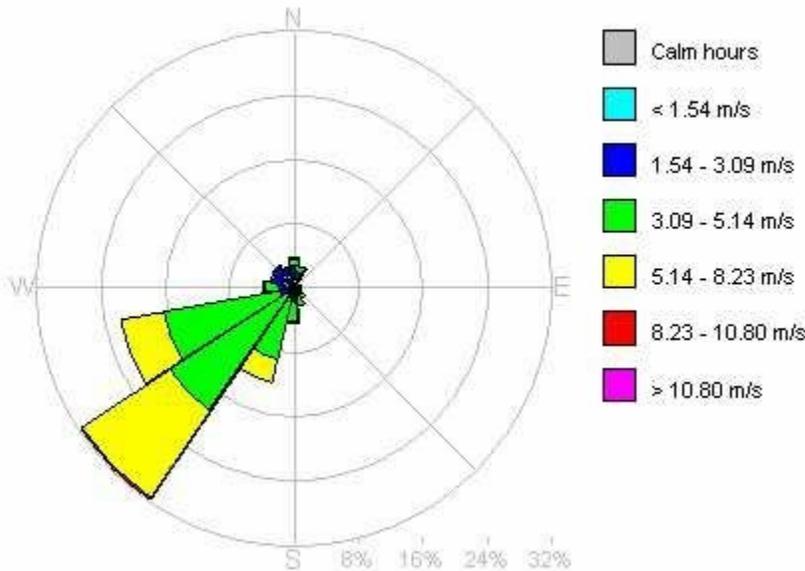


**Figure 4.8: Average Wind Speed of the Project Area (M/S)**

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 (0.3-1.5 m/sec). The wind speed of 0.4-1.4 m/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.

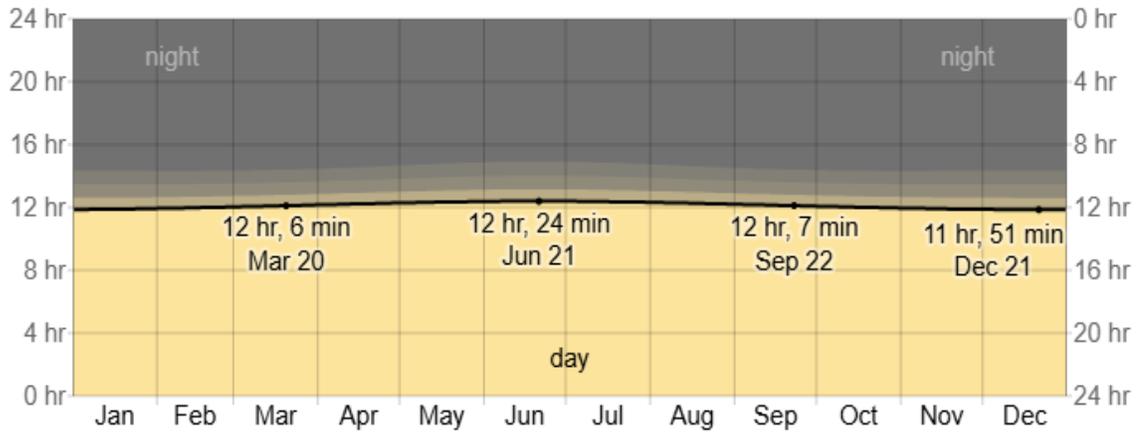


**Figure 4.9: Windrose showing wind speed and wind direction of the Project Area**

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 20" Gas Pipeline 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<sub>2</sub>, CO, NO<sub>2</sub>, SO<sub>2</sub>, H<sub>2</sub>S, CH<sub>4</sub> 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<sub>2</sub>, H<sub>2</sub>S, and NO<sub>2</sub>) 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)**

SAMPL E LOCATI	TIME	GEOGRAPHI C LOCATION Lat N Long E	TPS 2.5 (µg/m <sup>3</sup> )	TPS 10 (µg/m <sup>3</sup> )	NOISE Level dB(A)		RELATIV E HUMDITY %	WIND SPEED (m/s)		TEMP (°C)	CH <sub>4</sub> ppm	TVOC ug/M <sup>3</sup>	CO ppm	CO <sub>2</sub> ppm	SO <sub>2</sub> mg/m <sup>3</sup>	NH <sub>3</sub> ppm	H <sub>2</sub> S ppm	O <sub>2</sub>	NO <sub>2</sub> ppm
					Mi n	Ma x		Mi n	Ma x										
A/N 1	11:18a m	4.553152° 8.013386°	45	68	45.8	50.8	80.3	0.9	1.7	27.7	<0.01	0.012	1	407	0.02	0.006	0.008	19.7	0.02
A/N 2	11:27a m	4.553257° 8.015278°	47	61	39.9	41.5	81.4	0.8	1.2	27.8	<0.01	0.009	2	401	0.02	0.004	0.002	20.9	0.03
A/N 3	11:38a m	4.553855° 8.017138°	46	62	41.9	46.0	80.8	0.8	1.0	28.4	<0.01	0.016	1	412	0.02	0.004	0.005	19.1	0.02
A/N 4	11:47a m	4.553573° 8.019209°	46	61	45.8	49.1	80.0	0.6	1.1	28.8	<0.01	0.026	0	417	0.01	0.004	0.004	20.1	0.02
A/N 5	11:58a m	4.556878° 8.016295°	51	66	42.5	50.2	80.5	0.6	1.7	28.5	<0.01	0.018	3	422	0.02	0.002	0.003	20.1	0.03
A/N 6	12:43p m	4.554133° 8.024194°	46	63	39.8	45.4	80.3	0.6	1.7	29.5	<0.01	0.004	0	414	0.02	0.002	0.001	20.1	0.02
A/N 7	12:54p m	4.546526° 8.025515°	50	64	38.9	43.1	80.6	1.2	2.3	29.1	<0.01	0.019	0	411	0.02	0.004	0.003	20.1	0.02
A/N 8	01:07p m	4.542823° 8.023156°	45	67	44.2	48.4	79.4	0.9	1.0	29.3	<0.01	0.028	1	419	0.02	0.002	0.004	20.1	0.02
<b>Equipment Detection limit</b>			<b>0.01</b>	<b>0.01</b>	<b>30</b>		<b>10</b>	<b>0</b>		<b>10</b>	<b>0.01</b>	<b>0.001</b>	<b>0.1</b>	-	<b>0.01</b>	<b>0.001</b>	<b>0.001</b>	<b>1</b>	<b>0.01</b>
<b>Minimum value</b>			<b>45</b>	<b>61</b>	<b>38.9</b>	<b>41.5</b>	<b>79.4</b>	<b>0.6</b>	<b>1</b>	<b>27.7</b>	<b>&lt;0.01</b>	<b>0.004</b>	<b>0</b>	<b>401</b>	<b>0.01</b>	<b>0.002</b>	<b>0.001</b>	<b>19.1</b>	<b>0.02</b>
<b>Maximum value</b>			<b>51</b>	<b>68</b>	<b>45.8</b>	<b>50.8</b>	<b>81.4</b>	<b>1.2</b>	<b>2.3</b>	<b>29.5</b>	<b>&lt;0.01</b>	<b>0.028</b>	<b>3</b>	<b>422</b>	<b>0.02</b>	<b>0.006</b>	<b>0.008</b>	<b>20.9</b>	<b>0.03</b>
<b>FMEV/NESREA Limits</b>			<b>40/250</b>	<b>150/250</b>	<b>70</b>		-	-		<b>&lt;40</b>	-	-	<b>10</b>	-	<b>0.10</b>	<b>0.05</b>	<b>0.008</b>	<b>20.9</b>	<b>0.06</b>

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 <sup>3</sup> )					VOCs (mg/m <sup>3</sup> )	NO <sub>2</sub> (mg/m <sup>3</sup> )	SO <sub>2</sub> (mg/m <sup>3</sup> )	H <sub>2</sub> S (mg/m <sup>3</sup> )	CO (mg/m <sup>3</sup> )	CH <sub>4</sub> (mg/m <sup>3</sup> )	CO <sub>2</sub> (mg/m <sup>3</sup> )
	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
<b>Mean</b>	<b>0.20</b>	<b>0.51</b>	<b>1.43</b>	<b>2.11</b>	<b>0.74</b>	<b>2.89</b>	<b>0.01</b>	<b>0.07</b>	<b>0.09</b>	<b>0.00</b>	<b>0.25</b>	<b>888.00</b>
<b>Stdv</b>	<b>0.45</b>	<b>1.11</b>	<b>3.11</b>	<b>4.41</b>	<b>0.30</b>	<b>5.41</b>	<b>0.01</b>	<b>0.04</b>	<b>0.02</b>	<b>0.00</b>	<b>0.50</b>	<b>74.31</b>
<b>FMEnv Limits</b>	<b>0.250 (Daily mean of hourly values)</b>					<b>-</b>	<b>0.04-0.06</b>	<b>0.10</b>	<b>0.008</b>	<b>10</b>	<b>25</b>	<b>5000</b>

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<sub>2</sub>)** 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<sub>2</sub> occurred minimally within the range of 0.02 to 0.03ppm, below FMEnv permissible limit of 0.06ppm. lower vehicular movement and less commercial and food manufacturing ensured that the area is low of NO<sub>2</sub>. However, precipitation is a strong reason for these low concentration obtained during field study. The concentration of NO<sub>2</sub> (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 3 ppm, lower than FMEnv permissible limit of 10 ppm. No major roads constituting heavy vehicular traffic were observed within the proposed 20" Gas Pipeline project area.

**Carbon dioxide (CO<sub>2</sub>)**, 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 422ppm which is within the excellent region of the CO<sub>2</sub> scale.

**Sulfur oxides** especially sulfur dioxide, a chemical compound with the formula SO<sub>2</sub>. It is produced by various industrial processes. Since petroleum often contain sulfur compounds, their combustion generates sulfur dioxide. Further oxidation of SO<sub>2</sub>, usually in the presence of a catalyst such as NO<sub>2</sub>, forms H<sub>2</sub>SO<sub>4</sub>, 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 – 0.02 mg/m<sup>3</sup>. The standard deviation is 0.04. These values obtained were below the FMEnv limit of 0.10 mg/m<sup>3</sup>.

**Hydrogen Sulphide (H<sub>2</sub>S):** Hydrogen sulphide in the project area ranged from 0.001-0.008mg/m<sup>3</sup> with a mean of 0.04 mg/m<sup>3</sup> with a standard deviation of 0.02. These values obtained were within the FMEnv limit of 0.008 mg/m<sup>3</sup>. 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 20" Gas Pipeline 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 20" Gas Pipeline project area is relatively low, ranging between 45 and 68  $\mu\text{mg}/\text{m}^3$  as against FMEnv permissible limit of 0.25  $\text{mg}/\text{m}^3$ . 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<sup>2</sup> 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 Formation.

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 (Units in mg/kg) accepted stated	SS1	SS2	SSC3
	Coordinate	4.553231°	4.553545°	4.554265°
	Lat N	8.014453°	8.018413°	8.030138°
	Long E			
<b>A</b>	<b>PHYSICAL TEST</b>			
1	pH	8.00	8.15	7.94
2	ELECTRICAL CONDUCTIVITY (us/m)	66.3	70.8	62.5
3	Bulk Density mg/kg	1.66	1.38	1.42
4	PARTICLE SIZES/TEXTURE			
	Sand %	46.8	37.9	42.8
	Clay %	32.8	39.4	38.2
	Silt %	20.4	22.7	19.0
5	MOISTURE CONTENT (%)	20.52	16.32	14.84
6	Permeability %	52.8	47.3	44.2
7	Porosity %	48.6	50.0	48.1
<b>B</b>	<b>MACRO NUTRIENTS</b>			
8	Potassium	11.22	12.08	8.43
<b>C</b>	<b>ORGANICS</b>			
9	Total Hydrocarbon THC (mg/Kg)	2.531	3.142	2.142
	<b>ANIONS</b>			
10	Nitrate	1.043	1.050	0.173
11	Phosphate	1.127	1.108	0.134
12	Sulphate	0.155	0.214	0.152
	<b>METALS</b>			
13	Calcium	94	104	122
14	Magnesium	32.48	87.36	98.62
15	Sodium	44.2	48.6	23.8
16	Vanadium (mg/Kg)	1.218	1.036	0.714
17	Nickel (mg/Kg)	1.253	1.215	1.031
18	Iron (mg/Kg)	6.214	9.328	6.492
19	Lead (mg/Kg)	1.301	0.983	0.744
20	Copper (mg/Kg)	1.814	1.326	1.218
21	Zinc (mg/Kg)	15.613	14.824	15.418
	<b>MICROBIAL PARAMETERS</b>			
22	Total Heterotrophic Bacterial (THB) cfu 1/100g	3.2 x 10 <sup>2</sup>	3.1 x 10 <sup>2</sup>	3.0 x 10 <sup>2</sup>
23	Total Heterotrophic Fungi (THF) cfu 1/100g	2.4 X 10 <sup>2</sup>	2.4 x 10 <sup>2</sup>	2.4 X 10 <sup>2</sup>
24	Hydrocarbon Utilizing Bacteria (HUB) cfu 1/100g	2..2 x 10 <sup>2</sup>	2.1 x 10 <sup>2</sup>	2.0 x 10 <sup>2</sup>

25	Hydrocarbon Utilizing Fungi (HUF) cfu 1/100g	$1.6 \times 10^2$	$1.4 \times 10^2$	$1.6 \times 10^2$
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**Key:**

mg/Kg = milligram per kilogram

µS/cm = micro-Siemens per centimetre

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 7.94, and 8.15. 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 37.9–46.8%. The percentage sand content generally decreased with depth at any particular sampling point. The percentage clay content varied from 32.8– 39.4% 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<sub>3</sub>):** Nitrate from the sampling points varies between 0.173 to 1.050 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 2.142 mg/kg to 3.142 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 ( $\text{SO}_4^{2-}$ ):** The concentrations of sulphate ion in the area are in the range of 0.152 to 0.214mg/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 ( $\text{PO}_4^{2-}$ ):** Phosphate contents are within the range of 0.134 to 1.27mg/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 94 to 122mg/Kg, the range of concentration of magnesium is between 32.48 to 98.62mg/Kg while Sodium concentration ranges from 23.8 to 48.6mg/Kg, the range of concentration of potassium is between 8.43 to 12.08mg/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 6.214 – 9.328 mg/Kg, Zinc shows a concentration range of 14.824 – 15.613 mg/Kg. Copper shows a concentration range of 1.218 – 1.814 mg/Kg. Lead detected ranges from 0.744 - 1.814mg/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  $3.0 \times 10^2$  to  $3.2 \times 10^2$  cfu/g. Total Heterotrophic Fungi population recorded  $2.4 \times 10^2$  cfu/g for all the samples. Hydrocarbon Utilizing Bacteria showed noticeable presence. Their populations varied from  $2.0 \times 10^2$  to  $2.2 \times 10^2$ cfu/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  $1.4 \times 10^2$  –  $1.6 \times 10^2$  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
	<b>Micro - organisms</b>								
14	Faecal Coliform (MPN/100g)	65	75	60	65	75	70	80	70
15	THB (x10 <sup>4</sup> cfu/g)	3.2	2.8	5.5	3.8	4.2	2.4	5.7	4.0
16	THF (x10 <sup>4</sup> cfu/g)	2.9	5.1	3.7	3.0	5.6	3.4	2.4	3.8
17	HUB (x10 <sup>4</sup> cfu/g)	2.6	2.1	4.6	3.2	3.9	1.8	4.1	3.4
18	HUF (x10 <sup>4</sup> 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**

<b>Group</b>	<b>Scientific Name</b>
<b>Nematode</b>	<i>Acanthamoeba polyphaga</i>
	<i>Acrobeloides sp</i>
	<i>Porcellia scaber</i>
	<i>Phabditis sp</i>
<b>Annelids</b>	<i>Allolobophora caliginosa</i>
	<i>Octolasion lacteum</i>
	<i>Eudrilus eugenie</i>
<b>Arthropods</b>	<i>Myrmicarid striata</i>
	<i>Dorylus fimbriatus</i>
	<i>Glomens marginata</i>
<b>Myriopoda</b>	<i>Spirotreplus sp</i>
	<i>Lithobius sp</i>
<b>Arachnida</b>	<i>Gastrocantha sp</i>

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 20" Gas Pipeline 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 PERMISSIBLE LIMITS	WHO MAXIMUM PERMISSIBLE LIMIT	GWC2	GW1
					Lat 4.561194° Long 8.016468°	Lat 4.552374° Long 8.015008°
<b>PHYSICO- CHEMICAL PARAMETERS</b>						
1	General Appearance		CLEAR	CLEAR	Coloured	Clear
2	Temperature	°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
<b>ORGANICS</b>						
16	Dissolved Oxygen (DO)	Mg/L	NS	NS	24.8	3.2
17	Chemical oxygen	Mg/L	40.00	60-90	3.14	5.68

	demand (COD)					
18	Biological oxygen demand (BOD)	Mg/L	30.00	30-50	1.62	9.84
<b>ANIONS</b>						
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
<b>METALS</b>						
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
<b>MICROBIAL PARAMETERS</b>						
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 (FC)	cfu/ml	0	0	10	8

**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, turbidity 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 (CaCO<sub>3</sub>). 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<sub>3</sub>):** 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<sub>4</sub><sup>2-</sup>):** 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<sub>4</sub><sup>3-</sup>) & 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 Feecal 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<sup>3</sup> 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. Feecal 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 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). 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 °C	29.0	25.7	26.1	27.4	27.3
2	pH	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 <sup>-</sup> 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 Dissolve 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 x 10 <sup>3</sup>	2.8 x 10 <sup>2</sup>	2.4 x 10 <sup>2</sup>	2.3 x 10 <sup>2</sup>

