DRAFT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) REPORT FOR THE PROPOSED PORT HARCOURT INDUSTRIAL PARK PROJECT

IN

UBIMA, IKWERE LOCAL GOVERNMENT AREA, RIVERS STATE

BY FEDERAL MINISTRY OF TRANSPORTATION

SUBMITTED TO THE

FEDERAL MINISTRY OF ENVIRONMENT HEADQUARTERS

MABUSHI, ABUJA

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PREPARED BY

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%	Percentage
<	Less Than
AAS	Atomic Absorption Spectrophotometry
ALARP	As Low As Reasonably Practicable
APHA	American Public Health Association
AQ/MET	Air Quality and Meteorology
ASTM	American System of Testing and Methods
BH	Borehole
BSI	British Standard Institution
BOD	Biochemical Oxygen Demand
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CECC	China Civil Engineering Construction Corporation Nigeria Limited
DO	Dissolved Oxygen
EBS	Environmental Baseline Survey
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EMP	Environmental Monitoring Plan
Fig	Figure
FMEnv	Federal Ministry of Environment
FMoT	Federal Ministry of Transportation
FTZ	Free Trade Zone
GPS	Geographic Positioning System
H_2S	Hydrogen Sulphide
HSE-MS	Health, Safety and Environment – Management System
ISO	International Organization for Standardisation
Kg	Kilogram
LFN	Law of the Federal Republic of Nigeria
L.G.A	Local Government Area
M	Million
m	Metre
m/s	Mitres per seconds
m^2	Square metre
mg/l	Milligram per liter

Mg^{2+}	Magnesium ion
ml	Milliliter
NESREA	National Environmental Standards and Regulations Enforcement Agency
NH_3	Ammonia
Ni	Nickel
NOx	Oxides of Nitrogen
NRB	Non-Returnable Bottle
NTU	Nephelometric Units
^0C	Degrees Celsius
p.a.	per annum
ppm	parts per million
PRM	Packaging Raw Material
RAM	Risk Assessment Matrix
RH	Relative Humidity
RTAs	Road Transport Accidents
µS/cm	Micro Siemens per centimetre
$\mu g/m^3$	Microgramme per cubic metre
SAMP	Social Action and Management Plan
SG	Standard Gravity
SKU	Stock Keeping Unit
SO_4^{2-}	Sulphate ion
SOx	Oxides of Sulphur
sqm	square meters
STIs	Sexually Transmitted Infections
TDS	Total Dissolved Solids
THB	Total Heterotrophic Bacteria
THC	Total Hydrocarbon
THF	Total Heterotrophic Fungi
THUB	Total Hydrocarbon Utilizing Bacteria
TOC	Total Organic Carbon
ToR	Terms of Reference
TSS	Total Suspended Solids
TPH	Total Petroleum hydrocarbon
VOC	Volatile Organic Carbon
WHO	World Health Organization

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We would also want to use this opportunity to thank Escholes Integrated Service Resource Limited project team for their diligence and dedication in preparing the ESIA report.

EXECUTIVE SUMMARY

01 INTRODUCTION

The Federal Government of Nigeria with a view to achieve diversification of the economy from oil and absorb the growing workforce by creating productive jobs through effective industrialization process intends to construct an Industrial park in Ubima, Ikwere Local Government Area, Rivers State through the Federal Ministry of Transportation

Industrial Parks are created to enable the government expand the country's industrial base; introduce innovation and technology into the economy; create backward linkages between the zones and the domestic economy, attract foreign investment with a view to creating employment, security and fits well with the new trends in developing sustainable technologies and innovative products to address the challenges posed due to the rapid urbanization and fast depletion of natural resources.

The industrial park is divided into four functional areas which are production area, living area, public utility district and reserved area. The construction and operation of the park will comply with national regulations with full presence of relevant governmental authorities. It is expected to provide most modern and secured infrastructural facilities that will facilitate the attraction of economic activities to the area while bearing in mind the challenges facing the state and the country at large especially in the area of security.

Under the provisions of the Nigerian Environmental Impact Assessment Act No 86 of 1992 amended as EIA Act Cap E12 Law of the Federal Republic of Nigeria (LFN) 2004, an ESIA is required prior to the development of the proposed Project. The purpose of the ESIA is to identify and assess the potential environmental and social (E&S) risks and impacts of the Project so that they can be appropriately managed.

The ESIA covers the entire life cycle of the proposed Project i.e. pre-construction, construction, commissioning, operation and decommissioning and it has been carried out in line with the relevant requirements of the Federal Ministry of Environment (FMEnv).

Legal and Administrative Framework

The ESIA has been carried out in line with the applicable legal and administrative framework, including relevant international guidelines and conventions. Some of these include, but not necessarily limited to the following: EIA Act Cap E12 LFN 2004; Labour Act of 1990 (amended in 2004); Forestry Act, Cap F 36, LFN, 2004; Rivers State Ministry of Environment Law; China Exim Bank Legal Framework, World Bank Group Environmental, Health and Safety (EHS) General Guidelines; International Finance Corporation (IFC) Performance

Standards on Environmental and Social Sustainability, 2012 and World Bank Environmental and Social Framework.

Overview of Project Proponent

Federal Ministry of Transportation (FMoT) with Headquarters at Bukar Dipcharima House, Central Business District, Abuja is a cabinet Ministry of the Government of the Federation with a mission to build a safe, affordable and efficient transport industry focused on making Nigeria a hub that meets International Standards and Best Practices for the African Continent.

0.2 PROJECT JUSTIFICATION

Need for the Project

The project when implemented shall help achieve diversification of the Nation's economy and absorb the growing youth population by creating productive jobs. The project shall also promote National and International trade relations while generating foreign exchange. Nigeria, with a population of more than 200million, presents a large consumer market deemed enticing enough to lure investors to take advantage of the opportunities that will be presented by highly efficient infrastructural facilities, less bureaucracy and streamlined One-Stop-Shop operational procedures that the parks offer for cost effectiveness and enhanced global competitiveness.

Project Benefits

The proposed Port Harcourt Industrial park is a huge infrastructural project whose benefits are:

i. The construction of Park will be advantageous to the Eastern Railway line and road corridor within the south-south and eastern region of the country.
ii. Promote economic recovery and growth plans 2017 to 2020 of the FGN.
iii. Provide foreign exchange earnings by promoting non-traditional exports,
iv. Attract foreign direct investment and attendant technology transfer and knowledge spillover.
v. Provide consumers with more options and the benefit of lower prices given the lower or no tariff policy of Free Trade Zones;
vi. Boost socio-economic activities within the project location

Envisaged Sustainability of the Project

Economic Sustainability: The proposed Project shall guarantee economic sustainability due to the accruable revenue from project. Nigerians shall gain employment and skill acquisition opportunities through direct and indirect involvement of contractors,

consultants, suppliers and other professionals. Apart from the direct employment of persons at the facility, indirect employment and associated economic effects will be derived from the Project.

Technical Sustainability: The design, construction and operation of the proposed Project will be handled by properly trained and experienced personnel according to the pre-established standards and procedures. Stringent safety measures would be built into the design and fabrication of facilities also the company'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.

Environmental Sustainability: This project would have some potential negative impacts on the environment. The ESIA will identify all potential impacts associated with the proposed project and proffer appropriate mitigation measures that will ensure that all the impacts are minimized or completely avoided. However, incorporating the findings and recommendation of this ESIA, and implementing an effective Environmental Management Plan, at the planning, design, construction, operation and abandonment/decommissioning stages of the proposed project, will ensure its environmental sustainability. The project's activities shall be followed through as guided by National and International environmental regulatory guidelines and standards.

Social Sustainability: The project will be undertaken in a socially sustainable manner since it has a lot to do with the public and the local community around the project area. The nearest community bordering the project is well disposed to the project and is willing to support the implementation of the project to its logical conclusion. The Federal Ministry of Transportation will establish and maintain a conducive environment in the project area and maintain effective community relations during construction and throughout the life span of the project and also put in place Grievance Redress Mechanism.

Project Alternatives & Options

The various Options (No Project, Delay Project and Continue Project) and alternatives considered for the proposed expansion Project are briefly described as follows:

Alternative Site/Location: The location and selection of the Port Harcourt Industrial Park in the Ubima, Ikwere LGA, was based on technical reasons including its proximity to the Port Harcourt – Maiduguri Eastern railway line suitability for reception and business potential and provides an opportunity for manufacturing activities not to cause nuisance to residents. However, the site accessibility was also considered which is paramount in any development project.

Alternative Technology Option: The project will be constructed using modern, locally and internationally accepted materials by Standards Organization of Nigeria (SON) to achieve public health, safety, security and environmental aesthetic requirements. Equipment and systems that save resources including energy and use of solar systems, water conservation will be given first priority without compromising on cost or availability factors.

Alternative source of Energy: The project site for the proposed Industrial Park is virtually unoccupied and devoid of any meaningful economic activity. Operation of a project of such magnitude requires constant and reliable source of electricity which has been a great challenge throughout the country.

03 PROJECT OVERVIEW

The proponent intends to construct an Industrial park in Ubima, Ikwere LGA, Rivers state on a landtake of 114Ha. The proposed project site is a green field in close proximity to the project area is the Nigeria Naval Intelligence Headquarters and Port Harcourt – Owerri Expressway. The settlement within 5km radius of the proposed project site are Omueka, Omuowhor, Omuordu and Mgbuogba. The project would be divided into four functional areas namely Production Area, living area, Public Utility District and Reserved Area.

The Project activities can be categorised as follows:

Pre-construction phase: Site selection/land take; Construction of workers' /access road; Mobilization of personnel, materials, and equipment to site; site clearing and preparation

Construction/ Installation phase: Civil work activities include construction of buildings. Installation of equipment and machinery, installation of ancillary facilities; Waste generation and disposal Highlights of the project component are as follows:-

i. 12 standardized workshops with a total construction area of 100000m^2
ii. Office blocks of 2500m^2
iii. Living area of 11500m^2 and
iv. Other supporting facility

The workshop is a light industry standard workshop, which can provide a place for food processing, clothing and apparel, electronic products assembly and other enterprises.

The Living Area consists of accommodation, food court, shops and other entertainments utilities which could serve more than 650 people.

In addition, the project also set up a certain scale of offices. These offices will provide a variety of financial services, manpower services and other services for the park, but also can accommodate a variety of utility companies to serve the surrounding areas.

Factory buildings reflect the concept of modern, scientific and technological; the overall style is simple, bright colors.

Decommissioning: phase: Removal of equipment and industrial park infrastructure; Site remediation and rehabilitation of disturbed land; Waste generation and disposal.

0.4 DESCRIPTION OF THE ENVIRONMENT

A one season data gathering exercise was approved by the Ministry as contained in the Terms of Reference for the project which took place within 10th – 11th November, 2020 (Wet Season) witnessed by Representatives from Federal Ministry of Environment, Rivers State Ministry of Environment as well as Staff of Federal Ministry of Transportation. The wet season field data collected was augmented with dry season secondary data sourced from the Final EIA Report for Ubima Field Development Project (February 2017).

For the biophysical components, a 2km radius from the center of the Project site was selected as the spatial boundary while the socio-economic survey was extended to approximately 5km radius. The spatial boundary specifically encompasses:

- The Project site
- The immediate surroundings of the project site boundary which may be directly exposed to Project activities.
- The wider area of project influence which extends up to about 5 km.

The environmental and social condition of the Project's AoI is summarized as follows:

Climate and Meteorology: Rivers State belongs to the tropical zone with alternating wet and dry seasons. The wet season period is usually between April and October, while the dry season is experienced between November and March. Based on the long term climatic data (1991- 2015) of the Project area obtained from the Nigerian Meteorological Agency (NIMET),The mean temperature for the hottest months February/March is 34 ^{o}C while that of the coolest month (August) is 28 ^{o}C, The temperatures measured in the field ranged from 25.0^{o}C to 34.1^{o}C. Relative humidity (RH) in the study area was observed to be relatively constant ranging between 68.11% in January and 87.33% in August while in the afternoon the value ranges from 41.26% [in February] to 76.78% [in August]. The mean annual solar radiation varies from 1.5 – 1.9 J/cm^2/day. The longest monthly sunshine hours occur in December/January in the dry season while July usually experiences the lowest values of sunshine hours. Wind speed in the study area for dry season ranged from 0.5m/s to 1.8m/s while the wet season wind speed ranged from 0.2 to 1.00m/s. The wind is predominantly in the South Western direction accounting for about 75% of the annual winds.

Air Quality: The concentrations of air quality parameters recorded at twenty one (21) different locations sampled in the Project's AoI were within the FMEnv's regulatory limit.

The concentration of volatile organic compounds in the air was very low and had a mean value of 0.26ppm (0.03-0.6ppm). TSP determination yielded results within the range of 3.1ppm to 19.7ppm (mean=10.36) while the $PM_{2.5}$ and PM_{10} yielded results within the range of 0.4ppmto 2.5ppm (mean=1.34ppm) and 1.2ppm to 16.4ppm (mean=8.49ppm)

respectively; , CO concentration obtained ranged from 0.1ppm–2.6ppm (mean=0.72); NO_2 detected from all the sampling locations ranged from 0.01ppm to 0.04ppm; H_2S; ranged between 0.01ppmto 0.04ppm; NH3 values detected from all the sampling locations were all below equipment detection limit; SOx concentration ranged from 0.01 – 0.05ppm.

Noise Level

The minimum mean value of noise level at the proposed site was 40.40dB(A) with the highest Noise level of 71.40dB(A) which was as a result of the vehicular movement along Portharcourt-Owerri road in close proximity to the proposed site. Despite the differences in the values obtained, the values were relatively low compared with the 90.0 dB (A) limit provided by Federal Ministry of Environment for occupational Noise for 8-hour exposure

Soil Quality; soil samples were collected from 3 cores from each sampling point at depths of 0-15cm and 15-30cm for top soil and sub soil respectively**.** Samples were collected with stainless screw type soil auger into plastic bags for physicochemical and microorganism analysis. Separate samples were also collected into aluminium foil hydrocarbon content determination. In the study area, the mean(s) of heavy metals concentration for top and sub soil were respectively as follow; Fe (166.63 and 135.35mg/kg), Zn (0.03 and 0.02mg/kg), Cu (0.08 and 0.04mg/kg), Cr (0.03 and 0.01mg/kg). Mean microbial count of organisms were THB ($1.87x10^7$ cfu/g (top soil) and $1.72x10^7$ cfu/g (sub soil) in the study area, THF ($0.26x10^3$ cfu/g (top soil) and $0.16x10^3$ cfu/g (sub soil) in the study area, HUB ($0.38x10^5$ cfu/g (top soil) and $0.25x10^5$ cfu/g (sub soil) in the study area and HUF ($0.10x10^1$ cfu/g (top soil) and $0.04x10^1$ cfu/g (sub soil) in the study area.

In the dry season (Ubima Field Dev. 2017), only in the Soil (Top) and in the subsoil of control 3 were Copper recorded in the dry seasons with values of 0.015 and 0.014mg/kg respectively.

Geology and Hydrogeology: The project areas lie within Niger Delta Sedimentary Basin. The subsurface geology of the Niger Delta consist of three (3) lithostratigraphic units namely; Akata Agbada and Benin formation which are in turn overlain by various types of quaternary deposits, sands intercalated with lances of clay materials and silts.

Groundwater: Groundwater samples were collected from 5 boreholes within the proposed project area and immediately analysed for parameters with short holding analytical time such as pH, dissolved oxygen (DO), temperature, and turbidity. The results of physico-chemical and microbial properties of the groundwater samples were within Standard (FMEnv) limit.

In the dry season, Cadmium (Cd) and Iron (Fe), both recorded values lower than the detection limit of the measuring equipment, with values of (<0.002mg/L) and (<0.006mg/L) in the available samples measured

Vegetation

The prominent vegetation types in the study area were the rainforest and forest/farmland mosaic. The vegetation comprised of trees, shrubs, herbs, ferns, climbers and creepers. The trees consisted of plants about 40m high while the shrubs were between 15-25m and the rest consisted of herbaceous layer. The tree species included *Elaeis guineensis, Ficus exasperata, Musanga cepropoides, Rauvolfia vomitorias,* and *Spondias mombin. Shrubs species* included *Alchornea cordifolia, Bambosa vulgaris, Icacina trichanta, Manihot esculenta, Sida acuta* and *Voacanga africana. Herbaceous species* included *Chromolaena odorata, Palisota hirsute* and *Tridax procumbens*

Wildlife

The wildlife observed in the study area consists of wide varieties of invertebrates such as grasshopper, mosquito, houseflies, crickets, spiders among others and the vertebrates like amphibians, reptiles, birds and mammals. In the study site, many macro invertebrates are exploited for food and these include snails and crickets. Among the vertebrates, the amphibians (frogs) were the least exploited for food. Squirrel and cane rat were really exploited for food and occasionally, some birds were exploited as well.

Socio-economic Study

The socio-economic baseline description is focused on local level i.e. within Ubima in Ikwere Local Government Area. This is because it is expected that the proposed project will result in macro-economic benefits at a national level, the primary socioeconomic impacts of the Project will be experienced at the local level within 5-kilometer radius of the project location. In the context of this study, the Area of Influence (AoI) further includes areas around the site likely to be affected by the Project activities during the pre-construction, construction and operation phases. The effects can be positive or negative, short or long term or permanent, as well as direct and in-direct. Omueka, Omuowhor, Omuordu and Mgbuogba constitute the major communities of the project location.

The Ubima community is home to some prominent sons of Rivers State such as His Excellency, Rt. Hon. Rotimi C. Amaechi (Hon. Minister, Federal Ministry of Transportation). Sir Celestine Omehia former Governor of Rivers State. The community plays host to the Nigerian Navy Intelligence Headquarters. It is the home of Risonpalm. Risonpalm is a Rivers State Government oil palm industry which has become moribund.

Survey Methodology for Socio-economic Studies

The socio-economic study was undertaken during the Field work based on a review of available secondary information and primary data collected in the local communities. Primary data collected for this analysis are both qualitative and quantitative and derived from key informant interviews, village-level surveys and focus group discussions. The socio-economic study focused on the identification of stakeholders and impact on the community in terms of their infrastructures and also on their educational learning system, the institutional analysis and the system for monitoring and evaluation among others.

The study was designed to obtain relevant socio-economic data on the community as well as key stakeholders through primary and secondary sources. This led to adopting a study strategy that involved the following activities: Conducting literature search and reviews;

- Conducting field visits to the study area;
- Design and pretesting of household questionnaire/ appraisal tools for the study;
- Determining target population and sample size for participatory rural appraisal and interviews;
- Conducting consultations and socio-economic survey (Focus Group Discussions [FGDs] General Group Discussion [GGD] and In-Depth Interviews [IDI] with various stakeholder groups and interviews with key informants in the community
- Conduct interviews with key stakeholders involved with the project;
- Direct observations;
- Collating and analysing data obtained from all the sources; and
- Report preparation.

0.5 ASSOCIATED AND POTENTIAL IMPACT

Potential environmental and social impacts (including health and safety issues) associated with the proposed expansion Project was assessed using a modified Leopold Interaction Matrix. Impact significance was also determined. In determining the significance of impacts, the factors considered included: magnitude of impacts (which is a function of the combination of the following impact characteristics: extent, duration, scale and frequency); value/sensitivity/fragility and importance of relevant environmental and social receptors; legal/regulatory requirements; and public perceptions (based on stakeholders' consultation). The identified potential adverse impacts are summarized in Section 0.6 below along with the recommended mitigation measures.

0.6 MITIGATION MEASURES

In proffering mitigation measures for the identified impacts of the expansion Project, preference was given to avoidance or prevention of adverse impacts and where not feasible, measures which are practicable and cost-effective using best available technology were

provided to reduce and/or minimize the impacts while compensation/offset was considered as the last resort, in line with the standard mitigation hierarchy.

The summary of the identified impacts including the recommended mitigation measures is provided as follows:

Pre-construction Phase

The potential impacts associated with the pre-construction phase of the proposed Project include: Deterioration of ambient air quality from vehicular emissions (SPM, NOx, CO, SOx); increase in noise levels, Loss of economic crops on the affected farmland; Increase vehicular movement, traffic and potential accident; Soil compaction; spill contamination leading reduced soil quality The associated impacts of the pre-construction phase activities shall be mitigated through the following measures, amongst others:

- FMoT shall finalize documentation agreement with the Project Affected Persons and ensure that agreed compensation is paid.
- Allocation of other available undeveloped land to the affected persons for farming activities shall be ensured
- Project vehicles with efficient engine performance and with minimal emissions shall be selected and used. This can be achieved through regular servicing and maintenance. Onsite vehicle speed on unhardened roads and surfaces shall be limited to about 15km/h so as to reduce dust generation.
- Soil conservation measures shall be implemented such as stockpiling top soil or gravel for the remediation of disturbed areas.
- Disturbed areas shall be rehabilitated as soon as possible to prevent erosion.
- Only areas within the proposed camp site needed for construction workers camp and laydown of equipment shall be shall be cleared
- Cleared areas which are not being used shall be re-vegetated using plant

Construction Phase

The potential impacts associated with the construction phase of the proposed project include: reduction in the structural stability and percolative ability of soil resulting from compaction during excavation activities, laying foundations, erection of temporary buildings;, lifting cranes, welding, Cutting etc.; Loss of fauna and plant species as a result of increased human activities and introduction of alien plants which may prevent the natural recovery of the natural vegetation on the site; Disruption of family structure and social networks; increase in level of crime and drug and alcohol abuse, increase in incidence of sex workers and casual sexual relations, which may result in Sexually Transmitted Infections (STIs) and unwanted pregnancies; Road traffic including accidents; Risk of injury and health related issues, rights denial etc.

Mitigation measures for the potential impacts associated with the construction phase of the Project include:

- Excavation works shall not be executed under aggressive weather conditions.
- Stockpiles shall be appropriately covered to reduce soil loss as a result of wind or water erosion.
- Disturbed areas shall be rehabilitated as soon as possible to prevent erosion.
- Work areas shall be clearly defined and where necessary demarcated to avoid unnecessary disturbance of areas outside the development footprint.
- Any hydrocarbons, fuels, lubricants and chemicals to be used shall be stored in properly labelled oil storage tanks (surrounded with bund wall), with hoses and gauges kept within the bund. Waste and storage areas for hazardous substances shall be separated on site and waste storage areas shall be located on hard standing (or in a bund wall, where necessary) to prevent potential contamination.
- Training shall be provided for workers on safe storage and handling practices and rapid spill response and clean-up techniques during induction.

Decommissioning Phase

The potential impacts associated with the decommissioning phase of the expansion Project include soil, groundwater and surface water contamination due to decommissioning activities; decrease in ambient air quality, increase in noise level, traffic and road accident due to transportation of dismantled equipment and materials from site including waste; and workers' health and safety.

The associated impacts of the decommissioning phase activities shall be mitigated through the following measures, amongst others:

- A detailed decommissioning plan shall be developed and submitted to all relevant regulatory authorities for approval prior to the commencement of facility decommissioning.
- FMoT shall ensure that dismantled materials (e.g. scrap metals) are taken offsite for appropriate recycling.
- FMoT shall ensure that all major electrical items are removed from site and recycled appropriately.
- All impacted soil area shall be re-vegetated with native plant species

0.7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

An Environmental Social Management Plan (ESMP) has been developed to satisfy long term objectives of managing and monitoring the environmental and social impacts of the proposed Project. It covers all phase of the Project includes desired outcomes; performance indicators; monitoring (parameters to be monitored and frequency); timing for actions; responsibilities and cost estimates required for implementation of recommended mitigation measures, monitoring of the performance indicators and capacity building.

FMoT shall have principal responsibility for all measures outlined in the ESMP, but may delegate responsibility to its contractors, where appropriate and monitor the implementation.

FMoT shall provide specifications for environmental compliance and performance (through this ESMP and the associated plans) and, as a contractual requirement develop and provide its own specific management plans, incorporating:

Health, Safety and Environment Policy Statements, Programs, and Management Systems;

- Environmental Monitoring Plan
- Health, Safety, and Environment Organization;
- Health, Safety, and Environment Responsibilities;
- HSE Procedures;
- Employee HSE Training Programs;
- Waste Management Plans;
- Emergency Response/Evacuation Plans;
- Land Transportation Safety Management System;
- Hazardous Materials Management Program;
- Industrial Hygiene and Medical Protection Plans.

0.8 DECOMMISSIONING AND ABANDONMENT PLAN

In compliance with National regulatory requirements (FMEnv) and International standards, decommissioning and demobilization of equipment and personnel will be planned and implemented. The programme will include a plan to survey the site for contamination. All materials that could subsequently prove hazardous to the restoration of the site shall be treated. All contaminated material shall be disposed of in a safe and approved manner as stated in the ESMP. The site shall also be restored to meet environmental requirements approved by regulators, and all reusable items will be disconnected and handed over to the appropriate departments, while the non-reusable items will be carefully segregated, containerized, labelled and conveyed to approved disposal sites. Any polluted and contaminated soil will be treated in-situ or removed from the site and treated/disposed of safely. Bioremediation of any contaminated soils shall be considered where applicable. At

unit closure, maintenance contracts shall be terminated, e.g. equipment calibrations and equipment preventive maintenance. All automatic deliveries or services shall be stopped.

0.9 CONCLUSION

This ESIA study has identified positive and negative impacts of the Port Harcourt Industrial Park Project. Associated and potential negative effects on the environmental (biophysical), socio-economic, and health characteristics of the project area have been evaluated in detail. Mitigation measures have also been prescribed for significant negative impacts.

In line with applicable Nigerian and international regulatory requirements and widely accepted ESIA procedures, the assessment has been based on the standard practices of using the project details and relevant environmental, social and health baseline characteristics.

The few potential negative impacts identified were mitigated through the program implementation design stage. Adherence to these measures and regulatory compliance requirements by Federal Ministry of Transportation shall ensure that impacts assessed as having low significance subsequently remain at tolerable levels. The effects of those impacts identified as having potentially moderate and high significance consequences shall also be either eliminated or minimized through the implementation of appropriate mitigation measures as recommended in this report.

CHAPTER ONE
INTRODUCTION

Nigeria's economy has always been dependent on crude oil sales for most of its revenue and foreign exchange. This dependence often subjects the economy to the volatility of the global oil market with usually devastating effects. It was, therefore, imperative for the country to diversify its resources base. The Federal Government of Nigeria through Federal Ministry of Transportation intends to Construct an Industrial Park an industrial park in Ubima, Ikwere Local Government Area, Rivers State with a view to achieving diversification of the economy from oil, create job opportunities and also promote exportation through effective industrialization process.

Industrial Parks are created to enable governments expand the countries industrial base; introduce innovation and technology into the economy; create backward linkages between the zones and the domestic economy, attract foreign investment with a view to creating employment, security and fits well with the new trends in developing sustainable technologies and innovative products to address the challenges posed due to the rapid urbanization and fast depletion of natural resources.

Without doubt, the proposed project and eventual operation constitute a critical input in the sustenance of the State's socio-economic development and growth in particular and the nation, generally.

The project would be undertaken by China Civil Engineering Construction Corporation (CCECC) under a Private Public Partnership (PPP) program. China Civil Engineering Construction Corporation (CCECC) is a duly registered company incorporated on 7th September, 2016 under the Companies and Allied Matters Act 1990.

However, by the very nature of the activities associated with the project (construction, operations and decommissioning) there are interfaces with the natural and social environment. In other words, there are a number of environmental and social implications associated with the proposed project.

It is in view of the above, that Federal Ministry of Transportation engaged the services of Escholes Integrated Services Resources Limited a duly registered and accredited Environmental Consultancy firm to carry out a comprehensive Environmental and Social Impact Assessment (ESIA) study for the project in line with the EIA Act.

1.1. PROJECT PROPONENT

FEDERAL MINISTRY OF TRANSPORTATION

Federal Ministry of Transportation (FMoT) with Headquarters located at Bukar Dipcharima House, Central Business District, Abuja is a cabinet Ministry of the Government of the Federation. Currently, it has various operations departments among which are the Rail Transport Services Department which oversees the Nigerian Railway Corporation (NRC), the operators of the railway systems in Nigeria. Others include the Marine Services Department oversees NIMASA, NPA, NIWA (Marine and River transport systems). A Cabinet Minister heads the Ministry, supported by a Minister of State. The Permanent Secretary follows, as the chief accounting officer while the Departments are headed by Directors. The Ministry is responsible to build a world-class transportation system which will provide a fast, safe, secure, efficient, convenient, affordable and inter-

modal transport system that facilitates Nigeria's socio – economic developmental needs and enhances the quality of life of the public.

Table 1.1 Key Stakeholders for the Project

Parties	Role
Federal Executive Council	Approving Authority
Infrastructure Concession Regulatory Commission	Approval Authority
Federal Ministry of Transport	Project Ownership
CCECC Nigeria Limited	Concessionaire

1.2. OBJECTIVE OF THE PROJECT

The Federal Ministry of Transportation took the decision to embark in the development of the industrial park to achieve the following:

- To open ensure Industry expansion in the south-south regions,
- To boost trade, export and import of commodities
- To promote the efficiency, Production and collaborations amongst Industrialists
- Provision of reliable infrastructure and the establishment of common social facilities.
- Increased viability of the proposed Bonny Deep Sea Port and the rehabilitated Eastern Railway Line.

1.3 Project Location

The proposed industrial park project is located in Ubima, Ikwere Local Government Area, Rivers State with a total land take of 114 hectares for the first phase. Ubima lies in the northern part of Rivers State, the geographical coordinates for the proposed project are presented on Table 1.1, the proposed project site is a green field composed of vegetation cover. Figure 1.1 shows the map of Nigeria highlighting Rivers State while Figure 1.2 present the map of Rivers State highlighting Ikwere LGA.