**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 water 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 1221 $\mu$ S/cm to 1651 $\mu$ S/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<sup>o</sup>C value recorded ranged from 2.26mg/L 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  $2.3 \times 10^2$  to  $2.6 \times 10^3$ cfu/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
		N 4.554638° E 8.020172°	N 4.555570° E 8.030494°
<b>A</b>	<b>PHYSICAL TEST</b>		
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>B</b>	<b>MACRO NUTRIENTS</b>		
6	Total Potassium	8.80	7.15
<b>C</b>	<b>ORGANICS</b>		
7	Oil and Grease	0.110	0.112
8	Total Organic Nitrogen	0.027	0.032
<b>C</b>	<b>ANIONS</b>		
9	Nitrate	1.130	0.152
10	Phosphate	0.162	0.215
11	Sulphate	0.214	1.082
<b>D</b>	<b>METALS</b>		
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
<b>E</b>	<b>MICROBIAL PARAMETERS</b>		
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 X 10 <sup>3</sup>	3.5 X 10 <sup>3</sup>

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 ( $\text{SO}_4^{2-}$ ):** 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<sub>4</sub><sup>3-</sup>):** 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	-
<b>Micro-organisms</b>			
Coliform MPN/100m L	98	64	-
THB ( $\times 10^4$ cfu/ml)	5.2	4.6	-
THF ( $\times 10^4$ cfu/ml)	5.0	5.9	-
HUB ( $\times 10^4$ cfu/ml)	4.7	3.9	-
HUF ( $\times 10^4$ cfu/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  $\mu$ m 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 florae 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: Results of Phytoplankton Studies**

DIVISION	SPECIES
<i>Bacillariophyta</i>	<i>Achnanthes delicatula</i> ,
	<i>Bacillaria paradoxa</i>
	<i>Chaetocerosmulleri</i>
	<i>Cyclotellaquadricincira</i>

<i>Cyanophyta</i>	<i>Anabaena cylindrical</i>
	<i>Chroococcus sp</i>
	<i>Oscillatoria limosa</i>
<i>Dinophyta</i>	<i>Ceratiumhirudinella</i>
	<i>Gymnodinium sp</i>
	<i>Peridinium sp</i>
<i>Chlorophyta</i>	<i>Scenedesmus quadricauda</i>
	<i>Closterium parvulum</i>
	<i>Volvox Africana</i>
	<i>Volvox aureus</i>
<i>Euglenophyta</i>	<i>Euglena sp</i>
	<i>Phaculuslongicauda</i>

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
<i>Rotifera</i>	
Family <i>Asplanchnidae</i>	<i>Asplanchna priodonta</i>
Family <i>Brachionidae</i>	<i>Brachionus calyciflorus</i>
	<i>B. caudatus</i>
	<i>B. quadridentata</i>
	<i>Keratella sp</i>

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 which 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	<i>Littorina sp</i>
	<i>Neritaglabrata</i>
	<i>Melonoides</i>
	<i>Tuberculata</i>
ANNELIDA: <i>Polycha</i>	<i>Capitella sp</i>

<i>eta</i>	
	<i>Nereispelagica</i>
<i>Insecta</i>	<i>Baetis sp</i>
	<i>Coenagrion sp</i>
	<i>Chironomus sp</i>

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 fruticans*) and climber's as well salt-

tolerant trees and shrubs that grow along intertidal coastlines. The most abundant species across the proposed site include *Elaeis 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: Floral Species Indices and Result**

	Floral Features	Result
Species	<b>Species Diversity</b>	40
attribut es	Five most abundant species	<i>Elaeis guineensis</i> ; <i>Crytosperla senegalensis</i> ; <i>Alchornea laxiflora</i> ; <i>Tectona</i>

	<i>grandis Anthocleista vogelii; Griselinia littoralis and Nypa fruiticans</i>
Five least abundant species	<i>Berlinia grandifolia ; Anonas comosus ; Cola nigrum ; Gardenia sokotensis and Antidesma lacinatum</i>
Shannon Index	3.46
Five most Abundant Families	Aracaceae , Rubiaceae , Euphorbiaceae; Caesalpinoidea and Papilionoidea
Five least Abundant Families	Apocynaceae; Cucurbitaceae; Convolvulaceae ; Clusiaceae and Mimosoidea
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 erythropus* (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), *Osteolea leamus tetraspis* (dwarf crocodile) and many snakes species which include *Dendroaspis angusticeps* (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
<b>A. Mammalia</b>		
<i>Cercopithecus aethiops</i>	Green monkey	Cercopithecidae
<i>Cricetomys gambianus</i>	Giant rat	Muridae
<i>Erythrocebus patas</i>	Patas monkey	Cercopithecidae
<i>Heliosciurus rufobrachium</i>	Squirrel	Sciuridae
<i>Papio anubis</i>	Baboon	Cercopithecidae
<i>Phinolophus sp.</i>	House bat	Scuridae

<i>Rattus rattus</i>	Common rat	Muridae
<i>Xerus erythropus</i>	Ground squirrel	Sciuridae
<b>B. Aves</b>		
<i>Accipiter erythropus</i>	Sparrow hawk	Accipitridae
<i>Ardea cinerae</i>	Grey heron	Ardeidae
<i>Ardeola ibis</i>	Cattle egret	Ardeidae
<i>Calidris ferruginea</i>	Curlew sandpiper	Scolopacidae
<i>Ceryl erudis</i>	Pied kingfisher	Alcodinidae
<i>Corvus albus</i>	Pied crow	Corvidae
<i>Halcyon senegalensis</i>	Senegal kingfisher	Alcodinidae
<i>Haliaetus rocifer</i>	West African river eagle	Accipitridae
<i>Milvus migrans</i>	Black kite	Accipitridae
<i>Necrosyrtes monarcus</i>	Hooded vulture	Accipitridae
<i>Plesiositagra cucullatus</i>	Weaver bird	Accipitridae
<i>Pycnonotus barbatus</i>	Common garden bulbul	Pycnonotidae
<b>C. Reptilia</b>		
<i>Agama agama</i>	Common lizard	Agamidae
<i>Dendro aspisviridis</i>	Green mamba	Elaphidae
<i>Echis carinatus</i>	Carpet viper	Viperidae
<i>Hemidactylis gasciaus</i>	Wall gecko	Gekkonidae
<i>Nerodiaclarkii compressicauda</i>	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 16<sup>th</sup> July, 2025.
- Scoping workshop involving community leaders, youth, women leaders, fisher folks and government agencies/regulators on 17<sup>th</sup> July, 2025
- Consultation with the Ibeno Local Government Chairman on 18<sup>th</sup> 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 16<sup>th</sup> of July, 2025 is presented in the Appendix.

**Table 4.16: Summary of Consultations with Stakeholders**

Date	Participants	Mode of Engagement	Discussions/Decisions Reached
16 <sup>th</sup> July, 2025	Paramount Ruler of Ibeno and Council Members	Meeting	<p>Overview of the proposed project including project design, scope, benefits, potential beneficial and negative impacts/mitigation measures. Overview of the EIA studies and benefits.</p> <p>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.</p>
17 <sup>th</sup> July, 2025	Community Leaders, Men, Women, Youth groups, NGO, Government Regulators, EIA team.	Scoping Workshop	<p>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.</p> <p>Interactions and documentation of key</p>

Date	Participants	Mode of Engagement	Discussions/Decisions Reached
			<p>issues raised by participant.</p> <p>Feedback from Project Proponent/acceptance to abide by contents of MoU when finally put in place.</p>
18 <sup>th</sup> July, 2025	Ibeno Local Government Chairman	Meeting	<p>An overview of the proposed project and the EIA studies.</p> <p>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.</p>

Below are the scenes of consultation meetings held.





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





### **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 30<sup>th</sup> largest state in Nigeria, while demographically it is the 15<sup>th</sup> 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, Ekiid 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.

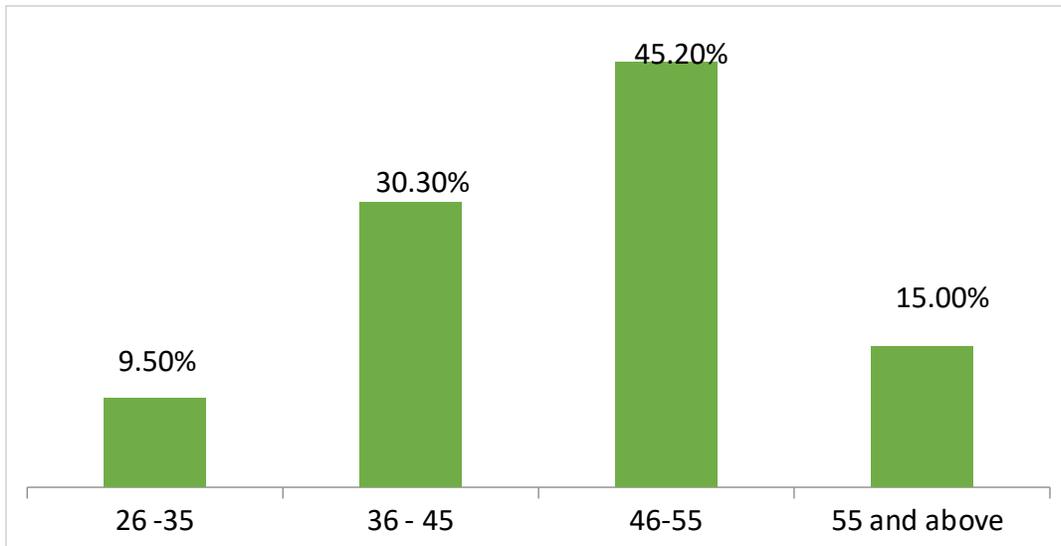
**Table 4.18: Distribution of Respondents by Age**

Age (Yrs.)	Frequency	%
26 -35	11	9.5
36 – 45	35	30.3
46-55	52	45.2
55 and above	18	15
<b>Total</b>	<b>116</b>	<b>100</b>

Source:

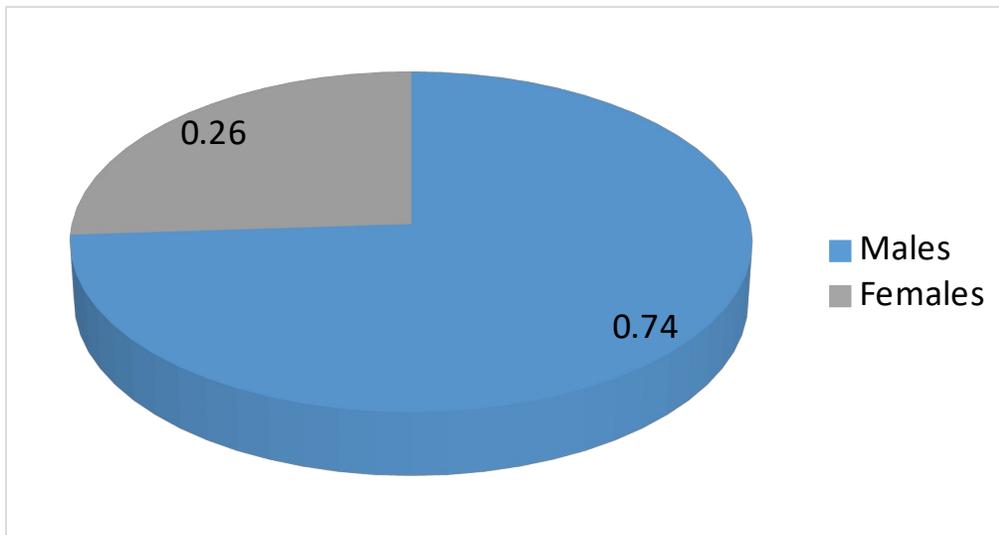
Fieldwork 2025

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**

<b>Marital Status</b>	<b>Frequency</b>	<b>%</b>
Single	24	20.7
Married	82	72.4
Divorced	0	0
Widowed	8	6.9
Others	2	4.1
<b>Total</b>	<b>116</b>	<b>100</b>

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**

<b>Educational Level</b>	<b>Frequency</b>	<b>%</b>
No formal education	9	15.5
Primary education	36	31.0
Secondary education	51	44.8
Post- secondary education	10	8.7
<b>Total</b>	<b>116</b>	<b>100</b>

Source: Fieldwork 2025

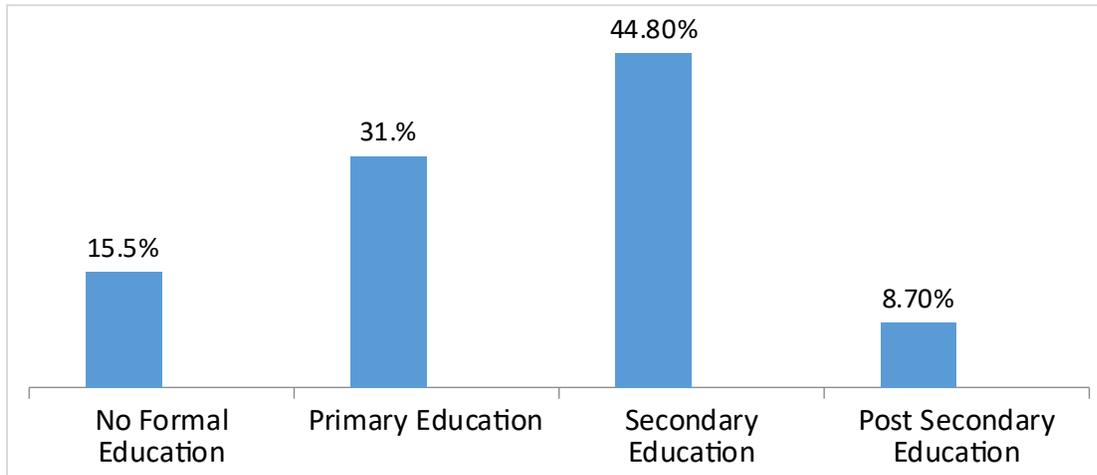


Figure 4.13: Graphical Representation of Educational Status Respondents

### 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**

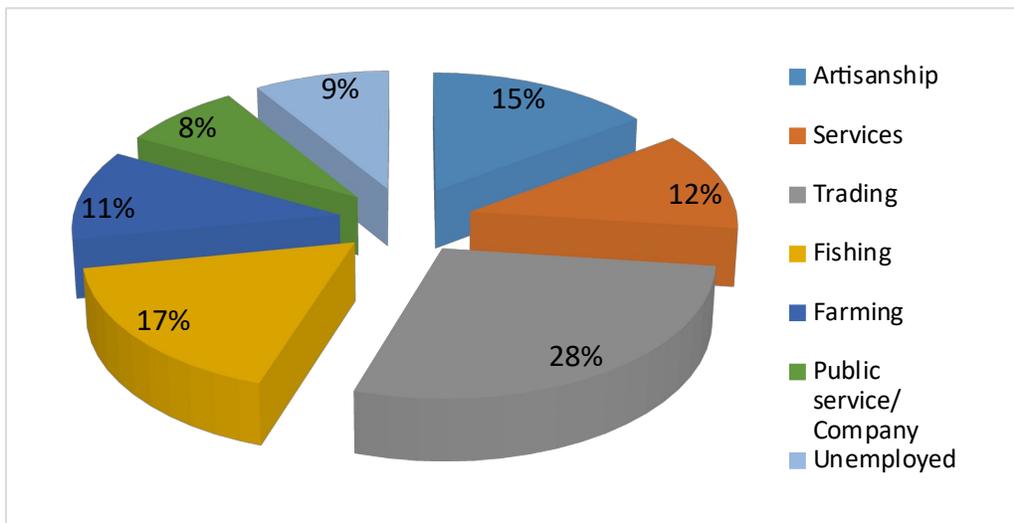
Traditionally, the prevalent occupation among people in the study communities is fishing. Ibeno is has a long coast near rivers and sea. As such, there is a setting and inclination to engage in fishing and fishing related activities such as fish/crayfish drying and fish selling. However, the review of 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
<b>Total</b>	<b>116</b>	<b>100</b>



**Plate 4.14: Distribution of Respondents by occupation**

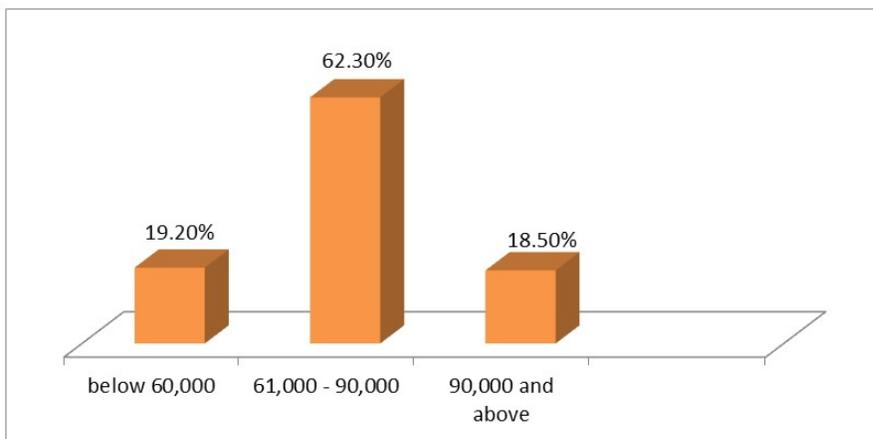
Source: Fieldwork 2025

### 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 **Figure 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.



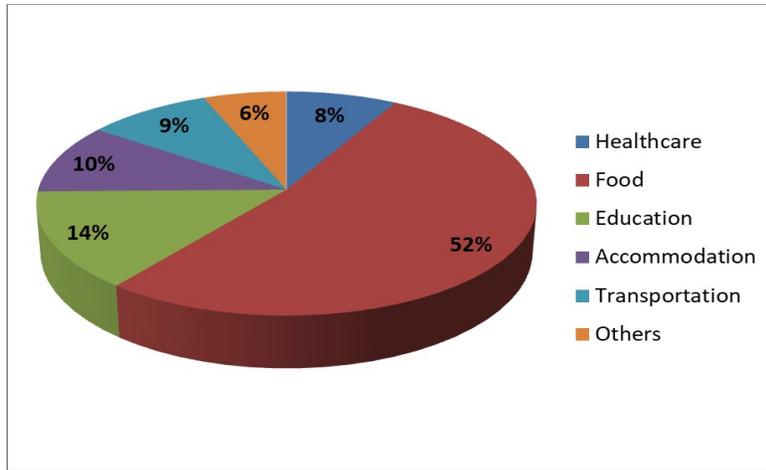
**Figure 4.15: Distribution of Respondents by Income Level**  
**Source: Fieldwork 2025**

### **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 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 26<sup>th</sup> 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 Ibena 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 Ibena.

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.

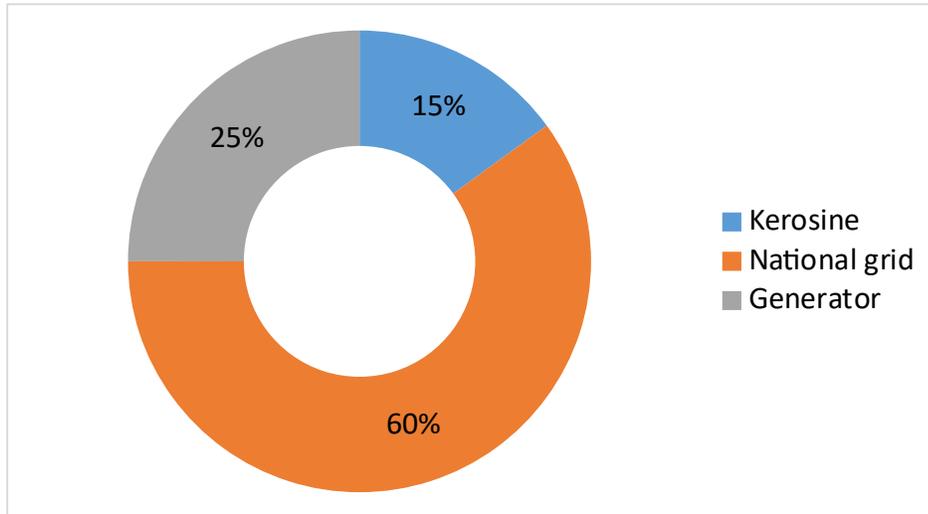


Figure 4.17: Sources of Light in the Study Area

### 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.

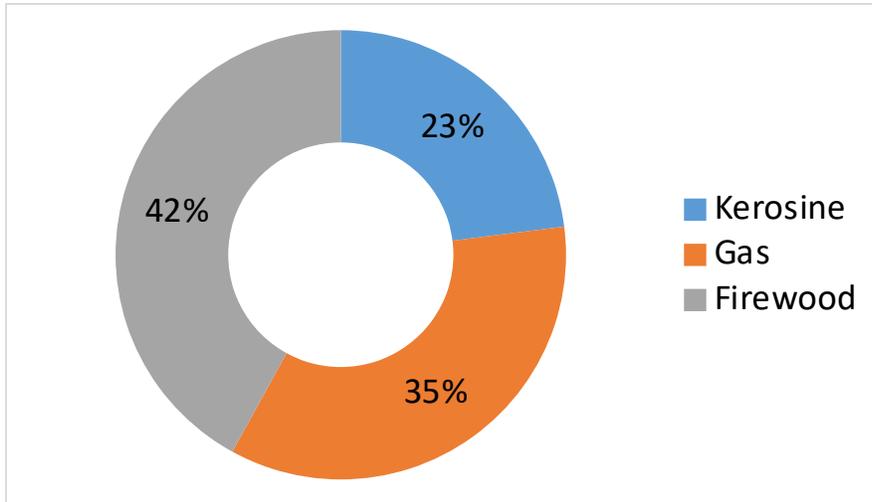


Figure 4.18: Distribution of Respondents by Energy Source

### 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 Mkpnanak 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 Mkpnanak 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 Mkpnanak 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 increase 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 collect 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 pipeline 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 pipeline 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 Revitalization and Utilization of 20' Gas Pipeline, Qua Iboe, Ibeno LGA, Akwa Ibom State, is presented hereunder.

#### 5.2 Impact Assessment Methodology

The guidelines of ISO 14001 were used for impact prediction and evaluation for the proposed gas pipeline project. The ISO 14001 method is simple to apply, provides a high level of detail and also relies on limited data. The ISO 14001. This allows for interactive and descriptive analysis of relationships between the proposed project activities and the various environmental components (biophysical, health and social). The impact assessment process is used to identify and qualify these potential impacts, evaluate their likelihood of occurrence, magnitude and significance. This is essentially a qualitative model that relies on the following:

- The professional judgment of the EIA Consultants
- Knowledge of the gas pipeline process and procedures to be used
- the baseline environmental status of the gas pipeline works area
- Experiences from similar gas pipeline project in the region and elsewhere
- The terms of reference for the ETA as generated from the scoping workshop
- Issues raised during consultation with stakeholders

### **Step 1 — Establishing the Basis for Impact Assessment**

- **Baseline development**
  - Collection of environmental (biophysical, social and health) baseline data in the project area.
  - Integration of environmental (biophysical, social and health) baseline data to develop an integrated understanding of the existing natural and social environment, baseline data have

been described in Chapter 3 and 4.

- **Determination of sensitivities**

Determination of sensitivities that characterize the natural and social environment by the expert environmental teams (biophysical, social and health) using their knowledge of the integrated baseline data.

- **Determination of project activities**

Determination of individual project activities undertaken in the respective project phases: pre-construction; construction; operation and maintenance; and decommissioning, restoration and abandonment.

## **Step 2 — Interaction Matrix Assessment of interaction**

Assessment of interactions between project activities and sensitivities (describing the biophysical, social and health environment) in a workshop setting with the environmental, social and health expert teams.

- **Description of interaction**

Brief description of anticipated interaction between the project and the sensitivities on the biophysical, social and health environment of the project is highlighted. These interactions and the sensitivities were developed into a matrix.

- **Identification of primary impacts based on interaction matrix**

Identification of impacts based on the interactions between project activities and sensitivities as identified in the interaction matrix. The identification of the impacts was phase-sensitive. The relevant project phases include pre-construction; construction; commissioning; operation and maintenance; and decommissioning,

restoration and abandonment. This approach helped in identifying impacts that cut across most of the project phases.

### **Step 3 — Integrated Impact Assessment**

- **Integration of Identified Impacts**

Identification of the significant impacts of the project taking a high level, integrated perspective while using information from the previous steps and expert opinions in the process, including the identification of residual impacts.

- **Description of Impacts**

Development of a brief description of the impacts including a description of the impacts of different project activities on a single sensitivity, using the integrated impact list and expert judgment of the specifics of the project and its natural and social environment.

- **Impact Classification**

From these exercises, a list of impacts was developed. These impacts were classified as either.

- adverse or beneficial
- short term or long term
- reversible) or irreversible
- short term < 3 months; long term > 3 months

- **Impact Evaluation**

Mind the interaction and/or connections between the project activities and the biophysical, social and health issues so that accurate predictions about what may happen can be made. This exercise identified the significant positive and significant negative impacts arising from the project.

• **Mitigation Measures**

- Development of mitigation measures based on the integrated list of significant impacts, clearly connecting impacts and mitigation measures.
- Assessment of residual impact after implementation of mitigation measures and a demonstration that any residual impact is as low as reasonably practicable (ALARP).
- Enhancement of significant positive impacts.

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.

**Table 5.1: Checklist of Identified Associated and Potential Impacts**

<b>Project Phase</b>	<b>Project Activity</b>	<b>Environment Component</b>	<b>Potential/Associated Impacts</b>
	Site Survey	Vegetation, Wildlife	

Pre-Construction	Land acquisition	Vegetation, Social aspect	
	Mobilization of workforce and equipment to site	Social	
		Social & Health	
		Air Quality	
	ROW Clearing	Vegetation	
		Soil	
		Surface Water Quality	
Wildlife			
	Air Quality		
Construction Phase	Pipe Stringing & Welding	Environmental, Social and Health	
	NDT (examination of welding joints)	Social and Health	
	Coating and Holiday detection	Soil and Surface and Ground Water	
	Trenching	Soil	Removal of top soil, damage to roads, likely spillage of crude oil (if there is an existing crude oil pipe) if existing pipes are ruptured
		Surface Water System	Surface water contamination
		Air Quality/Noise	Changes in noise and exhaust gases from excavators. Increase in dust during the dry season.
		Soil	Alteration of soil profile
	Soil and Ground Water	Contamination of soil and water (ground) from	

			chemicals used for cathodic protection.
		Surface Water	Increase in surface water turbidity
		Soil	Soil contamination
		Surface water	Alteration in water quality status
		Ground water	Groundwater contamination
		Social Issues	Contamination on farm land and crops
		Soil	Soil contamination
		Social Issues	Community agitation
		Surface Water System	Discharged hydrotest water can contaminate surface water and also can increase surface water temperature.

## 5.2.2 Environmental Impact Indicators Sensitivities

Based on the baseline, as described in Chapter 3, a list of sensitivities that characterize the biophysical, social and health environment of the proposed gas pipeline project was examined. The aim of impact identification is to ensure that both significant and insignificant potential and associated bio-physical, social and health impacts are accounted for. The anticipated impacts were determined based on the interaction between project activities and environmental sensitivities. 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 5.2.

**Table 5.2: Environmental Components and Potential Impact**

**Indicators**

Component		Impact Indicators
Biophysical	Soil	Changes to soil quality indices (physicochemical properties, hydrocarbons, heavymetals, Microbiology)
	Air	Emissions of NO <sub>2</sub> , SO <sub>2</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> , CO, VOC, greenhouse (CO <sub>2</sub> , CH <sub>4</sub> )
	Noise	Change in noise levels at sensitive receptors
Social	Population	Changes in population indices, total population, gender ratio
	Infrastructure	Improvement or pressure on existing urban/rural infrastructure including waste handling facilities
	Macro and micro economy	Change in macroand micro economy, employment, standard of living, occupation
	Social and Cultural Structure	Disruption in local authority and governance structure; change in social behaviour, intra- and inter-ethnic classes
	Transportation	Alteration in means of transportation or ability to move efficiently

	Education	Change in primary, secondary and tertiary education school enrolment and attendance
Health	Pollution Related Health Effects	Increase in concentration of air pollutants of concern (NO <sub>2</sub> , SO <sub>2</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> , CO, VOC) and contamination of surface waters and potable ground water, increased noise beyond regulatory limits, increased night time beyond acceptable.
	Communicable and Non-Communicable disease	Change in incidence of communicable and non-communicable diseases or disease – causing factors
	Morbidity and mortality	Change in health of workers and general public, change in security of the area
	Health care/recreational facilities	Changes in availability of and access to health care and recreational facilities
	Psychosocial factors	Drug use/abuse, communal violence, crime, suicide, depression and prostitution; changing expectations of quality of life.
	Accidents/Fires/Explosions	Changes in rate of occurrence and severity of accidents/fires/explosions

### 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 5.3: 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:

	<ul style="list-style-type: none"> <li>• Irreversible and undesirable change(s) in the biophysical environment.</li> <li>• Decrease in the quality of the biophysical environment.</li> <li>• Limitation, restriction or denial of access to or use of any component of the environment to others, including future generations and</li> <li>• Sacrifice of long-term environmental viability or integrity for short term economic goals</li> </ul>
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 5.4: Legal/Regulatory Requirements Criterion**

Condition	Rating
No legal / regulatory requirement for carrying out project activity	<b>Low =1</b>
Legal / regulatory requirement exist for carrying out activity	<b>Medium =3</b>
A permit is required prior to carrying out project activity which may result in impact on the environment	<b>High =5</b>

***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 5.5.

**Table 5.5: Risk Assessment Matrix (RAM)**

Consequences	Probability	
	Probability Category	Definition
	<b>A</b>	Possibility of Repeated Incidents
	<b>B</b>	Possibility of Isolated Incidents
	<b>C</b>	Possibility of Occurring Sometime
<b>D</b>	Not Likely to Occur	

<b>E</b>	Practically Impossible
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**Table 5.5: continued**

Consequence Category	Considerations			
	Safety / Health	Public Disruption	Environmental Aspects	Financial Aspects
<b>I</b>	Fatalities / Serious Impact on Public	Large Community	Major/Extended Duration/Full Scale Response	<b>High =5</b>
<b>II</b>	Serious Injury to Personnel / Limited Impact on Public	Small Community	Serious / Significant Resource Commitment	<b>Medium =3</b>
<b>III</b>	Medical Treatment for Personnel / No Impact on Public	Minor	Moderate / Limited Response of Short Duration	<b>Low =1</b>
<b>IV</b>	Minor Impact on Personnel	Minimal to None	Minor / Little or No Response Needed	<b>None</b>

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 5.6: Risk Criterion**

Risk	Attribute – Environmental, Human Health, Safety and Reputation
<b>1= Low</b>	<ul style="list-style-type: none"> <li>• This means that no further mitigation may be required</li> </ul>
<b>3= Medium</b>	<ul style="list-style-type: none"> <li>• This means that the impact can be mitigated with additional controls and modifications</li> </ul>
<b>5=High</b>	<ul style="list-style-type: none"> <li>• This means that the impact requires avoidance or major control/mitigation</li> </ul>

### ***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 5.7: Frequency Criterion**

<b>Frequency</b>	<b>Attribute – Environmental, Human Health and Safety</b>
<b>High = 5</b>	<ul style="list-style-type: none"> <li>• Major degradation in quality in terms of scale (&gt;1% of study area or habitat within the study area), appearance, duration (beyond duration of project)</li> <li>• Irreversible or only slowly recoverable (change lasting more than 1 year) degradation of environmental ecosystem level (population, abundance, diversity, productivity)</li> <li>• High frequency of impact (occur continuously and almost throughout the project execution period (&lt; 4months))</li> <li>• Geographic extent of impact (e.g. encompassing areas beyond study area)</li> </ul>
<b>Medium =3</b>	<ul style="list-style-type: none"> <li>• Degradation in quality in terms of scale (&gt;0.1% of study area, habitat), appearance, duration (a few months)</li> <li>• Effect beyond naturally occurring impacts variability</li> <li>• Slow reversibility (change lasting a few months before recovery), lasting residual impact</li> <li>• Potential for cumulative impact</li> <li>• Intermittent frequency of impact (occur in only a few occasions during the project execution period)</li> <li>• Limited geographic extent of impact (large area within study Area)</li> </ul>
<b>Low = 1</b>	<ul style="list-style-type: none"> <li>• Minor degradation in quality in terms of scale (&lt;0.1% of study area, habitat, very localized), appearance, duration (a few days to a month)</li> <li>• Effect within range of naturally occurring impacts, changes, dynamics</li> <li>• Rapid reversibility (change lasting only a few weeks before recovery), no lasting residual impact of significance</li> <li>• No potential for significant cumulative impact</li> <li>• Low frequency of impact (occur in just about one occasion during the project execution period)</li> <li>• Only very localized geographic extent of impact (e.g. not more than a few meters from impact source point)</li> </ul>

### ***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 5.8: Importance Criterion**

Importance	Attribute – Environmental, Human Health and Safety
<b>High = 5</b>	<ul style="list-style-type: none"> <li>• Highly undesirable outcome (e.g., impairment of endangered, protected habitat, species)</li> <li>• Detrimental, extended flora and fauna behavioral change (breeding, spawning, molting)</li> <li>• Major reduction or disruption in value, function or service of impacted resource</li> <li>• Impact during environmentally sensitive period</li> <li>• Continuous non-compliance with international best practices</li> </ul>
<b>Medium = 3</b>	<ul style="list-style-type: none"> <li>• Negative outcome</li> <li>• Measurable reduction or disruption in value, function or service of impacted resource</li> <li>• Potential for non-compliance with international best practices</li> </ul>
<b>Low =1</b>	<ul style="list-style-type: none"> <li>• Imperceptible outcome</li> <li>• Insignificant alteration in value, function or service of impacted resource</li> <li>• Within compliance, no controls required</li> </ul>

### 5.3 Result of Impact Assessment

The results of the impact assessment exercise as discussed in the previous sections are presented in Table 5.9. 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 5.9 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 =  $(L+R+F+I+P) \geq 15$  or  $(F+I) \geq 6$  or  $P = 5$

Medium =  $(L+R+F+I+P) \geq 9$  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 Quantification						Impact Quantification						Overall Ranking (High/Medium/Low)
			Adverse	Beneficial	Short term < 3moths	Long term > 3months	Reversible	Irreversible	L	R	F	I	P	F+I+P +R+L	
Pre-construction	Land acquisition for Flowlines	Loss of farmland	X			X		X	3	5	5	5	5	15	H
		Community unrest	X		X	X	X		0	5	3	5	5	13	H
		Loss of habitat	X			X		X	0	1	5	1	1	7	M
		Loss of biodiversity	X			X		X	0	1	1	3	1	5	L
		Loss of income	X		X		X		0	3	5	5	5	15	H
		Changes in traditional occupation	X			X	X		0	1	3	3	5	11	H
		Generation of capital from land compensation		X	X			X	3	3	5	5	5	15	H
Mobilization	Movement of goods, equipment and personnel	Increase in potential for road traffic volume	X		X				3	5	5	5	5	15	H
		Increase in potential for road traffic incidents	X		X				3	5	3	3	3	9	M
		Increase in noise	X		X				3	3	5	3	3	11	H
		Stress on existing security structures	X					X	0	3	1	3	5	9	M
		Reduction in air quality (dust, exhaust)	X		X				0	1	3	3	3	9	M