Table 1:1 Geographical Coordinates of the proposed site

S/N	PHASE 1	N	E
1.	A	5.106336	6.892999
2.	B	5.104119	6.891644
3.	C	5.100424	6.890552
4.	K	5.098725	6.889597
5.	J	5.108726	6.882653
6.	I	5.117408	6.886706

Figure 1.1: Map of Nigeria Showing Rivers State

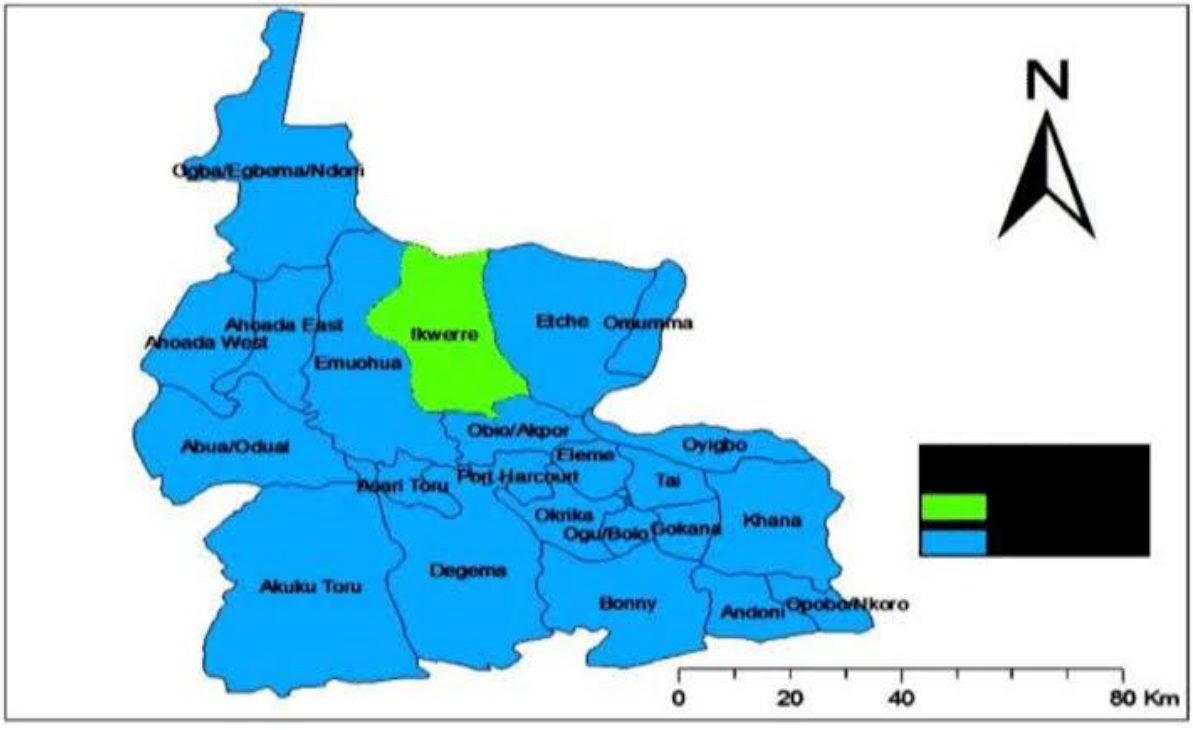

Figure 1.2: Map of Rivers State Showing Ikwere LGA

1.4. Objectives of the ESIA

The main objective of the ESIA study for the proposed project is to proactively evaluate the potential Environmental and Social Impacts and other associated impacts (including health and socio-economic impact on the environment) of the proposed Industrial Park. This is to ensure that the planned activities exert minimal impacts on the environment and nearby community. The specific objectives of the ESIA are to:

i. Determine the baseline conditions of the environment (biophysical, social and health).

ii. Determine the extent, magnitude and concentration of pollutants emanating from all the activities of the construction and operation of the proposed project.

iii. Determine and evaluate the potential impacts of the proposed project activities on the environment.

iv. Identify and evaluate the potential socio-economic effects of the project on the communities including impacts on cultural properties, social infrastructures and natural resources.

v. Identify health hazards that may result from various phases of the project and evaluation of local population's exposure to these hazards.

vi. Develop cost effective mitigation measures and appropriate Environmental and Social Management Plan (EMP) for the facilities.

vii. Prepare a detailed ESIA report presenting clear and concise information on the Environmental and Social Impact of the proposed project activities.

1.5. Terms of Reference for the study

The TOR of the ESIA study is intended to cover all the activities that constitute the project, this study will address the potential environmental impacts associated with the proposed project Full text of the Terms of Reference is contained in the Appendix while the summary is as follows:

i. Assessment of facilities to be installed/constructed and review of the project/process alternatives.

ii. Qualitative and quantitative assessment and description of the baseline environmental conditions of the project area. Data shall be collected on the following environmental components:-

- Meteorology
- Air Quality/Noise
- Soil
- Wildlife Resources
- Groundwater
- Geology/Hydrogeology
- Land Use
- Socio-economics

iii. Identification and assessment of real and potential impacts of the proposed Port Harcourt Industrial Park on the various environmental components listed in (ii) above.

iv. Develop control strategies with a view to mitigate and ameliorate significant impacts of the project. This will include:
   - Identification of measures to reduce harmful effects
   - Monitoring measures or steps to avoid the occurrence of such effects if preventable, etc.

v. Provide measures to maximize beneficial impacts and eliminate or minimize adverse impacts on the ecological and socio-economic status of the host community.

vi. Estimate and describe the nature and likelihood of environmental and social damage and incidents and thus, provide a basis for contingence planning.

vii. Recommend an Environmental and Social Management Plan (ESMP): The ESMP shall contain the following:
   - The environmental and social objectives and commitments
   - Monitoring frequency and parameters to be monitored
   - The means by which these will be achieved
   - The responsibilities/accountabilities
   - The corrective actions which will be employed should the need arise
   - Review schedules and criteria
   - Post commissioning monitoring (environmental audit, compliance monitoring, etc.).

viii. Develop decommissioning and abandonment plan after project closure including site restoration plan.

1.6 Legal and Administrative Framework

The legal, regulatory and policy framework for carrying out the ESIA of the proposed Industrial park project is contained in the applicable acts and regulations of the Federal and State Government, statutes and international conventions to which the Nigerian Government is a signatory. Various environmental studies and related strategic initiatives would meet or surpass the relevant Nigerian and international environmental legislative requirements and guidelines. In Nigeria, the power to enforce all activities that might impact on the environment is vested in the Federal Ministry of Environment (FMEnv.) while international; agencies such as the World Bank, Chinese Nexim Bank, AfDB and other financial organizations have environmental criteria which must be obliged before the agencies invest in the project. This section therefore seeks to identify the most pertinent policies and legislation governing the environment and social impacts in relation to the project both on national and international scale such as:

1.6.1 National Policy on Environment

Environmental management in Nigeria is based on the National Policy on the Environment (1989), revised in 1999 and 2017. The Policy states that Nigeria is committed to safeguarding the country's natural and built environment for the use of present and future generations. This commitment demands that efficient resource use and the reduction of environmental impacts be a core requirement of all developmental activities. The National Policy on the Environment aims to achieve sustainable development in Nigeria, and in particular to:

- Secure a quality of environment adequate for good health and well-being;
- Conserve and use the environment and natural resources for the benefit of present and future generations;
- Restore, maintain and enhance the ecosystem and ecological processes essential for the functioning of the biosphere to preserve biological diversity, and the principle of optimum sustainable yield in the use of living natural resources and ecosystems;
- Raise public awareness and public understanding between the environment and development and encourage individual and community participation in environmental improvement efforts.

1.6.2 The Federal Ministry of Environment

Act No 58 of 1988 established the Federal Environmental Protection Agency (FEPA), now Federal Ministry Environment, as the chief regulatory body for environmental protection in Nigeria. The Act establishing FEPA placed on it the responsibility of ensuring that all industries respect the limits prescribed in the national guidelines and standards and the associated various regulations of environmental pollution management in Nigeria (e.g. effluent limitation, management of solid hazardous waste, etc.). FMEnv may update the National Guidelines and Standards from time to time. Relevant specific standards, discharge limits, and other environmental requirements of the FEPA guidelines (1991) and subsequent relevant directives were reviewed.

1.6.2.1 Environmental Impact Assessment Act 86 of 1992

The EIA Act 86 of 1992 also known as EIA Cap E12 LFN, 2004 requires the preparation of an EIA for projects developments. The act specifies the content of an Environmental Statement to include the assessment of all actions that will result in a physical, chemical, biological, cultural, social, modification of the environment as a result of the new project/development.

Special permits are required for access to forest reserves and other designated areas. Applications for such permits should only be made after a thorough review of alternatives and a detailed survey of the proposed route. The permit application should also include details of technical and operational controls that will be applied to minimize impact. By and large, the environmental management activities at each phase of the project should be guided by environmental standards including those imposed by legislation and those established by self-regulating industrial codes of practice.

National Guidelines and Standards for Environmental Pollution Control in Nigeria, 1991

This document was drafted in March 1991 to serve as a basic instrument for monitoring and controlling industrial and urban pollution. These guidelines were initiated sequel to the drafting of the National Environmental Policy in 1989. The guidelines and standards relate to six (6) areas of environmental concern, thus;

- Effluent limitations
- Water quality or industrial water uses at points of intake
- Industrial emission limitations
- Noise exposure limitations.
- Management of solid and Hazardous waste
- Pollution abatement in industries.

National Environmental Protection (Effluent Limitation) Regulations, 1991

The National Effluent Limitation Regulation, S.1.8 of 1991 (No. 42, Vol. 78, August, 1991) makes it mandatory for industries as waste generating facilities (including research institutes, clinics, hotels etc) to install antipollution and pollution abatement equipment on site. The regulation is specific for each category of waste generating facility with respect to limitations of solid and liquid discharges or gaseous emissions into the ecosystem. Appropriate penalties for contravention are also specified in the regulation.

National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations, 1991

Where and when applicable, the pollution abatement regulation, S.1.9 of 1991 (No. 42, Vol. 78, August, 1991) imposes restrictions on the release of toxic substances and stipulates requirements for pollution monitoring units, machinery for combating pollution and contingency plan by industries; submission of lists and details of chemicals used by industries to the FMEnv, requirement of permit by industries for the storage and transportation of harmful or toxic waste, the generator's liability, strategies for waste reduction, permissible limits of discharge into public drains, protection of workers and safety requirements, (environmental audit for existing industries or Environmental Impact Assessment for new industries) and penalty for contravention.

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

The management of hazardous and solid waste regulation, S.1.15 of 1991 (No. 102, Vol. 7, August, 1991) defines the requirements for groundwater protection, surface impoundment, land treatment, water piles, landfills, incinerators etc. It also describes the hazardous substances tracking programme with a comprehensive list of acutely hazardous chemical products and dangerous waste constituent. It also states the requirements and procedure for inspection, enforcement and penalty.

National Environmental Impact Assessment Procedural and Sectoral Guidelines

In response to the promulgation of the EIA Act, the FMEnv developed National EIA Procedural Guidelines and other set of guidelines on various sectors of the National economy. Applicable to this study is the EIA Guidelines for Infrastructural Sector (2013). The guidelines have been developed by the FMEnv to assist proponents in conducting detailed environmental and social assessment with regards to Infrastructural projects in Nigeria.

1.6.2.2 National Environmental Standards and Regulations Enforcement Agency (NESREA) Act, 2007

The National Environmental Standards and Regulations Enforcement Agency (NESREA) was established in 2007 by the Federal Government of Nigeria as a parastatal of the FMEnv. The Agency is charged with the responsibility of enforcing the environmental laws, guidelines, standards and regulations in Nigeria, specifically during the operational phase of developmental projects. The NESREA's regulations applicable to this Project include:

- **National Environmental (Sanitation and Wastes Control) Regulations, 2009**
  The purpose of this regulation is the adoption of sustainable and environment friendly practices in environmental sanitation and waste management to minimize pollution.
- **National Environmental (Noise Standards and Control) Regulations, 2009**
  This regulation highlights the permissible noise levels to which a person may be exposed; control and mitigation of noise; permits for noise emissions in excess of permissible levels; and enforcement. NESREA's permissible noise level for ambient environment is 85 dB (A).
- **National Environmental (Surface and Groundwater Quality Control) Regulations, 2011**
  The purpose of this regulation is to enhance and preserve the physical, chemical and biological integrity of the groundwater and surface water resources.
- **National Environmental (Construction Sector) Regulation, 2011**
  The purpose of this regulation is to prevent and minimize pollution from construction, decommissioning and demolition activities to the Nigerian environment.

1.6.3. Environmental Impact Assessment Sectoral Guidelines for Infrastructures 1995

In furtherance of the mandate of the defunct Federal Environmental Protection Agency (FEPA) now known as the Federal Ministry of Environment (FMEnv), the apex Environment and Conservation of Natural Resources as contained in Decrees 58 of 1988 and 59 of 1992, this guideline on infrastructural sector of the National Economy was developed. This is to ensure the environmental sustainability of this sector through

compliance with EIA decree 86 of 1992 which makes Environmental Impact Assessment (EIA) mandatory for all new projects.

In order to achieve sustainable development, the significance of EIA for projects, process or activities cannot be overemphasized. This guideline is to assist project proponents in conducting detailed environmental assessment of projects with emphasis on significant associated and potential impacts of such projects.

1.6.3.1 National Guidelines and Standard for Water Quality 1999

The National guidelines and standards for water quality in Nigeria is to guide water management with regards to maintaining safe quality of water for various uses throughout the country and in order to improve the quality of the environment and to free it from pollutant and other environmental and health hazards.

1.6.3.2 National Guidelines on Environmental Management Systems (EMS) 1999

Environmental Management System (EMS) provides a mechanism that integrates economic growth, sustainable development and environmental management within a business organization. It is a proactive approach to sustainable environmental management, which aims to enable organizations reduce their risks and liabilities, whilst enhancing their corporate image.

1.6.3.3 The Nigerian Urban and Regional Planning Act, 2004

This Act establishes a Development Control Department (DCD) charged with the responsibility for matters relating to development control and implementation of physical development plans at Federal, State and Local Government levels within their respective jurisdiction.

1.6.3.4 Water Resources Act, Cap W2, LFN, 2004

The Act is aimed at promoting the optimum planning, development and use of the 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.

1.6.3.5 Harmful Waste (Special Criminal Provisions) Act No 42 of 1988 (amended in 2004)

Activities relating to the purchase, sale, importation, transit, transportation, deposit and storage of harmful wastes are prohibited and declared unlawful under the Act. From the commencement of this Act, any person who, without lawful authority: (a) carries, deposits, dumps or causes to be carried, deposited or dumped, or is in possession for the purpose of carrying, depositing or dumping, any harmful waste on any land or in any territorial waters or contiguous zone or Exclusive Economic Zone of Nigeria or its inland waterways; or (b) transports or causes to be transported or is in possession for purpose of transporting any harmful waste; or (c) imports or causes to be imported or negotiates

for the purpose of importing any harmful waste; or (d)sells, offers for sale, buys or otherwise deals in any harmful waste, shall be guilty of a crime under this Act. Remaining provisions deal with prosecution, crimes by body corporate and penalties.

1.6.3.6 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 so as to make it noxious to the health of persons in general in the neighborhood.

1.6.3.7 Labour Act of 1990 (amended in 2004)

The Labour Act is the primary law protecting the employment rights of individual workers. The Act covers protection of wages, contracts, employment terms and conditions, and recruitment; and classifies types of workers and special workers.

1.6.3.8 Forestry Act, Cap F 36, LFN, 2004

This Act of 1958 provides for the preservation of forests and the setting up of forest reserves. It is an offense, punishable with up to 6 months of imprisonment, to cut down trees over 2ft in girth or to set fire to the forest except under special circumstances.

1.6.3.9 Trade Unions (Amendment) Act, 2005

This Act contains provisions with respect to the formation, registration and organization of trade unions. It includes stipulation of 'equal pay for equal workers without discrimination on account of sex, or any other ground whatsoever'.

1.6.3.10 Employees Compensation Act, 2010

This Act repeals the Workmen's Compensation Act W6 LFN 2004 and makes comprehensive provisions for payment of compensation to employees that suffer from occupational diseases or suffer injuries from accident at workplace or in the course of the employment.

1.6.3.11 Factories Act, CAP F1, LFN, 2004

The Factories Act is the primary law regulating health, safety and welfare of workers in factories/facilities in the country. The law holds management and staff personally responsible for violations of the provisions in the Act. With respect to safety, there are general provisions as to the securing, fixing, usage, maintenance and storage of machinery, hoists and lifts, chains, ropes and lifting tackle, and other lifting machines. There are in addition to these, standards set for the training of workers, safe access to any work place, and fire prevention.

1.6.3.12 Endangered Species Act, Cap E9, LFN, 2004

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

- **Section 1** prohibits, except under a valid Certificate, the hunting, capture or trade in 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.

1.6.3.13 Nigerian Content Act

The Nigerian Local Content law was created to enhance utilization of the country's human and material resources for the provision of goods and services to the petroleum industry.

- Nigerians shall be given first consideration in the award of oil blocks, oil field licenses, oil lifting license and shipping service as well as projects for which contracts are to be awarded in the industry;
- there shall be exclusive consideration for Nigerian indigenous services to the oil and gas industry subject to the fulfilment of specified conditions;
- every multinational oil company operating in Nigeria is to domicile a minimum of 10% of its annual profit in Nigerian banks;
- Nigerian insurance companies are to do all aspect of insurance in the oil and gas sector except where local capacity has been exhausted;
- one percent of every contract awarded in Nigeria's oil and gas sector to be set aside for capacity building;
- At least 50% of the asset of any company seeking to execute oil and gas contract in Nigeria must be domicile in Nigeria, among others.

1.6.3.14 Pension Reform Act, 2014

This Act makes provision for the contributory pension scheme for public and private sectors in Nigeria.

1.6.3.15 Land Use Act CAP L5, LFN, 2004

The Land Use Act of 1978, revised 2004 under the Constitution of 1999 and the Public Lands Acquisition Laws of the relevant states constitute the governing policy for land acquisition in Nigeria. As it is the case with most National and State laws on acquisition of land in the public interest or for a public purpose, the legislation enables the state to acquire land. The Acts also specify the procedures the state must follow to clear the land, and define the compensatory measures the state must implement in order to compensate the affected people.

1.6.3.16 Public Health Law

In Nigeria, the Public Health Law provides justification for the execution of developmental projects under guidelines that promote health by protecting the environment and safeguarding the humans' health. Subsections 6 and 7 of the Public Health Laws empower Medical Officers of Health (operating at the local government council, under the supervision of the State and Federal Ministries) to ensure the promotion of good health.

1.6.3.17 National Policy on Occupational Safety and Health

Section 17(3c) of the constitution of the Federal Republic of Nigeria (1999) stipulates that the health, safety and welfare of all persons in employment must be safeguarded and not endangered or abused.

1.6.3.18 The Nigerian Cultural Policy

The national cultural policy (1996) is generally regarded as an instrument of promoting national identity and Nigerian unity and the protection of cultural heritages.

1.6.3.19 Public Participation and Disclosure

To a large extent, relevant regulatory authorities are required to inform the public of environment-related issues. Section 55 of the EIA Act provides for the maintenance of a Public Registry for the purpose of facilitating public access to records relating to environmental assessments. Public hearings to which interested members of the public are invited to provide comments on ESIA of a proposed project are a key part of the approval process by the FMEnv.

1.6.4 State and Local Government Regulations

Section 20 of the 1999 constitution of the Federal Republic of Nigeria, states that, "The State shall protect and improve the environment and safeguard the water, air and land, forest and wild life of Nigeria". Furthermore, the EIA Act No. 86 of 1992 recommends the setting up of state environmental agencies to support the efforts of the FMEnv in regulating the consequences of project development on their environment.

1.6.4.1 Rivers State Ministry of Environment

Since the inauguration of the present democratic administration, Rivers State Government has established a full-fledged Ministry of Environment (RSMENV) headed by a Commissioner. The Ministry was created from the Rivers State Environmental Protection Agency (RSEPA). RSMENV was empowered by the decree that set up the repealed FEPA (Decree 58 of 1988, as amended by Decree 59 of 1992), which encourages State governments to set up their own Environmental Protection Agencies. Consequently, RSMENV is charged with the protection of the environment of Rivers State, and operates with Edict No. 2 of 1994.

In 2002, RSMENV published the Interim Guidelines and Standards on Environmental Pollution Control and Management in Rivers State. The guidelines seek to:

- Regulate the generation, handling, storage, disposal and management of all wastes of whatever origin in Rivers State
- Regulate physical development in compliance with the principle of sustainable development
- Enhance and where possible, restore the quality of the environment and protect the biodiversity of the flora and fauna of Rivers State.

1.6.4.2 Rivers State Environmental Sanitation Authority (RSESA)

The River State Environmental Sanitation Authority (RSESA), a parastatal under the Rivers state ministry of environment was established by an edict to manage the solid waste generated within the metropolis and its environments.

1.6.4.3 Ubima Local Government Edicts

Bye-Laws and other policies on the environment in place in Ubima Local Government Area (LGA) are in line with the Rivers State Ministry of Environment and Rivers State Environmental Sanitation Authority requirements.

Furthermore, the LGA is expressly empowered under section 33 of the Urban & Regional Planning Act to refuse an application by a developer which does not have a detailed environmental impact assessment attached to it where what is sought to develop, in respect of a residential land, is in excess of 2 hectares of land or in the case of an office building, is in excess of four floors or 5000 square meters of a lettable space. All these are in respect of the land in the areas within the jurisdiction of the Local Government.

1.6.5 INTERNATIONAL GUIDELINES AND CONVENTIONS

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. Some International conventions and regulations that are applicable to the proposed Project include:

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 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 in order 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 Framework 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.

Convention on the Protection and Promotion of the Diversity of Cultural Expressions

The United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention on the Protection and Promotion of the Diversity of Cultural Expression is a binding International legal instrument and adopted on October 20, 2005. The Convention recognizes the rights of Parties to take measures to protect and promote the diversity of cultural expressions.

International Health Regulations

The International Health Regulations (IHR) is an international legal instrument that is binding on 196 countries across the globe, including all the Member States of World Health Organization (WHO). This binding instrument of international law entered into force on 15 June 2007. The purpose and scope is "to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks and which avoid unnecessary interference with international traffic and trade".

- *Declaration of the United Nations Conference on Human Environment* United Nations Conference on the Human Environment proclaims that "a point has been

reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences."

The principles of this Declaration relevant to the Project are summarized below:

Principle 2: The natural resources of the earth, including the air, water, land, flora and fauna especially representative samples of natural ecosystems, must be safeguarded for the benefit of present and future generations through careful planning or management, as appropriate.

Principle 3: The capacity of the earth to produce vital renewable resources must be maintained and, wherever practicable, restored or improved.

Principle 4: Nature conservation, including wildlife, must receive importance in planning for economic development.

Principle 15: Planning must be applied to human settlements and urbanization with a view to avoiding adverse effects on the environment and obtaining maximum social, economic and environmental benefits for all.

Principle 18: Science and technology, as part of their contribution to economic and social development, must be applied to the identification, avoidance and control of environmental risks and the solution of environmental problems and for the common good of mankind.

The Rio Declaration on Environment and Development

The Declaration was made in 1992 in Rio de Janeiro reaffirming the declaration of the United Nations Conference on Human Environment adopted at Stockholm in 1972. The Principle works towards international agreement which respects the interest of all and protects the integrity of the global environment and development. The relevant principles include:

Principle 4: In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

Principle 17: ESIA as a national instrument shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

International Labour Organisation (ILO): ILO-OSH 2001 - Guidelines on Occupational Safety and Health (OSH) Management Systems

These guidelines call for coherent policies to protect workers from occupational hazards and risks while improving productivity. The guidelines present practical approaches and tools for assisting organizations, competent national institutions, employers, workers and other social partners in establishing, implementing and improving occupational safety and health management systems, with the aim of reducing work-related injuries, ill health, diseases, incidents and deaths.

At the organizational level, the guidelines encourage the integration of OSH management system elements as an important component of overall policy and management arrangements. Organizations, employers, owners, managerial staff, workers and their representatives are motivated in applying appropriate OSH management principles and methods to improve OSH performance. Nigeria ratified the guidelines in 2001.

World Bank OP/BP 4.01; Environmental Assessment (EA)

This is one of the Environmental and Social Safeguard Policies of the World Bank. It is used in the Bank to examine the potential environmental risks and benefits associated with Bank lending operations. Under OP/BP 4.01, Bank lending operations are broadly defined to include investment lending, sector lending, rehabilitation lending through financial intermediaries, and investment components of hybrid lending. Prototype Carbon Fund (PCF) and Global Environmental Facility (GEF) co-financed projects are also subject to the provisions of OP/BP 4.01.

Under this guideline, The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The Bank favours preventive measures over mitigatory or compensatory measures, whenever feasible.

EA takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and trans-boundary and global environmental aspects. EA considers natural and social aspects in an integrated way. It also takes into account the variations in project and country conditions; the findings of country environmental studies; national environmental action plans; the country's overall policy framework, national legislation, and institutional capabilities related to the environment and social aspects; and obligations of the country, pertaining to project activities, under relevant international environmental treaties and agreements.

The Bank does not finance project activities that would contravene such country obligations, as identified during the EA. EA is initiated as early as possible in project processing and is integrated closely with the economic, financial, institutional, social, and technical analyses of a proposed project. The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EA. The Bank classifies the proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.

Depending on the project, a range of instruments can be used to satisfy the Bank's EA requirement: environmental impact assessment (EIA), regional or sectoral EA, environmental audit, hazard or risk assessment, and environmental management plan

(EMP). EA applies one or more of these instruments, or elements of them, as appropriate. When the project is likely to have sectoral or regional impacts, sectoral or regional EA is required. Other Banks guidelines and procedures that were considered in this study include the following:

- OP/BP 4.02, Environmental Action Plans;
- OP/BP 4.04, Natural Habitats;
- OP 4.07, Water Resources Management; and
- OP/BP 4.36, Forests;

International Finance Corporation (IFC) Performance Standards (PS)

IFC is a member of the World Bank Group which provides investment assistance to private sectors in developing countries. IFC applies its PSs to manage social and environmental risks and impacts and to enhance development opportunities in its private sector financing in its member countries eligible for financing. The PSs may also be applied by other financial institutions electing to apply them to projects in emerging markets. Out of the eight IFC's Performance Standards established to enable the clients ensure sustainability in projects throughout the life of an investment by IFC or other relevant financial institution, the following were considered in this EIA:

Performance Standard 1: Social and Environmental Assessment and Management System

This PS underscores the importance of managing social and environmental performance throughout the life of a project (or business activity that is subject to assessment and management). An effective social and environmental management system is a dynamic, continuous process initiated by management and involving communication between the client, its workers, and the local communities directly affected by the project. Drawing on the elements of the established business management process of "plan, implement, check, and act," the system entails the thorough assessment of potential social and environmental impacts and risks from the early stages of project development, and provides order and consistency for mitigating and managing these on an on-going basis. A good management system appropriate to the size and nature of a project promotes sound and sustainable social and environmental performance, and can lead to improved financial, social and environmental project outcomes. PS1 has the following objectives:

- To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence;
- To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities , and the environment;
- To ensure that affected communities are appropriately engaged on issues that could potentially affect them;
- To promote improved social and environment performance of companies through the effective use of management systems.

Performance Standard 2: Labour and Working Conditions

Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers. For any business, the workforce is a valuable asset, and a sound

worker-management relationship is a key ingredient to the sustainability of the enterprise. Failure to establish and foster a sound worker management relationship can undermine worker commitment and retention, and can jeopardize a project. Conversely, through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and healthy working conditions, clients may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.

Performance Standard 3: Pollution Prevention and Abatement

This PS recognizes that increased industrial activity and urbanization often generate increased levels of pollution to air, water, and land that may threaten people and the environment at the local, regional, and global level. On the other hand, along with international trade, pollution prevention and control technologies and practices have become more accessible and achievable in virtually all parts of the world. This Performance Standard outlines a project approach to pollution prevention and abatement in line with these internationally disseminated technologies and practices. In addition, this Performance Standard promotes the private sector's ability to integrate such technologies and practices as far as their use is technically and financially feasible and cost-effective in the context of a project that relies on commercially available skills and resources. The PS3 has the following objectives;

- To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities;
- To promote the reduction of emissions that contributes to climate change.

Performance Standard 4: Community Health, Safety and Security

This PS recognizes that project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development. However, projects can also increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failures, and releases of hazardous materials. Communities may also be affected by impacts on their natural resources, exposure to diseases, and the use of security personnel. While acknowledging the public authorities' role in promoting the health, safety and security of the public, this Performance Standard addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety and security that may arise from project activities. The level of risks and impacts described in this Performance Standard may be greater in projects located in conflict and post-conflict areas.

- To avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances;
- To ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security.

Performance Standard 5: Land Acquisition and Involuntary Resettlement

Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or means of livelihood) as a result of project-related land acquisition. Resettlement is considered involuntary when affected individuals or communities do not have the right to refuse land acquisition that results in displacement. This occurs in cases of: (i) lawful expropriation or restrictions on land use based on eminent domain; and ii) negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail.

The objectives of this standard are:

- To avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs;
- To mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected;
- To improve or at least restore the livelihoods and standards of living of displaced persons; and
- To improve living conditions among displaced persons through provision of adequate housing with security of tenure4 at resettlement sites.

Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management

This performance Standard recognizes that protecting and conserving biodiversity - the variety of life in all its forms, including genetic, species and ecosystem diversity - and its ability to change and evolve is fundamental to sustainable development. The components of biodiversity, as defined in the Convention on Biological Diversity, include ecosystems and habitats, species and communities, and genes and genomes, all of which have social, economic, cultural and scientific importance. This Performance Standard reflects the objectives of the Convention on Biological Diversity to conserve biological diversity and promote use of renewable natural resources in a sustainable manner. This Performance Standard addresses how clients can avoid or mitigate threats to biodiversity arising from their operations as well as sustainably manage renewable natural resources. PS6 has the following objectives:

- To protect and conserve biodiversity; and
- To promote the sustainable management and use of natural resources through the adoption of practices that integrates conservation needs and development priorities.

Performance Standard 8: Cultural Heritage

This Performance Standard recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the

World Cultural and Natural Heritage, this Performance Standard aims to protect irreplaceable cultural heritage and to guide clients on protecting cultural heritage in the course of their business operations. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity. The objectives of this PS are as follows:

- To protect cultural heritage from the adverse impacts of project activities and support its preservation; and
- To promote the equitable sharing of benefits from the use of cultural heritage in business activities.

- **The Equator Principles**

Project financing, a method of funding in which the lender looks primarily to the revenues generated by a single project both as the source of repayment and as security for the exposure, plays an important role in financing development throughout the world. Project financiers may encounter social and environmental issues that are both complex and challenging, particularly with respect to projects in the emerging markets.

The Equator Principles Financial Institutions (EPFIs) have consequently adopted these Principles in order to ensure that the projects they finance are developed in a manner that is socially responsible and reflect sound environmental management practices. By doing so, negative impacts on project-affected ecosystems and communities should be avoided where possible, and if these impacts are unavoidable, they should be reduced, mitigated and/or compensated for appropriately. The EPFIs believe that adoption of and adherence to these principles offers significant benefits to financiers, borrowers and local stakeholders through borrowers' engagement with locally affected communities.

The Principles are intended to serve as a common baseline and framework for the implementation by each EPFI of its own internal social and environmental policies, procedures and standards related to its project financing activities. The EPFIs will not provide loans to projects where the borrower will not or is unable to comply with respective social and environmental policies and procedures that implement the Equator Principles.

The key components of the Equator Principles are:

- Principle 1: Review
- Principle 2: Environmental and Social
- Principle 3: Applicable Environmental and Social Standard
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan
- Principle 5: Stakeholder Engagement
- Principle 6: Grievance Mechanism
- Principle 7: Independent
- Principle 8: Covenants
- Principle 9: Independent Monitoring
- Principle 10: Reporting and Transparency

- **China Export Import Bank (China Exim Bank)**

The Export-Import Bank of China is a state-funded and state-owned policy bank with the status of an independent legal entity. It is a bank directly under the leadership of the State Council and dedicated to supporting China's foreign trade, investment and international economic cooperation. With the Chinese government's credit support, the Bank plays a crucial role in promoting steady economic growth and structural adjustment, supporting foreign trade, and implementing the "going global" strategy. It is committed to reinforcing financial support to key sectors and weak links in the Chinese economy to ensure sustainable and healthy economic and social development. In China, the Bank has 32 branches on the mainland and one representative office in Hong Kong. Overseas, it has the Paris Branch, Representative Office for Southern and Eastern Africa, St. Petersburg Representative Office, Representative Office for Northern and Western Africa.

The Bank's main mandate is to facilitate China's national development strategies, and build a policy bank which has clear-cut market positioning, well-defined business portfolio, unique functions, sufficient capital, good governance, strict internal control, safe operation, high-quality service and sustainable development capability. Its financial support goes to foreign trade, cross-border investment, the Belt and Road Initiative, international industrial capacity and equipment manufacturing cooperation, science and technology, cultural industry, "going global" endeavors of small and medium enterprises, and the building of an open economy. The bank is a part of the Chinese foreign aid system and administers the Two Preferential Loan Program. The concessional loan and preferential export buyer's credit are the two main loan products under the preferential loan program.

For concessional loans the bank advances a no interest or very low interest rate loan to a developing country government or agency to build a project (e.g. power plant, road, water treatment facility). The term of the concession loan is up to 20 years and a maximum grace period of 7 years is given. The preferential export buyer's credit is provided to a foreign borrower to purchase Chinese goods or services (e.g. construction contractor building the project). Like the concessional loan, this type of loan is also subsidized by the Chinese government. Interest rates are below market rates at around 3 to 6%. However, the preferential export buyer's credit is generally classified as a commercial loan rather than foreign aid even if the interest rate is very low because the purpose is to promote Chinese exports. These two types of loans are a major part of the financing support for China's Belt and Road Initiative.

1.7 The ESIA Process

This ESIA study has been carried out in line with the Nigerian (FMEnv) EIA Procedural Guidelines as well as the relevant International Standards and Guidelines. The Nigerian EIA process is summarized in Figure 1.6. The ESIA involves a number of key phases carried out in a stepwise manner. These include: scoping; literature review, two-season field data gathering; laboratory analysis; stakeholder engagement; impact identification and evaluation; development of mitigation measures and EMP, report writing and disclosure (in line with the FMEnv guidelines, this ESIA report will be displayed for a 21-

working day at various centres for public review. The general public will be notified through newspaper advertisements and radio announcement). Each of these phases is explained in detailed in the subsequent chapters of this report.

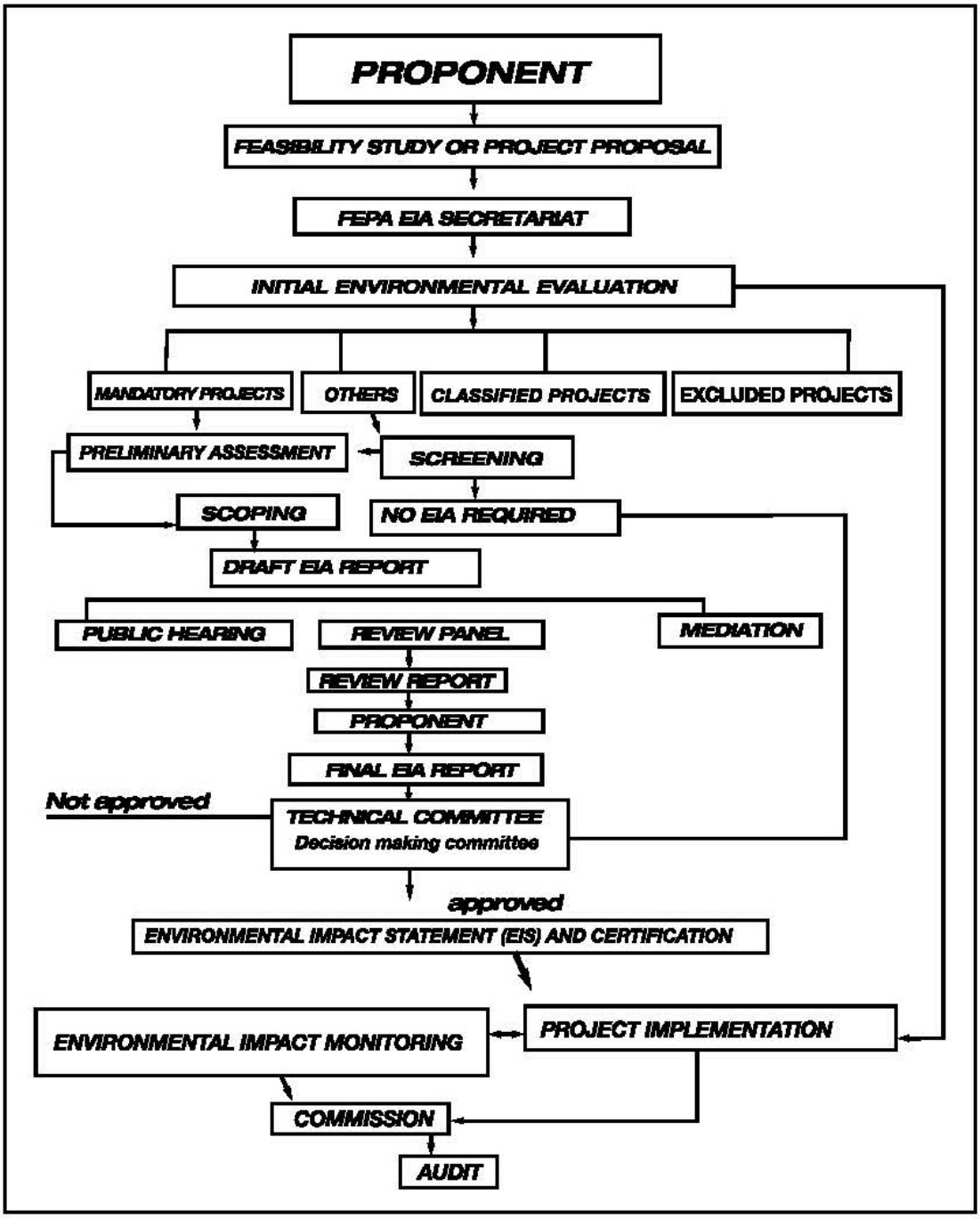

Figure 1.6: Overview of ESIA Process

Furthermore, the ESIA has been carried out in line with industry practice and regulatory guidelines on environmental assessment. The step by step methods employed in this process are described below.

Project Conceptualization and Project Location Feasibility

This stage involved initiation of the project idea by the proponent and thereafter feasibility review of choice project location. Relevant environmental information on the

proposed project location were identified using maps, charts, geographic coordinates, photographs, etc. Further preliminary activities defining the scope of project and environmental studies were also carried out in this stage.

ESIA Registration and Submission of Proposal

This stage involved development of proposal for ESIA permit to the FMEnv and payment of registration fees for same ESIA permit to the FMEnv.

Screening of Proposal Leading to ESIA Categorization

After registration of the EIA with the FMEnv, a site verification visit comprising FMEnv, proponent, consultant and other necessary regulatory stakeholders was conducted to gain firsthand knowledge of the project area. Furthermore, in-house screening was carried out by the FMEnv to categorize the project on level of assessment required. Afterwards the project was placed in a category.

Development of Terms of Reference

The site verification visit and screening represents an initial step of the ESIA process. This step is followed by a scoping activity. A key outcome of this is the creation of Terms of Reference for a full EIA study. The ESIA study will then be carried out prior to approval and environmental licensing of the project.

Reporting and Review

This stage requires preparation of the full ESIA report for submission to regulatory authority for review and approval. As applicable to the category of the project the preparation of the ESIA report will involve in no particular order:

- Identification of applicable legal, regulatory and administrative frameworks guiding the project;
- Field data gathering, literature review and existing baseline condition documentation;
- Results of stakeholders disclosure and consultation programmes;
- Impact assessment, mitigation and environmental management plans for the project; and
- Summary, conclusion and appropriate recommendations.

The next stage after reporting and submission is the review stage. It is required that internal stakeholders (client and consultant) make appropriate reviews prior to submission to regulators. Technical and or public panel review for approval follows depending on category of project.

1.8 Structure of the report

In line with the FMEnv guidelines, this ESIA report has been organized into nine (9) chapters, which is similar to the indicative outline of an ESIA provided by the World Bank in its Environmental and Social Framework, 2016.

The ESIA report is structured as follows:

- **Preliminary Sections**: These include Table of Contents, List of Tables, Figures and Plates, and Executive Summary
- **Chapter One**: Introduction containing an overview of the proposed Project, the ESIA objectives and process and applicable legal and institutional framework.

- **Chapter Two**: Project Justification containing a rationale for the proposed Project as well as the analysis of Project alternatives.
- **Chapter Three**: Project Description containing the technical elements of the Project. It concisely describes the proposed Project and its geographic, environmental, social and temporal context, including the Project's associated infrastructure and facilities.
- **Chapter Four**: Description of the Environment. It details the baseline data that are relevant to decisions about the Project location, design, and operation.
- **Chapter Five**: Potential and Associated Impacts. This takes into account all relevant environmental and social risks and impacts of the Project, including cumulative impacts.
- **Chapter Six**: Mitigation measures for the identified environmental and social impacts.
- **Chapter Seven**: is the EMP for the Project. It summarizes the key measures and actions and the timeframe including responsibility for the implementation of the recommended measures.
- **Chapter Eight**: presents an overview of remediation plan after decommissioning and project closure.
- **Chapter Nine**: Conclusions and Recommendations
- References
- Appendices

CHAPTER TWO
PROJECT JUSTIFICATION

2.1 Project justification

This section highlights the project needs, benefits, alternatives and options as well as its sustainability for the Port Harcourt Industrial Park project. The development of an Industrial park can be viewed as an integrated solution for development and economic growth. Industrial park has proven to be an instrumental tool in ensuring social and economic development in the world. Industrial park is one of the modern phenomena adopted according to the speed with which more and more business entities, cities, municipalities and regions in the world are growing. The development is in accordance with the economic and industrial needs of Nigeria which constitutes an economic resource of unimaginable magnitude when the expected demand for services is considered together with the necessary infrastructural facilities that would have to be provided to make the park run efficiently. It is justified on the basis of the Government's desire in contributing towards the rapid development of Nigeria through the provision of an organized setting for diverse sector of industries to thrive as recognizable symbol of economic strength, boosting export of locally manufactured products against import, bringing together businesses, persons, corporations and government agencies.

2.2 Need for the Project

Nigeria's economy has always been dependent on crude oil sales for most of its revenue and foreign exchange. This dependence often subjects the economy to the volatility of the global oil market with usually devastating effects. It was, therefore, imperative for the country to diversify its resources base. The Federal Government of Nigeria with a view to achieving diversification of the economy from oil, and absorb the growing workforce by creating productive jobs and also promote exportation through effective industrialization process leveraging on economic projects and also in recognition of the deficient state of Nigeria's infrastructure stock vis-a-vis the size of the economy and the important role of being a catalyst to the development and growth of large and small businesses intends to construct

an industrial park in Ubima, Ikwere Local Government Area, Rivers State. Nigeria, with a population of more than 200million, presents a large consumer market deemed enticing enough to lure investors to take advantage of the opportunities that will be presented by highly efficient infrastructural facilities, less bureaucracy and streamlined One-Stop-Shop operational procedures that the parks offer for cost effectiveness and enhanced global competitiveness. Other industrial parks in Nigeria have also witnessed considerable investment too despite some infrastructural challenges. The Park is expected to benefit from first-mover advantage as pioneering a truly focus industrial park of one of a kind in the South-South region of Nigeria.

The uses generally permitted in General Industrial areas include those activities where the predominant use of land, buildings and/or structures is for the purpose of manufacturing, assembling, fabricating, processing, repairing, warehousing and wholesaling, storage yards, contractors' yards, transportation terminals, and research and communication facilities, Automotive machine shops, body shops, collision repair shops and towing compounds.

The proposed Park will be supported with necessary infrastructure-power, water supply, waste and sewage treatment plant, drainage, road network Information and communications technology (ICT).

2.3 Project Benefits

The proposed Port Harcourt Industrial Park project is a huge infrastructural project whose benefits include but not limited to the following:

i. The construction of Park will be advantageous to the Eastern Railway line and road corridor within the south-south and eastern region of the country.
ii. Ensure comfort of freight forwarder and freights movement across the country.
iii. Promote the regional infrastructural development.
iv. Facilitate an integrated mode of transportation in the country.
v. Develop indigenous manpower through technology transfer.
vi. Develop safe, efficient, and affordable integrated multi-modal transportation. etc.
vii. Promote economic recovery and growth plans 2017 to 2020 of the FGN.
viii. Provide foreign exchange earnings by promoting nontraditional exports,

ix. Provide jobs and income Generation,

x. Attract foreign direct investment and attendant technology transfer and knowledge spillover.

2.4 Value of the Project

The cost of the project is estimated at Two Hundred and Forty One million, Two Hundred Thousand dollars ($241,200,000). The source of funding for the proposed Port Harcourt Industrial Park project is via Private Public Partnership (PPP).

2.5 Envisaged Sustainability

The sustainability of this project stems from the fact that it will make economic contributions and also satisfy environmental requirements. The goal is to meet the needs of the present without compromising the ability of future generations to meet their own need, this can be achieved if the longevity of the project is assured and is hinged on the key pillars of sustainability, which are Economic, Environmental and Social sustainability.

2.5.1 Economic Sustainability

The proposed Project shall improve local and International trade relations between Nigeria and the rest of the world; bringing in foreign investments into the country and expanding local markets and trades in Nigeria which in turn will increase foreign exchange inflow as well as generate revenue for the government.

The Private Public Partnership (PPP) model shall ensure economic sustainability of the project as contained in the contractual agreement with the concessioner which would in turn ensure financial sustainability of the project. In addition, the project has local and national economic values in terms of employment opportunities for various categories of Nigerian professionals, skilled and semi-skilled craftsmen, business opportunities and additional revenue for the government.

2.5.2 Environmental Sustainability

The Environmental and Social Impact Assessment have been conducted to identify all potential impacts associated with the proposed project and proffer appropriate mitigation

measures that will ensure that all the impacts are minimized or completely avoided thereby ensuring the present development does not affect the future generations from meeting their own needs. However, incorporating the findings and recommendation of this ESIA, and implementing an effective Environmental Management Plan, at the planning, design, construction, operation and abandonment/decommissioning stages of the proposed project, will further ensure its environmental sustainability.

The project's activities shall be followed through as guided by National and International environmental regulatory guidelines and standards.

2.5.3 Technical Sustainability

The technical sustainability of the proposed project shall involve the application of Best available technology not entailing excessive cost (BATNEEC). Also, strict adherence to International and National engineering design, construction standards and codes of practices shall ensure the technical viability of the project.

Federal Ministry of Transportation as well as the engineering procurement construction (EPC) contractors (CCECC Nigeria Limited) will in addition develop operating manuals and appropriate documentation regarding the operation and maintenance of the facilities. All the projects facility designs and construction shall be handled by properly trained and experienced personnel and competent contractors.

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

(i) The company'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.

(ii) 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.

(iii) Stringent safety measures would be built into the construction of park.

2.5.4 Social Sustainability

The concept of "social sustainability" considered in this report encompasses: live ability, social equity, health equity, community development, social capital, social support, human rights, labor rights, and social justice. These elements of social sustainability are more achievable if stakeholders in a project area are given a sense of ownership of the project.

The project will be undertaken in a socially sustainable manner since it has a lot to do with the public and the local community around the project area. The nearest community bordering the project is well disposed to the project and is willing to support the implementation of the project to its logical conclusion.

The Federal Ministry of Transportation will establish and maintain a conducive environment in the project area and put in place Grievance Redress Mechanism while maintaining effective community relations during construction and throughout the life span of the project.

2.6 Project Alternatives

2.6.1 Alternative Site/Location Option

The location and selection of the Port Harcourt Industrial Park in the Ubima, Ikwere LGA, was based on technical reasons including its proximity to the Port Harcourt – Maiduguri Eastern railway line suitability for reception and business potential and provides an opportunity for manufacturing activities not to cause nuisance to residents. However, the site accessibility was also considered which is paramount in any development project.

The Port Harcourt – Maiduguri Eastern railway line and the Bonny Deep Sea port will provide other forms of transportation via railway and water connections to the area for easy import and export of commodities to the industrial park. The site was carefully selected to meet the set out criteria for project of this magnitude which include; minimum possible infringement, availability of adequate space, avoidance of historic sites and environmental sensitive areas.

2.6.2 Alternative Technology Option

The project will be constructed using modern, locally and internationally accepted materials by Standards Organization of Nigeria (SON) to achieve public health, safety, security and environmental aesthetic requirements. Equipment and systems that save resources including energy and use of solar systems, water conservation will be given first priority without compromising on cost or availability factors.

Asphalt mixers, crushers and other construction equipment and machineries will be incorporated with pollution control devices like dust arrestors/precipitators, emission control, noise abatement devices and desulfurization devices. The equipment and vehicles will have highest levels of combustion efficiency, capability to use cleaner fuels like bio-diesel and will have enhanced safety features.

2.6.3 Waste water management alternatives

The proposed project available technologies for domestic waste management alternatives are discussed below:

2.6.3.1 Alternative One - Use of septic tanks

This involves the construction of underground concrete-made tanks to store the sludge with soak pits. It is expensive to construct and regular emptying in large discharge points. Given the kind of liquid waste emanating from the proposed project this option is not preferred since it will be uneconomical.

2.6.3.2. Alternative Two - Waste water treatment plant

This involves the construction of a plant and use of chemicals to treat the effluents to locally/internationally accepted environmental standards before it is discharged. It is usually expensive to construct and maintain, but it is the most reliable, efficient and cost-effective in the long term. This option is viable and will be adopted for this project. It is planned that waste water from the operation of the Industrial Park shall be treated via a Central Wastewater Treatment Plant before discharge.

2.6.3 Alternative source of Energy

The project site for the proposed Industrial Park is virtually unoccupied and devoid of any meaningful economic activity. Operation of a project of such magnitude requires constant and reliable source of electricity which has been a great challenge throughout the country. The construction of a substation and 10 dry type transformers each of 1600KVA and the use of 6 diesel generators settled each of 2,000KW, 1 standby, a total of 7 was the only source of energy considered for the park.

2.7 Project Options

The following project options were considered for the construction of the proposed project:

2.7.1 No-Project Option

Taking no action would, naturally, be a feasible option. Under the No-Project option, the Industrial Park will not be constructed. No action would mean a lack of a viable infrastructural solution in Ibadan, limiting economic growth. As in all development projects, this may be an environmentally viable option. However, Nigeria stands to lose the economic and environmental benefits of the project if the "no project option" is adopted. Moreover, it is well known that development has improved man's living conditions especially when pursued with environmental management as a goal of equal importance. Furthermore, useful data has so far been obtained from several feasibility studies and economic analysis, while significant resources have been expended to date on the project.

2.7.2 Delayed project option

This option implies a delay in the Port Harcourt Industrial Park project which means postponing all the preliminary plans that have been made on the proposed project. Delay in project implementation is usually considered when prevailing conditions are unfavorable, such as land acquisition, resistance from host communities or if the economics of the project are unacceptable and unattractive. None of the above circumstances is applicable here. On the contrary, both economics and political environment are favorably disposed towards the project. The delayed project option is therefore not the considered option.

2.7.3 Go ahead project option

This option proposes that the project proceed as planned. The Port Harcourt Industrial Park project has been conceptualized and designed with the best available and environmentally compliant technology. A substantial investment has been made by the proponent during the preliminary design processes. The continue project option is therefore the preferred option.

CHAPTER THREE

3.1 INTRODUCTION

This Chapter presents the project details including design, project components, project status, waste stream from the construction and operation of the Port Harcourt Industrial Park, as well as project life span and schedule.

The proposed industrial Park is a huge business venture that will not only boost the status of the nation's industrial hub but also serve as a vision of changing the entire economy of the country and the West African sub-region by extension as its objective is in line with the concept to globally fast-track industrialization, socio-economics development of designated areas and jobs/wealth creation.

3.2 THE PROJECT

This project is planned to provide a unique business environment for stakeholders of innovation process in Nigeria's industrial sector to interact with each other, attract domestic and foreign venture capital, as well as technological development, transfer and adoption. The project is divided into four functional areas: Production Area, living area, Public Utility District and Reserved Area and when fully completed will be made up of the following components:

i. 12 standardized workshops with a total construction area of 100,000m^2
ii. Office blocks of 2500m^2
iii. Living area of 11500m^2 and
iv. Other supporting facility

The workshop is a light industry standard workshop, which can provide a place for food processing, clothing and apparel, electronic products assembly and other enterprises.
The Living Area consists of accommodation, food court, shops and other entertainments utilities which could serve more than 650 people.
In addition, the project also set up a certain scale of offices. These offices will provide a variety of financial services, manpower services and other services for the park, but also can accommodate a variety of utility companies to serve the surrounding areas.
Factory buildings reflect the concept of modern, scientific and technological; the overall style is simple, bright colors. The style and color of the supporting buildings are consistent with the factory buildings, to ensure the overall effect of the park is neat.

3.2.1 Project Layout

With the goal of building a first-class industrial park, based on the premise of ensuring environmental and social benefits, the general layout of the plan optimizes the combination of site selection, layout, safe production, efficient operation and environmental protection. Effectively control the cost to meet the requirements of the sustainable development of the industrial park. The concept design of the industrial park are shown as follows:

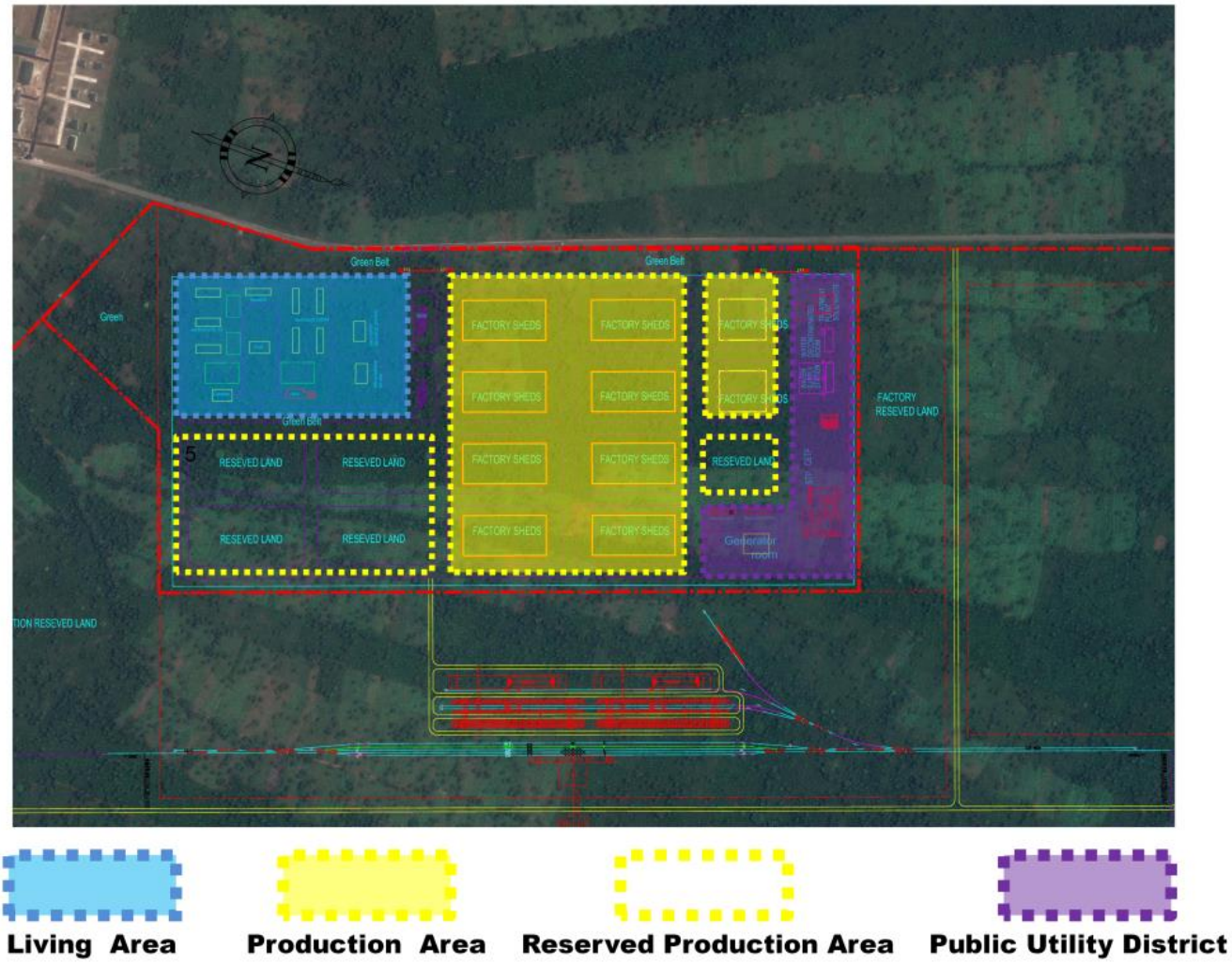

Fig 3.1 shows the Master Plan for the proposed Port Harcourt Industrial Park

3.2.2 Project Phases

The proposed project phases will involve the following:-

- **Design & Preliminary Phase**
  - Survey and Design
  - Geotechnical Investigation
  - Environmental and Social Impact Assessment study
  - Detailed engineering designs and drawings
  - Approval
- **Development/Construction Phase**
  - Construction & maintenance of temporary access road
  - Construction and maintenance of Site offices and Workshops
  - Mobilization & demobilization of facilities/plants/equipment to & from the site
  - Construction of Main Buildings, like Offices, & Other Commercial Activities

- Installation of Power Infrastructures
- Construction of public utilities such as Sewage Treatment Plant, Water System and Treatment Plant
- Installation of Communication and Automatic Control Systems
- Project on-site training programmes

❖ **Operating and Maintaining the Park**

- Fees Collection
- Routine Maintenance
- Periodic Maintenance

❖ **Park Transfer**

- Upon the expiration of the contract, the Park assets and infrastructure will be handed over to the Federal Government of Nigeria.

3.3 PROJECT LOCATION

The proposed industrial park project is located in Ubima, Ikwere Local Government Area, Rivers State with a total land take of 114 hectares. Ubima lies onshore in the northern part of Rivers State, the geographical coordinates for the proposed project are presented on Table 1.1, the proposed project site is a green field. In close proximity to the project area is the Nigeria Naval Intelligence Headquarters and Port Harcourt – Owerri Expressway. The settlement within 5km radius of the proposed project site are Omueka, Omuowhor, Omuordu and Mgbuogba.