		Damage to existing roads	X		X		X		0	3	3	3	50	1	H	
		Increase in economic activities			X	X			0	1	5	5	5	15	H	
Construction	Site preparation (Land clearing, Excavation)	Loss of flora and fauna	X				X		0	1	3	3	3	9	M	
		Community unrest	X		X		X		0	5	3	5	5	13	H	
		Stress on existing security structures	X					X		0	3	1	3	5	9	M
		Increase in employment		X	X		X		3	5	5	5	5	15	H	
		Increase in dust and noise	X		X		X		3	3	3	3	3	9	M	
		Increase in economic activities		X	X		X		0	1	5	5	5	15	H	
		Changes in landscape	X			X		X		3	1	3	1	1	5	L

		Increase in erosion potential	X			X	X	X	0	5	5	5	3	13	H
		Threat to health of workers (snake bites) insect bites and stings, injuries etc)	X		X	X		X	3	5	3	5	5	13	H
	Influx of labour and followers	Changes in local population	X	X	X	X		X	0	3	5	5	5	15	H
		Increase in mortality, morbidity and STIs	X					X	0	5	5	5	5	15	H
		Increase in social vices	X					X	0	3	3	3	3	9	M
		Pressure on existing infrastructure and utilities	X					X	0	1	5	5	5	15	H
		Increase in inflation level	X					X	0	3	5	5	5	15	H
		Changes in culture, lifestyle and habits	X	X		X		X	0	1	3	3	1	7	M
		Increase in economic activities	X	X				X	0	1	5	5	5	15	H
		Reduction in air quality	X					X	0	1	3	1	3	7	M
		Waste Generation and disposal	Increase in breeding grounds for disease vectors and other agents of diseases	X			X	X		3	5	3	5	3	11
	Increase in nuisance		X		X		X		0	1	3	3	3	9	M
	Blockage of natural drainage		X		X		X		0	1	3	3	1	7	M
	Pressure on existing waste management system		X			X	X		0	3	3	3	3	9	M
Pre-Construction	Land acquisition for flowlines	Loss of farmland	X			X		X	3	5	5	5	5	15	H
		Community unrest	X		X	X	X		0	5	3	5	5	13	H
		Loss of habitat	X			X		X	0	1	5	1	1	7	M
		Loss of biodiversity	X			X		X	0	1	1	3	1	5	L
		Loss of income	X		X		X		0	3	5	5	5	15	H
		Changes in traditional occupation	X			X	X		0	1	3	3	5	11	H
		Generation of capital from land compensation		X	X			X	X	3	3	5	5	5	15

Mobilization	Movement of goods, equipment and personnel	Increase in potential for road traffic volume	X		X		X		3	5	5	5	5	15	H
		Increase in potential for road traffic incidents	X		X		X		3	5	5	3	3	9	M
		Increase in noise	X		X		X		3	3	5	3	3	11	H
		Stress on existing security structures	X		X			X	0	3	1	3	5	9	M
		Reduction in air quality (dust, exhaust)	X			X		X	0	1	3	3	3	9	M
		Damage to existing roads	X		X	X		X	0	3	3	3	5	9	M
		Increase in economic activities			X	X		X	0	1	5	5	5	15	H
Construction	Site preparation (Land)	Loss of flora and fauna	X			X		X	0	1	3	3	3	9	M
		Community unrest	X		X		X		0	5	3	5	5	13	H
		Stress on existing	X			X		X	0	3	1	3	3	9	M
		Increase in employment		X	X		X		3	5	5	5	5	15	H
		Increase in dust and noise	X		X		X		3	3	3	3	3	9	M
		Increase in economic activities		X	X		X		0	1	5	5	5	15	H
		Changes in landscape	X			X		X	3	1	3	1	1	5	L
		Increase in erosion potential	X			X		X	0	5	5	5	3	13	H
		Threat to health of workers (snake bites, insect bites and stings, injuries, etc)	X		X	X	X	X	3	5	3	5	5	13	H
		Changes in local population	X	X	X	X		X	0	3	5	5	5	15	H
		Increase in mortality, morbidity and STIs	X			X	X	X	0	5	5	5	5	15	H
		Increase in social vices	X			X		X	0	3	3	3	3	9	M
		Pressure on existing infrastructure and utilities	X			X		X	0	1	5	5	5	15	H
Increase in inflation level	X			X		X	0	3	5	5	5	15	H		

Changes in culture, lifestyle and habits	X	X		X		X	0	1	3	3	1		
Increase in economic activities		X		X		X	0	1	5	5	5	15	H
Reduction in air quality	X			X	X		0	1	3	1	3	7	M
Reduction of flora and fauna population													
Re-increase in employment opportunities	X			X	X		0	3	3	3	3	9	M
Threat to health of workers (snake bites, insect bites and stings, injuries, etc)		X		X	X		3	3	3	3	3	9	M
Reduction in air quality (dust levels)	X		X	X	X	X	3	5	3	5	5	13	H
Increase in noise level	X		X		X		3	3	3	3	3	9	M
Increase in erosion potential	X		X		X		0	3	3	3	3	9	M
Contamination of surface water bodies	X		X		X		3	5	3	5	5	13	H
Pressure on existing waste management systems	X		X		X		0	1	3	1	1	5	L
Habitat fragmentation	X		X		X		0	1	3	1	1	5	L
Loss of Habitat	X		X		X		0	1	3	1	1	5	L
Potential for falls into exposed trenches (animals, unsuspecting passers-by)	X		X		X		0	3	3	3	3	9	M
Soil degradation from spills and leaks	X		X		X		3	3	3	3	5	11	H
Degradation from soil compaction	X		X		X		0	1	3	1	1	5	L

Change in topography of the soil	X		X		X		0	3	3	3	1	7	M
Exposure to radiation materials	X		X	X	X	X	3	5	1	5	3	9	M
Potential for inhalation of welding fumes	X		X		X		3	3	3	3	1	7	M
Potential for conflicts arising from labour issues (welders)	X		X		X		0	3	3	3	3	9	M
Stress on existing security structures	X			X		X	0	3	1	3	5	9	M
Erosion from release of hydrotest water	X			X		X	0	3	5	5	3	13	H
Contamination of surface and underground water and soil from inhibited hydrotest water	X		X			X	3	5	3	5	3	11	H
Increase in potential for incidents (high pressure of pipes during hydrotesting)	X		X	X	X	X	3	5	1	5	5	11	H
Increase in employment opportunities		X		X	X		3	5	5	5	5	15	H
Increase in noise levels	X			X	X		3	1	3	3	3	9	M
Reduction in gas flaring	X			X		X	5	3	3	5	5	13	H
Reduction in air quality	X			X	X		3	1	1	3	3	7	H
Degradation of soil and surface water from spills and leaks	X			X	X		3	1	3	3	3	9	M
Relative drop in economic activities	X			X		X	0	1	3	3	3	9	M
Decrease in commercial waste generation		X		X	X		0	1	3	1	1	5	L
Increase in industrial waste	X			X	X		3	1	1	3	1	5	L

	generation (rags, filters, lubricating oil, etc)														
	Increase in employment opportunities		X		X	X		3	3	3	3	3	11	H	
	Degradation of soil and surface water from spills and leaks	X			X	X		3	1	3	3	3	9	M	
	Stress on exiting security structures	X			X		X	0	3	1	3	5	9	M	
	Threat to health of workers (snake bites, insect bites and stings, injuries, etc)	X			X	X	X	0	5	3	5	5	13	H	

## **5.4 Impact Discussion**

The impacts associated with the proposed gas pipeline project have been identified and evaluated visa-vis the recipient environment. They have also been subjected to the impact severity evaluation. All potential impacts to the environment as summarised are intended to provide an insight into the nature and level of significance of the identified impacts as well as a description of mitigation measures outlined in the various phases of the development.

### **5.4.1 Potential Negative impacts of the project activities**

#### **Impact on Air Quality**

Short-term air emissions that could degrade air quality may result from construction related operations. All diesel-powered facilities such as power generators, bull- dozers, trucks and heavy machineries would emit SO<sub>x</sub>, CO<sub>2</sub>, CO, NO<sub>x</sub>, VOCs and other hazardous gases. These combustion gases can cause air pollution problems and health related hazards for people in the vicinity. Dust generated during construction especially during clearing and trenching, could also alter air quality of the environment. The impact is significant; short term, reversible and local.

#### **Impact on Vegetation/Biodiversity**

A wide variety of plant species in the primary swamp forest, secondary rainforest regrowth vegetation and bush fallows will be cleared to make way for ROW and access roads. This would have local disruptive effects on the vegetation structure and function. The impact is significant in the short term and reversible.

### **Impact on Land Use**

The entire length of the pipeline route shall be freshly acquired. Land acquisition entails loss of farmland by the indigenous farmers who use the land to cultivate various crops. The negative impact is significant, reversible and of long-term effect.

### **Impact on Soil**

Clearing of the vegetation would expose the soil to direct sunshine, which would elicit chains of significant negative impacts. The direct exposure would lead to increase in soil temperature, fluctuating moisture regimes, erosion and topographic changes. Dramatic increases in soil temperature would result in high mortality of soil organisms and drying of the soil to the extent that regeneration is hindered. These impacts would be both direct and indirect, long term, reversible and local. Approximately 8,640m<sup>3</sup> of soil will be excavated and backfilled. This would render the soil loose and unstable and may trigger soil erosion.

### **Impact on Surface and Ground waters**

The Qua Iboe River and Douglas Creek and their tributaries in the project area may be polluted by runoff and sedimentation as well as trenching and excavation. Incidental discharges comprising petrol, diesel and lubricants may degrade both surface and ground waters. Surface runoff of chemicals, metals and solid wastes frequently stored in piles on the facility site can pollute surface waters and percolate to groundwater. The impact is short term, reversible and local.

### Impacts on Socio-economics

The settlement types within the project area are predominantly semi-urban. Therefore their population sizes are averagely large. Given population size, the influx of workers during the construction phase will significantly affect the demographic pattern of the host communities. Construction activities will no doubt affect the sex ratio of communities' for the period the activity is taking place in particular communities. Farming is by far the dominant occupation in the host communities, and as a result, personal incomes are generally on the low side. The project will potentially impact occupation and income, among others. This is so because employment will attract higher income, there would be some redirection of labour from farming, fishing, etc to the project. In addition, the higher personal incomes associated with employment could cause some inflation in the local economy. Therefore, price increases and redirection of labour are likely to be among the major impacts of the project on the local economy. Large concentrations of construction workers around the town could bring about increased demands on services and facilities. This may result in significant increases in prices, which would be a burden on the local populace. At the end of construction activities, there may be local economic depression in the host communities and neighbouring settlements following withdrawal of labour force, i.e. a “boom and burst” scenario. Conflicts may also arise between non-native construction crew and local people as a result of the former’s disregard or lack of respect for native culture, local norms (traditions), religious practices and lifestyles. A common impact on lifestyles concerns sexual and other forms of behaviour, as well as

modes of dressing. Sexual laxity/prostitution and alcoholism are the most common and are associated with migrant workers living alone, away from their families. In some cases, youth militancy develops as youths organize in order to extract money from project owners or contractor either for themselves or for their communities.

### **Impacts on Social Infrastructure**

The most common social infrastructures in the host communities are primary and secondary schools, healthcare facilities and water supply systems. The project will bring about population growth due to the influx of workers. The capacity of local infrastructures in some of the communities is very limited and so cannot cope with the increased demand that will result from population growth during the project, especially the construction phase.

### **Pressure on existing infrastructure and utilities**

The study area has limited physical, social and economic institutional infrastructure. Potable water, recreational facilities, electricity, clinics, banks and post offices were inadequate. With the influx of labour and followers, there will be pressure on the already grossly inadequate infrastructure of the area, such as recreational facilities, schools, clinics, water supply, communication facilities, markets, housing, hotels, drinking parlours, etc. An influx of people into the area could cause an increase in levels of crime and other social vices. Also the project may increase risks for community unrest, sabotage actions and violent protests. It is unlikely that the existing security forces will be able to cope with such situation based on their current strength.

### **Increase in morbidity (including STIs and HIV) and mortality**

Currently morbidity (and mortality) from communicable diseases such as malaria, respiratory tract infections and diarrhoea diseases is very high. Health services are few with low capabilities. Based on baseline health survey, the current knowledge, attitude and practice with regards to sexually transmitted infections is low. There are practices of multiple sexual partners and condom use is low. The expatriates and other migrant workforce from outside the area may import some communicable diseases such as Tuberculosis, HIV/AIDS, SARS etc. Contact with the communities could lead to transmission of these diseases among the locals. Influx of labour could also act indirectly to cause an increase in the levels of other communicable diseases such as diarrhoea/gastroenteritis, respiratory tract infections and malaria through poor housing and overcrowding. This is likely to occur as the present living standard of the people is low with poor housing, inadequate sanitation and water supply occasioned by pressure on an already deficient and inadequate community infrastructure. The influx of people including commercial sex workers and migrant workmen, many of whom are likely to be young, sexually active and either single or without their families could therefore increase the potential for casual sex and the transmission of STI including HIV/AIDS. Given the current low level of knowledge of STI, low availability and use of protective mechanisms in the local communities and the public health importance of STI/HIV/AIDS in the nation, this impact cannot be over emphasized.

### **Impacts on Health Status**

During construction activities, the health of local people may be negatively impacted when non-native labourers from outside the locality import diseases, which the local medical facilities are inadequate to handle. The labourers can also contact diseases, most especially, sexually transmitted infections such as gonorrhoea, syphilis, herpes, HIV/AIDS, etc. Increased commercial sexual activities among construction workers could lead to a sharp increase in the influx of commercial sex workers neighbouring metropolis with the attendant health risks.

### **Environmental Sanitation and Waste Management**

A number of waste types shall be generated during the construction, operation and abandonment phases of the project. These include metal scraps, spent lubricant, domestic waste (including sewage) etc. Improper waste disposal would lead to loss of aesthetics, increase of disease vectors, risk of accidents by sharp objects/scrap piles, and contamination of soil and water bodies (through run-offs). The impacts of waste generation are significant, short term and reversible.

### **Risk of Fire and/or Explosion**

Fire and explosion can occur in any section of the pipeline in varying degrees of magnitude. This could be as a result of gas leaks from the pipes, operational errors, or activities of vandals. The most vulnerable targets of fire/explosion are vegetation, wildlife and people.

### **Increase in potential for road traffic incidents**

It is anticipated that road traffic will increase during mobilization of personnel and equipment to site over the period. During the construction phase which is expected to last about six months, intensive movement of personnel and

equipment will also take place as well as during operation and maintenance. During the period, an added number of 5 - 10 tonnes truck per day will be added to traffic volume. Given the present condition of the road, there is the potential for increased road traffic accidents/injuries during these phases.

#### **Exposure to Dangerous Animals, Insects and harmful Plants**

The species of reptiles found in the area include crocodiles, snakes, bees, tsetse flies. Contact with harmful plants (*Mimosa sp*) in the area could lead to allergic reactions. The healthcare centres in the area do not have a record of any human injury from these plants. The clearing of the vegetation could expose the workforce to these animals/insects thereby triggering attack. The impact is direct, negative, short/long term, reversible/ irreversible and was rated minor.

#### **Increase in the cost of living**

Average monthly income in the study area is about 50,000, which is below the national minimum wage of N70,000. An injection of workers with significantly higher incomes into the project area could create a local inflationary pressure. This impact is described as direct, negative, short term, local, reversible, and the rating is minor.

#### **Emission of exhaust fumes/noxious gases to the atmosphere**

Emission of exhaust fumes/noxious gases to the atmosphere from the crafts will result in the temporary deterioration of ambient air quality. The sources of emissions of noxious gases into the atmosphere related to transportation include; the increased number of boat movements into the area. These are expected to generate an undetermined quantity of gases which are released into the

atmosphere. The gases from machinery include SO<sub>x</sub>, NO<sub>x</sub>, CO, CO<sub>2</sub> suspended particulate matter (SPM) etc. The inhalation of these gases could trigger respiratory tract diseases and worsen existing ones like asthma, chronic bronchitis. The concentration of these emissions will depend on wind speed and direction. The impact was rated as minor due to the anticipated minimal quantity of emissions. The impact is direct, negative, short term, local and reversible.

### **Potential impacts on air quality**

Emissions from construction equipment, work equipment, trucks and other vehicles used in construction work could be a source of air pollution. Dust from construction activities is also a possible source of air pollution.

### **Noise and vibration**

Construction activities may create a problem of noise and vibration generated by construction equipment, truck traffic, work vessels and other similar sources.

### **Construction Waste management**

Wastes from construction activities are mainly spoils generated. Disposal of dredged material on land may cause destruction of plants, loss of vegetation, leakage of contaminated materials and salt, odour, an unsightly view and other nuisances to the local community. Disposal in water may cause problems.

### **Third party agitation**

The community agitation could arise from: reduction in the surface water quality of the water bodies in the area, disturbances of fishing activities,

discontent from business/employment issues. The impact is qualified as direct, negative, short/long term, local and reversible. It is rated major.

### **General Waste Management**

As in most other industrial terminals, the wastes generated in this study area included both degradable and non-degradable types. Most of the degradable wastes were mainly kitchen wastes that included food wastes or remnants (garbage), papers etc. The non-degradable wastes were mainly metals, plastics, polythene bags, cans/tins etc. For human waste disposal, vacuum trucks were the most commonly used method of disposal, followed by defecation in the bush and then water cistern. There is deliberate private modern waste management practice in the project area predominant waste disposal method in the area is disposal in burrow pits. The activities planned for the gas pipeline project will not alter the waste generation and disposal pattern in the study area. These wastes will consist of domestic wastes (hazardous and non-hazardous, sanitary wastes (grey and black water), construction waste, used lubricating oils, rags and filters as well as vegetation and paper. As a result of anticipated increased activities of service providers and followers associated with this project, it can be anticipated that the total quantity of waste generation apart from industrial wastes will not in any dimension adversely increase over and above the capabilities of the existing waste management facilities in the project area.

### **Contamination of surface water from fuel and oils**

Power generation requires the use of refined petroleum products and lubricating oils. Accidental discharges and leakages from generator and storage tanks are a potential source of hydrocarbons in the water. Inorganic

additives in fuel and oil can add to heavy metal contents in the environment. This impact is rated minor and is direct, negative, local, short term and reversible.

#### **5.4.2 Potential Positive impacts of the project activities**

In this instance the cumulative impacts may arise from the parallel running of the proposed gas pipeline project. The construction and operation of gas pipeline can also create cumulative impacts in-terms fixed point project. These impacts have been assessed to pose beneficial to medium significant adverse impacts. Cumulative impacts relating to the construction of the proposed gas pipeline include:

- Pollution (Air, soil & Water)
- Incidents (Road accidents)
- Population (migrants, Workers, followers)
- Aesthetic value of area where there are existing industries
- Pressure on existing infrastructure

Based on the individual impact assessment for the projects, majority of the cumulative impacts would occur during the early phases of these projects: mobilization and construction, while a small number would occur during operation of the various facilities.

The cumulative positive impacts identified are

- Business Opportunity/Economic enhancement
- Skills acquisition
- Increase in revenue

The cumulative negative impacts identified are:

- Increase in potential for road traffic volume
- Increase in noise nuisance
- Reduction in air quality (dust, exhaust)
- Stress on existing security structures
- Changes in local population
- Increase in social vices
- Pressure on existing infrastructure and utilities
- Increase in communicable diseases (including STIs)
- Pollution of surface water sources
- Loss of biodiversity

The significance rating of each of these impacts has been obtained through the process of impact identification, ranking and quantification, in each of the projects.

**Table. 5.10: Cumulative Impact Analysis**

<b>Impacts</b>	<b>Gas Pipeline</b>
Reduction in biodiversity/Loss of flora and fauna	Low
Increase in cost of living/inflation	Low
Increase in potential for road traffic volume	Low
Increase in noise nuisance	Medium
Reduction in air quality (dust, fumes and exhaust)	High
Community unrest	Low
Stress on existing security structures	Medium
Business opportunity/Economic enhancement	Positive
Changes in local population	Low
Increase in social vices	Medium
Pressure on existing infrastructure and utilities	Medium
Skills acquisition	Positive
Injury to workers	Low

Increase in communicable diseases	Low
Pollution of surface water sources	High
Soil degradation from spills and leaks	Low

### 5.4.3 Cumulative Positive Impacts

#### **Business Opportunities/Economic Enhancement**

A percentage of the various project costs would be reserved for local contracting. These projects would therefore, create various opportunities for local contractors to take advantage for the supply of goods and services. This would ultimately enhance the economy of the area and improve the economic well-being of the contractors.

#### **Employment & Skills Acquisition**

The project would require skills of various types and there is the potential for the acquisition of new skills by qualified community indigenes in various areas during construction only. Acquisition of these skills would improve the chances of such individuals within the labour market of getting similar jobs based on the new skills acquired. Also skills that would be of indirect service to these projects would also be of benefit to the communities. Within the service industry, barbing, tailoring, repairs, waste management, etc would expand to cater for the influx of personnel and waste they would generate, while the supply industry (foodstuff, office consumables, provisions etc) would also expand.

#### **Increase in Revenue to the Government**

With the commissioning of the gas pipeline revenue for the company will increase based on the increase activities and objects of the pipeline project.

#### **5.4.4 Cumulative Negative Impacts**

Most of these impacts were individually rated as medium or high for the various projects. Their cumulative effects would most likely be high or medium.

##### **Reduction in air quality (dust & exhaust emissions)**

During the dry season, harmattan dust, construction dust and exhaust fumes would be deposited on vegetation, pedestrians, and structures close to the road in higher concentrations due to the increase in traffic volume. Similarly, the activities of Qua Iboe Terminal and other oil and gas companies will contribute to the reduction in air quality in the area.

##### **Stress on existing infrastructure & Utilities**

Though contractors would provide accommodation, feeding, transport etc for their workers, the camp followers would utilize those services and infrastructure available within the communities. Thus, there would be cumulative stress on the poor infrastructure and utilities with each influx of camp followers.

##### **Increase in communicable diseases**

With each influx of construction workers & camp followers, the frequency of STIs would increase as well as the chances of individuals contacting different types of infections. The cumulative effects of different infections in individuals would compromise their health status leading to absence from work, loss of income and, in the extreme case, death.

Water and soil contamination

With simultaneous construction activities at the various locations there is the increased potential for accidental spills and leaks that could cause water and soil contamination. With an increase in the frequency of contamination there is the potential for some of the contaminants to accumulate especially in soil and sediments.

**Potential for community unrest**

With simultaneous construction activities, the host communities of the project area would experience an increase in population due to the influx of workers, camp followers, contractors, job seekers etc. This could lead to negative stress within the communities of several types. These could be cumulative with the influx of persons for each project and lead to community unrest. Other extraneous factors not related to the projects such as border dispute; inter-communal disputes & politics could also heighten the situation.

## CHAPTER SIX

### 6.0 MITIGATION MEASURES AND ALTERNATIVE MEASURES

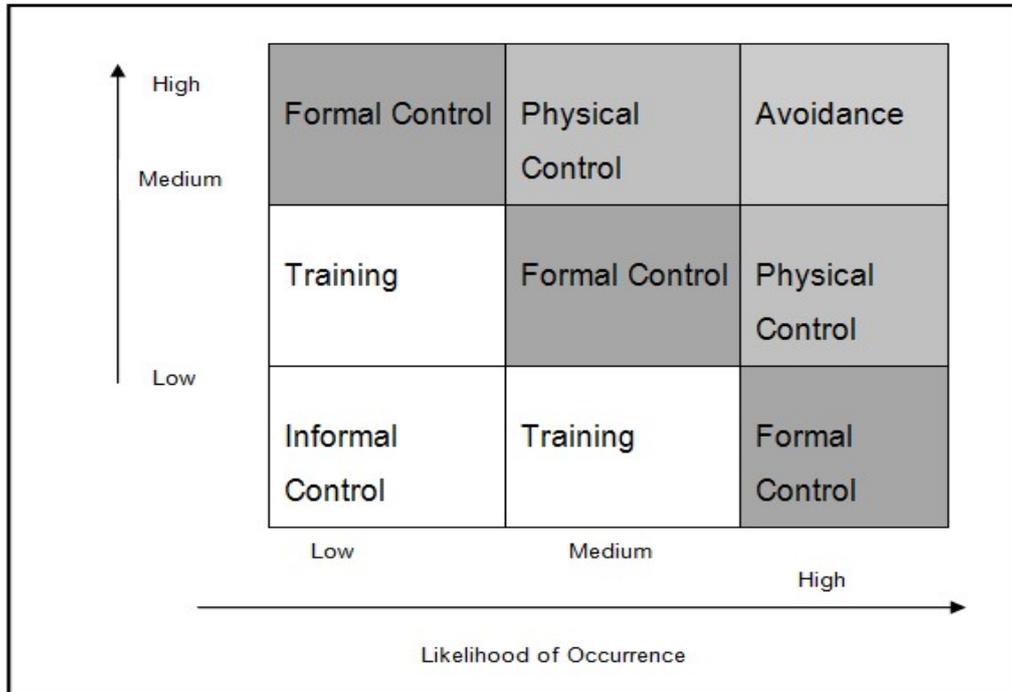
#### 6.1 Introduction

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 Installation of 20 inches Gas Pipeline 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.

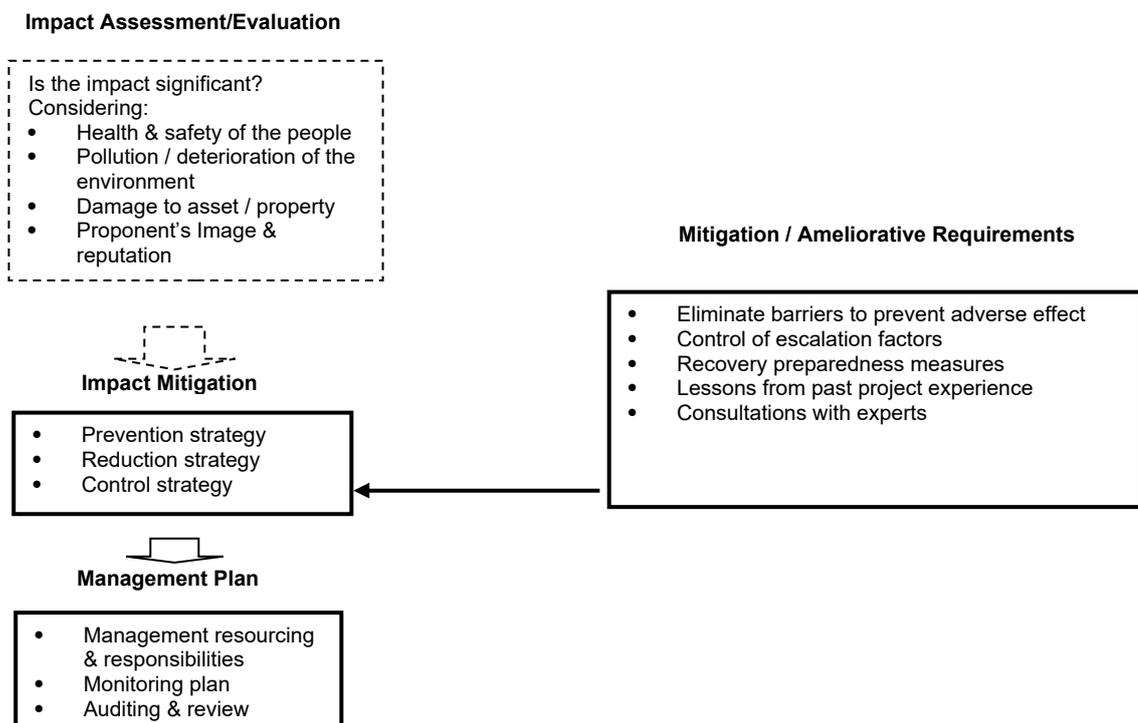
**Physical control:** This involves the application of physical processes or instruments (pegs, flags, signage), not necessarily requiring any special technology, in order to mitigate the impacts of a project or impacts.

**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**.

**Table 6.1: Proposed Mitigation Measures**

<b>Project Phase</b>	<b>Project Activity</b>	<b>Description of Impact</b>	<b>Significance Rating Before Mitigation</b>	<b>Mitigation</b>	<b>Significance Rating After Mitigation (Residual Impact Rating)</b>
Pre-Construction	Land acquisition for Manifold and flow lines	Loss of farmland and associated income	High	<ul style="list-style-type: none"> <li>DeSadel shall pay adequate compensation to affected land owners</li> <li>DeSadel shall increase productivity of remaining farmers through provision of farming support facilities such as improved varieties of seedlings and other extension services.</li> </ul>	Low
		Community unrest	High	<ul style="list-style-type: none"> <li>DeSadel shall identify all bona-fide land owners prior to land acquisition and payment of compensation.</li> <li>DeSadel shall ensure adequate consultations and enlightenment of host communities using established channels of communication to ensure transparency of the land acquisition and compensation payment process.</li> </ul>	Low
Mobilization	Movement of goods, equipment	Potential increase in road traffic	High	<ul style="list-style-type: none"> <li>Large and slow moving vehicles should be scheduled during off peak periods</li> </ul>	Low

	and personnel	volume		<ul style="list-style-type: none"> <li>• Ensure maintenance of all roads of any damage caused by project</li> <li>• Raise community awareness of unusual activity through the HSE/SD team</li> </ul>	
		Potential increase in road traffic incidents	Medium	<ul style="list-style-type: none"> <li>• Pre-mobilization of all vehicles</li> <li>• Visible warning signs on roads and vehicles</li> <li>• Speed breakers at sections traversing communities</li> <li>• Defensive driving course for DeSadel and contractor drivers</li> </ul>	Low
				<ul style="list-style-type: none"> <li>• Vehicle monitoring device/DeSadel journey management policy/night driving and alcohol policy shall be enforced</li> <li>• First aid training of workforce and provision of first aid boxes in operational vehicles.</li> </ul>	
		Increase in noise levels	High	<ul style="list-style-type: none"> <li>• Enforce night driving policy (no night driving except when unavoidable)</li> <li>• DeSadel shall ensure that all vehicles and equipment conform to World Bank limits for noise</li> </ul>	Low
		Reduction in air quality (dust, exhaust fumes)	Medium	<ul style="list-style-type: none"> <li>• DeSadel shall ensure that only vehicles with pre-mobilization certificates are used to reduce emissions from vehicle exhaust.</li> </ul>	Low
		Damage to the existing Road	High	<ul style="list-style-type: none"> <li>• DeSadel shall ensure repair of road when damage is caused by the project</li> </ul>	Low

Construction	Site preparation (land clearing, excavation )	Loss of flora and fauna	Medium	<ul style="list-style-type: none"> <li>• Site clearing shall commence from developed (e.g. roads) to undeveloped areas to provide escape routes for wildlife.</li> <li>• Hunting by employees of contractors shall be prohibited</li> <li>• DeSadel shall educate construction workers on the sensitive nature of the biodiversity of the area and the need for conservation</li> </ul>	Low
		Loss of habitat	Medium	<ul style="list-style-type: none"> <li>• DeSadel shall limit cleared area to what is required</li> <li>• DeSadel shall encourage the re-vegetation of land cleared for temporary use where feasible.</li> </ul>	Low
		Community unrest	High	<ul style="list-style-type: none"> <li>• DeSadel shall ensure that all host communities are represented in the employment of locals during land clearing and excavation to avert any conflict that could arise from perceptions of unfairness</li> <li>• DeSadel shall ensure that land clearing and excavation jobs are reserved exclusively for the host communities.</li> <li>• DeSadel shall abide by all MOUs signed with the host communities</li> </ul>	Medium
		Stress on existing	High	<ul style="list-style-type: none"> <li>• DeSadel shall ensure that both contractor and DeSadel personnel</li> </ul>	Medium

		security structures		<p>develops a high level of security consciousness both within and outside the work area.</p> <ul style="list-style-type: none"> <li>• Daily security reports shall have reviewed by the DeSadel Project Manager</li> <li>• Special security force shall be established and deployed for the project. This shall include deploying some of DeSadel security system to strengthen security in the area.</li> <li>• DeSadel shall ensure that a liaison to foster partnership with the community so as to guarantee security for the project is established and substained.</li> <li>• In order to beef up security for the project, DeSadel shall contact government authorities to improve the strength of the police force and shall consider providing assistance with equipment e.g. patrol vehicles, to ensure improved security.</li> <li>• DeSadel shall ensure that safety workshops to identify, security risks are regularly organized.</li> </ul>	
		Increase in dust and noise	Medium	<ul style="list-style-type: none"> <li>• DeSadel shall ensure that nose masks and ear muffs are worn by site workers during excavation.</li> </ul>	Low

				<ul style="list-style-type: none"> <li>Water shall be sprayed on construction sites to reduce dust levels especially during dry season</li> </ul>	
		Potential increase in erosion	High	<ul style="list-style-type: none"> <li>DeSadel shall re-vegetate areas not needed for construction as soon as possible following excavation.</li> </ul>	Low
		Threat to health of workers (snakes bites, insect stings, injuries, etc)	High	<ul style="list-style-type: none"> <li>DeSadel shall ensure usage of PPE by field workers</li> <li>DeSadel will ensure there are adequately trained and sufficient numbers of first aiders at each site</li> <li>DeSadel shall ensure that anti-venon/anti-histamine is provided on site to mitigate snake bites and insect stings.</li> <li>DeSadel shall ensure that awareness is created among site workers and nearby communities on the likelihood of exposure to poisonous wildlife and plants</li> </ul>	Low
Construction		Changes in local population	High	<ul style="list-style-type: none"> <li>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 the local population will</li> </ul>	Medium

				<p>grow.</p> <ul style="list-style-type: none"> <li>• DeSadel will look into the development of off-site job recruitment based on the training provided for local community personnel.</li> <li>• Movement of unauthorized persons into camps shall be strictly restricted</li> </ul>	
Construction		Increased in morbidity (including STIs) and mortality	High	<ul style="list-style-type: none"> <li>• Health awareness lectures shall be given to workers on the mode of transmission of STIs (including HIV/AIDS)</li> </ul>	Low
				<ul style="list-style-type: none"> <li>• As much as possible provide psychological support to persons living with the HIV virus</li> <li>• DeSadel shall insure immunization of workforce against as appropriate.</li> <li>• Provision of insecticide treated nets to field workers to reduce incidence of malaria.</li> <li>• Awareness campaign shall be carried out to enlighten the communities/field workers on the common communicable diseases and the health implications of drug and alcohol abuse, unprotected sex, prostitution and the need to sustain cultural values.</li> </ul>	