Table 1:1 Geographical Coordinates of the proposed site

S/N	PHASE 1	N	E
1.	A	5.106336	6.892999
2.	B	5.104119	6.891644
3.	C	5.100424	6.890552
4.	K	5.098725	6.889597
5.	J	5.108726	6.882653
6.	I	5.117408	6.886706

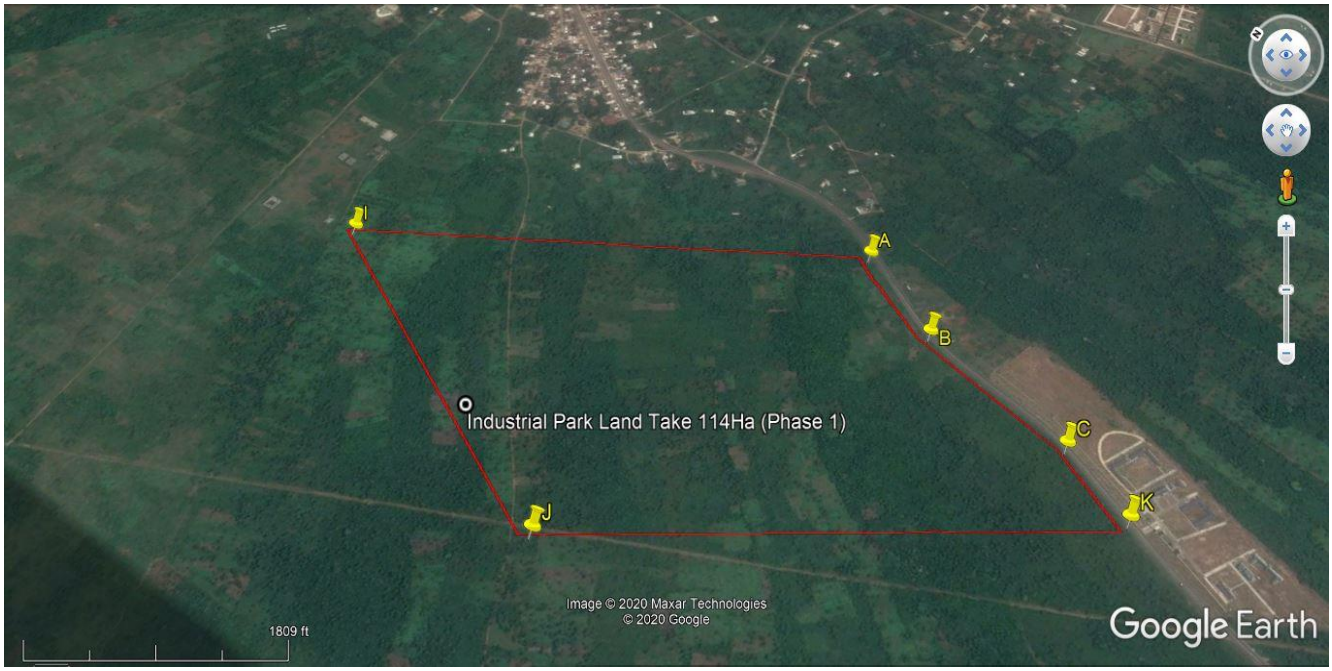

Fig. 3.2: Satellite Imagery of the proposed project site

3.4 OBJECTIVE OF THE PROJECT

A viable industrial park project is needed in the oil and gas producing area in the Niger Delta region of Nigeria, where most petroleum products terminal and tank farms are located. It has direct linkage to the soon to be rehabilitated Port-Harcourt Maiduguri narrow gauge railway line. This is in line with the aspirations of the Federal Government Economic recovery and growth plans as well as to diversify the Nation's economy and provide job opportunities.

3.5 LAND USE PLAN

The land use for the area would be made up of designated areas for various category of development. The land use plan would serve as the basis for all the facility and service needs of the industrial park. Land use plan, category descriptions and allocated land space in hectares and percentage accommodates the development projections emerging from the Market Analysis study.

3.5.1 Functional Arrangement/Zoning

The production area is located centrally in the site, and at the heart of the development. This location provides direct contact to all of the adjacent functional zones. The residential areas have been divided into smaller areas creating a tight urban fabric using landscape interventions to delineate the different areas. Within the residential zone, the areas allocated for workers are closest to the industrial area.

Public utility district is located at the end of the site. Recreational and leisure activities are also located close to the residential zones. Landscape interventions, using existing topography landscape features, will provide buffer zones between functional zones, and also provide exciting public open space with integrated play elements.

3.6.2 Road Analysis

There are two main entrances in the factory building area in the park. The interior is connected by a loop. The commercial area establishes independent entrances.

- The width of the main road is 35m. It contains 4 lanes and 4m wide sidewalks in both directions; open drainage ditch and green belt.
- The width of the secondary road is 23.5m. It contains 2 lanes and 2m wide sidewalks in both directions; open drainage ditch and green belt.
- The width of the maintenance road is 7m (excluding sidewalks) to meet the traffic requirements of motor vehicles and fire trucks.
- A loading and unloading site is reserved around each industrial plant to meet the passing requirements of emergency vehicles (fire fighting vehicles, emergency vehicles, police cars, etc.).
- The carriageway structure is (from bottom to top) subgrade compacted 93%, 20cm gravel base, permeable layer (MC1), 5cm thick asphalt concrete, Tack coat, 4cm thick asphalt concrete. Pavement structure (from bottom to top) subgrade compacted 93%, 10cm cement stabilized gravel base, 3cm1:4 cement sand, 8cm concrete block.

3.6.2.1 The Structure Design

Brief description of construction and structures are as follows:

- Concrete structure: the foundation cushion adopts C15 plain concrete, the independent foundation adopts C30 reinforced concrete, and the foundation beam adopts C30 reinforced concrete; Reinforced concrete frame column, beam and slab adopt C30 reinforced concrete; The underground structure of reinforced concrete adopts C30 impermeable reinforced concrete.
- The mezzanine platform structure in the workshop adopts composite floor, using 1mm thick pressed steel plate as the formwork. The platform adopts C30 reinforced concrete, and the floor thickness is not less than 120mm;
- Steel structure and reinforcement bar: the grade of main steel structure is q345-b; the grades of secondary and sporadic steel structure are q235-b; the grade of reinforcement bar is Hpb-300 (diameter less than 10) or hrb-400 (diameter greater than or equal to 10).
- There are 8 plants each of 11,000㎡ in total. The plants adopt single-floor four-span portal frame structure. The distance of the column is 7.5m, the span is 4x18m, and the cornice elevation is 8m;
- Roofing system. The roof structure adopts steel structure with purlin system and support system.
- Wall frame structure. Wall frame structure is independent steel structure. Wall purlin cold-bent thin walled C section.

- There are 2 plants each of 6,000㎡ in total. The plants adopt single-floor two-span portal frame structure. The distance of the column is 7.5m, the span is 4x18m, and the cornice elevation is 8m.
- The reinforced concrete structure is adopted for office building and living area buildings, and the foundation is independent foundation under column. The storey height of office building and other buildings in the living area is 4.5m, and the storey height of accommodation building is 5.4m.

3.6.2.2 Other supporting facilities

- The one-stop service building is a two-story reinforced concrete frame structure; each floor platform is cast-in-place reinforced concrete slab. Independent reinforced concrete foundation.
- The fire station is a single reinforced concrete frame structure with basic column spacing of 4m and 6m and span of 8.4m. Independent reinforced concrete foundation. The car shed is a single-layer single-span frame structure system.
- The clinic and police office are constructed with a single reinforced concrete frame structure. The basic columns are 3m and 6m apart, with a span of 8.4m. Independent reinforced concrete foundation.
- The deep pump station is a single layer reinforced concrete structure; the column net is 5.1m x 5.1m, and the reinforced concrete independent foundation.
- Water supply station (domestic - fire water supply) for the ground structure adopts the reinforced concrete frame structure, reinforced concrete independent foundation. The roof is equipped with an electric single beam hanging crane, with a lifting weight of 5t.
- The cistern is an above-ground structure, which is made of glass fiber reinforced plastic.
- Transformer room and distribution duty room are single layer reinforced concrete frame structure and independent reinforced concrete foundation.

3.6.2.3 Single Design Feature

- The workshop is a light industry standard workshop, which can provide a place for food processing, clothing and apparel, electronic products assembly and other enterprises.
- The Living Area consists of accommodation, food court, shops and other entertainments utilities which could serve more than 650 people.
- In addition, the project also set up a certain scale of offices. These offices will provide a variety of financial services, manpower services and other services for the park, but also can accommodate a variety of utility companies to serve the surrounding areas.
- Factory buildings reflect the concept of modern, scientific and technological; the overall style is simple, bright colors. The style and color of the supporting buildings are consistent with the factory buildings, to ensure the overall effect of the park is neat.

3.6.2.4 Ventilation

The ventilation design of the factory building makes use of the natural wind as much as possible. The building layout is conducive for ventilation and heat dissipation inside the factory. Natural light is used as much as possible in factory buildings. Adopting the dormer and vertical lighting strip for external walls, the use of artificial lighting will be minimized in the factory during the day, and the lighting coefficient of transparent materials will be controlled to ensure the uniformity of indoor lighting and meet the requirements of working light environment. The design style of the gate, supporting buildings and administrative buildings reflects the unique style and identification of the industrial park.

3.6.2.5 Cultures

The facade modeling of factory buildings has the commonness of industrial buildings: it is light and efficient, while the appearance and color have distinct, unique and delicate characteristics, consistent with people's aesthetic. The harmonious relationship of symbiotic symbiosis is pursued between the buildings, structures, outdoor sites, woodlands, flowers and trees in the site, and each element can find the most suitable position for itself.

3.6.2.6 Landscaping

Soft landscape is a key and integral element of an open space environment. The primary purpose of planting material is to enhance the character of an area, promote biodiversity by augmenting the existing plant palette, provide shade and amenity, screen or delineate user zones, create visual identity for spaces within the industrial park and to reinforce the overall design of the open spaces. The master plan shall ensure that existing trees are preserved as much as possible. Where possible, mature trees should be retained in their current location. However, if necessary, they can be raised and relocated into a nursery area for holding before being moved into its new permanent location such and the green network parks and buffers. In the detail design stage, existing trees need to be accurately surveyed to assess age and value of existing trees. Before development starts, mature trees will have to be raised and moved to an on-site temporary nursery, where they will be tended to until their relocation throughout the site.

3.6.2.7 Green buffers

Green buffers would generally be developed at the allocated area and along the peripheries of the park. Their main purpose would be to act as both a demarcation of the park from its surrounding as well as to project a green environment to outsiders. The buffer zones play an important role in the development of the landscape strategy.

Fig. 3.4: Factory building perspective

Fig. 3.5: One stop service building perspective

Fig. 3.6: Police room perspective

Fig. 3.7: Main gate perspective

3.6.2.8 Water supply

There is no pipe borne water supply system in close proximity to the project area. Water for production, domestic and firefighting use in the project shall be supplied by means of self-provided Wells and water tower pressurization. The maximum water consumption for daily production and living is estimated at 1200m m^3/d, and the fire water consumption is estimated at 200 m^3/d.

3.6.2.9 Fire fighting

Domestic (production) water supply system pump water from the underground, later transport to the tank (domestic - fire) of water station after purification filter treatment, the tank can support about either 24 hours for domestic, 8 hours for production or 3 hours for firefighting. A combined network will be provided for the domestic Water Supply and Fire Fighting.

3.6.2.10 Sewage and rainwater

The rainwater and sewage shall be discharged separately, and the production and domestic water shall be discharged after being treated. The water source of domestic drainage system is mainly domestic sewage in the park, the displacement shall be treated according to 80% of the domestic water consumption. Collected by the dry drainage pipeline of the park, domestic sewage flows into the integrated domestic sewage treatment station, which containing well, Primary regulating tank, Hydrolytic acidizing tank, aeration regulating tank, contact oxidation tank, secondary contact oxidation tank, high efficiency sedimentation tank, secondary lift pump station, filtration room, etc.. The treated sewage shall be able to discharge to the municipal drainage network. Based on the calculation of 80% of the water needs to be treated, the sewage treatment capacity is estimated to be 1000 tons /d.

3.6.2.11 Drainage System

The proposed drainage system is designed to cater for the surface runoff within the project area solely by gravity flow. Covered drains will be used for the proposed drainage system in the development. This will reduce unauthorized garbage disposal into the drains and prolong service life of the underground drains since they are protected against the elements. Drains will be maintained, to ensure proper flow; maintenance would include inspection, de-silting, repair of any damaged drains and monitoring solid waste disposal. The following highlights how drainage system would be constructed. The landscape strategy also includes a Sustainable Urban Drainage System (SUDS). This system works to direct rainwater and run-off away from the industrial premises and into the natural drainage system. The increase in area of hard surfaces will affect the management of the water, and a SUDS system would alleviate potential flooding. It should be noted that values presented here are estimates.

- All drains to be constructed are proposed along the roads;
- Drainage type would be closed box drain with reinforced concrete construction;
- Proposed minimum gradient would be 1:1000;
- All secondary drains are expected to discharge to the primary drains;
- Primary drains are proposed to discharge to the Kainji Lake;
- The maximum primary drain width would be 2.5 m but the depth varies from 1.4m to 2.5m; and
- The maximum secondary drain width would be 1.5m but the depth varies from 0.6m to 2.0m.

3.6.2.12 Ventilation and air conditioning design

The air conditioning system of this project adopts a separate air conditioning system. If there are air-conditioning requirements by individual plants, it should be handled by them themselves.

3.6.2.13 Power supply/ Energy Requirement

The project site for the proposed Industrial Park is virtually unoccupied and devoid of any meaningful economic activity. Operation of a project of such magnitude requires constant and reliable source of electricity which has been a great challenge throughout the country. This makes the provision of power supply fundamental to the success of the proposed industrial park as no industry can be sustained without adequate and reliable source of energy supply. The energy requirement for the proposed Port Harcourt Industrial park is total power load is about 12.8MW, operating voltage: high voltage 33kV, low voltage 0.415/0.24kv, frequency: 50Hz

This project site will require a substation, 10 dry type transformers each of 1600KVA, 6 diesel generators settled each of 2,000KW and 1 standby, a total of 7.

3.6.2.14 Codes and Standards

All electrical systems shall be designed and specified in compliance with the

recommendations, codes and standards, as follows:

- Latest edition of the "British standard"- Europe norms (BS –EN).
- Standard Handbook for Electrical Engineers, published by Mc Graw Hill Handbooks, Donald G. Fink and H. Wayne Beaty.
- Nominal characteristics of all equipment forming part of the electrical works shall be specified to conform to the relevant BS Standards or "National Electrical Manufacturing Association" (NEMA) and the "International Standards Organization" (ISO).

3.6.2.15 Lighting

4 lighting distribution boxes are set up in each 11,000 ㎡ plant and 2 lighting distribution boxes are set up in the 3000㎡ plant. Production lighting is 300 lux, and the minimum lighting for office area is 400 lux. The production and manufacturing plant is equipped with high-efficient and energy-saving industrial high-shed T5 lamps with electronic ballast, and metal halide lamps are used in warehouses. Other buildings are fitted with energy-saving lamps.

All metal halide lamps are equipped with energy-saving inductance rectifier, the power factor after compensation is not less than 0.95, all fluorescent lamps are equipped with electronic ballast power factor is not less than 0.9, and the lamp efficiency is not less than 75%. Evacuation and emergency lighting are set in the entrances and exits of the workshop and corresponding parts of the workshop. All emergency lighting lamps are equipped with cd-ni battery and control circuit. When the lighting power is interrupted, the cd-ni battery is used as emergency lighting, and the emergency time is more than 30 minutes.

LED lights are used for road lighting. The average road illumination of main and secondary roads should not be less than 30 lux. The minimum average illumination for perimeter lighting, road lighting and site lighting is 30 lux.

3.6.2.16 Wiring network

The network wiring system adopts star structure, and the data system is designed according to 6 kinds of non-shielding standards, which can meet the needs of fast Ethernet. Data information point horizontal distribution cable adapts 6 kinds of unshielded cable and information socket. Network cabling adopts modular structure.

3.6.2.17 TV monitoring system

Closed Circuit Television (CCTV) mainly realizes that the management personnel of the park can master the real-time status of each important area in the park in real time, and it also acts as a deterrent to illegal personnel. This video monitoring system of this scheme is only for security purpose not for production.

3.6.2.18 Perimeter security system

This project sets up an electronic fence system on the perimeter wall of the park to prevent illegal entry into the park for 24 hours and realize the closed management of the whole park.

The perimeter protection adopts four-wire pulsed electronic fence system, which consists of three parts: the pulse electronic fence host, the front end of the pulse electronic fence and the alarm signal management equipment of the alarm center. The front end of the electronic fence is installed on the top of the perimeter fence, and the pulse electronic fence host is installed on the side of the fence. The pulse electronic fence host transmits the high voltage pulse to the front detection fence to form an electronic fence. Pulse electronic fence system is the first line of defense, anti-theft alarm when someone illegally crossing the fence or destruction of the front fence, pulse electronic fence host will alert immediately transmitted to the monitoring center, monitoring center, the alarm signal receiving and processing center, identify the invasion, and open the sound and light alarm, remind nearby alert; If it is linked with the monitoring system, the real-time scene of the invasion area can jump out immediately on the monitoring screen, and the staff can quickly inform the security personnel in the patrol to immediately rush to the scene.

Pulse electronic fence system has three functions: deterrence, blocking and alarm. First, every 10 meters or so to hang the "high pressure danger do not climb" yellow warning board, remind passers-by and warn would-be intruders; Secondly, an electronic fence 75 centimeters high is installed on top of the original fence, which makes it more difficult for intruders to enter. Finally, if the intruder forcibly broke the electronic fence invasion, the electronic fence host will immediately sound an alarm sound, indicating that the security room personnel someone to invade, can be dealt with in a timely manner.

3.6.2.19 Automatic fire alarm and linkage control system

In order to ensure the production and office facilities and personal safety in the park and prevent fire, automatic fire alarm and fire linkage facilities are set up in the one-stop service building, fire station, police office, clinic, production plant and public auxiliary facilities where fire hazard may happen.

3.6.2.20 Parking

Parking for the industrial zones should be provided on-site. In the mixed use areas it is recommend that parking is provided as shared parking in public car parks; On-street parking should only be permitted on designated local roads and access roads, where it can be provided such that it does not impact adversely on road safety, traffic flow or the environment. All on-street parking in non-residential areas where demand is expected to be high, should be controlled and subject to regulations that will ensure it is used efficiently and to the maximum benefit of the local areas it serves.

3.7 SOLID WASTE

The purpose of the waste assessment is to determine the types and management of waste that will be generated from each project phase. The objectives are: to assess the

construction activities for the proposed works to identify any potential environmental impacts from the generation of waste associated with the project work; to categorize waste materials where practical, i.e. suitability for re-use/recycling, disposal to public filling areas, disposal to landfill and to recommend appropriate solid waste management options (including waste minimization) on-site, re-use or recycling opportunities and off-site disposal options); to identify site management/mitigation measures that should be implemented to minimize any potential impacts from the generation, handling, storage and disposal measures/routings of waste, in accordance with the current legislative and administrative requirements.

Based on available data from similar projects and research, the following waste types are expected from this project: cut pieces, cotton waste, metal scraps, plastic/ rubber, paper, card board, rags, glass, wood, stones, spent chemical/ oil and waste minerals amongst others. The design of solid waste disposal system shall be based on the unit rate of waste generation. The general type of wastes expected from project of this nature is presented in **table 3.3** below.

Table 3.3: Expected Wastes Sources and Types

Waste Generation Sources	**Waste Category**		
	Solid	**Liquid**	**Gaseous**
Pre – Construction Phase	Vegetation, excavated materials, topsoil/overburden, wood off-cuts		Particulate matter
Construction phase	Papers, cartons, metal scraps, plastics, cans, packaging materials, food wastes cement packs, wood, caked cement, debris, glass off- cuts, aluminum sheets, excavated, top soil and litters	Sewage, spent oil, paints and solvents	Emissions from vehicle usage e.g dust COx, NOx and SOx, etc Noise and vibration from equipment and machinery
Operation phase	Packaging materials, papers, domestic wastes, broken bottles/glasses, damage electronics/house appliances, changed part from generators and stationary waste	Sewage, waste water, chemicals etc.	Emissions from different sources (vehicles, factories) e.g dust, COx, NOx and SOx, etc.
Administrative offices/ shops	Papers, waste packages, plastics, polythene bags, metal scrap, cans, glasses, food wastes etc	Sewage	

Recreational areas	Food remains, bottles, plastic glasses, cans, papers/ packages, rags, leather, leaves, wood, electronic wastes	Waste water, sewage, chemicals,	
Logistic & Stacking Area	Scrap metals, cans, plastics, rags, electronic-waste, copper cores, aluminum, wood scrap, papers, solidified waste paints	Waste water, chemicals, spent oil, detergents, sewage etc	Fumes from vehicles and other machineries
Power generating units	Generator/ metal scraps, rags, plastics, electrical cable waste, fire-extinguisher's, cans	Waste water, grease, spent oil degreasing agent, paint	
Decommissioning phase	Metal cuttings, rocks, concretes, cables, rejected materials, surplus materials, surplus spoil, excavated materials, broken pipes, among others		Dust, noise, vibration, COx, NOx. SOx etc.

In order to adopt a concept that follows a sustainable flexible approach and suits any potential future progress in Solid Waste Management at the State-wide level (in terms of plans, policies and regulations), source separation practices based on 3 streams is proposed in the city. The Consultants believe such an approach would result in the establishment of an infrastructure that may suit and aid future sustainable plans set by relevant authorities at the Municipal level.

Based on the above, a 3 streams source separation was proposed as follows:

- Organic Waste
- Dry Recyclables (Paper/Cardboard, Plastics, metals, Glass)
- General Waste

The introduction of source-separation practices will aid in provision of flexibility during the handling of such waste streams at the downstream end of the entire Solid Waste Management chain (i.e. treatment/disposal schemes) at offsite Municipality facilities. However although it is good practice to propose sustainable solutions in line with a chronological order of preference displayed in the Waste Hierarchy presented in the figure below. It is of also important to uphold feasible solutions, on environmental and economic scales.

3.7.1 Solid Waste Minimization

This refers to all the activities generating waste whether residential, logistics, retail or industrial. Waste generators should adopt all practical and feasible efforts to minimize

the amount of material to be discarded as 'waste'. Basic measures to be taken by waste generators, specifically at the industrial and logistics areas, include:

- Implementing good housekeeping through adopting environmental management systems and standards (EMS) such as ISO 14000 series,
- Conducting regular environmental audits particularly for solid waste involving material flow charts and optimized material balance models as applicable,
- Utilizing efficient and environment friendly raw material and technological processes in their activities,
- Using recycled material, where applicable,
- Reusing discarded material prior to storage,
- Establishing a waste exchange scheme and reusing material prior to disposal, i.e. taking into consideration that one industry's waste could be the other industry's raw or input material.

3.7.2 Solid Waste Types and Sources

Solid wastes will be generated form basically all activities within the industrial Park. The present land use plan depicts various industrial activities with associated logistics and accommodation. Most of these activities will generate mainly solid waste that is typical of the Municipal Solid Waste (MSW) stream, such as accommodation, educational facilities, retail centers, etc. However, specific industrial land uses could, in addition to MSW, also generate industrial wastes which in turn could be non-hazardous and hazardous.

The following SW characterization is used for the purpose of this project:

Municipal Solid Waste (MSW): generated from residential and commercial land use areas and may typically contain food waste, paper, cardboard, plastics, uncontaminated textiles, glass, wood, metals, inert debris, yard trimmings, and other bulky items.

Industrial Waste (IW): generated from industrial facilities and comprising the following:

- Industrial Non-Hazardous Waste (INHW): similar in nature to MSW, however the various components might have different proportions, sizes and characteristics depending on industry size and type; and Industrial Hazardous Waste (IHW): likely to be hazardous in nature and exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity.

3.7.3 Solid Waste Management System Basic Concept

Based on the initial assessment of waste characteristics, and at this planning stage where specific function/data regarding the individual industrial activities/facilities is yet to be fully defined, the consultants envisage that the main options for the proposed SWMS should take into consideration the following general planning aspects:

- The adequate management of different waste types from different facilities within the project sites encourages the need to establish pertinent Health and Safety operational unit and environmental guidelines for enforcement and monitoring within the industrial districts;
- As part of a long-term vision towards achieving sustainable practices, waste minimization measures in the form of applying the 3R's (Reduce, Re-use, and

Recycle) are of utmost importance to minimize any potential impacts from future operations. In practice, this can be complemented within the industries by establishing a waste exchange policy and programs;

- The handling of downstream component (treatment/disposal of the various waste streams) should be incorporated with current approved operations and future plans set by the SWM relevant authorities.
- The management of upstream collection services for all waste types is encouraged to be handled by licensed Contractors under special agreements with tenants and in close coordination with the management authority;
- The likely generation of both MSW/INHW as well as an anticipated lesser portion of IHW raises the need to handle such waste types separately;
- As part of their duty of care, tenants should be given the responsibility of proper storage and handling of their generated waste within their own premises, in close coordination with/authorization by the Management prior to transfer of MSW to the Transfer Station (TS) or ultimate dispatch of Industrial Waste to offsite approved destination site(s);

3.7.4 Waste Water Collection / Disposal System

This section describes the waste water collection, disposal, and recycling for the Port Harcourt industrial park. The sewage system will collect the waste water and convey it to the disposal location which is a proposed waste water treatment plant (WWTP). This will allow the re-use of the treated effluent (water trees and greeneries or any other purpose). A Waste water treatment plant (WWTP) will be installed in order to allow collecting the waste water. The WWTP will treat the collected waste water from the proposed network.

3.8 PROJECT PHASE

3.8.1 Site Preparation Phase

During the land preparation works, the Occupation Health and Safety Regulations will be applied to ensure that workers are not exposed to the risks of occupational accidents. There shall be provision and strict adherence on the use of Personal Protective Equipment (PPE's); helmet, headphones for noise, eye goggles, nose masks, and warning signs at positions prone to danger.

3.8.2 Construction Phase

The construction of the facility, fire-fighting equipment shall be installed, such as fire extinguishers, sand bucket, fire rake, lightning arrestors, water hydrant (fire hose reel). Also, a clinic will be constructed within the Industrial Park which will be accessible to every staff in the facility in case of any health emergency. The workers will be trained on basic HSE procedures.

3.8.2.1 Project's Construction Activities

The construction activities consist of several components which include: investigation of the site biological and physical resources as well as geotechnical study, site preparation, identification of sources of water, identification of sources of construction material, recruitment of labourers, emergency response plan and management plan.

3.8.2.2 Sourcing and Transportation of Materials

Materials will be transported to the project site from their extraction point, manufacture, or storage sites using transport trucks. Materials shall be sourced from within the local area for both economic and environmental benefits since it reduces negative impacts of transportation of the materials to the project site through reduced distance of travel by the materials transport vehicles.

3.8.2.3 Storage of Materials

The materials will be stored on site, bulky materials such as rough stones, sand and steel shall be carefully stored at site and protected from elements of weather in order to avoid wastage due to weather conditions like wind and rain. Chemicals material such as cement, emulsifiers, stabilizers, paint, petroleum products and solvents will also be stored onsite appropriately.

3.8.2.4 Excavation and Foundation Works

The project implementation activities will involve excavation of top soil so as to pave way for development and excavation both at the project site and material sites. These activities will be accompanied by noise, vibration, dust evolution and use of heavy machinery.

3.8.2.5 Concrete Work

The construction of the building's foundations, floors, and drainage systems among other components of the project shall involve a lot of masonry work and related activities. These activities are labour intensive and are to be supplemented by machinery such as concrete mixers. In addition, activities such as concrete mixing and curing require large amounts of water.

3.8.2.6 Water

Water to be used for construction activities shall be sourced from drilled boreholes. Water shall be used for restrooms and other domestic activities during operation phase. For human consumption, water shall be provided by vendors.

3.8.2.7 Rock Aggregates

Rock aggregate of various diameter such as hard core, rough stone and gravel will be required for the construction of foundation and other function and will be purchased from quarries around the area. Since substantial quantities of these materials will be required for the construction, the availability and sustainability of such resources at the extraction sites will be negatively affected, as they are not renewable.

3.8.2.8 Power Supply

Generators shall be used to power the project yard at the construction phase, while a substation with transformers and 7 diesel powered generators will generate power at the operation phase. The generators that will be used during the construction phase shall be diesel powered.

3.8.3 Decommissioning Phase

Upon decommissioning, the project components including the buildings, water supply facility, power generation plant, storm water line, wastewater treatment facility, solid waste recycling facility, etc. will be demolished and a lot of waste will be generated; some of the components can be reused or recycled while the other waste will be managed by an accredited waste contractor. It is anticipated that this project will have a lifespan of several decades save for periodic maintenance.

Once all the wastes resulting from demolition and dismantling works is removed from the project site, the site will be rehabilitated and restored to its original state.

3.9. Labour/ staff requirement

The labour requirements for the proposed project consist of skilled/technical, semi - skilled and unskilled staffs. The proposed project is anticipated to employ over 500 persons at the construction and operation phase of the project with future plan to progressively increase the number during the operational phase of the project.

3.21 Project Life Span

It is envisaged that this project will last for 80years 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 will be carried out, with recommendations for either decommissioning or a total overhaul.