				<ul style="list-style-type: none"> <li>Alcohol and drug policy shall be implemented to encourage healthy lifestyle for workers.</li> <li>DeSadel shall assist the activities of the state action committee on STIs/HIV/AIDS within the local communities.</li> <li>DeSadel shall ensure site clinic is provided to take care of minor illnesses for all construction workers</li> <li>DeSadel shall ensure the provision of condoms for construction workers</li> </ul>	
		Increase in social vices	Medium	<ul style="list-style-type: none"> <li>DeSadel shall conduct enlightenment campaign and health education for the abatement of abuse of drugs, alcohol among workers throughout the life of the project</li> <li>DeSadel shall ensure that contractor enforces the alcohol and drug policy for Staff</li> <li>DeSadel shall encourage contractor to support sporting activities</li> <li>DeSadel shall support public health lectures with emphasis on common communicable diseases such as malaria, TB, STIs including HIV/AIDS.</li> <li>DeSadel shall engage and support local security systems</li> <li>DeSadel shall provide condoms for</li> </ul>	Low

				<p>construction workers</p> <ul style="list-style-type: none"> <li>DeSadel shall ensure that contractor implements social and health awareness programs for all workers at induction and on a continuous basis throughout the life of the project</li> </ul>	
		Pressure on existing infrastructures and utilities	High	<ul style="list-style-type: none"> <li>DeSadel shall make adequate accommodation arrangement prior to mobilization on workforce to reduce pressure on local housing.</li> <li>As appropriate, DeSadel shall support the development of the health facility</li> <li>DeSadel shall provide basic recreational facilities for workers within their camps</li> <li>DeSadel shall extend water supply from camps/worksites to communities at strategic points</li> </ul>	medium
		Increase in inflation level	High	<ul style="list-style-type: none"> <li>DeSadel shall support skill development and enhancement of the local communities through training and complemented by cooperatives and micro-credit schemes.</li> </ul>	Medium
		Changes in culture, lifestyle	Medium	<ul style="list-style-type: none"> <li>DeSadel shall carry out enlightenment complains to encourage positive influence on</li> </ul>	Low

		and habits		cultural values and healthy lifestyles (e.g. breast feeding habits, alcohol and drug use, exercise, monogamy, high moral values with regard to sexuality etc) and discourage adverse influences (e.g. prostitution, drug abuse, alcoholism etc).	
		Increase in potential for erosion	High	<ul style="list-style-type: none"> <li>DeSadel shall re-vegetate areas not needed for construction as soon as possible.</li> </ul>	Low
		Soil degradation	Medium	<ul style="list-style-type: none"> <li>DeSadel shall provide containment for chemicals and liquid discharges.</li> <li>DeSadel waste management policy shall be enforced in cases of domestic waste, scrap metals, non-plastic combustible packaging materials, plastic packaging materials, drums and containers as well as medical wastes.</li> <li>DeSadel shall ensure that a controlled fuelling, maintenance and servicing protocol for construction machinery at worksite is established and followed to minimize leaks and spills.</li> </ul>	Low
		Injury to	High	<ul style="list-style-type: none"> <li>DeSadel will ensure there are</li> </ul>	Medium

		workers		<p>adequately trained numbers of first aiders at each site.</p> <ul style="list-style-type: none"> <li>• DeSadel shall provide and enforce appropriate use of PPEs (e.g. coveralls, hard hats, eye goggles)</li> <li>• DeSadel shall ensure that health talks awareness lectures and job hazard analysis are conducted prior to work activities.</li> </ul>	
		Loss of biodiversity	Medium	<ul style="list-style-type: none"> <li>• DeSadel shall limit cleared area to what is required DeSadel shall ensure that site clearing is commenced from developed (e.g. roads) to undeveloped areas to provide escape routes for wildlife</li> <li>• DeSadel shall undertake to educate construction workers and locals on the sensitive nature of the biodiversity of the area and the need for conservation</li> <li>• DeSadel shall ensure that hunting by employees of the contractors shall be prohibited</li> <li>• DeSadel shall encourage the contractor to re-vegetate land cleared for temporary use where feasible</li> </ul>	Low

		Reduction in air quality	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure that all mobile and stationary internal combustion engines are properly maintained</li> </ul>	low
		Increase in breeding ground for disease vectors and other agents of diseases	High	<ul style="list-style-type: none"> <li>DeSadel waste management policy shall be enforced</li> </ul>	Low
		Increase in nuisance	Medium	<ul style="list-style-type: none"> <li>DeSadel CLOs will ensure there is continuous communication with the communities</li> </ul>	Low
		Blockage of natural drainage	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure that wastes are disposed of at appropriate locations provided for waste disposal and collected as quickly as possible.</li> </ul>	Low
		Contamination of the environment by domestic wastes	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure regular collection and disposal of wastes in accordance with the project waste management plan</li> </ul>	Low
		Threat to health of workers	High	<ul style="list-style-type: none"> <li>Enntec shall ensure that fully equipped first aid boxes, and trained first aiders are available on site at all times in addition to a functional site clinic</li> <li>DeSadel shall enforce appropriate use of personal protection</li> </ul>	Medium

				<p>equipment (PPE)</p> <ul style="list-style-type: none"> <li>DeSadel shall ensure the training of first aiders (at least 1:50)</li> <li>DeSadel shall ensure that anti-venom/anti-histamine is be provided on site to mitigate snake bites and insect stings.</li> </ul>	
		Pollution of surface water sources	High	<ul style="list-style-type: none"> <li>DeSadel shall ensure that bund walls used for storage of drilling materials are not cracked</li> <li>DeSadel shall ensure regular collection and disposal of wastes in accordance with the DeSadel 's waste management plan</li> <li>DeSadel shall ensure that disposal of drilling wastes is in line with regulatory standards</li> </ul>	Low
Laying of flow lines and pipe line network	ROW bush clearing, Trenching Stringing Welding Radiography	Reduction in flora and fauna population	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure that only the minimum required land for the ROW shall be cleared</li> <li>DeSadel shall re-vegetate areas not utilized during operation of the pipeline</li> </ul>	Low
	Field joint coating Lowering Backfilling Hydro-testing	Threat to health of workers (snake bites, insect stings, injuries, etc)	High	<ul style="list-style-type: none"> <li>DeSadel shall ensure that fully equipped first aid boxes are available on site at all times in addition to a functional site clinic</li> <li>DeSadel shall enforce appropriate use of PPE's</li> </ul>	Medium

				<ul style="list-style-type: none"> <li>• DeSadel shall ensure the training of first aiders (at least 1:50)</li> <li>• DeSadel shall ensure that anti-venom/anti-histamine is provided on site to mitigate snake bites and insect stings.</li> </ul>	
		Increase in noise levels	Medium	<ul style="list-style-type: none"> <li>• DeSadel shall inform communities in advance of likely increase in noise level during trenching</li> <li>• DeSadel shall ensure that workers in high noise areas wear ear protecting equipment</li> </ul>	Low
		Reduction in air quality (dust, exhaust fumes)	Medium	<ul style="list-style-type: none"> <li>• DeSadel shall ensure that appropriate maintenance programs are in place for all equipment</li> <li>• DeSadel shall ensure that water is sprayed regularly to reduce dust levels in dry season</li> </ul>	Low
		Potential increase in erosion	Medium	<ul style="list-style-type: none"> <li>• DeSadel shall ensure that trenches are back-filled as quickly as possible.</li> </ul>	Low
	Laying of flow lines and pipe line networks	Contamination of surface water bodies	High	<ul style="list-style-type: none"> <li>• DeSadel shall ensure that trenches are back-filled as quickly as possible.</li> </ul>	Low
		Potential for falls into	Medium	<ul style="list-style-type: none"> <li>• DeSadel shall put barriers and warning signs close to open</li> </ul>	Low

	(ROW bush clearing, Trenching, Stinging, Welding,	exposed trenches (by animals, unsuspecting passers-by)		trenches.	
	Radiography, Field joint coating, Lowering, Backfilling, Hydro-testing)	Soil degradation from spills and leaks	High	<ul style="list-style-type: none"> <li>DeSadel shall ensure that all maintenance and repair of equipment and vehicles are done in a secure location with clean-up materials (e.g. drip pans, containers, absorbent materials etc) readily available.</li> </ul>	Low
		Change in the topography of the soil	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure that the original topography is maintained as far as Practically possible.</li> </ul>	Low
		Exposure to radiation materials	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure that adequate safety measures (appropriate PPR and engineering techniques) are put in place to avoid exposure to radioactive materials.</li> </ul>	Low
		Potential for inhalation of welding fumes	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure that adequate safety measures (appropriate PPE) are put in place or avoid inhalation of welding fumes</li> </ul>	Low
		Potential for conflicts arising from labour	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure that she abides by agreements reached with the welders union before</li> </ul>	Low

		issues (welders)		their engagement	
		Erosion from release of Hydro- test water	High	<ul style="list-style-type: none"> <li>As far as is practicable DeSadel shall control the rate, flow and location of the release of hydro-test water.</li> </ul>	Low
		Contaminatio n of surface and underground water and soil from inhibited hydro-test water	High	<ul style="list-style-type: none"> <li>If required, DeSadel shall treat inhibited hydro-test water before discharging to the environemnt</li> </ul>	Low
		Decrease in communities water source due to collection of hydro-test water	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure that hydro-test water is not collected from community borehole/water sources</li> </ul>	Low
		Potential increase in incidents (arising, for example from high pressure of pipes during hydrotest)	High	<ul style="list-style-type: none"> <li>DeSadel shall place warning signs near the high pressure pipes during hydro- testing</li> <li>As far as is practicable, DeSadel shall ensure the enginnering integrity of the hydro-test process</li> </ul>	Low
	Pipeline Operations	Degradation of soil and	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure the provision of containment for</li> </ul>	Low

		surface water from spills and leaks		<p>chemicals and liquid discharges</p> <ul style="list-style-type: none"> <li>• DeSadel waste management policy shall be enforced</li> <li>• DeSadel shall ensure that a controlled fuelling, maintenance and servicing protocol for machinery is established and followed to minimize leaks and spills.</li> </ul>	
		Threat to health of workers (snake bites, insect stings, injuries, etc)	High	<ul style="list-style-type: none"> <li>• DeSadel shall ensure that fully equipped first aid boxes, and trained first aiders are available on site at all times in addition to a functional site clinic</li> <li>• DeSadel shall enforce appropriate use PPE</li> <li>• DeSadel shall ensure that anti-venom/anti-histamine is provided on site to mitigate snake bites and insect stings</li> <li>• DeSadel shall ensure the training of first aiders (at least 1:50)</li> </ul>	Low
Decommissioning Restoration and Abandonment	Surface equipment dismantling, Excavation, Removal and Disposal of concrete works and pipes	Increase in dust generation	Medium	<ul style="list-style-type: none"> <li>• DeSadel shall ensure proper use of PPEs</li> <li>• DeSadel shall ensure that water is sprayed to reduce dust levels</li> </ul>	Low

		Increase in noise levels	Medium	<ul style="list-style-type: none"> <li>DeSadel shall inform communities in advance of likely increase in noise level during decommissioning</li> <li>DeSadel shall ensure proper use of PPE (ear muffs)</li> </ul>	Low
		Increase in respiratory tract diseases	Medium	<ul style="list-style-type: none"> <li>DeSadel shall ensure that all personnel are medically certified for the operation prior to engagement</li> <li>DeSadel shall enforce appropriate use of PPE (nose mask)</li> <li>DeSadel shall use barriers to separate dusty activities from non dusty ones</li> </ul>	Low
		Increase in waste generation	High	<ul style="list-style-type: none"> <li>DeSadel shall ensure that wastes are disposed of in accordance with her waste management plan for this project</li> </ul>	Low
		Potential for community unrest (from employment, pollution and resistance to dismantling of equipment)	High	<ul style="list-style-type: none"> <li>DeSadel shall ensure fair community representation in the employment of local labour</li> <li>DeSadel shall ensure that the waste management plan for this project is implemented</li> <li>DeSadel shall abide by the MOUs signed with the communities for this project.</li> </ul>	Medium

## **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 all the 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.

### **6.7.7 Land Use Conflict**

Careful selection of survey lines shall be made to avoid important social and agricultural resources impacts. No community shall be displaced and no compensation made because only setback shall be used for the project.

#### **Mitigation of Vegetation impacts and soil conservation**

Vegetation clearing shall be restricted to the Work and camp sites, acquired right of way and additional areas essentially needed for the development and safety of operations. On completion of pipe laying, cleared areas that are not part of the immediate ROW shall be re-vegetated and restored to its original state as much as possible. The exposed land area and duration of exposure will be minimized. Temporary (during construction) and permanent, erosion control measures shall be installed. After the commissioning, all excavated

areas and camp bases shall be properly backfilled and exposed areas re-vegetated with native plant species.

Proposed erosion control measures shall adopt the following techniques:

- Silt fencing;
- Temporary silt trap basin/construction;
- Short term seeding or mulching of exposed soil areas, particularly on slopes;
- Limitations on access for heavy machinery and the storage of pipes to avoid soil compaction.

#### **Control of vegetation in Right-of-Way**

Control of vegetation will employ selective clearing using mechanical means. Broadcast aerial spraying of herbicides shall be avoided because it affords no selectivity and may release unnecessarily large amounts of chemicals into the environment.

#### **Control of Noise and Vibration**

Major construction activities such as, excavation, crane work and backfilling, will be limited to daylight hours to minimize construction noise. Mufflers will be used on diesel equipment and power generators. Appropriate PPE such as ear muffs shall be provided for the workforce and their usage enforced with sound policies like:

- Effective staff awareness campaign on the implications of non-compliance with PPE policy shall be embarked upon. It is the employer's responsibility to make proper use of the protection equipment provided by management;
- Records of noise-exposure measurement of workers shall be kept

- Individual worker's exposure to excessive noise shall therefore be controlled by shift arrangement; and
- Acoustic enclosures and silencers shall be used for high-capacity diesel generators.

### **Wildlife Displacement and loss**

Displaced animals such as antelopes, monkeys, birds and reptiles would migrate and find refuge in undisturbed adjacent vegetation, which is similar in structure, physiognomy and floristic composition to the one in the proposed locations.

- Hunting, fishing, trapping and gathering of food resources by workers, when on- and off-duty, shall be strictly prohibited;
- Poaching shall be prohibited during all phases of project; and
- Roosting, breeding and feeding sites shall be avoided by careful routing.

### **Control of surface and ground water pollution**

Proposed location shall be selected to avoid impacts to water bodies and floodplains. Sediments traps shall be installed to control runoff and sedimentation. Drainage dishes shall also be designed to avoid affecting nearby lands. Wastewater (hydrotesting) shall be properly treated to meet water quality standards before discharge.

## **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 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

### ENVIRONMENTAL MANAGEMENT PLAN (EMP)

#### 7.1 General

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 associated and 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 life cycle. The EMP for the proposed gas pipeline project, which outlines the strategies for managing hazards, associated and potential impacts and their effects on the environment, is presented in this chapter. This EMP is developed to ensure that mitigation measures and monitoring requirements are provided for environmental impacts described in chapter six of this report. It is also providing the basis for the environmental compliance review that shall be carried out in subsequent stages of the project. EMP is an important management tool which sets out conditions and targets to be met during project implementation. This EMP contains among others the following key items:

- Summary of potential impacts
- Planned mitigation measures
- Planned environmental monitoring
- Planned public consultation process
- Responsibilities and authorities for implementation of mitigation measures and monitoring requirements
- Mechanisms for feedback and adjustment

## 7.2 EMP Objective

The EMP is designed to:

- ensure progressive reduction of the impacts of the project activities on the biophysical, socioeconomic and health environment with the ultimate aim of eliminating them;
- ensure that all mitigation and enhancement measures prescribed during the impact assessment process for eliminating or minimising the adverse project impacts as well as optimally enhancing the beneficial impacts are fully implemented; and
- provide part of the basis and standards needed for overall planning, monitoring, auditing and review of environmental and socio-economic performance throughout the project life cycle.
- Demonstrate that a systematic procedure ensuring that all project activities are executed in compliance with applicable legislations and policies on Health, Safety, Environment, Security and Community Relations have been established for the project;
- Show that mitigation measures for all impacts and effects have been established and shall be maintained throughout the project's life cycle, so that impact risk levels will remain ALARP;
- 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

These objectives shall be achieved by:

- ensuring compliance with all stipulated legislation on protection of health, safety and environment policies;
- integrating environmental issues fully into the project development and operational philosophies;
- promoting environmental management awareness among workers;
- rationalising and streamlining existing environmental activities to add value to efficiency and effectiveness; and
- ensuring that only environmentally sound procedures should be employed during the project.

The EMP includes the following plans/programs:

- Environmental Capacity Building Program;
- Environmental Monitoring Program;
- Audit Program;
- Traffic Management Plan;
- Risk Management Plan for polluted Waterway
- Hazardous Materials Management Plan;
- Decommissioning and Closure Plan

### **7.3 Management Organization**

#### **(a) DeSadel Nigeria Limited Establishment**

DeSadel Nigeria Limited shall retain the primary responsibility of ensuring that environmental commitments are met through-out 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 Works and Environment Department of DeSadel Nigeria Limited shall offer expert advice on protection measures and shall assist to monitor performance. DeSadel Nigeria Limited shall appoint an Environmental Monitoring Team (EMT) to ensure effective implementation of the recommendations of the EIA and its management plan. The EM Team shall verify the effectiveness of the EMP implementation in liaison with Regulators and other stakeholders as appropriate. DeSadel Nigeria Limited shall take responsibility for all environmental matters and ensure that contractors comply with all applicable environmental laws, regulations and policies as they apply to this proposed gas pipeline project. In principle, the Contractor responsible for construction of the transmission line and associated facility project shall be responsible for implementing those aspects of the EIA recommendations that pertain to the engineering, procurement and construction phase. The Contractors for this project shall be required to submit, for approval, their proposal to manage HSE inherent in their contract execution. The Environmental Management Team will operate in an advisory capacity in all matters.

#### **(b) HSE Coordinator**

The HSE coordinator shall report directly to the transmission line Project Manager (PM). The coordinator shall have the authority to stop work or any activity which poses danger to the environment, workers, or the general public during the project construction phase, until measures are instituted to eliminate the dangers or threats. The responsibilities shall include:

- ensure that mitigation measures outlined in the EIA are implemented;

- liaise with the project manager, contractors and other supervisors to ensure as far as reasonably practical, environmental protection, safe and healthy conditions at all work sites;
- coordinate environmental and safety activities between DeSadel Nigeria Limited and all contractors/organisations providing services at the project site;
- ensure clear communication of safety, health and environmental and socio- cultural information to all categories of workers;
- liaise with management in deciding which environmental and safety concerns could be handled in-house and which matters shall require external assistance; and
- co-ordinate, investigate and review environmental and safety incidents and complaints and maintain separate site incident and complaint records

#### **7.4 Use and Maintenance of the EMP**

The EMP shall remain a dynamic working tool and will be owned by the proposed gas pipeline project. DeSadel Nigeria Limited supervisor 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 Environmental Management Team and integrated into the EMP.

## **7.5 Regulatory Compliance**

The EMP implementation shall be closely FMEnv and this shall involve a two-way information flow between DeSadel Nigeria Limited and the regulatory body. The FMEnv has the responsibility of enforcing national environmental laws including international environmental laws which Nigeria has subscribed to;

- The FMEnv will serve as a regulatory oversight to the EMP implementation of this project;
- The FMEnv and NESREA shall ensure that DeSadel Nigeria Limited periodically make available documentations in form of monthly/quarterly reports or as may be required showing evidences of caring out monitoring requirements, etc. Environment-related regulations as they apply to the Project has been be documented and described in this EIA. DeSadel Nigeria Limited management shall ensure compliance with these regulations throughout the project's lifecycle in line with measures inherent in the Engineering Project Management Guide (EPMG).

## **7.6 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 facilities for this gas pipeline project have been established as part of the Engineering Development phase of this project. These standards and criteria are meant to ensure that the design of the facilities for this project is in line with currently accepted HSE principles and policies. In particular, the

HSE premise 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 facilities for this project, efficient use of natural resources and energy sources as a 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 premise 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 operation of the gas pipeline Project.

### **7.7 Stakeholders Engagement**

DeSadel Nigeria Limited shall welcome suggestions and information from relevant stakeholders, contractors, visitors and the general public, which shall help improve its operations in order to minimize impact on the environment and worker health and safety. The office of the transmission manager shall be open to the general public for complaints and suggestions. Complaints received from the public shall be documented and follow-ups made to ensure that such grievances are addressed accordiDeSadelly and in line the DeSadel Limited's grievance redress mechanism.

### **7.8 Monitoring**

Project activities shall be monitored in order to:

- ensure that the EMP is implemented; and
- assess the efficiency of mitigation actions;
- provide updates where necessary

All contractors shall be required to self-monitor their performance with respect to environmental and social performance. The DeSadel Nigeria Limited HSE Engineer shall also undertake quarterly environmental assessment and random walk through and spot checks throughout the project lifecycle. Assessment findings shall be reviewed by the project management team and where corrective actions are necessary, specific plans (with designated responsibility and timing) shall be developed to ensure continuous performance improvement. In addition to assessing operational aspects and monitoring assessments shall also consider compliance with agreed objectives and targets, and the effectiveness of the EMP and its implementation. The EMP shall, therefore, be subject to ongoing review and development to ensure that it remains appropriate for all aspects of the project. As is typical with all Federal Ministry of Environment and Department of petroleum Resources approved projects, the ministry will carry out an assessment before the end of the project to confirm compliance of project activities to the terms and conditions of the EIA approval.

### **7.9 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 have been developed into an EMP that provides a detailed action plan with roles and responsibilities for their implementation. Part of the conditions of the approval of the EIA by the Federal Ministry of Environment (FMEnv) is that

there will be regulatory monitoring of the approved project impacts mitigations and monitoring measures.

### **7.10 Prevention of Accidents/Incidents**

Prevention of workplace accidents and incidents during the proposed project shall be achieved using the Job Hazard Analysis (JHA) tool and written Work Instructions (WIs). Consequently, the HSE and Security Team Leaders 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 Nigeria Limited and contractors, shall address the following emergency situations.

- Fires and Explosions;
- Serious injury or illness;
- hydrocarbons/chemical spills
- Weather related disasters; and
- Land vehicle mishaps.
- Civil unrest and kidnapping

The HSE and Security Team Leaders 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-ordinated from a common viewpoint by all stakeholders and be in line with DeSadel security guidelines. In addition, each contractor shall be required to submit a project security plan to DeSadel Nigeria Limited for review and approval. As part of the Environmental Management Plan and with the approval of the Project Manager, the Security Team Leader shall organize security workshops to identify, evaluate and recommend contingency plans for all security risks associated with the gas pipeline and associated facilities Project.

### **7.11 Training and Awareness**

In order to assure competence and awareness amongst DeSadel personnel and Contractor staff, 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:

- **Module I:** Environmental Overview
- **Module II:** Environmental Regulations and Acts
- **Module III:** Pollution
- **Module IV:** Environmental Impact Assessment

- **Module V:** Environmental Management System
- **Module VI:** Mobilization and Environmental Issues
- **Module VII:** Environmental Issues in the Project
- **Module VIII:** The Environmental Management Plan for construction Projects
- **Module IX:** Environmentally Sound Construction Management
- **Module X:** Long Term Environmental Issues in Management

Certificates of attendance shall be issued to successful participants. DeSadel Nigeria Limited 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 Environmental Audits. The training modules are combined into different training components. There are overlaps in the composition of the target groups and the constitution of the training components. However, each training module would be developed keeping in view the composition and responsibilities of the target group members. Other Components may be imparted throughout the implementation period and held in the initial months of project implementation, preferably on site. The following tools are expected for the implementation of environmental training programme:

- Informal Training Sessions;
- Audio-Visual Communications;
- Case Studies;
- Lecture Sessions;

- Workshops;
- Group Discussions;
- Short-Term Training Courses;
- Seminars;
- Full-term Training Courses.

### **7.12 Maintenance Programme**

The maintenance officer to be employed by the contractors for the project shall develop a comprehensive maintenance programme for all equipment. 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 and Security 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.

### **7.13 Construction Guidelines**

#### **7.13.1 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 the portion of land not used for project activities shall be cordoned off and left undisturbed.

#### **7.13.2 Health and Safety of Workers**

Throughout the project development Hazards and Effects Management Process (HEMP) 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. Operations at all work sites shall be subject to government, industry and DeSadel Nigeria Limited HSE policies and guidelines. All DeSadel Nigeria Limited centre 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. Contractors shall provide adequate health services as well as site first aid services for its workforce. The first aid services shall be extended to work related visiting personnel and employed 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;
- Regular emergency drills;
- Prohibition of smoking in fire hazard areas.

### **7.13.3 Emergency Response**

The following equipment shall be provided as minimum requirements for emergency response action.

- Safety showers at locations in the project site where accidental

spillage of chemicals could occur. Supply shall be taken from the firewater system;

- Safety signs and notices shall be provided throughout the centre in accordance with FMEnv requirements and standards;
- A general alarm system shall be provided, capable of giving an audible alarm in all areas of the project facility and visual display in areas of high background noise;
- Emergency response procedures shall be put in place for snakebites, road traffic accidents, medevac/medial rescue and gas leaks.

During operations, firefighting and associated facilities shall be inspected and tested on a periodic basis to verify inventory and function. Also, DeSadel Nigeria Limited through the administration department shall carry out programmes to educate the communities and local health facilities on what to do in case of a major incident of fire/accident. DeSadel Nigeria Limited's emergency response guidelines relevant to this project shall be publicly displayed at strategic locations. In order to safe guard the lives of personnel and contractors during emergency situation, DESADEL contractor shall develop and implement an emergency response plan. Emergency training shall be conducted by the HSE Manager to enhance worker's preparedness to respond appropriately to emergencies. Emergency drill shall be conducted periodically and such drill shall include fire, abandonment as well as first aid emergencies. Response time and roll call shall be monitored and recorded by the HSE Manager, supervisor or fire warden as required, at each drill/training to ensure compliance. All drills and training exercise shall be documented by the HSE Manager or the supervisor and copies sent to DeSadel. In situations where evacuation of personnel is necessary as a result of fire or any other related accidents,

DeSadel Nigeria Limited shall follow the emergency medical evacuation procedure with responsible parties.

#### **7.13.4 Waste Management Guidelines**

Waste shall be managed in accordance with Federal Ministry of Environment, Department of Petroleum Resources and the various local Government council DeSadel waste management procedures. The principle of waste reduction, recycling, recovery and reusing shall be practiced. In addition to the regulations, the project will also comply with other national and international environmental standards that are binding on all staff and contractors involved in the proposed project with respect to the following:

- emission or release of pollutant, exhaust and/or fugitive gases;
- discharge or spill of effluent into surface water or land; and
- discharge of wastes (including domestic waste) into surface water, swamp or land;

The DESADEL contractor is also expected to develop and submit for approval to DeSadel Nigeria Limited a comprehensive waste management plan to be used during the construction phase of the project. This waste management plan shall be in line with DeSadel HSE Management System and shall comply with national and international waste management standards. The handling, storage and disposal of all wastes that will be generated during the life of the project shall be in accordance with regulatory standards and approved waste management guidelines. These guidelines are binding on all staff and contractors involved in the proposed project with respect to:

- Emission or release of pollutants, exhaust and/or fugitive gases.

- Discharge or spill of effluent into surface water or land.
- Discharge of wastes (including domestic waste) into surface water or land.
- Generation of noise and vibration.

In the design of the waste management plan the focus shall be on reduce of use, optimal recycling and reuse of materials.

### **1)Waste Handling**

Wastes for proper handling and disposal shall be well defined at source and the definition transmitted along with the waste to the final disposal points. Contractors and DeSadel Nigeria Limited personnel shall define and document all wastes generated in the course of work. Basic information that must be provided, as a minimum, for adequate definition of wastes include:

- Waste type identification
- Proper waste categorization
- Waste segregation information
- Recommended Management practices.

### **ii) Waste Minimization**

Waste minimization implies reduction to the greatest extent possible of the volume or toxicity of waste materials. The five principles of waste minimization process: recycle, reduce, reuse, repair and recover shall be adopted as applicable. Opportunities to achieve significant waste volume reductions during the proposed project are functions of activity level, age, depreciation and maintenance level of operating equipment.

### **iii) Waste Segregation**

It is important that for effective implementation of appropriate wastes disposal methods, wastes be segregated, preferably at source into clearly designated bins at strategic locations. It is the responsibility of the contractors, during their operations to provide enough clearly marked bins at strategic locations to ensure proper segregation.

Different colour codes are assigned to specific waste bins

**Table 7.1: Waste Bin Colour Code**

Food/Vegetation Waste	Green
Glass waste	Blue
Plastic waste	Brown
General (non-useable)	Black
Medical waste	Yellow
Toner/developer	White
Metal scraps	Purple

For medical wastes (hazardous & non-hazardous) segregation at source into colour coded bags would be as follows:

**Table 7.2: Medical waste colour code**

<b>Hazardous medical waste</b>	
Clinical combustibles	Yellow or yellow tagged bags
Sharps	Cin bin
No sharp/non-combustible	Black or black tagged bags
Foul or infected linen	Red or pink bags
Recyclable linen	White or white tagged bag
Cytotoxic waste	Orange bin
<b>Non-hazardous</b>	
Paper	Clear or clear tagged bag

### iii) Wastes Inventory

An inventory of waste generated shall be maintained. Weighing scales or measuring

devices shall be provided to measure quantities of waste generated/discharged. Records of waste generated, treated and sent for disposal shall be maintained on site. Wastes to be transferred to offsite facilities for treatment and disposal shall be done in accordance with the various State Ministry of Environment waste transfer process and in line with other statutory requirements.

#### **iv) Waste Disposal**

All debris, spoil materials, rubbish and other waste, except excavated soil and rock, shall be cleared regularly from the site and cleared by approved various state approved waste managers. Instructions on material safety handling sheet shall be strictly adhered to and shall form the basis for the disposal of wastes related to such products. Wastes in transit shall be accompanied and tracked by consignment notes.

**Table 7.3: Management of waste streams**

Project Phase	Activity/Source of Waste	Waste Generated	Management Options
Pre-Construction	Delivery of equipment to site (light vehicles and heavy vehicles, portable toilets)	Packaging (ropes and strapping, cardboard), timbers-kids, fibre/nylon rope spacers, pallets, drums and scrap metals	Recycle metals; Dispose general off site to local licenced landfill
	Camp Site/site Office	General and paper wastes	General waste to local licensed landfill. Recyclable material to recycling facility (where available)
	Installation of fencing and gates	Fencing wire off cuts	General waste to local licensed landfill.
	Bush clearing	Green waste (felled vegetation and plant matter)	Stockpiled vegetation will be reapplied during restoration of RoW
	Excavation/Trenching	Topsoil and excavated material stockpiled for backfilling and application to RoW)	All topsoil and excavated material reused for backfilling in RoW
	Pipe bending, stringing	PVC or polyethylene pipe end caps	Recycling of PVC
	Welding	Mild steel pipe off cuts and defective pipe, metal filings	Recycling of waste metals
	Coating of welding joints	Chemical containers (i.e. paint/epoxy coating cans, empty containers of rust proofing agents	Transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill
	In field servicing and maintenance of construction plant and equipment	Oily rags, spent absorbent material in field servicing and maintenance waste oil	Licensed contractor to transport regulated waste to a licensed recycling facility

		and grease e.g lube oil hydraulic oil and engine oil waste associated with diesel generator operation and Maintenance	Waste oil to be recycle and reused, treated before disposal
Commissioning	Hydro-test	Hydrostatic test water not treated with biocides, corrosion inhibitor	Hydro-test water treated before discharge to land or water
Operation & Maintenance	Pipping	Pipe cleaning waste (pigging grit – scale, rust, or other foreign material) Contaminated excavated soil	Pigging grit – licensed contractor to transport regulated waste to a licensed regulated waste landfill incinerate with IDU before disposal.
		Spent toner and printer cartridges, electronic and electrical equipment, white goods, computers, office equipment.	Equipment reuse and recycle
	Office waste, construction materials and equipment store	Spent lamps and fluorescent tubes. Paper – office paper.	Recyclable material to recycling facility (where available) General waste to local licensed landfill.
		Wood (pallets) construction materials and other equipment.	Pallets will be collected by suppliers during subsequent deliveries.
Decommissioning	Restoration and rehabilitation (decommissioning and abandonment)	Construction materials, concrete, scrap metal, plywood, plastics, electrical wiring, etc.	On decommissioning any remaining material will be offered to local land owners for reuse or removed for treatment or disposal in accordance with the principles of the Corporation

The waste consignment notes shall contain the following information as a minimum:

- Date of dispatch;
- Description of waste;
- Waste quantity/container type;
- Type of waste
- Consignee/driver name and means of transportation; and
- Confirmation of actual disposal (time and date).

### **7.13.5 Pollution Control**

#### **i) Air Pollution**

In operating equipment DeSadel Nigeria Limited 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.

#### **ii) Water and Soil Pollution**

**a) Wastewaters:** DeSadel Nigeria Limited Pollution of surface water by project-related waste including excavation exercise and wastewater shall be prevented by proper management practices. Contaminated or potentially contaminated area run-offs shall be collected and treated to meet regulatory requirements before discharge.

**b) Soil:** DeSadel Nigeria Limited 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 Nigeria Limited shall comply with all requirements for noise control and with regulatory standards. For example, DeSadel Nigeria Limited shall ensure that contractor plans activities such that FMEnv and NESREA 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 visitor within 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 Nigeria Limited will 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. Also, noise mapping of the facility shall be done and a map produced and visibly displayed. The possibility of encroachment up to the fence line is taken into account in the design of noise reduction measures.

## **7.14 Site Inspection Procedures**

Throughout the projects life, The Environmental Management Team and representatives of regulatory bodies 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 and Security Team Leader request 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 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 Contractor shall be requested to take appropriate measures. The inspection procedure shall be repeated after implementation.

### **7.15 Audit Programme**

FME<sub>env</sub> and NESREA directed Environmental audit shall be conducted at the project site three (3) years after closeout of impact mitigation monitoring (1MM) DeSadel Nigeria Limited Works Director on the advice of the HSE and

Security Team Leader shall provide authorization. The audit process shall be used to confirm that mitigation measures listed in the EMP of the EIA have been followed and complied with as well as to assess the environmental performance of project management during the all phases of the project. This will ensure that environmental protection and management procedures are being enforced. In implementing the audit programme, facilities on the gas pipeline and other facilities perceived as having high environmental risks shall be thoroughly investigated. The audit programme shall:

- Examine compliance with regulatory requirements;
- Examine line management systems, pipeline 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 operations in the proposed gas pipeline.

After every audit exercise, the environmental auditor shall produce an Environmental Audit Report that shall be submitted to DeSadel Nigeria Limited HSE, FMEnv, AKSEPWMA, AKSMENV and NESREA. Audits of the facility activities shall be conducted in order to ascertain extent of compliance with set guidelines, policies and requirements. The audits shall be carried out by certified auditors (both in-house and independent auditors) and in accordance with regulatory requirement and ISO 14001 guidelines. The scope of the audit shall include the following:

- compliance with all necessary codes, standards and procedures;

- examination of line management systems, operations, monitoring practices etc.;
- identification of current and potential environmental problems especially during the operational phase of the project;
- checking the predictions in EIA and assure implementations and application of recommended practices and procedures; and
- make recommendation for the improvement of the management system of the operation.