4.0 Project Schedule

The overall conceptual project implementation schedule for the Pre-construction, Construction and commissioning Phase of the Project is illustrated in table 3.4 below:

Table 3.4: The conceptual project schedule for the proposed Port Harcourt Industrial Park Project

S/N	Activity	2021		2022				2022				2023				2024			
		Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1.	Preconstruction Phase: • Pre-mobilisation/Project design • Clearing of vegetation and other debris • Construction of workers' camp and upgrade of existing access road • Mobilisation of equipment and men to site • Transportation of materials																		
2.	Construction Phase: • Civil work activities include construction of factory buildings, workshop, warehouse • Construction of access roads and public utilities (sewage, power, water system) • On site fabrication of materials • Installation of equipment and machinery, • installation of ancillary facilities • Waste generation and disposal																		

3.	Commissioning																		
4.	Operation and Maintenance Phase • Operation of the industrial park • Operation and maintenance of infrastructure and other facilities • Waste generation and management.																		

CHAPTER FOUR

DESCRIPTION OF THE ENVIRONMENT

4.1 Background Information

This section provides a description of the current biophysical and socioeconomic conditions against which the potential impacts of the construction and operations of the proposed Port Harcourt Industrial Park can be assessed, and future changes monitored. An overview of the aspects of the environment related to the surrounding area in which the proposed project will take place and which may be directly or indirectly affected are considered.

Furthermore, the baseline environmental conditions were established using available literatures, previous environmental study reports, publications and journals that relate to the study area. This activity commenced before the field study and the information obtained was used in designing the field study methodology and Terms of Reference for the study as contained in the Appendix.

4.2 Study Methodology

4.2.1 Sampling Design

A one season data gathering exercise was approved by the Ministry which took place within 10th – 11th November, 2020 (Wet Season) witnessed by Representatives from Federal Ministry of Environment, Rivers State Ministry of Environment as well as Staff of Federal Ministry of Transportation. The wet season field data collected was augmented with dry season secondary data sourced from the Final EIA Report for Ubima Field Development Project (February 2017).

The sampling was carried out in accordance with the requirements of the EIA Act CAP E12 LFN 2004. A total of three (3) geo-referenced sampling stations and additional two (2) control points were established in line with the ESIA Terms of Reference (ToR) for groundwater. Twenty-two (22) geo-referenced sampling stations and additional two (2) control points were established for Soil, air Quality and noise sampling within 2km spatial boundary (See Figure 4.1).

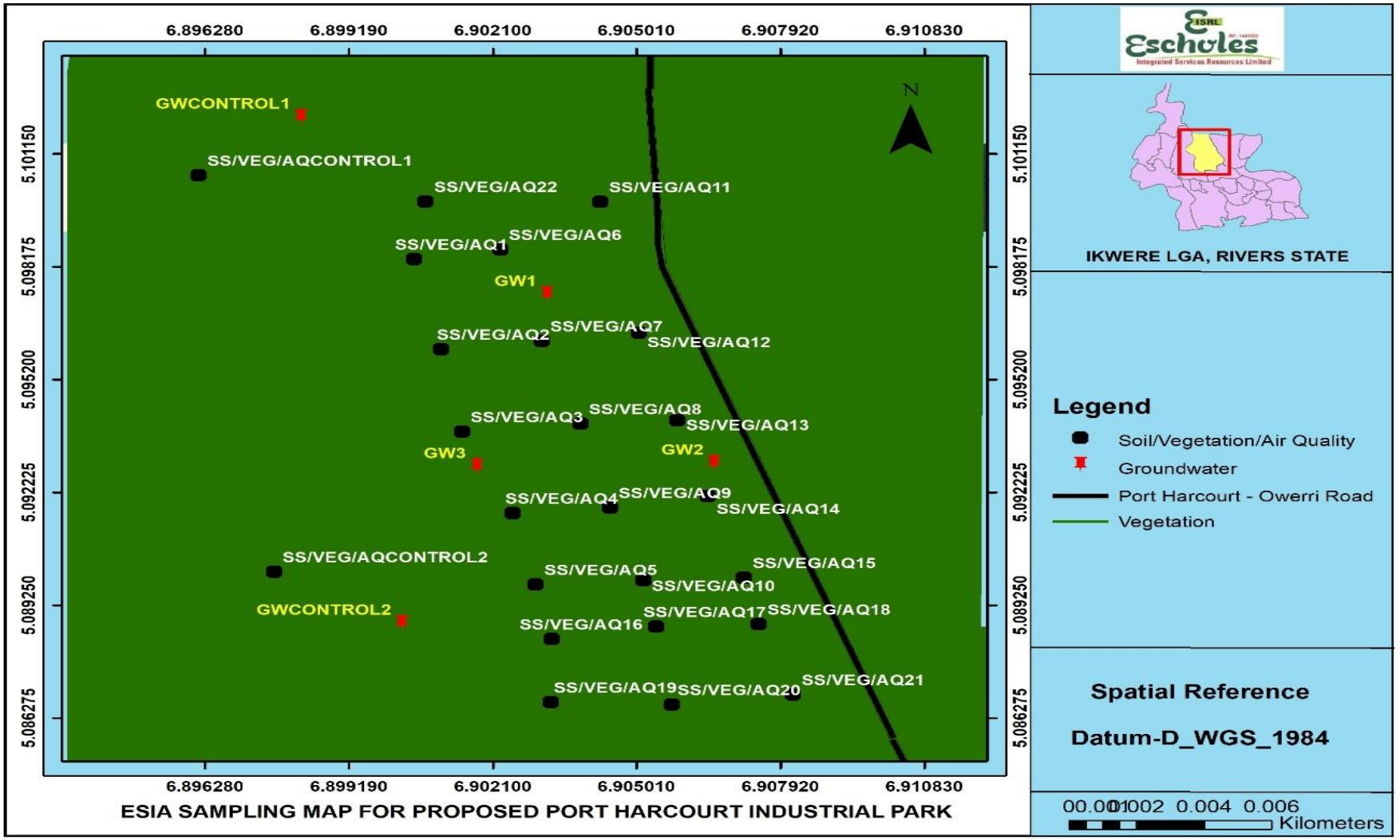

Figure 4.1: Map showing sampling stations for air quality, soil and Groundwater

4.2.2 Sampling Equipment and Laboratory Technique

Sample collection, handling, storage, transfer, data coding and documentation followed National and international best practices to ensure Quality Control and Quality Assurance of test samples. All the samples collected on the field were preserved with ice chests and immediately taken to Tudaka Environmental Consultants Limited laboratory which is accredited by FMENv.

Plate 4.1: Sampling Materials

The samples were then stored in designated freezers at <4^{O}C prior to analysis. Laboratory analysis was timely carried out in line with the samples' respective analytical times as recommended in FEPA (1991) ***(Table 4.1)*** and APHA *et al*, 1980; Golterman *et al*., 1978; and US EPA, 1979.

Table 4.1: Sampling and Laboratory Technique

Parameter	Symbol	Unit	Test method
Physico-chemistry			
pH	Ph		in situ
Temperature	T	ºC	in situ
Conductivity	EC	S/cm	in situ
Dissolved oxygen	DO	mg/l	in situ
Salinity	S	‰	in situ
Turbidity	Turb	NTU	in situ
Total suspended solids	TSS	mg/l	APHA 2540D

Parameter	Symbol	Unit	Test method
Total dissolved solids	TDS	mg/l	APHA 2540C
Heavy metals			
Arsenic	As	mg/l	AAS
Cadmium	Cd	mg/l	AAS
Arsenic	As	mg/l	AAS
Chromium	Cr	mg/l	AAS
Copper	Cu	mg/l	AAS
Mercury	Hg	Mg/l	AAS
Ferric iron	Fe3+	mg/l	AAS
Ferro iron	Fe2+	mg/l	AAS
Lead	Pb	mg/l	AAS
Nickel	Ni	Mg/l	AAS
Manganese	Mn	Mg/l	AAS
Cations			
Magnesium	Mg	mg/l	AAS
Potassium	K	mg/l	AAS
Sodium	Na	mg/l	AAS
Zinc	Zn	mg/l	AAS
Aluminium	Al	mg/l	AAS
Anions			
Carbon dioxide	CO2	mg/l	APHA 4500-CO2
Carbonate and	HCO3	mg/l	APHA 2320B
Fluoride	F	mg/l	APHA 4500
Nitrate	NO3	mg/l	APHA 4500
Nitrite	NO2	mg/l	APHA 4500
Phosphorus total	P	mg/l	APHA 4500
Sulphate	SO4	mg/l	APHA 4500
Sulphide	ς2-	mg/l	APHA 4500
Organics			
Total Organic Carbon	TOC	mg/l	APHA 5310
Dissolved organic carbon	DOC	mg/l	APHA 5310
Total mineral oil		mg/l	EPA 8015
BTEX	BTEX	mg/l	EPA 8260
Phenol		mg/l	APHA 5330C
Chemical oxygen demand	COD	mg O2/l	APHA 5220B
Biological oxygen demand	BOD	mg O2/l	APHA 5210B
Polycyclic	PAH	mg/l	EPA8260
Macro and Micro-			
Chlorophyll		mg/l	UV
		(cfu/100m	

FEPA, 1991

4.2.3 Sampled Parameters

Abiotic and biotic components were studied; they include Climate/Meteorology, Air Quality and Noise, Soil, Vegetation, Ecology, Geology, Hydrogeology, Socio-economics and Health status. During sampling, in situ measurements were conducted for

parameters with short holding analytical time, samples were also collected for laboratory analysis.

4.2.4 Abiotic Component

a) Climate and meteorological studies

The purpose of the Climatic and Meteorological study is to establish meteorological conditions in-and-around the study area. The climatic characteristics of the study area relating to the following were extracted from historical and field sampling data. The following data were collected:

a) Temperature
b) Relative humidity
c) Wind speed
d) Wind direction

A hand-held battery powered high precision Skymaster (SM 28) pocket Weather Tracker, made in the USA was used for data collection for wind speed, humidity, temperature and wind direction (i.e. microclimatic data). Although the microclimatic data was acquired via field measurement, macroclimatic data (long term data) was acquired from the database of the Nigerian Meteorological Agency (NiMet) which spans from 1991 to 2017 and World Meteorological Organization (WMO).

A weather station was set up at the same sampling stations for soil sampling during the field survey. Sampling was allowed to run for a minimum of 30 minutes in order to establish a microclimatic data of that particular station. All precautions taken when setting up a weather station and during measurements were observed for the onsite measurements according to the World Meteorological Organization (WMO) standard. These include setting up the weather station away from obstacles like buildings and tall vegetation, using an instrument shelter to display all temperature sensitive instruments, orienting the instrument shelter so that the sun's radiation does not fall directly on the instrument during reading and setting up the weather station in an area representative of the study area's totality. ***Table 4.2*** below presents weather data acquisition techniques.

Table 4.2: Weather Study Equipment

Climatic Variable	**Instrumentation/Method**
Air temperature	Dry bulb thermometer
Relative humidity	Psychrometer/hygrometer
Wind speed	Anemometer
Wind direction	Wind vane
Cloud Cover	Direct observation

b) Ambient air quality and air borne noise level investigations

Gases that are of environmental importance such as toxic gases, greenhouses gases and ozone depleting gases were examined. Portable AEROQUAL Air Quality Monitor (Series 300 Model) was used for air quality determination. Pollutant gases such as NOx, SOx, NH_3, H_2S, CO and VOC were determined. The analyser contains sensor for each gas and each sensor analyse the quality of the respective gases in the ambient air. It is a digital meter, which reads parameters at a time weighted average. An EXTECH instrument (USA), model 407730 Sound level meter with high sensitivity was used, the instrument can measure as low as 30 dB (A) and as high as 150 dB (A). The accuracy is ±1.5 dB (A). Field Air quality, Noise and Weather condition were determined in situ and recorded. Data collected was carried out from the hours of 10:00AM – 5:00PM on the sampling day.

c) Water quality investigations (groundwater water)

Groundwater samples were collected from 5 boreholes within the proposed project area and immediately analysed for parameters with short holding analytical time such as pH, dissolved oxygen (DO), temperature, and turbidity. However, there was no surface water within the 2 km spatial boundary of the proposed project area. All sampling was carried out in line with standard quality control/quality assurance procedures.

d) Soil quality investigation

To ensure a representative sampling, soil samples were collected from 3 cores from each sampling point at depths of 0-15cm and 15-30cm for top soil and sub soil respectively. Samples were collected with stainless screw type soil auger into plastic bags for

physicochemical and microorganism analysis. Separate samples were also collected into aluminium foil hydrocarbon content determination

4.2.5 Biotic Components

Vegetation and Wildlife Studies

- ***Sampling Technique for Floristic and Faunal Data Collection***

Floristic data were collected using systematic sampling technique with 6 quadrats of one square meter each at each sampling location for assessment of herbaceous flora. Sampling for faunal species followed point sampling design, and walking along foot paths was used (Walsh and White, 1999). Data collected on faunal species included species composition of each sampling location.

- ***Species Identification***

Identification of species was done in situ and all identification were done using available literatures like Akobundu and Agyakwa (1998); Johnson (1997) for herbaceous flora; and Dalziel and Hutchinson (1979) and Keay *et al.* (1967) for woody flora. Identification of faunal species was done using Adeyanju *et al.* (2012)

- ***Data Analyses***

All quantitative data were subjected to Relative Importance Values analysis following; Kent and Coker (1992) and Olubode *et al* (2009). Multivariate analyses for ordination and phytosociology of species and stands describing the ecology of the sampling stations followed Hammer *et al.* (2001) using Paleontological Statistics (PAST) 2.14 version software for detrended correspondence and cluster analyses. Two-Way Indicator Species Analyses (TWINSPAN), 2012 version software was used for determination of phytosociology of the flora (Hill, 1994, 2012).

Microbiology

Soil and groundwater samples were collected into sterile plastic bottles and polythene bags, kept at 2 - 6^{O}C and analysed for microbial contents.

- ***Heterotrophic Bacterial Counts***

The total heterotrophic bacteria in the groundwater samples were enumerated using modified yeast extract agar (Cruickshank *et al*, 1975). Bacteria isolates were identified according to the scheme for Buchanan and Gibbons (1974).

- ***Determination of Fungal Content***

The total fungal counts in the groundwater samples were determined using Emmons, Binford and Utz's modified Sabouraud Dextrose Agar (Cruickshank, et *al*, 1975). Isolated fungi were identified based on the associated spores and mycelia and their growth characteristic on the isolation medium.

- ***Determination of Percentage Petroleum Degrading Bacteria and Fungi***

The petroleum degrading bacteria were enumerated on petroleum agar medium, while chloramphenicol was added to this medium for the selective isolation and enumeration of petroleum degrading fungi. Any bacteria or fungi growing on these media were regarded as petroleum utilizers or degraders. The percentage of these counts on the total heterotrophic bacteria or fungal counts were then calculated to obtain the percentage petroleum degrading bacteria and fungi respectively in each sample.

4.2.6 Quality Control/Quality Assurance (QA/QC) Procedures

QA/QC procedures cover all aspects of the study, including sample collection and handling, laboratory analyses, generation of data and coding, data storage and treatment and report preparation. The quality assurance programme employed in the fieldwork and laboratory analyses were in accordance with *Appendix II-4 and Part VIII (E) of EGASPIN and FEPA (1991)*.

- ***Sample Collection and Handling***

In preparation for fieldwork, glassware to be used were washed with detergent solutions, rinsed with tap water, then soaked in 1:3 nitric acid solutions for 24 hours to remove organic materials, washed again with tap water and rinsed with distilled water. Plastic containers were washed with detergents, rinsed with tap water, followed by distilled water. After drying, all the containers were rinsed with acetone to remove organic materials, and rinsed with distilled water. Aluminium foils were obtained for soil and sediment samples. Sampling equipment was rinsed with portions of the water to be sampled. Samples per sampling point were taken with thoroughly cleansed containers. Sterile wide-mouth polypropylene and Pyrex glass sample bottles were used. Samples for

oil and grease were collected in clean and dry glass-stoppered bottles and were usually not completely filled to avoid losing oil when the stopper was inserted.

- ***Sample Identification***

Specific details on sample identification were entered on a permanent label to reflect node, date, sample matrix, sampling point, sample number, depth etc.

- ***Laboratory Analysis and Generation of Data***

Possible sources of error in laboratory analysis include contamination of reagents and materials, lack of sensitivity of equipment, lack of calibrations, poor data entry and interpretation. Glassware and other containers used for each analysis were thoroughly cleansed as appropriate for each parameter. All glassware used for oil and grease determination was pre-rinsed with Analar grade xylene. Glassware for determination of metals were pre-soaked in dilute nitric acid and then rinsed well with distilled water. All reagents and chemicals of high purity (mostly Analar grade) were used. Freshly distilled water prepared in our laboratory was used for all dilutions.

The various instruments and equipment for measuring physico-chemical parameters used were in good working condition. Periodic control checks were usually carried out on such instruments/equipment and the performance record maintained. The pH meters were calibrated using HACH commercial buffer standards. Appropriate colour standards of diluted potassium dichromate or potassium permanganate solutions are frequently used to check the wavelength settings and sensitivities of the absorption spectrophotometer. For analytical determination requiring the use of calibration curves, such curves were plotted using standard solutions prepared from analytical grade reagents. Records of such calibration curves were maintained and frequent re- calibration checks were carried out. Analytical blanks were incorporated per specific batches of samples to compensate for the sample preparation and determination steps. All the analyses were replicated and the means reported. The samples were analysed at Tudaka Environmental Consultants Limited laboratory.

- ***Storage/Preservation***

Samples were stored in ice-chest as a cooling device and transported to the laboratory where they were refrigerated at 4°C or kept in a freezer as appropriate.

Samples for heavy metal analyses were preserved with 1:1 nitric acid and oil and grease with 1 ml of 1:1 H_2SO_4 as soon as they were collected. Adherence to good preservation procedures ensured that errors were not introduced into the analytical process.

- ***Chain of Samples Custody Procedure***

There is a Master Register for all samples brought into the laboratory. Following registration of the sample, a Sample data sheet containing pertinent information on the sample was opened for each sample. The information includes:

a) Sample reference number;
b) Nature or type of sample;
c) Site of collection;
d) Date and time of collection; and
e) Mode of preservation (depends on nature of material) and analytical data from the field and results of laboratory analyses of representative samples.

Appropriate methods were used in storing the remaining stock materials and sub samples. Samples for storage were kept in labelled compartments on shelves in a storage room. Samples sent to co-operating laboratories were recorded in the Master Register and accompanied by essential data pertaining to the sample material.

- ***Evaluation of Results***

Raw data obtained from the instrumental measurements were used in calculating the concentrations of the various parameters, using standardized formulae. All such calculations were crosschecked. Outlying values were deleted from the replicate data before calculation of mean concentrations. A quick identification of results, which deviate from the normal trend, was usually done. The sum of the anion concentration in meq/l should be equal to the sum of the cations concentration also in meq/l. Differences within 5% are acceptable.

$$\% \text{ Difference} = \frac{(\text{Cations}) \text{ minus } (\text{anions})}{(\text{Cations}) \text{ plus } (\text{anions})}$$

Also, calculated and observed conductivity measurements and IDS data were compared, to check reliability and accuracy of data. The laboratory analytical methods used were those recommended by FEPA, 1991.

- ***Occupational Safety and Health (OSH) Program***

Safety measures were adopted for field samples and lab analysis. On arrival at the proposed project area in Ubima, the entire team were briefed on safety on site to familiarize them with essential safety precautionary measures, emergency response procedures and hazards associated with the proposed project area. The safety briefing was corroborated with Safety pep-talk on each sampling day. Protective equipment were worn in all situations before sampling took place.

4.3 Socioeconomics

4.3.1 Socioeconomics and health data collection

The socio-economic data gathering involved the use of some techniques like interview schedule, survey question administration, key informant interview and focus group discussion (FGD). These techniques are found to be useful in participatory rural and learning appraisal techniques. Firstly, the conduct of preliminary investigations during which the extent of the intended area to be surveyed (within 2km radius to the proposed project site) and good rapports were established with the residents of the project area.

4.3.2 Public Health Assessment

Ethnographic research design was adopted for the study through stratified random sampling technique. The choice of stratified random sampling technique was informed by the observed dispersed settlements in the area of project influence. The adoption of stratified random sampling, therefore, was inevitable in order to gauge the health status of the people as well as their disparities in opinions and attitudes regarding the impact of the proposed thermal plant on the health of the people that are likely to benefit from the project. Secondary data were collected from the following institutions:

The health status of the communities in the project area was carried out and determined by means of baseline health data collected from below:

(i) Local health statistics from the health centres and clinics.

(ii) Consultation process with major stakeholders.

(iii) Field data in relation to:

- Water Supply.
- Waste Disposal.
- Refuse Disposal.
- Health Institutions
- Immunization status

4.4 Baseline Environmental Condition

4.4.1 Climate and Meteorology

The most abundant meteorological information on air temperature, rainfall, wind direction, and humidity collected are from thermometers, rain gauge, wind vane and hydrometer in meteorological gardens. These data are randomly taken thrice a day at 6am, 2pm, and 10pm. Weather and climate data play very significant role in weather forecasting, and in socio-economic activities throughout Nigeria.

The weather variables of rainfall, humidity, temperature, solar radiation in the Niger Delta, are primarily as a result of the interplay between two major pressure and wind The weather variables of rainfall, humidity, temperature, solar radiation in the Niger Delta, are primarily as a result of the interplay between two major pressure and wind systems. The moist South-West wind transports its moisture to Port Harcourt (Nigeria) along the coast line. This air stream blows over the area between February and October. This is the wet season in which the region receives its rains. Conversely, the North-East trade winds bring dry conditions, having passed over the hot dry Sahara Desert to reach Port Harcourt from the North. This air blows over Port Harcourt between November and February during which the area experiences its dry season.

The dispersion and transportation of pollutants emitted are always influenced by meteorological conditions. The two seasons that characterize the area are thus the dry and rainy (wet) seasons. The wet season spreads from April to October while the dry season is from November to March.

Table 4.3: Micro-climatic data of the study area

Parameters	Avg. Temp. (°C)	Avg, Atm. Press. (Hg/In)	Avg. Rel. Hum. (%)	Avg, Dew Point (°C)	Avg, Heat Index (°C)	Cloud Cover (Okt-8)	Avg, Wind Speed (km-hr)	Wind Direction
Min	25.6	29	69	26.3	33.9	7	0.9	
Max	34.1	29.98	89	27.9	34.5	7	3.6	
Mean	30.50	29.64	78.88	26.63	34.25	7	2.03	SW

Source: Field work, 2020

Wind Pattern

The prevalent wind direction within the study area is generally the South-West (210 – 240°) for 8 months. Wind speed in the study area for dry season ranged from 0.5m/s to 1.8m/s while the wet season wind speed ranged from 0.2 to 1.00m/s. The wind is predominantly in the South Western direction accounting for about 75% of the annual winds. The North- Easterly winds predominate during the dry season (November – March); this makes up about 25 % of the annual winds within the study area. Its penetration into the Niger Delta region between December and February is characterized by dry and low humidity with dusty haze.

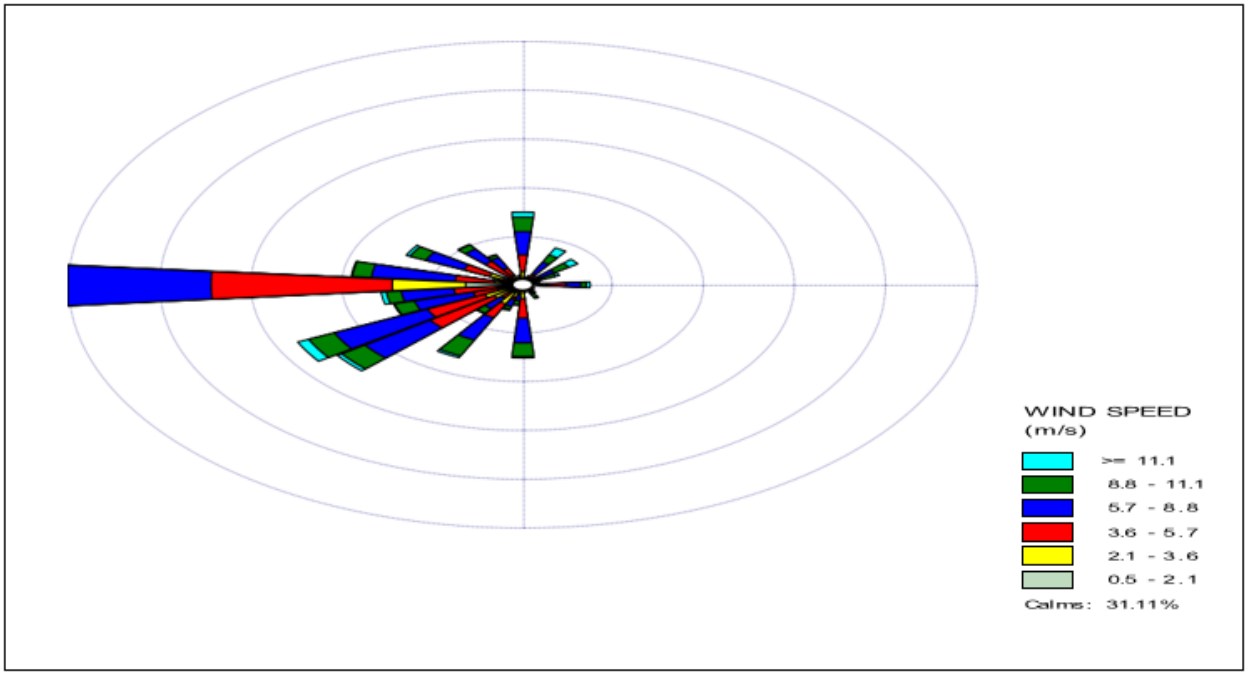

Figure 4.2: Wind Rose of Port Harcourt for the Period of 1993 – 2001 (Source: NIMET 2011)

Rainfall

Fig 4.4 shows rainfall pattern within the study area. Generally, the wettest period of the year within the area is July - September with the peak period in July while lower rainfall values are usually recorded in the months of December, January, February and March. The rainfall regime is determined by the two major air masses dominating the area: the moist Tropical Maritime (Tm) with its associated westerlies and the dry Tropical Continental air mass (Tc) with its associated easterlies. The long-wet season is characterized by a short break in August as the sun passes over the equator on its way from the Northern to the Southern Hemisphere). The specific month to month rainfall amounts at the proposed project area for 26 years, from January 1991 to December 2017 from Nigerian Meteorological Agency (NIMET) is presented in table 4.4., While the mean monthly distribution is shown in Figure 4.3.

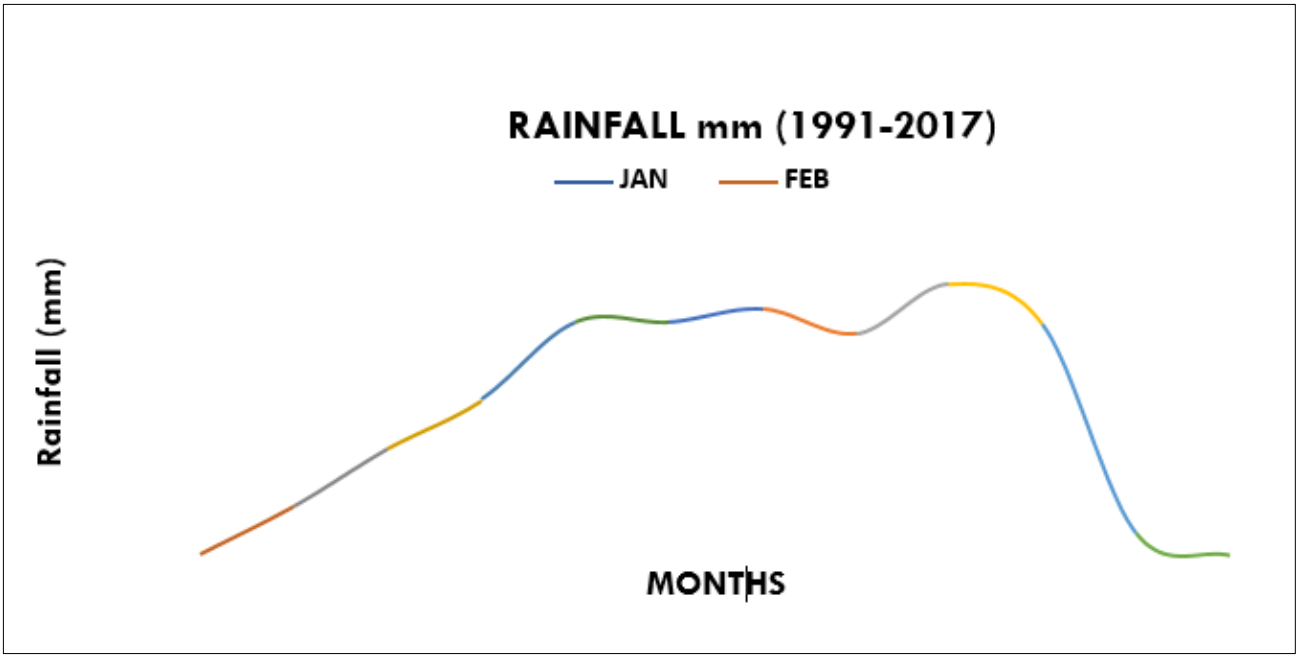

Figure 4.3: Rainfall in the study area (1991 - 2017)

Table 4.4: Rainfall data (mm) in Rivers state from January 1991 to December 2017

YEAR	RAINFALL (mm)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1991	Trace	165.	19	174.	135.	82.3	219.	191.	170.	182.	2.2	26
1992	0	0	28.5	92.9	103.	237.	202.	107.	127.	152.	36.	0
1993	0	25.9	141.	44	145.	187.	26.2	384	235.	183.	55.	48
1994	2.1	30.2	20.9	75.4	234.	62.9	177.	36.8	135.	112.	17.	0
1995	0	11.4	106.	118.	256.	267.	188.	204.	159.	185.	36.	Trace
1996	0.1	125.	133	167.	146.	187.	305.	242.	184.	160.	0	Trace
1997	9.3	0	200.	158.	128.	98.8	63.8	111.	113.	182.	5.8	23
1998	0	23.4	37.6	70.1	133.	95.8	115.	149.	248.	122.	17.	5.2
1999	0.3	75	111	74.2	122.	321.	385.	149.	209.	348	16.	0
2000	30.	0	95.7	126.	80.6	116	220.	232.	127	215.	0	0
2001	0	8.4	121.	142.	231.	114.	257.	53.2	285.	72.3	2.1	1.1
2002	0	6.9	57	122.	184.	323.	171.	247.	114.	207.	79.	0
2003	25.	81.6	3.6	184.	191.	147.	156.	40.9	128.	132.	51.	0
2004	78.	32.5	92	231.	183.	181.	161.	156.	196.	0.3	0	Trace
2005	0	33.1	101.	118.	114.	212.	182.	64	225.	134.	4	12
2006	19.	1.5	109.	79	197.	164.	65.2	128.	312.	166	17.	0
2007	0	0.5	36.2	39.5	303.	173.	138.	98.1	231.	254	6.5	8.3
2008	0	43.7	49.3	57.7	164.	162.	164.	149.	209.	261.	49	26
2009	1.5	138.	80.4	203.	129.	217.	205.		328.	205.	21.	16
2010	0.8	18	64.4	88.8	195	76.9	109.	320.	311.	214.	34.	0
2011	0	61.3	66.2	64.1	151.12	285.4	298.8	511.1	238.2	213.3	19.4	0
2012	0		36.2	125.	215.	215	218.	93.3	218.	141.	54.	0
2013	2.1	30.2	20.9	75.4	231.	62.9	177.	36.8	135.	112.	17.	0
2014	0	11.4	106.	118.	256.	267.	188.	204.	159.	185.	36.	Trace
2015	0.1	125.	133	167.	146.	187.	305.	242.	184.	160.	0	Trace
2016	9.2	0	200.	158.	125.	98.8	63.8	112.	113.	182.	5.8	23
2017	0	23.4	37.6	70.1	133.	95.8	115.	149.	248.	122.	17.	5.2

Source: Nigerian Meteorological Agency, 2017

Ambient Temperature

Figure 4.4 shows the 10-year average maximum, minimum and the mean monthly temperatures for the project area. Temperatures are usually high and vary little year round which is typical of the equatorial belt. The mean temperature for the hottest months February/March is 34 ^{o}C while that of the coolest month (August) is 28 ^{o}C. The average temperature difference between the hottest and coolest months is about 3 ^{o}C while the mean daily temperatures range is over twice that (at about 6.5 ^{o}C). The temperatures measured in the field ranged from 25.0^{o}C to 34.1^{o}C

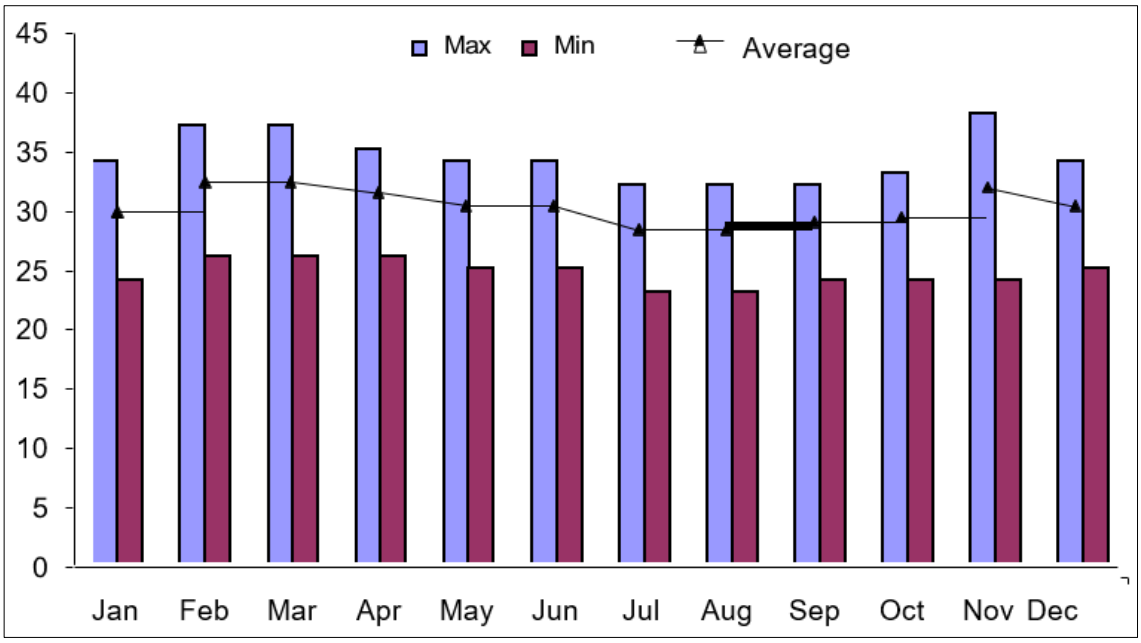

Figure 4.4: Mean Temperature at period site. Source NIMET,2017.

Relative Humidity

The study area experiences high relative humidity as a result of the prevailing Tropical Maritime (Tm) air mass that blows over the environment almost all the year round. Data for Rivers State area indicate that humidity measured in the morning ranges between 68.11% in January and 87.33% in August while in the afternoon the value ranges from 41.26% [in February] to 76.78% [in August] (**Figures 4.5**).

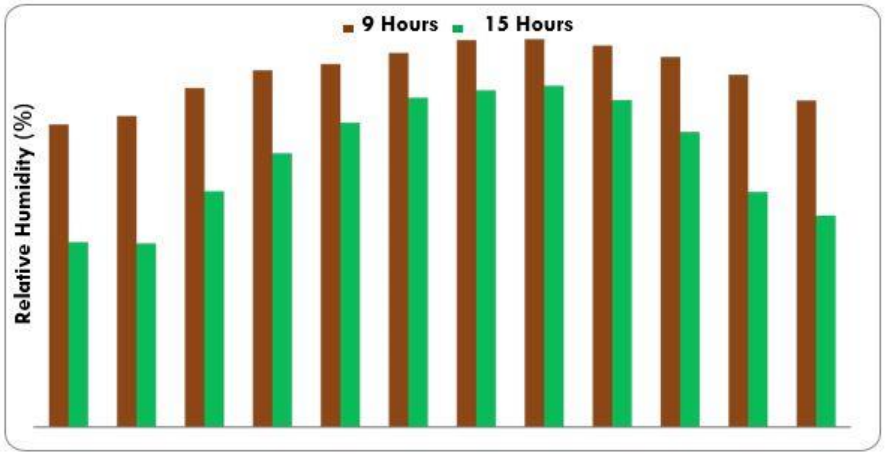

Figure 4.5: Relative Humidity in the project area (1991 to 2017)

Source: **NIMET, 2017**

Sunshine

The mean daily sunshine is between three and six hours in dry season and it often falls to less than two hours in the wet season. The mean annual solar radiation varies from 1.5 – 1.9 J/cm^2/day. The longest monthly sunshine hours occur in December/January in the dry season while July usually experiences the lowest values of sunshine hours. This can be attributed to constant cloudiness from rain clouds in the wettest months. Sunshine hours are directly proportional to the net radiation. Net radiation and air temperature are highest during the dry season except when relatively cold harmattan winds occur.

ii) Air Quality

A summary of the air quality measurement around the proposed site is presented in **Table 4.5** while the detailed results are in the Appendix. The sampling map is as shown in **Figure 4.6**.

Plate 4.2: Field Sampling Exercise witnessed by FMEnv & SMEnv Reps.

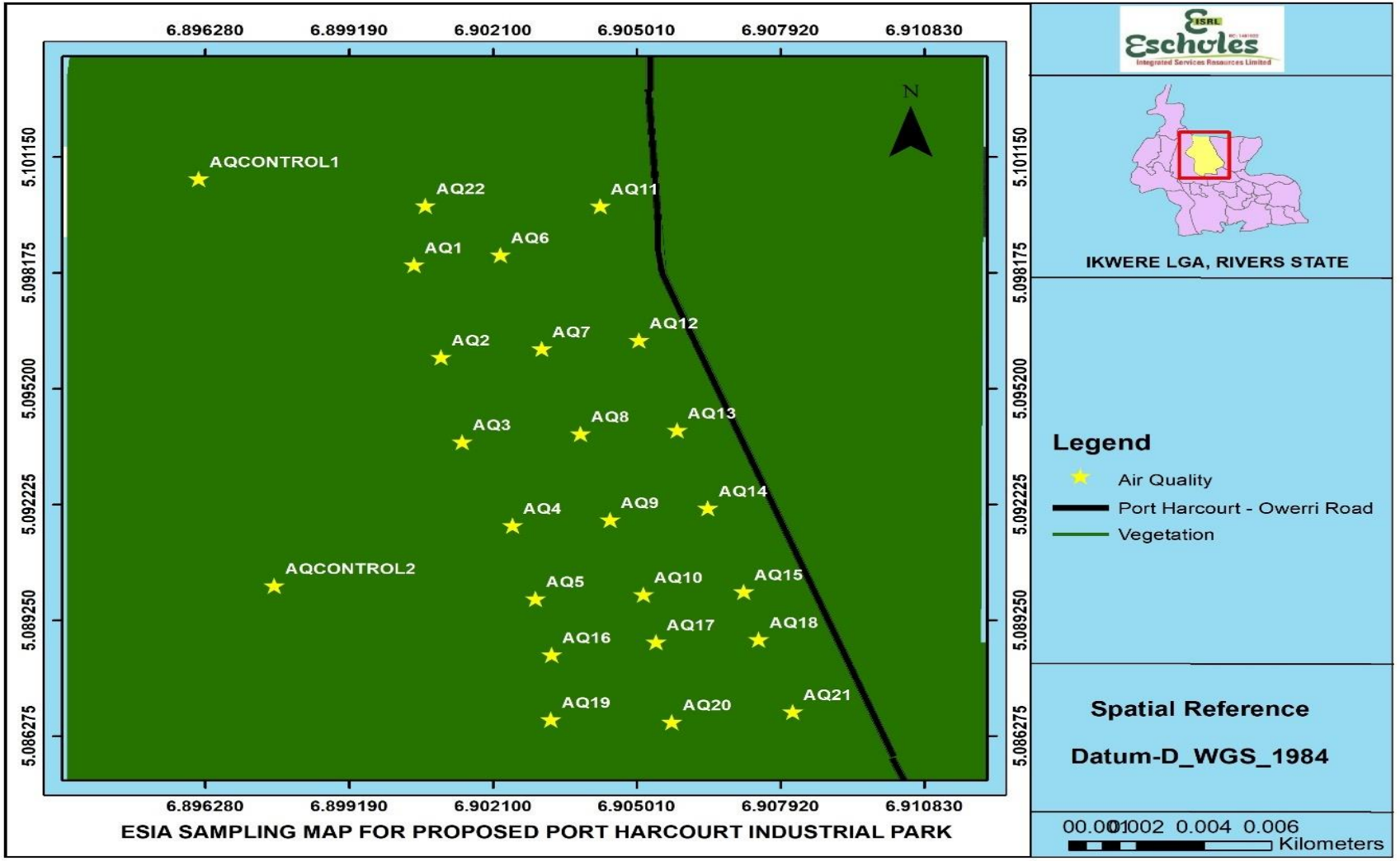

Figure 4.6: Map showing sampling stations for air quality. Source: FMOT Fieldwork, 2020

- **Volatile Organic Compounds (VOC)**

VOC is an aggregate parameter defining volatile hydrocarbon species. These are airborne and are usually composed of low and intermediate molecular weight hydrocarbons. The concentration of volatile organic compounds in the air was very low and had a mean value of 0.26ppm (0.03-0.6ppm). The concentrations were below the FMEnv limit of 160ppm.

- **Total Suspended Particulate (TSP)**

This is the term for a mixture of solid particles and liquid droplets found in the air such as dust, dirt, soot, smoke. These are grouped as 'inhalable coarse particles' with diameters ranging between 2.5 pm and 10 pm; and 'fine particles' having diameters less than 2.5pm. They can also deface cultural and traditional artefacts, monuments and buildings. On a macro-scale, particulate matter affects the earths-atmospheric heat balance by disturbing the evaporation-condensation cycle (Pope *et al,* 1999). TSP determination yielded results within the range of 3.1ppm to 19.7ppm (mean=10.36) while the $PM_{2.5}$ and PM_{10} yielded results within the range of 0.4ppmto 2.5ppm (mean=1.34ppm) and 1.2ppm to 16.4ppm (mean=8.49ppm) respectively. The $PM_{2.5}$, PM_{10} and TSP concentrations determined were far below the World bank limit of 25ppmfor PM2.5 and 80ppm for PM10 and also FMEnv limit of 250ppm.

- **Carbon monoxide (CO)**

CO is a colorless, odorless gas emitted from combustion processes of fossil fuel. In urban areas, the majority of CO emissions to ambient air come from mobile sources. At extremely high levels, CO can cause death (Kao, 1994). In the study area, CO concentration obtained ranged from 0.1ppm–2.6ppm (mean=0.72) The CO concentrations detected were far below the FMEnv limit of 22.8ppm.

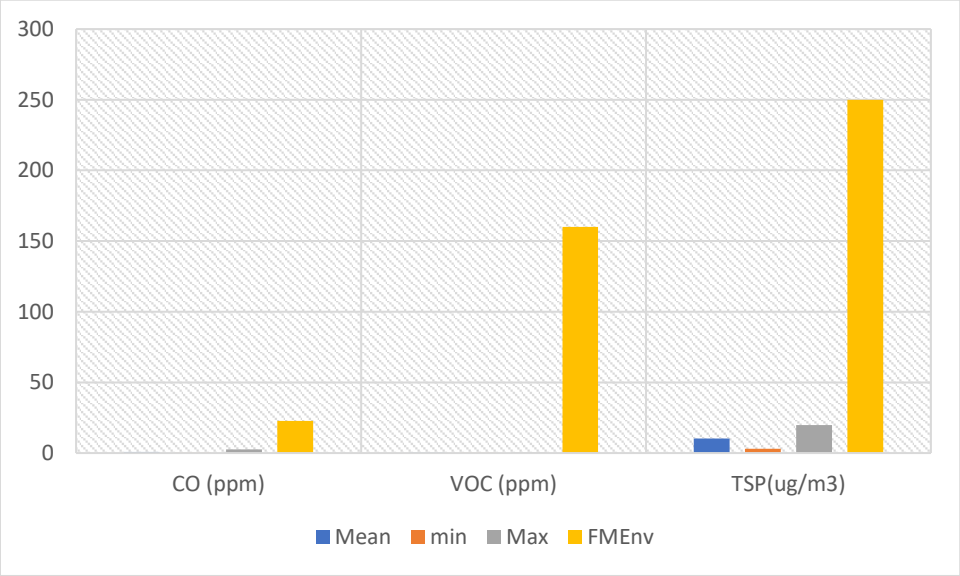

Figure 4.7: CO, VOC and TSP levels Oxides of Nitrogen (NOx)

Nitrogen dioxide (NO2) is a suffocating brownish gas that belongs to a family of highly reactive gases called nitrogen oxides (NOx). It results from high temperature combustion of fuel and occurs mainly from motor exhaust and stationary sources such as electric utilities and industrial boilers. It is a strong oxidizing agent that reacts with air in the presence of water to form corrosive nitric acid, as well as toxic organic nitrates. It plays a major role in the atmospheric reactions that produce ground level ozone or smog. Exposure to NO2 concentrations higher than regulatory limits could alter pulmonary immunologic responses and may increase susceptibility to bacterial infection such as influenza. Levels of NO2 above $563g/m^3$ may cause pulmonary diseases in man and animals. The NOx detected from all the sampling locations ranged from 0.01ppm to 0.04ppm and were all below the FMEnv limit which is 113 ppm.

- **Hydrogen Sulphide (H_2S)**

H_2S is known to be immediately dangerous to life and health (IDLH). It has a pungent smell when in low concentration, but at a high concentration, the odour will no longer be detected by human nose. Hydrogen sulphide has both natural and man-made sources (such as biodegradable waste sites). Hydrogen sulphide does not have regulatory limits, because it is a "non-criteria" pollutant. H_2S concentrations were above FMEnv limit in the all locations sampled as values ranged between 0.01ppmto 0.04ppm.

- **Ammonia (NH_3)**

Ammonia or azane is a compound of nitrogen and hydrogen with the formula NH_3. It is a colourless gas with a characteristic pungent smell. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to food and fertilizers. Ammonia, both directly or indirectly, is also a building block for the synthesis of many pharmaceuticals and is used in many commercial cleaning products. Although common in nature and in wide use, ammonia is both caustic and hazardous in its concentrated form. The NH_3 values detected from all the sampling locations were all below equipment detection limit.

- **Oxides of Sulphur (SOx)**

SOx is the group formula for oxides of sulphur such as SO and SO_2 which usually occur as both primary and secondary air pollutants. Power plants and other equipment that burn fossil emit these species as primary pollutants. In addition, biological decay processes and some industrial sources emit H_2S which is oxidized to form the secondary pollutant, SO_2. The combustion of fossil fuels containing sulphur yields SO_2 in direct proportion to the sulphur content of the fuel.

The primary threat of SO_2 to urban atmosphere may arise not from SO_2 itself but from the changes it undergoes in the atmosphere such as the formation of sulphuric acid (H_2SO_4), a reaction which is catalysed by particulate matter; and the formation of sulphate aerosols. SO2 can also be absorbed on small particles such as the salts of iron, manganese and vanadium present in the atmosphere and thus enter the alveoli of the lungs. SOx concentration (0.01 – 0.05ppm) was detected below the FMEnv limit.

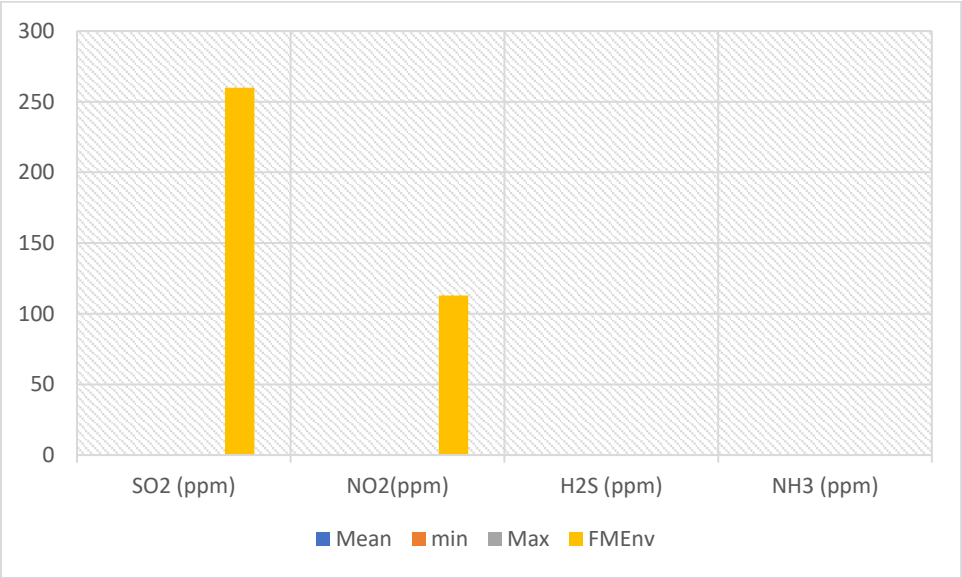

Figure 4.8:SO_2, NO_2, H_2S and NH_3 Levels. Source: FMOT Fieldwork, 2020

Table 4.5: Air Quality and Noise Level measured at the proposed project site

Parameters	Mean	min	Max	FMEnv	World Bank
CO (ppm)	0.720833	0.1	2.6	22.8	-
SO_2 (ppm)	0.021053	0.01	0.05	260	-
NO_2(ppm)	0.02	0.01	0.04	75-113	-
H_2S (ppm)	0.018125	0.01	0.04	0.008	-
VOC (ppm)	0.255417	0.03	0.6	160	-
NH_3 (ppm)	BDL	BDL	BDL	0.28	-
CH_4 (ppm)	0.032083	0.01	0.08	-	-
PM2.5(ug/m3)	1.345833	0.4	2.5	-	25
PM10(ug/m3)	8.491667	1.2	16.4	-	80
TSP(ug/m3)	10.35833	3.1	19.7	250	-
CO_2 (ppm)	278.04	250.00	295.00	-	-
O_3 (ppm)	0.02	BDL	0.04	-	-

;BDL- Below Detection Limit (0.01). Source: FMoT Fieldwork, 2020

iii) Noise Level:

The minimum mean value of noise level at the proposed site was 40.40dB(A) with the highest Noise level of 71.40dB(A) which was as a result of the vehicular movement along Portharcourt-Owerri road in close proximity to the proposed site. Despite the differences in the values obtained, the values were relatively low compared with the 90.0 dB (A) limit provided by Federal Ministry of Environment for occupational Noise for 8-hour exposure Figure **4.9**.

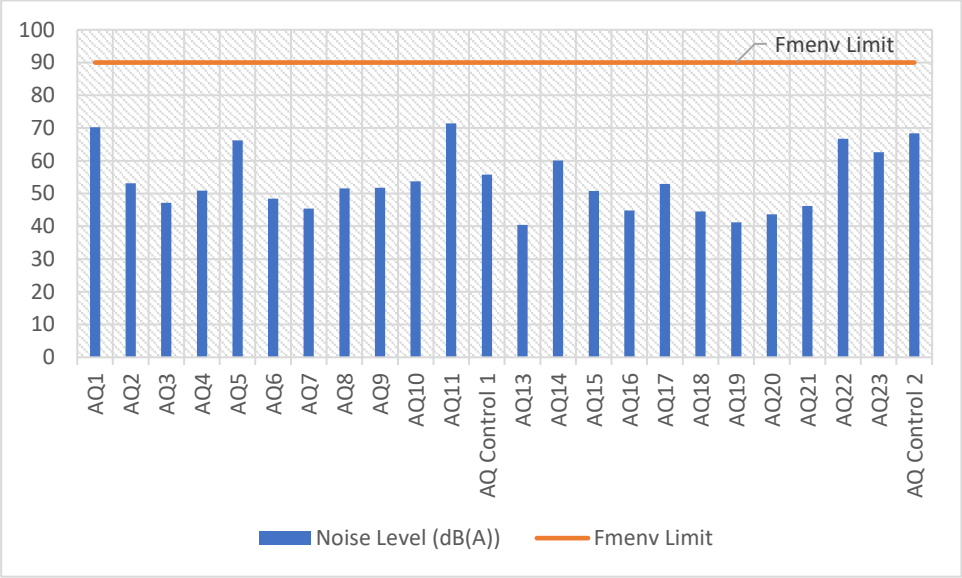

Figure 4.9: Noise Level in Study Area. Source: FMoT Fieldwork, 2020

4.4.2 Soil Quality Study

Physico-chemical properties of soil samples collected within the study area are presented in **Table 4.6, 4.9** while **Figure4.11** shows the sampling points.

Soil Geology

The study areas lie within Niger Delta Sedimentary Basin. The subsurface geology of the Niger Delta consist of three (3) lithostratigraphic units namely; Akata Agbada and Benin formation which are in turn overlain by various types of quarternary deposits, sands intercalated with lences of clay materials and silts. The Benin formation is the most

prolific aquifer in the area. The Agbada formation which consists of sands deposits, underlained Benin formation.

However, Akata formation which underlained Agbada formation is considered as a sources fork for Hydrocarbon formation. The land surface in the area shares the characteristics of low lying plain of the modern Niger Delta and slopes very imperceptibly toward the Atlantic Ocean in the southern direction.

The known onshore and near shore Tertiary reservoirs of the Niger Delta Basin are all units of the Agbada Formation. These paralic and deltaic sand are comprised mainly of quartz arenites and, except for occasional shale laminae, they are very clean. Due to the high sedimentation rates of this formation, the sands are under-compacted. Deepwater channel and turbidite equivalents of these sands have been found seawards within the Akata Formation. Figure 4.10 shows the geology of the Niger Delta region.

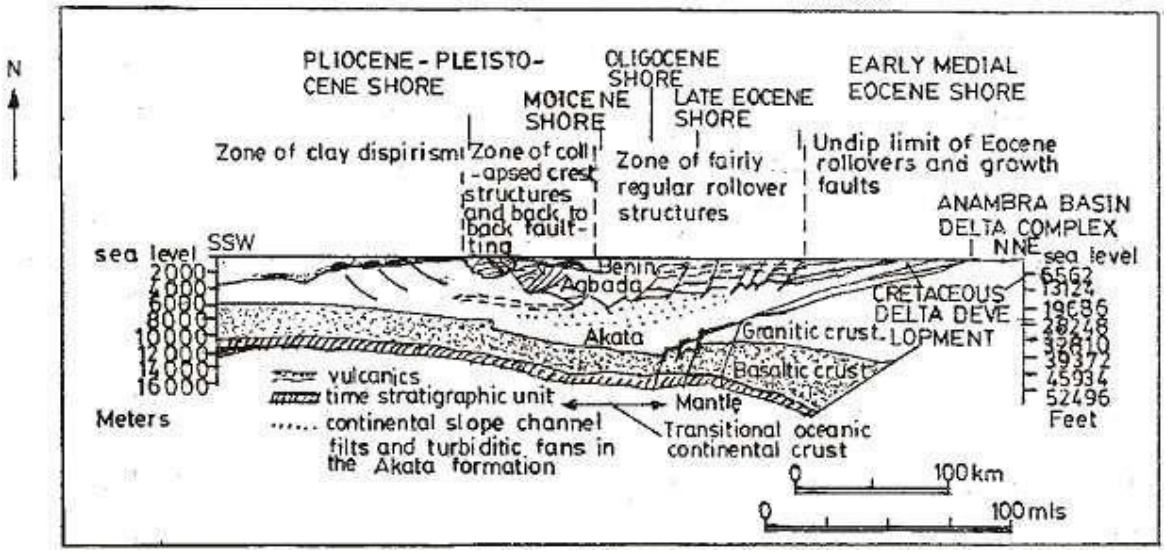

Figure 4.10: Geology of Niger Delta

Soil Profile

The soil profile has well defined dark brown organic matter layer (top soil). The thickness of this A horizon was about 15cm. The B horizon generally consists of light brown coloured clay- an impermeable 'hardpan' layer that may likely prevent water and/or any other liquid from reaching the soil deeper layers. The thickness of this layer was about 45cm. sandy mixed with clay soils predominates the C horizon with thickness of about

40cm (profile of 100cm or 1m depth). The soil profile further reveals that depth to water table is more than 1meter.

The profile indicates that the soils could best be described as forest soils (podzol) that develop in areas of abundant rainfall (Enger and Smith, 2000) which is consistent with the central Niger Delta terrain.

Figure 4.11: Schematic Diagram and pictures of the Soil Profile in the Study Area

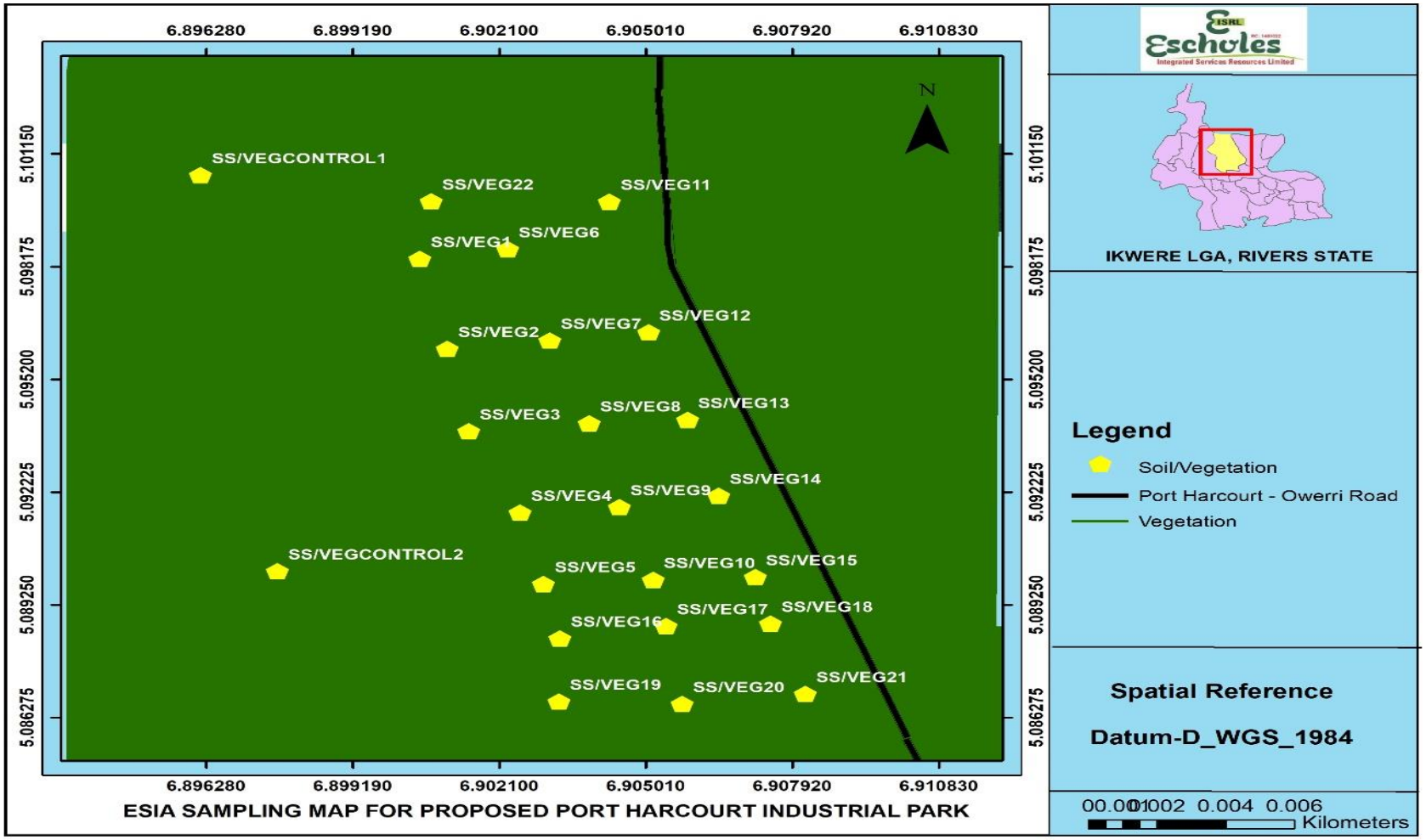

Figure 4.12: Map showing sampling stations for Soil Quality Study. Source: FMoT **Fieldwork, 2020**

Physical Properties

The particle size distribution of the soils is as shown in **table 4.6**. The entire soil fraction was dominated by the sandy particles, with a mean of 48.8% and 52.5% respectively at the top level and sub depth of the soil. This was followed by the clay component of 27.4% and 24.9% at the top and sub layer respectively. The silt component had a mean value of 24.0% and 22.4% at the top layer and the sub depth respectively. In all, the soil was observed to have a relatively fair permeability. Permeability values ranged from 002cm/s to 0.10cm/s at the top level of the soil and from 0.02cm/s to 0.1cm/s at the sub level of the soil. However, porosity at the top and sub soil level was between 33.0% and 86.0%.