Also as part of audit and review this EMP shall be reviewed annually to determine its adequacy/suitability for continuous use.

#### **7.15.1 Capacity Assessments**

Capacity assessment and development process for those to be charged with managing the mitigation measures and grievance procedures is usually a cyclical process. Such a cycle will comprise several steps, from recognition of capacity deficiencies/efficiencies to the implementation of capacity development initiatives. Contract Agreement requirement is that the DESADEL submit the resume of key personnel, especially for those who would be directly responsible for the implementation, reporting, and monitoring of the EIA impacts mitigation and monitoring measures. Approval of personnel will depend on their proven experiences and capability to manage the recommended measures. Those whose capabilities are determined to meet the requirement will be approved for engagement in the project but those whose experiences and skill are determined to be insufficient will not be approved. The implication is that the DESADEL may retain and engage their services from temporary to permanent basis if it so wishes but they will not be engaged by DeSadel Nigeria Limited for the operation of the gas pipeline.

DESADEL deliverables will include engagement of sufficient and skilled personnel for key project areas especially in the HSE and socio-economic sections to ensure effective implementation of the project impacts mitigation and monitoring measures. The Project and DESADEL's Environmental Management Plan will specify the roles and responsibilities of those charged with HSE duties especially for those responsible for implementing the mitigation and monitoring measures. The EMP will also include training programs for such personnel in order to enhance their capabilities and performance. The project specific plans to be developed by the DESADEL such as the Environmental Management Plan, Waste Management Plan, Regulatory Compliance Plan, Socioeconomic/Community Relations and Engagement Plan, and Spill Response Plan will be submitted to DeSadel project management team for review and approval prior to implementation. This will ensure that the key elements are captured in the plans. It will also ensure well-coordinated execution of project activities as well as confirm harmonized implementation of DESADEL's documented strategies in accordance with the terms and conditions of the approved project EIA. DeSadel Governmental Department shall be responsible for capacity assessment of DESADEL personnel responsible for the management and monitoring of impacts mitigation measures as documented in this EMP and as regularly updated to cover for the project life span. Capacity assessments and other trainings as well as competency certification and validations of personnel shall progress from before the commencement of the project, through construction and operation phases. Assessment shall also form part of the auditing/training program to be developed for the project. In addition to overseeing the implementation of the mitigation and monitoring measures, DeSadel HSE will also be

responsible for operation of the grievance procedures. In order to assure the competency of DeSadel Nigeria Limited personnel charged with the above responsibilities, experienced personnel will be engaged for the execution of the project. Capacities of personnel assigned to the project will be assessed prior to their involvement in the project and appropriate trainings provided to cover identified capacity gaps. DeSadel shall engage reputable consultancy firms to provide such capacity enhancement trainings and certifications. Federal Ministry of Environment (FMEnv) and the Nigerian Upstream Regulatory Commission (NESREA) formerly the Department of Petroleum Resources (DPR) will be responsible for the regulatory monitoring of the implementation of the project EIA approved mitigation and monitoring measures. The Ministry assigns personnel with proven competencies to such tasks.

**Table 7.4: Impact Management and Monitoring Plan**

Project Activities	Impact Description	Impact Ranking	Mitigation Measures	Action Party	Parameter	Frequency
<b>Pre-Construction Phase</b>						
Mobilization	Influx of migrant workers	M	Employ most unskilled/semi-skilled workforce from communities	DeSadel	Work register	Quarterly
	Exposure to risk and contraction of STIs and HIV/AIDs	H	DeSadel shall ensure contractors given health education to workforce, security agents shall ensure restriction of movement of non-staff to camp site; provision of condoms at site clinics	DeSadel	Compliance	Every 6 months
	Interference with public transport by high traffic	M	DeSadel shall avoid mobilizing during rush hours or restrict mobilization to weekends; develop appropriate traffic plan; create awareness	DeSadel	Compliance	Monthly
<b>Construction Phase</b>						
ROW Clearing	Biodiversity lose vegetation an wildlife	H	DeSadel shall restric survey lines, avavoid sensitive habitats.	DeSadel	Compliance	Quarterly
	Alteration of air quality from heavy duty machines	M	DeSadel shall certify contractor equipment before mobilization; installation of catalytic converters on equipment that emit noxious gases; regular maintenance	DeSadel	Compliance	Monthly
	Topsoil removal and exposure to direct sunshine	M	DeSadel shall revegetate at intervals after backfilling.	DeSadel	Compliance	Monthly
	Employment opportunity	Positive	DeSadel shall use indigenous and qualified personnel; DeSadel shall also develop procedure for indigenous	DeSadel Contractor	Compliance	Quarterly

Pipe stringing and welding	Environmental degradation from pipe/metal wastes	M	DeSadel shall designate safe area for waste (scrap) disposal on site, develop appropriate waste management plan.	DeSadel Contractor	Compliance	Quarterly
	Employment opportunity	Positive	DeSadel shall use indigenous and qualified personnel;	DeSadel Contractor	Compliance	Quarterly

			<ul style="list-style-type: none"> <li>DeSadel shall also develop procedure for indigenous labour Sourcing</li> </ul>			
NDT	Exposure to radio active substances	H	<ul style="list-style-type: none"> <li>DeSadel shall conduct health awareness training prior to commencement of activity. DeSadel and contractor shall ensure that staff undergoes routine medical check-ups.</li> <li>Contractor shall provide and enforce the use of protective aprons.</li> </ul>	DeSadel Contractor	Compliance	Daily
Coating & holiday detection	Contamination of soil and surface water from chemicals used for coating	M	<ul style="list-style-type: none"> <li>Contractor shall provide the installation of cathodic protection devices to maintain the integrity of pipeline.</li> </ul>	DeSadel Contractor	Compliance	Daily
Trenching & Excavation	Removal of top soil, that may lead to soil erosion	M	<ul style="list-style-type: none"> <li>Ensure trenches are covered with excavated soil and</li> <li>Revegetate immediately</li> </ul>	Contractor DeSadel	Compliance	Quarterly
	Surface water contamination from run-offs	M	<ul style="list-style-type: none"> <li>DeSadel shall ensure that non-off is directed into water bodies by using silt trap to</li> <li>Remove sediments/particles</li> </ul>	Contractor DeSadel	Compliance	Monthly
	Air quality disruption from increased dust and vehicular emission from exhaust	M	<ul style="list-style-type: none"> <li>DeSadel shall certify contractor equipment before mobilization; installation of catalytic converters on equipment that emit noxious gases; regular maintenance</li> </ul>	Contractor DeSadel	Compliance	Daily
Lowering & Backfilling	Alteration of soil profile	M	<ul style="list-style-type: none"> <li>Ensure soil returned are compacted properly</li> </ul>	Contractor DeSadel	Compliance	Quarterly
Cathodic Protection	Contamination of soil and water (ground) from	M	<ul style="list-style-type: none"> <li>DeSadel shall enforce the installation of cathodic protection</li> </ul>	Contractor DeSadel	Compliance	Quarterly

	anodes		<p>devices to</p> <ul style="list-style-type: none"> <li>• Maintain the integrity of pipeline</li> </ul>			
HDD for River Crossing	Soil contamination for drilling chemicals.	M	<ul style="list-style-type: none"> <li>• Restrict chemical stack area</li> <li>• Channel drill muds to recycle pits and reuse</li> </ul>	Contractor DeSadel	Compliance	Quarterly
	Alteration in water quality status as a results of run offs	M	<ul style="list-style-type: none"> <li>• DeSadel shall ensure that run-off is directed into water bodies by using silt trap to remove sediments/particles</li> </ul>	Contractor DeSadel	Compliance	Quarterly

	Groundwater contamination	M	<ul style="list-style-type: none"> <li>Implements spill response when drill mud spill and remediate immediately to avoid percolation</li> </ul>	Contractor DeSadel	Compliance	Quarterly
	Community issues as a result of contamination on farm land and crops	H	<ul style="list-style-type: none"> <li>Remediate immediately</li> <li>Pay appropriate compensation to affected persons</li> <li>Restrict chemical stack area</li> </ul>	Contractor DeSadel	Incidents documentation	Quarterly
Thrust Boring for Road Crossing	Soil contamination for drilling chemicals	M	<ul style="list-style-type: none"> <li>Restrict chemical stack area</li> <li>Channel drill mud to recycle pits and reuse</li> </ul>	Contractor DeSadel	Incidents documentation	Quarterly
	Community agitation resulting from accidents caused by dishing	H	<ul style="list-style-type: none"> <li>Proper enlightenment before commencement;</li> <li>Intervene and compensate adequately when it occurs</li> </ul>	Contractor DeSadel	Compliance	Quarterly
	Contamination of soil by water used for hydro testing	M	<ul style="list-style-type: none"> <li>Contractor shall treat hydro-test water and dispose responsibly according to regulatory guidelines</li> </ul>	Contractor DeSadel	Compliance	Quarterly
Hydrotesting	Contamination of surface water by discharged hydro- test water.	M	<ul style="list-style-type: none"> <li>Contractor shall treat hydro-test water and dispose responsibly according to regulatory guidelines</li> <li>Avoid discharging into rivers/streams</li> </ul>	Contractor DeSadel	Compliance	Quarterly
<b>Operation and Maintenance Phase</b>						
Pipping	Contamination of soil and surface water by condensate	H	<ul style="list-style-type: none"> <li>DeSadel shall bleed pressure from system before removal of condensate</li> <li>Immediate remediation (bioremediation) of impacted site in the event of condensate spill</li> </ul>	DeSadel	Work register	Quarterly
Maintenance	Severe damage to	H	<ul style="list-style-type: none"> <li>Restoration of site by remediation</li> </ul>	DeSadel	Species	Quarterly

	biodiversity in the event of fire/explosion		and revegetation		composition	
	Agitation due damage to farmlands, settlements, ect by fire	H	<ul style="list-style-type: none"> <li>Pay adequate compensation if explosion is a result of equipment failure</li> </ul>	DeSadel	Compliance	Monthly
<b>Decommissioning Phase</b>						

Excavation to remove pipes and other structure	Contamination of soil and water	M	<ul style="list-style-type: none"> <li>DeSadel shall carry out the excavation with state of the art technology to minimize impact</li> </ul>	DeSadel	Compliance	Quarterly
	Temporal job creation	Positive	<ul style="list-style-type: none"> <li>DeSadel shall use indigenous and qualified personnel; DeSadel Nigeria Limited shall also develop procedure for indigenous labour sourcing.</li> </ul>	DeSadel	Work register	Quarterly
	Risk of STIs and HIV/AIDs as a result of influx of migrant workers and commercial sex workers	H	<ul style="list-style-type: none"> <li>DeSadel shall ensure contractors give health education to workforce; security agents shall ensure restriction of movement of non-staff to camp site; provisions of condoms at site clinics</li> </ul>	DeSadel	Medical records	Quarterly
Abandonment	Social issues: Loss of jobs, increased social vices	H	<ul style="list-style-type: none"> <li>DeSadel Nigeria Limited shall ensure full implement of existing MOUs. DeSadel /contractors shall ensure full implementation of contract agreements related to end-of-contract benefits</li> </ul>	DeSadel	MoU records	Quarterly

## **7.16 EMP and Community Development**

Most Community Development (CD) projects arise out of Participatory Rural Appraisal (PRA) exercises. The DESADEL shall ensure that in implementing the provisions of this EMP, development projects arising from PRAs do not conflict with the development programmes of government authorities, NGOs and aid agencies for project area. The EMT shall integrate whatever projects arise from the PRA for this project area with the community development programmes of external bodies.

## **7.17 Decommissioning, Restoration and Abandonment**

The Federal Ministry of Environment (FMEnv) EIA process requires that a project of this status should contain an environmentally sound decommissioning and abandonment plan. This plan needs to be fully prepared a few years before decommissioning would actually take place and should take into account the best applicable technology at that time. A general approach will be to commence detailed planning of decommissioning and abandonment activities about five years to the decommissioning date.

Before decommissioning of this project, DESADEL shall develop decommissioning plans for:

- Facilities to be abandoned or removed
- Environmental aspects of the decommissioning activity
- Methods for facility re-use, recycling, disposal, removal or abandonment
- Proper consultation with all stakeholders (communities, other land users and regulators)
- Efforts to mitigate negative environmental impacts and appropriately

rehabilitate the site

- Programmes for restoring the environment in accordance with national FMEnv. Regulatory requirements and international best-practices.
- Scope of work to assess possible residual impacts of the process on the environment; specifically, any future restrictions on other activities.

The content of the plan shall 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 the 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 appropriate restoration and remedial measures. In general decommissioning activities shall be conducted in compliance with Federal Ministry of Environment guidelines. The DESADEL Health Safety and Environmental Management Systems shall 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
- Waste handling
- Spill containment and management.

### **7.17.2 Reporting**

As required by regulations, a post decommissioning report (PDR) will be prepared and submitted to the FMEnv. The PDR will provide 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
- Decommissioning Schedule
- State of the surrounding environment
- Waste Management Plan
- Plans for restoration/remediation where necessary.

### **7.17.3 Sequenced Decommissioning and Abandonment Plan**

DESADEL will develop sequenced decommissioning and abandonment plan which shall include:

- Identification of components of the project that will be removed.
- The choice of environmentally sound methods of removal, re-use, recycling or disposal and other waste that may arise from the decommissioning process, liaison with FMEnv and other relevant stakeholders.
- Expressly outline the time frame/schedule for the decommissioning and post decommissioning processes and communicate the same to FMEnv, NESREA, and AKWSMEnv and other relevant regulatory agencies as well as the affected or concerned persons and groups.
- Proper rehabilitation and decommissioning process.

- Appropriate site rehabilitation, remediation and enhancement technique and technologies.

There shall be post-decommissioning assessment to compare ameliorated project- related impact, relative to the baseline conditions

### **7.18 Managing Stakeholder Perceptions**

Public interest in this project is expected to be high. The project will have impacts on the surrounding communities especially during construction and operation (e.g. noise, traffic, dust, emissions etc) and from the influx of workforce. Effective and realistic measures to mitigate/enhance these impacts have been proposed. Nevertheless, stakeholder perceptions are bound to persist, so a social action/stakeholder following actions amongst other others.

- DeSadel Nigeria Limited shall ensure that the communities are involved in the environmental monitoring and management plan for this project.
- Use available records on community development and other community-based activities as evidence of a good corporate neighbour.
- Nominate Community Relation units to receive complaints
- Develop and establish a grievance redress mechanism.
- Palliative measures shall be conducted on the existing road and discussion will be conducted with relevant authorities on construction of the road
- A Memoranda of Understanding (MOU) explicitly stating the agreement between DeSadel Nigeria Limited and all project affected community shall be established to prevent future frictions and agitations

### **7.19 Environmental Monitoring**

Environmental monitoring programs for this sector shall be implemented to address all activities that have been identified to have potentially significant impacts on the environment during normal operations and upset conditions. Environmental monitoring activities shall be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the proposed gas pipeline project. Monitoring frequency shall be sufficient to provide representative data for the parameter being monitored. Monitoring shall be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data shall be analysed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. The overall objective of (performance) monitoring shall be to identify any unanticipated changes to the biophysical, health and social environment brought about by the proposed gas pipeline and associated facilities Project. Baseline information against which development and post development impacts and mitigation measures can be measured and compared has been established. DeSadel Nigeria Limited 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. Tables 7.4 present the impact management and mitigation plan at the various stages of the project. In formulating this plan, care has been taken to ensure that DeSadel Nigeria Limited complies fully with FMEnv and NESREA regulatory control measures; international best practice and self-imposed standards. 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. The national regulatory agencies in conjunction with the relevant states and local government authorities shall conduct routine impact mitigation monitoring visits as and at when due. 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. Once this proposed Environmental Monitoring Plan has been reviewed, it shall be prepared as a stand-alone document and signed by the asset manager. This is to ensure ownership and implementation of the EMP and shall be updated as results of monitoring.

**Table 7.5: Key Monitoring Parameters**

S/N	Impact Parameter	Impact Indicator	Sampling Location	Sampling Method	Sampling Frequency	Sampling Duration	End Use of Data	Monitoring Party
1	Air Quality	CO2 CO NOX VOC	Along pipeline route	In situ gas monitors	Weekly during excavation, monthly thereafter	Long Term	Compliance Data bank	DeSadel Contractor
2	Soil Quality	pH Organic Carbon THC Oil & Grease Heavy Metals	Pipeline Route	pH Meter UV Spec, AAS	Quarterly after construction	Long Term	Compliance	DeSadel Contractor
3	Water Quality (surface)	pH BOD COD THC Heavy Metals	Pipeline River Crossing points	pH Meter UV Spec, AAS	Monthly (during construction); Annually thereafter	Short Term	Data bank	DeSadel Contractor
4	Ground Water	pH BOD COD THC Heavy Metals <sup>1</sup>	Existing monitoring borehole	pH Meter UV Spec, AAS	Monthly (during construction); Annually thereafter	Long Term	Compliance	DeSadel Contractor
5	Vegetation	Morphology Floristic Composition Pathology	Work site Base Camp Line Cuttings	Field assessment Culturing & Identification	monthly	Long Term	Data bank	DeSadel Contractor



**ESIA for the Proposed Revitalization of 20' Gas Pipeline Project, Qua Iboe, Ibeno LGA, Akwa Ibom State**

		Species density						
6	Consultation		All Stakeholders	Interviews dialogue	Yearly	Long Term	Openness	DeSadel Contractor
7	Waste	Collection, storage and disposal	w Work site Base Camp Line Cuttings	Field assessment Culturing & Identification	Monthly	Short Term	Compliance	DeSadel regulators

## 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 Installation of 20" X 80km Gas Pipeline Project, 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 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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