Table 4.6: Particle Size Distribution Measured at the proposed Project Site

Parameters	Particle Size						Textural class		Permeability (cm/s)		Porosity (%)		Bulk density (g/cm³)	
Units	% sand		% silt		% clay									
	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub
SS 1T	9.3	12.5	21.3	19.4	69.4	68.1	Clay	Clay	0.02	0.02	86	86	1.76	1.73
SS 2T	22.6	27.8	47.7	49.3	29.7	22.9	Clay Loam	Loam	0.05	0.05	59	59	1.4	1.38
SS 3T	87.7	91.3	7.5	6.1	4.8	2.6	Sandy	Sandy	0.09	0.11	36	36	1.19	1.16
SS 4T	45.1	49.4	11.3	10.7	43.6	39.9	Sandy Clay	Sandy Clay	0.03	0.04	77	77	1.54	1.51
SS 5T	91	94.1	5.9	4.6	3.1	1.3	Sandy	Sandy	0.1	0.13	33	33	1.17	1.14
SS 6T	32.8	36.6	25.1	24.7	42.1	38.7	Clay	Clay Loam	0.03	0.04	75	75	1.54	1.5
SS 7T	60.3	60.7	22.6	21.5	19.1	17.8	Sandy Loam	Sandy Loam	0.04	0.05	53	53	1.35	1.34
SS 8T	39.5	44.5	42.9	38.6	17.6	13.9	Loamy	Loamy	0.02	0.02	68	68	1.45	1.41
SS 9T	50.7	52.6	42.1	40.4	7.2	7	Sandy Loam	Sandy Loam	0.03	0.04	74	74	1.47	1.43

SS 10T	56.7	62.5	30.3	26.4	14	11.1	Sandy Loam	Sandy Loam	0.02	0.03	69..0	69..0	1.39	1.35
SS 11T	35.7	41.6	20.6	16.8	43.7	41.6	Clay Loamy	Sandy Clay	0.02	0.03	71	71	1.49	1.46
SS 12T	42.7	48.3	40.6	36.3	16.7	15.4	Loamy	Loamy	0.02	0.03	66	66	1.38	1.35
SS 13T	39.7	43.4	50.3	46.4	11	10.2	Sandy Loam	Sandy Loam	0.04	0.06	59	59	1.35	1.32
SS 15T	51.2	58.8	32.3	28.5	16.5	12.7	Sandy Loam	Sandy Loam	0.04	0.04	56	56	1.32	1.29
SS 16T	47.5	50.4	15.1	13.3	37.4	36.3	Sandy Clay	Sandy Clay	0.03	0.04	62	62	1.35	1.32
SS 17T	64.1	66.5	14.5	12.8	21.4	20.7	Sandy Clay	Sandy Clay	0.03	0.04	61	61	1.35	1.33
SS 18T	48.3	52.4	14.7	12.8	37	34.8	Sandy Clay	Sandy Clay	0.03	0.04	64	64	1.35	1.33
SS 19T	48.7	53.4	13.2	10.3	38.1	36.3	Sandy Clay	Sandy Clay	0.03	0.04	63	63	1.38	1.36
SS 20T	41.6	43.8	43.2	43.5	15.2	12.7	Loamy	Loamy	0.02	0.03	68	68	1.45	1.4
SS 21T	47.1	53.2	12.4	11.3	40.5	35.5	Sandy Clay	Sandy Clay	0.04	0.05	64	64	1.36	1.32
SS 22T	49.3	53.4	13.7	11.8	37	34.8	Sandy Clay	Sandy Clay	0.04	0.05	51	51	1.27	1.24
SS 23T	43.8	45.4	15.9	15.6	40.3	39	Clay Loamy	Clay Loamy	0.03	0.04	70	70	1.46	1.42
SS T (Ctrl 1)	68.5	68.9	19.4	19.8	12.1	11.3	Sandy Loam	Sandy Loam	0.04	0.05	50	50	1.28	1.26
SS T (Ctrl 2)	46.9	49.5	13.9	16.8	39.2	33.7	Sandy Clay	Sandy Clay	0.04	0.04	69	69	1.46	1.42
Mean	48.8	52.5	24.0	22.4	27.4	24.9	NA	NA	0.04	0.05	62.4	62.4	1.4	1.4
Minim	9.3	12.5	5.9	4.6	3.1	1.3			0.02	0.02	33.0	33.0	1.2	1.1
Maxim	91.0	94.1	50.3	49.3	69.4	68.1			0.10	0.1	86.0	86.0	1.8	1.7

Source: FMoT Fieldwork, 2020

Table 4.20: Particle Size Distribution of Soil within the Project Area (Dry season)

Sample ID	% Sand		%Silt		%Clay	
	Top	Sub	Top	Sub	Top	Sub
SL I	61.53	61.32	17.92	22.43	20.55	16.25
SL 2	62.78	65.07	17.34	16.35	19.88	18.58
SL 3	63.61	60.11	16.53	19.21	19.86	20.68
SL 4	61.86	59.31	19.64	20.21	18.5	20.48
SL 5	68.72	58.37	21.57	15.96	9.71	25.67
SL 6	63.27	65.09	21.53	17.89	15.2	17.02
SL 7	54.68	71.04	34.21	19.35	11.11	9.61
SL 8	50.14	46.83	17.47	19.21	32.39	33.96
SL 9	52.02	46.32	15.46	15.93	32.52	37.75
SL 10	50.36	56.71	17.42	23.64	32.22	19.65
SL 11	60.01	53.16	17.25	19.05	22.74	27.79
SL 12	66.78	58.34	19.53	16.87	13.69	24.79
SL 13	64.92	48.47	12.76	20.43	22.32	31.1
SL 14	61.17	58.03	14.89	15.93	23.94	26.04
SL 15	49.22	50.87	20.96	18.43	29.82	30.7
SL 16	62.93	50.04	19.73	11.04	17.34	38.92
SL 17	63.17	57.96	25.01	19.21	11.82	22.83
SL 18	53.76	59.43	15.97	21.87	30.27	18.7
SL 19	63.89	58.67	32.86	27.11	3.25	14.22
SL 20	61.43	50.12	18.08	13.07	20.49	36.81
SL 21	51.88	49.54	14.96	18.45	33.16	32.01
SL 22	53.57	60.64	18.32	19.54	28.11	19.82
SL 23	63.42	71.35	12.94	15.74	23.64	12.91
SL 24	63.68	56.73	19.65	21.09	16.67	22.18
SL 25	61.83	67.35	14.96	10.49	23.21	22.16
SL 26	59.56	64.53	17.63	20.74	22.81	14.73
SL 27	65.78	59.24	18.52	17.46	15.7	23.3
SL 28	68.63	66.94	12.23	13.74	19.14	19.32
SL 29	59.26	67.32	18.43	19.47	22.31	13.21
SL 30	69.63	66.36	9.03	9.67	21.34	23.97
CTRL 1	67.92	68.26	17.63	20.54	14.45	11.2
CTRL 2	56.84	64.84	21.53	22.73	21.63	12.43
CTRL 3	72.15	71.84	19.43	14.62	8.42	13.54
Min	49.22	46.32	9.03	9.67	3.25	9.61
Max	72.15	71.84	34.21	27.11	33.16	38.92
Mean	60.92	59.70	18.53	18.11	20.55	22.19

Source: Ubima Field Dev. EIA (2017)

Soil pH

The pH of the soils in the study area ranged from 4.10 to 5.30 (mean=4.68) in the top soil and from 3.20 to 4.30 (mean=3.84) in the sub soil which shows acidity in the top soil and sub soil. (**Table 4.7**). Factors that affect soil pH include precipitation (rainfall), drainage, soil vegetative cover, type of soil with respect to mineral composition. The result of the present study revealed relatively high amount of sand in the soil aeration which could cause fluctuation of soil pH (moderate acidity).

Electrical Conductivity: During the study period, the electrical conductivity of the soil had a mean value of 0.13µS/cm and 0.08µS/cm respectively for both top and sub soil with a range of 0.08 to 0.17µS/cm and 0.05 to 0.12 µS/cm respectively (**Table 4.7**). It is important to state that the electrical conductivity measurement reveals the amount of dissolved cations or anions (salts) in solution. In the dry season (Ubima Field EIA, 2017), the topsoil ranged between 103µS/cm and 214µS/cm with a mean value of 147.03µS/cm, while subsoil samples ranged from 48µS/cm to 198µS/cm) with a mean value of 137.21µS/cm.

Total Organic Carbon: Total organic carbon content in the entire soils was generally moderate. The result, see (**Table 4.7**) indicates that the soil had a mean total organic content of 1.76% (1.26% - 2.36%) and 1.50% (0.79% - 1.89%) in top and sub soil respectively. The principal factors responsible for high organic matter in soil include vegetative cover and decay of plant residue. These factors are significantly present in the proposed project area. Hence, return of organic matter to the soil may be enhanced. This phenomenon is equally responsible for the trend of total nitrogen in the soils.

In the dry season (Ubima Field EIA, 2017), TOC ranged from 0.05% to 1.99% with a mean value of 0.99% for top soil samples while subsoil samples ranged from 0.08% to 1.85% with a mean value of 0.98%. These concentrations placed the soil in the study to between low and medium TOC classes during the wet and dry seasons respectively.

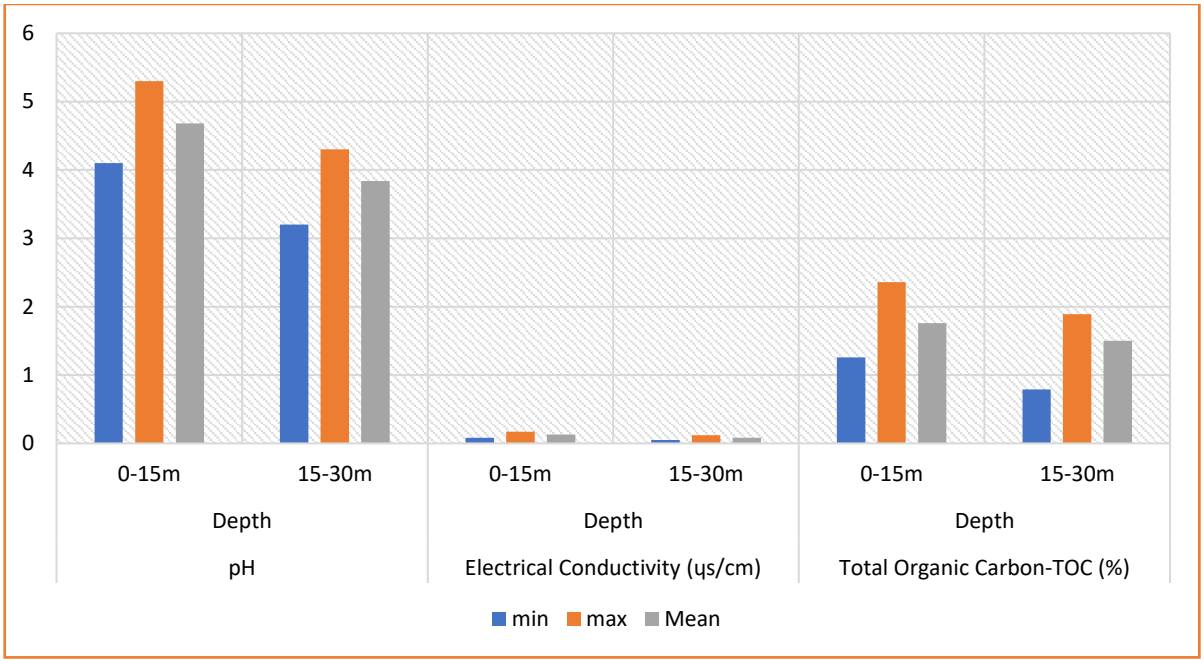

Figure 4.13: Soil pH, Electrical Conductivity and Total Organic Carbon

Exchangeable Bases (Cation Exchange Capacity CeC)

The cation exchange capacity of the soils (CEC) is the summation of the exchangeable bases of Na, K, Ca and Mg. In all, the entire CEC was moderately high with calcium and magnesium dominating the exchange site.

The mean calcium value in the study area was 66.3mg/kg at the top soil and 78.85mg/kg at the sub soil. Similarly, the mean magnesium value in dry season was 62.50mg/kg at the top soil and 76.62mg/kg at the sub soil. Two factors which mainly contribute to CEC in soil are organic matter content and clay composition. In the assessment area these two parameters were moderately present giving rise to the level of CEC observed.

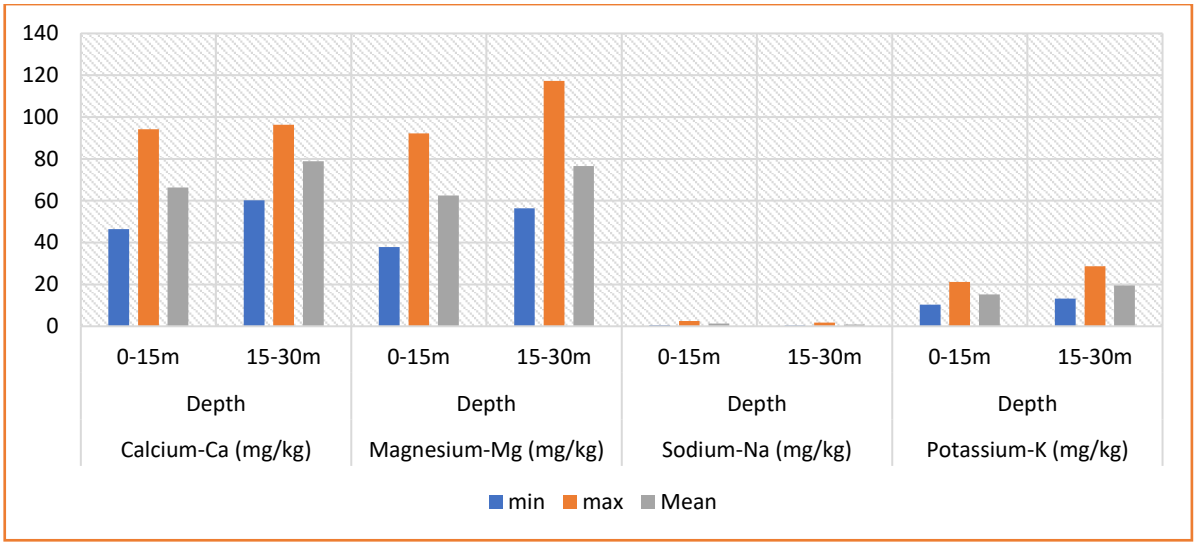

Figure 4.13: Exchangeable Bases. Source: FMoT Fieldwork, 2020

Anions Concentration of the Soils

Total Nitrogen-N: The concentration of total nitrogen in the study area (**Table 4.7**) ranged between 0.02 to 0.08% in the top soil while it ranged between 0.01 to 0.06% in the sub soil. These levels observed may increase with time due to the presence of organic matter.

Available Phosphorus-P: In the study area, available phosphorus values ranged from 0.63 to 2.31mg/kg and 0.42 to 1.77mg/kg respectively in top and sub soil.

Sulphate: In the study area, sulphate values ranged from 1.79 to 5.83mg/kg and from 0.73 to 3.79mg/kg respectively for top and sub soil.

Nitrate: In the study area, nitrate values ranged from 0.09 to 0.25mg/kg and from 0.03 to 0.16mg/kg respectively for top and sub soil.

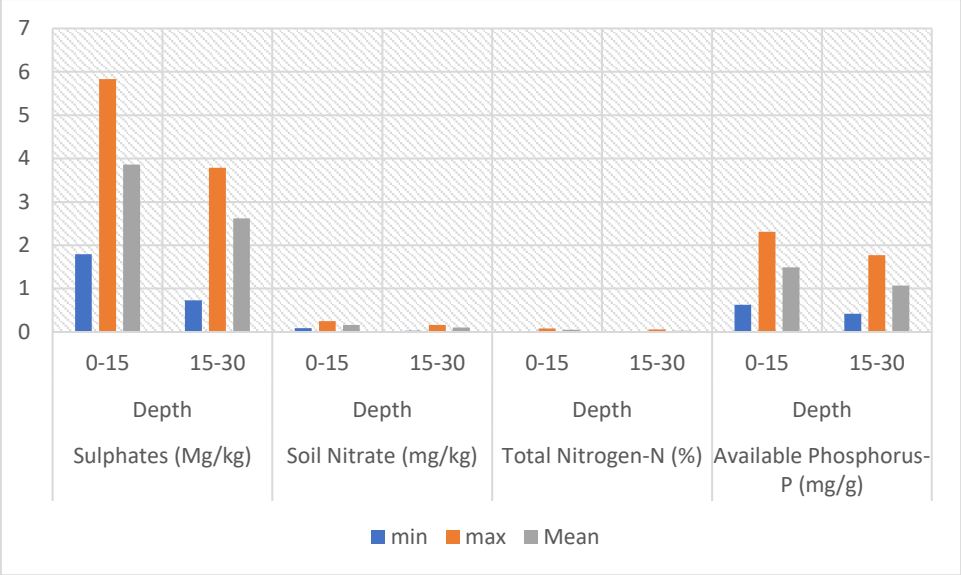

Figure 4.14: Anions Concentration. Source: FMOT Fieldwork, 2020

Heavy Metals Concentration of the Soils

The heavy metals concentration of the entire soils was generally low and most of them (Cd, As, Vn, Ba, Pb and Ni) were below the detection limit of the atomic absorption spectrophotometer used for the analysis.

In the study area, the mean(s) of heavy metals concentration for top and sub soil were respectively as follow; Fe (166.63 and 135.35mg/kg), Zn (0.03 and 0.02mg/kg), Cu (0.08 and 0.04mg/kg), Cr (0.03 and 0.01mg/kg).

In the dry season (Ubima Field Dev. 2017), only in the Soil (Top) and in the subsoil of control 3 were Copper recorded in the dry seasons with values of 0.015 and 0.014mg/kg respectively. Iron, ranged between 0.182mg/kg and 6.823mg/kg with a mean value of 3.167mg/kg for top soil while the subsoil ranged between 0.288 and 6.685mg/kg with a mean value of 3.213mg/kg. During the dry season, a marginally higher value of range between 0.271mg/kg and 10.353mg/kg with a mean value of 4.589mg/kg was recorded in top soil while the subsoil ranged between 0.363 and 11.944 mg/kg with a mean value of 5.191 mg/kg.

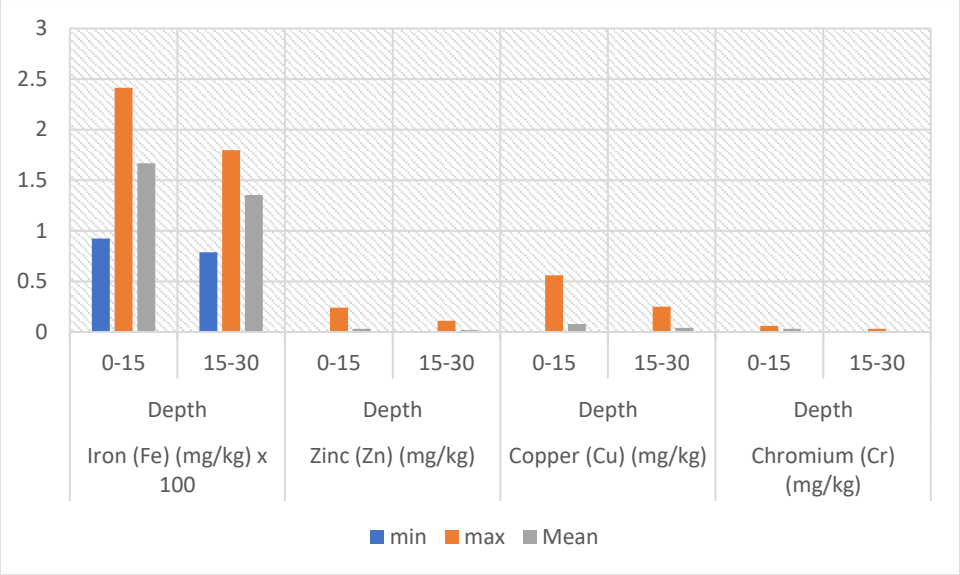

Figure 4.15: Heavy Metals Concentration. Source: FMOT Fieldwork, 2020

Organics Content of Soils

Total Hydrocarbon Content (THC): The results obtained from the laboratory showed that the soil of the proposed project area has a constant value of <0.01 mg/kg in all the sampling locations. **Total Petroleum Hydrocarbon (TPH):** The results obtained from the laboratory showed that the soil of the proposed project area has a constant value of <0.01 mg/kg in all the sampling locations. **BTEX (Benzene, Toluene, Ethylbenzene and Xylene):** The results obtained from the laboratory showed that the soil of the proposed project area has a constant value of <0.01 mg/kg in all the sampling locations.

Soil Microbiology

Mean microbial count of organisms were THB ($1.87x10^7$ cfu/g (top soil) and $1.72x10^7$ cfu/g (sub soil)) in the study area, THF ($0.26x10^3$ cfu/g (top soil) and $0.16x10^3$ cfu/g (sub soil)) in the study area, HUB ($0.38x10^5$ cfu/g (top soil) and $0.25x10^5$ cfu/g (sub soil)) in the study area and HUF ($0.10x10^1$ cfu/g (top soil) and $0.04x10^1$ cfu/g (sub soil)) in the study area.

Table 4.7: Summary of Physico-Chemical and Microbiology Result of Soil Samples

Parameters		Depth	min	max	Mean
pH		0-15	4.10	5.30	4.68
		15-30	3.20	4.30	3.84
Electrical Conductivity (µs/cm)		0-15	0.08	0.17	0.13
		15-30	0.05	0.12	0.08
Sulphates (Mg/kg)		0-15	1.79	5.83	3.86
		15-30	0.73	3.79	2.62
Soil Nitrate (mg/kg)		0-15	0.09	0.25	0.16
		15-30	0.03	0.16	0.10
Total Organic Carbon-TOC (%)		0-15	1.26	2.36	1.76
		15-30	0.79	1.89	1.50
Exchangeable Bases	Calcium-Ca (mg/kg)	0-15	46.38	94.18	66.30
		15-30	60.17	96.37	78.85
	Magnesium-Mg (mg/kg)	0-15	37.86	92.19	62.50
		15-30	56.37	117.28	76.62
	Sodium-Na (mg/kg)	0-15	0.54	2.53	1.28
		15-30	0.39	1.76	0.90
	Potassium-K (mg/kg)	0-15	10.29	21.23	15.21
		15-30	13.29	28.76	19.53
Total Nitrogen-N (%)		0-15	0.02	0.08	0.05
		15-30	0.01	0.06	0.03
Available Phosphorus-P (mg/g)		0-15	0.63	2.31	1.49
		15-30	0.42	1.77	1.07
Total Hydrocarbon Content (mg/g)		0-15	BDL	BDL	BDL
		15-30	BDL	BDL	BDL
Total Petroleum Hydrocarbons (mg/kg)		0-15	BDL	BDL	BDL
		15-30	BDL	BDL	BDL
Polycyclic Aromatic Hydrocarbons-PAHs (mg/kg)		0-15	BDL	BDL	BDL
		15-30	BDL	BDL	BDL

Parameters		Depth	min	max	Mean
BTEX	Benzene	BDL	BDL	BDL	BDL
		BDL	BDL	BDL	BDL
	Toluene	BDL	BDL	BDL	BDL
		BDL	BDL	BDL	BDL
	Ethylbenzene	BDL	BDL	BDL	BDL
		BDL	BDL	BDL	BDL
	Xylene	BDL	BDL	BDL	BDL
		BDL	BDL	BDL	BDL
Heavy Metals	Cadmium (Cd) (mg/kg)	0-15	BDL	BDL	BDL
		15-30	BDL	BDL	BDL
	Iron (Fe) (mg/kg)	0-15	92.40	241.30	166.63
		15-30	78.91	179.65	135.35
	Zinc (Zn) (mg/kg)	0-15	BDL	0.24	0.03
		15-30	BDL	0.11	0.02
	Arsenic (As) (mg/kg)	0-15	BDL	BDL	BDL
		15-30	BDL	BDL	BDL
	Copper (Cu) (mg/kg)	0-15	BDL	0.56	0.08
		15-30	BDL	0.25	0.04
	Vanadium (Vn) (mg/kg)	0-15	BDL	BDL	BDL
		15-30	BDL	BDL	BDL
	Barium (Ba) (mg/kg)	0-15	BDL	BDL	BDL
		15-30	BDL	BDL	BDL
	Chromium (Cr) (mg/kg)	0-15	0.01	0.06	0.03
		15-30	0.01	0.03	0.01
	Lead (Pb) (mg/kg)	0-15	BDL	BDL	BDL
		15-30	BDL	BDL	BDL
	Nickel (Ni) (mg/kg)	0-15	BDL	BDL	BDL
		15-30	BDL	BDL	BDL
Microbiology	(THB) **(cfu/gx10^7)**	0-15	1.47	2.71	1.87
		15-30	1.40	2.38	1.72

Parameters		Depth	min	max	Mean
/Micro biodiversity	(THF) (**cfu/g x10^3**)	0-15	BDL	0.69	0.26
		15-30	BDL	0.52	0.16
	(HUB) (**cfu/g x10^5**)	0-15	BDL	0.78	0.38
		15-30	BDL	0.63	0.25
	(HUF) (**cfu/g x10^1**)	0-15	BDL	0.42	0.10
		15-30	BDL	0.36	0.04

THB: Total Heterotrophic Bacteria x 10^7; THF: Total Heterotrophic Fungi x 10^3; HUB: Hydrocarbon Utilizing Bacteria X 10^5; HUF: Hydrocarbon Utilizing Fungi X 10^1; BDL: Below Detection Limit; TC: Source: FMoT Fieldwork,2020

4.4.3 Ground Water

Physico-chemical properties of water samples collected from underground sources within the study area are presented in (**Table 4.8**) while **figure 4.16** shows the sampling points

Plate 4.3 Drilling of Groundwater Study Borehole at Project Location.

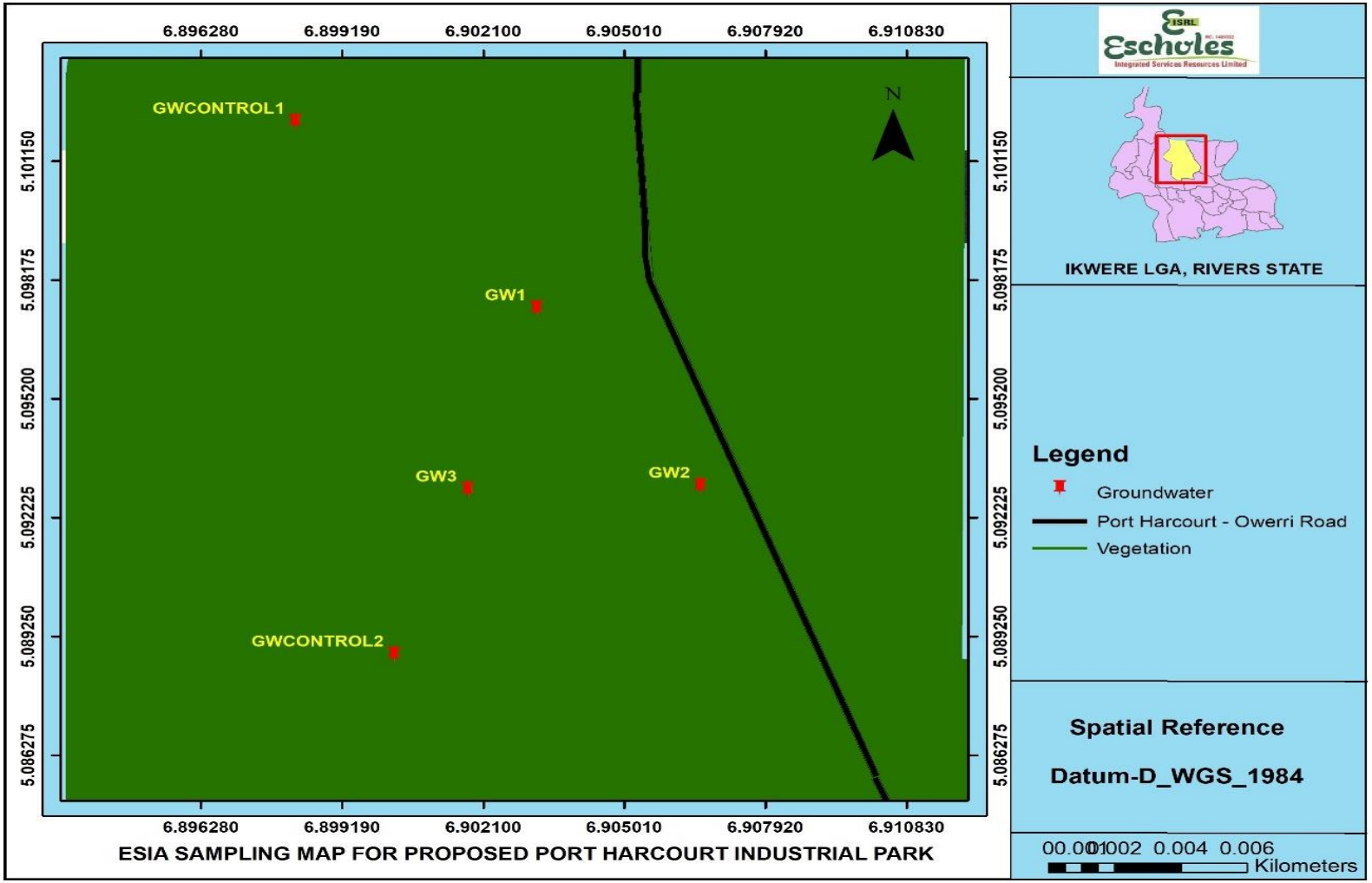

Figure 4.16: Map showing sampling stations for Groundwater Study. Source: FMOT Fieldwork, 2020

Physico-Chemical Characteristics

pH values ranged from 5.30 to 6.30 with a mean value of 5.76 for the five underground water samples collected in study area. These values are tending towards acidity and are below the stipulated limits by WHO and FMEnv. Conductivity and TDS values ranged between 40.0µS/cm to 150.0µS/ cm and 15.0mg/l to 90.0mg/l respectively in the study area. The range of values recorded for Total Suspended Solids ranged from 1.00 to 5.00mg/l with a mean value of 2.20mg/l.

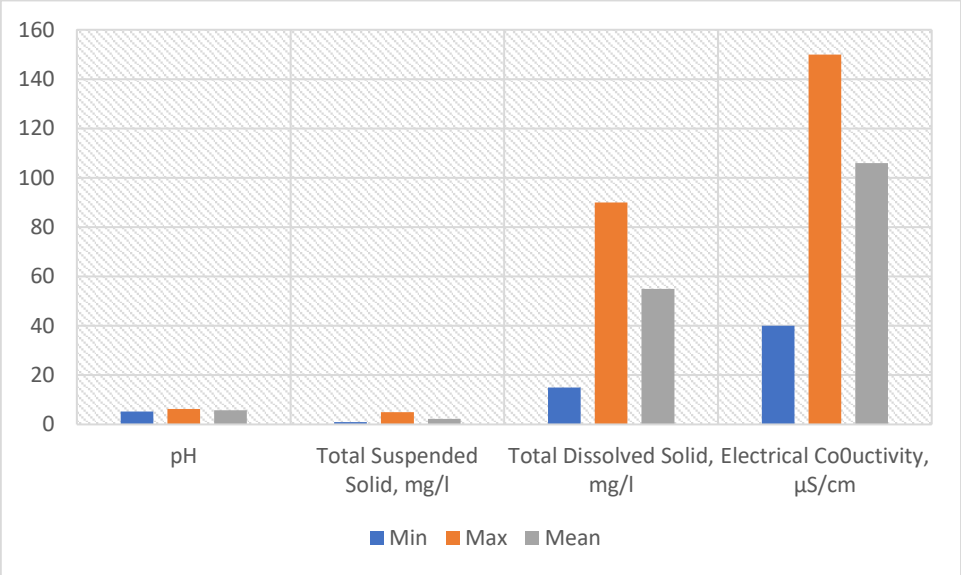

Figure 4.17: pH, Total Dissolved Solids, Electrical Conductivity and Total Suspended Solids Levels in Ground water. Source: FMOT Fieldwork, 2020

DO and BOD

The dissolved oxygen values ranged between 3.10mg/L and 4.10mg/L with a mean value of 3.56mg/l in the study area. The results reveal that the water body in the project area can sustain life forms. The BOD in ground water was between 0.90 and 1.40mg/l with a mean of 1.12mg/l (**Figure 4.8**).

The BOD in the ground water was low in dry season with an average value of 1.44mg/L. This can be attributed to the absence of high levels of contaminating organic materials in the water.

COD and Turbidity

COD values recorded ranged from 1.98mg/l to 3.26mg/l with a mean of 2.56mg/l while Turbidity ranged between 0.01NTU and 1.68NTU (mean=0.51NTU) in the study area. The turbidity levels are all below WHO and FMEnv limit While (Figure 4.18).

On the other hand, COD as an indirect measurement of dissolved chemically oxidizable matter a higher range of 272mg/L and 544mg/L with an average value of 408mg/L was recorded during the dry season. Turbidity values recorded no readings (zero values) in the dry season.

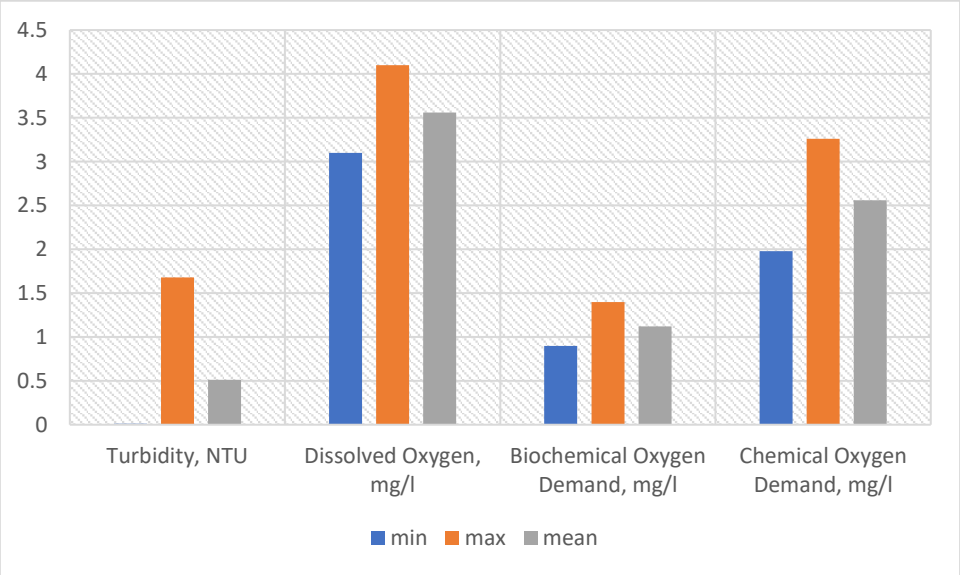

Figure 4.18: Turbidity, DO, COD and BOD and Levels in Groundwater. Source: FMOT Fieldwork, 2020

Anions and Exchangeable Cations

From the (**Table 4.8 and Figure 4.19**) the concentration of chloride accounted for the larger part of the anion content being in the range of 6.90mg/l and 18.64mg/L with an average of 12.96mg/l in the study area. Other anions analyzed include nitrate(0.03-0.17mg/l), sulphate (0.34-2.11mg/l) and phosphate (BDL-0.03mg/l).

Dry season nitrate values recorded a range from 0.0mg/L to 19.0mg/L with an average of 9.5mg/L. while slightly lower chloride values were recorded during the dry season. Phosphate ranged between 0.166mg/L and 0.33mg/L with an average of 0.25mg/L during the dry season. All the anions fell below regulatory limits of the DPR and FMEnv.

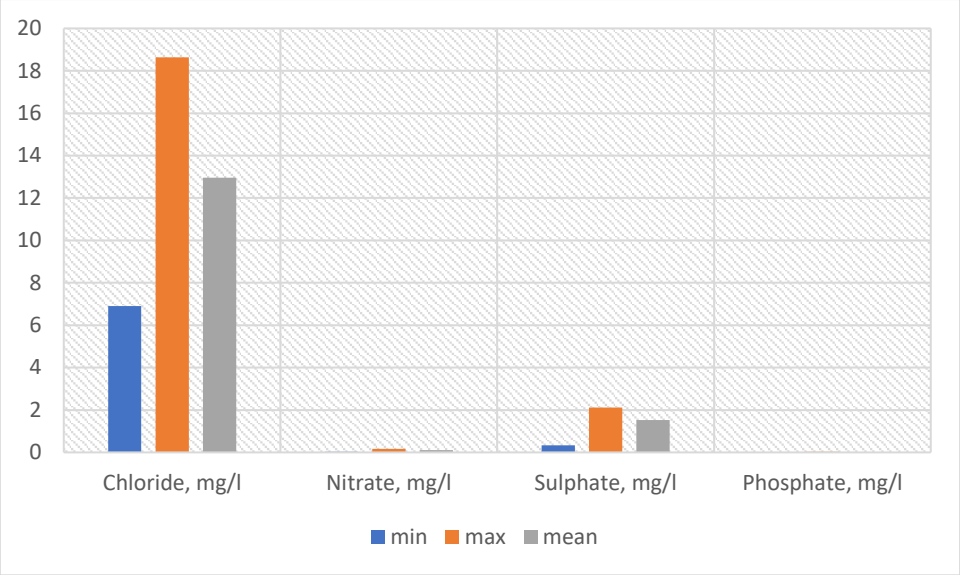

Figure 4.19: Anions Levels in Groundwater. Source: FMOT **Fieldwork, 2020**

Cations concentrations on the other hand were highest with magnesium and sodium, which ranged between 0.52mg/l to 3.56mg/l and 0.77mg/l to 3.65mg/l respectively in the study area.

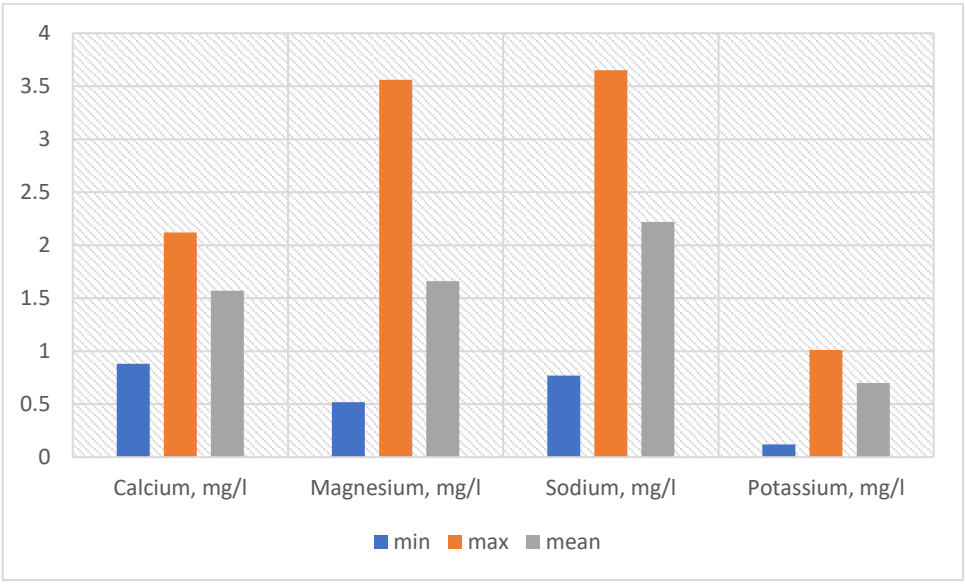

Figure 4.20: Exchangeable Cations Levels in Groundwater. Source: FMoT **Fieldwork, 2020**

Heavy Metals

The heavy metals analyzed in the groundwater samples include lead, copper, iron, zinc, cadmium, barium and vanadium. Concentrations were mostly below the detection limit of the atomic absorption spectrophotometer used for the analysis (**Table 4.8**).

In the dry season, Cadmium (Cd) and Iron (Fe), both recorded values lower than the detection limit of the measuring equipment, with values of (<0.002mg/L) and (<0.006mg/L) in the available samples measured. Zinc (Zn) and Lead (Pb) ranged between less than their respective detection limits (<0.0010mg/L) and (<0.01mg/L), and values of 0.3029mg/L and 0.19mg/L respectively.

Ground Water Microbiology

The results of microbial counts in underground water samples collected in the project area are presented in **Table 4.8.** Total coliform count ranged from 10MPN/100ml to 40MPN/100ml while Feacal Coliform count were not observed.

Table 4.8: Summary of Physico-Chemical and Microbiology Result of Groundwater Samples

Parameters, units	Min	Max	Mean	WHO Limits	FMEnv Limits
pH	5.30	6.30	5.76	6 -9	6.5 – 8.5
Temperature, °C	26.90	28.80	27.58	-	-
Total Dissolved Solid, mg/l	15.00	90.00	55.00	-	-
Electrical Co0uctivity, µS/cm	40.00	150.00	106.00	-	-
Colour, TCU	1.00	2.00	1.20	-	-
Odour	U/O	U/O	U/O	-	-
Turbidity, NTU	0.01	1.68	0.51	30	30
Total Suspended Solid, mg/l	1.00	5.00	2.20	-	-
Dissolved Oxygen, mg/l	3.10	4.10	3.56	-	-

Biochemical Oxygen Demand, mg/l	0.90	1.40	1.12	-	4.5
Chemical Oxygen Demand, mg/l	1.98	3.26	2.56	-	-
Salinity, mg/l	11.19	31.17	20.90	-	-
Total Alkalinity, mg/l as $CaCO_3$	10.00	19.00	15.00	-	-
Total Hardness, mg/l as $CaCO_3$	4.30	11.70	9.08	-	-
Chloride, mg/l	6.90	18.64	12.96	-	-
Sulphate, mg/l	0.34	2.11	1.52	-	-
Nitrate, mg/l	0.03	0.17	0.10	-	-
Phosphate, mg/l	BDL	0.03	0.01	-	-
Calcium, mg/l	0.88	2.12	1.57	-	-
Magnesium, mg/l	0.52	3.56	1.66	-	-
Sodium, mg/l	0.77	3.65	2.22	-	-
Potassium, mg/l	0.12	1.01	0.70	-	-
Total Hydrocarbon Content, mg/l	BDL	BDL	BDL	-	-
Lead, mg/l	BDL	BDL	BDL	1	5
Copper, mg/l	BDL	BDL	BDL	1	20
Iron, mg/l	BDL	0.01	BDL	-	-
Zinc, mg/l	BDL	BDL	BDL		50
Cadmium, mg/l	BDL	BDL	BDL	-	-
Barium, mg/l	BDL	BDL	BDL	-	-
Vanadium, mg/l	BDL	BDL	BDL	-	-
Total Coliform Count, MPN/100ml	10.00	40.00	22.00	-	-
Feacal Coliform Count, MPN/100ml	BDL	BDL	BDL	-	-

BDL: Below Detection Limit; Source: FMoT Fieldwork, 2020

Table 4.9: Underground water Physico-chemical parameters in Ubima Field (Dry Season)

Sample ID	pH	Temp (oC)	Cond (mS/cm)	TDS (ppt)	TSS (mg/L)	Turb (NTU)	DO	BOD (mg/L)	COD	Acidity (mgCaCO3/L)	Alkalinity (mgCaCO3/L)
BH 1	7.89	28.69	0.073	0.037	4	0	6.34	1.03	272	12	840
GW 2	7.91	29.34	0.064	0.034	6	0	9.27	1.84	544	16	900
Min	7.89	28.69	0.064	0.034	4	0	6.34	1.03	272	12	840
Max	7.91	29.34	0.073	0.037	6	0	9.27	1.84	544	16	900
Mean	7.90	29.02	0.07	0.04	5.00	0	7.81	1.44	408	14	870
FMEnv Standard	6-9	NS	NS	2000	30	-	NS	50	NS	-	NS
DPR Standard	6.5-8	-	-	450 – 2000	-	-	4-5	-	-		-

Source: Ubima Field Dev. 2017

4.4.4 Vegetation Study

Along pre-selected transects, the vegetation association was characterized using the segmented Belt Transect Sampling Technique which ensured maximum opportunity of recording most of the component species in the area.

Block of 100metres x 50metres in size was laid and this became one random quadrat that was studied. This was repeated at four (4) randomly chosen locations (segments) to cover the entire study area since data collection is generally more efficient than a contiguous or 100 percent assessment on a smaller length of transect (Oosting, 1956).

For each random quadrat, the general nature of the vegetation was noted; all plant species including trees, shrubs and herbs were identified as far as possible on the sites. Those that could not be identified with certainty were collected, labelled and taken to the herbarium for proper identification. Photographs of the major vegetation types were taken during the field work.

The number of strata in the vegetation was noted and the dominant species recorded. The height of the plants was measured with measuring tape and Haga altimeter. Where counting of individuals was not possible in situations where there are creeping plants, cover was measured according to Greig-smith (1983).

Land-use investigation was carried out along four cardinal points with the tracks serving as the baseline. The major crop species, farming system, habitat and non-farming activities along each of the cardinal points were documented. Plants that were of economic importance were identified and counted

The project area shows abandoned well-heads surrounded by secondary rainforest vegetation and cultivated farmlands.

The prominent vegetation types in the study area were the rainforest and forest/farmland mosaic. The vegetation comprised of trees, shrubs, herbs, ferns, climbers and creepers. The trees consisted of plants about 40m high while the shrubs were between 15-25m and the rest consisted of herbaceous layer. The tree species included *Elaeis guineensis, Ficus exasperata, Musanga cepropoides, Rauvolfia vomitorias,* and *Spondias mombin. Shrubs species* included *Alchornea cordifolia, Bambosa vulgaris, Icacina trichanta, Manihot esculenta, Sida acuta* and *Voacanga africana. Herbaceous species* included *Chromolaena odorata, Palisota hirsute* and *Tridax procumbens* (Table4.10).

Table 4.10: Fauna Species composition in the Project Area

SN	Species	English Name	Families	Ecological	Life Form
1	*Alchornea cordifolia*	Christmas bush	*Euphorbiaceae*	Common	Shrub
2	*Anthocleista nobilis*	Cabbage tree	*Loganiaceae*	Rare	Tree
3	*Bambosa vulgaris*	Bamboo	*Poaceae*	Abundance	Shrub
4	*Centrosema pubescence*	Fodder pea	*Papilionaceae*	Rare	Creeper
5	*Chromolaena odorata*	Siam weed	*Asteraceae*	Rare	Herb
6	*Colocasia esculenta*	Cocoyam	*Araceae*	Common	Herb
7	*Combretum racemosum*	Bush willow	*Combretaceae*	Rare	Climber
8	*Costus afer*	Spiral ginger	*Costaceae*	Common	Shrub
9	*Cyclosorus afer*	Fern	*Thelypteridaceae*	Rare	Fern
10	*Elaeis guineensis*	Oil Palm tree	*Arecaceae*	Abundance	Tree
11	*Ficus exasperate*	Sand paper tree	*Moraceae*	Common	Tree
12	*Icacina trichanta*	Icacina	*Icacinaceae*	Common	Shrub
26	*Ipoemea involvucrata*		*Convolvulaceae*	Common	Climber
13	*Manihot esculenta*	*Cassava*	*Euphorbiaceae*	*Abundance*	Shrub
14	*Musa paradisiaca*	*Plantain*	*Musaceae*	*Common*	Shrub

15	*Musa sapientum*	*Banana*	*Musaceae*	*Common*	Shrub
16	*Musanga cepropoides*	*Umbrella tree*	*Moraceae*	*Rare*	Tree
17	*Palisota hirsute*	*Palisota*	*Commelinaceae*	*Common*	Herb
18	*Panicum maximum*	*Guinea grass*	*Poaceae*	*Rare*	Grass
20	*Sida acuta*	*Broom weed*	*Malvaceae*	*Common*	Shrub
21	*Smilax anceps*	*Cat briers*	*Smilacaceae*	*Common*	Climber
22	*Spondias mombin*	*Hog plum*	*Anacardiaceae*	*Common*	Tree
23	*Tragia benthami*	*African joker*	*Euphorbiaceae*	*Common*	Climber
24	*Tridax procumbens*	*Tridax*	*Asteraceae*	*Rare*	Herb/Creeper
25	*Voacanga africana*	*Black pepper*	*Apocynaceae*	*Common*	Shrub

Source: FMoT Ubima Field Work 2020

Some of these plant species can be observed in Plates 4.5-4.13. The analysis on the life forms show that tree made up of 22.22%, shrub 33.33%, each of creeper, fern, grass and herb/creeper was 3.70% while each of climber and herb had 14.81% (Table 4.11). In addition, the analysis on the species' ecological status shows that the species that were abundant made up 11.11%, common species was made up of 55.56% while the rare species was made up 33.33% (Table 4.12). Among the abundant species included *Bambosa vulgaris*, *Elaeis guineensis* and *Manihot esculenta* while the common species included Alchornea cordifolia, Ficus exasperate, Smilax anceps and *Voacanga africana*. The rare species included *Anthocleista nobilis, Combretum racemosum, Rauvolfia vomitorias and Tridax procumbens.* The families of plants found in the study area included *Anacardiaceae, Euphobiaceae, Poaceae, Papilionaceae* etc, but the higher frequent among them are *Euphorbiaceae, Musaceae, Moraceae,* and *Apocynaceae.*

Analysis of life forms of vegetation in the study area shows that 33.3% of the vegetation is shrubs, 22% are trees, 14% are climbers and herbs respectively, while 3.7% are creepers, ferns and grasses.

Table 4.11: Analysis on Life Form of vegetation

S/N	Life form	Frequency	Percentage (%)
1	Tree	6	22.22
2	Shrub	9	33.33
3	Creeper	1	3.70
4	Climber	4	14.81
5	Fern	1	3.70
6	Grass	1	3.70
7	Herb	4	14.81
8	Herb/Creeper	1	3.70
Total		27	100.0

Table 4.12: Analysis of Ecological Status of vegetation

S/N	Ecological Status	Frequency	Percentage (%)
1	Abundance	3	11.11
2	Common	15	55.56
3	Rare	9	33.33
Total		27	100.0

Ecological status of the vegetation shows 55% for common, 33% for rarity and 11 % for abundance. There was no distinct and significant seasonal variation in the ecological status of vegetation in the study area.

Plate 4.4: Cassava Plantation around the Project Area

Plate 4.5: *Ficus exasperate* (forest sandpaper fig tree)

Plate 4.6: *Ipoemea involucrata* (morning glory weed)

Plate 4.7: Cyclosorus afer

Plate 4.8: *Bambosa vulgaris* (bamboo tree)

Plate 4.9: Panicum maximum (Guinea grass)

Plate 4.10: Colocasia esculenta (Elephant's ear plant/cocoyam)

Plate 4.11: *Elaeis guineensis* (African oil palm tree)

Plate 4.12: *Anthocleista vogelii* (Cabbage Tree)

Plate 4.13: Costus afer (ginger lily/spiral ginger)

4.4.5 Wildlife and Endangered Species

Wildlife studies within the areas adjoining the project site were conducted between 9.00am and 6.00pm local time respectively during the reconnaissance visits. The area was delineated into four quadrats and the hunt for wildlife was carried out in each of the 4 quadrats and in the entire habitat types identified, namely, the secondary forest, fallow land with its low vegetation, the farmland vegetation, weeds and herbaceous vegetation. Population census of the mammals, reptiles, amphibians and avifauna which readily offered themselves for observation was carried out by the Direct Count method and with the aid of a pair of powerful binoculars.

By probing the humid habitats such as logs, heaps of dry or decaying leaves, forest undergrowth and burrows, the presence of some animals like amphibians, reptiles and other small mammals, was detected. All sighted or captured animals were identified often on the spot to possible taxonomic levels using various keys and field guides by Walter et al., 1968; Happold, 1987 and Branch, 1988.

Indirect methods of population estimate was also employed for species which were not readily seen, particularly the very secretive mammals. Evidence of the animals' presence such as signs of the animals' occupation of the habitat e.g. burrows, faecal pellets (droppings), furs, footprints (tracks), sloughed skin, devoured cassava, maize and oil-palm fruits as well as skeleton/ carcass and trampled grass were found to be of immense value in the course of this investigation.

Animal calls were often listened to during the period of observation. Further source of information on wildlife diversity and abundance was obtained from snare (snap) traps set by hunters and by interviewing the local hunters. Only information for which more than 60 percent of the hunters had consensus opinion was taken.

The wildlife observed in the study area consists of wide varieties of invertebrates such as grasshopper, mosquito, houseflies, crickets, spiders among others (Table 4.13) and the vertebrates like amphibians, reptiles, birds and mammals (Table 4.14). In the study site, many macro invertebrates are exploited for food and these include snails and crickets. Among the vertebrates, the amphibians (frogs) were the least exploited for food. Squirrel and cane rat were really exploited for food and occasionally, some birds were exploited as well. The populations of these vertebrates have become depleted due to human-

induced habitat alterations to the extent that some species like Tiger *(Panthera tigris),* Elephant *(Loxodanta africana)* and Antelope *(Antilocapra americana)* had become threatened or endangered.

Table 4.13: The terrestrial macro invertebrate fauna of the project area

Scientific Name	Common Names	Level of Abundance	Remarks
Helix promata	Snail	Common	Handpicked in the forest for food
Musca domestica	Housefly	Very common	Contaminates food and causes diseases like cholera
Culicidae *Culex spp* *Anopheles spp*	Mosquito	Very common	Transmits malaria
Caelifera	Grasshopper	Common	Destroys the leaves of crops
	Butterfly	Very common	Helps in pollination
Achaearanea spp	Spider	Very Common	Makes cobwebs
	Millipede	Common	Enrich the soil

Invertebrate macro-fauna of the project area shows high level of commonality in the area. In other words, they are highly abundant in their composition and distribution. Also, seasonal variation was observed in the distributions of these macro-fauna. They were observed to be more in numbers during the rainy season than in the dry season, except for butterflies and spider.

Table 4.14: The terrestrial vertebrate fauna of the project area

Scientific Names	Common Names	Level of Abundance
Sciurus carolinensis	Squirrel	Common
Agama agama	Lizard	Common
Bubulcus ibis	Cattle egret	Common
Phoenicopterus roscus	Flamingo	Rare
Thryonomys swinderianus	Cane rat	Common
Bufo regularis	Toad	Common
Rana papiens	Frog	Common
Loxodonta africana	Elephant	Extinct

Antilocapra americana	Antelope	Rare
Bitis spp	Cobra	Rare
Sus scrofa	Wild pig	Rare
Passer domesticus	House sparrow	Common
Panthera tigris	Tiger	Rare
Macaca fascicularis	Monkey	Common

Plate 4.14: A butterfly on the leaf

Plate 4.15: A grasshopper on the leaf

Plate 4.16: Millipede

4.5: Socio - economic Survey

This aspect of the ESIA on the proposed Port Harcourt Industrial Park project presents the findings of the socio-economic and health studies assessments as well as the expected impact of the project on the people. Specifically, the objective of the study includes;

- The study and documentation of the socio-economic and the cultural setting of the project area.
- Determining the impacts of the project on settlement, cultural treasure, population, social and physical infrastructures, amenities, predominant economics structures and the baseline health status of the people.
- Documenting the views of the affected population, industries and other relevant institutions/agencies in terms of environmental problems, perceived community problems and needs.

4.5.1: Consultations

The key objective of the consultation is to notify the stakeholders of the nature, scale and timing of the proposed project, thereby eliminating any fears or apprehensions. Secondly, it facilitates information gathering between the proponent and other stakeholders. This two-way communication enables the proponent to learn from its stakeholders and neighbours and avoid misunderstandings about the project. Consultation also provides a mechanism by which stakeholders will be carried along all through the project's lifetime, as well as a forum of addressing community's concerns, issues and needs.

Consultation equally helps the proponent learn through the input of local knowledge, enhance the acceptability of the projects, limit unrealistic expectations and focus on the delivery of benefits.

Throughout the lifespan of the project, the proponent shall maintain effective communications with authorities and other relevant stakeholders. The intention of this is to:

- avoid conflicts by addressing issues promptly;
- ensure that fears and apprehensions about the nature, extent and impact of the operation have been addressed; and
- avoid any misunderstanding about the development.

The ESIA document will be made available to public for comments through the regulatory agencies. One of the stages of consultation was carried out in the Scoping Workshop organized for all the communities likely to be impacted by the proposed project. The screening workshop held on 13th November 2020 in Port Harcourt. (Attendance and Report Contained in Appendix)

Detailed activities of the project were discussed at the workshop and the communities raised issues and concerns based on the following themes: Project impacts, stakeholders likely to be affected, sensitive/vulnerable environmental components that could be impacted as well as measures to enhance beneficial impacts and reduce/eliminate identified adverse impacts.

All these were collated and integrated into the Terms of Reference for this study. Another stage of consultation was done by the environmental consultant which involved paying homage to the selected communities, and informing them of the proposed project. The last stage was during the focus group discussions held with the various groups at the community level. During the consultations, the consultants explained the scope and justification of the project and took note of the people's fears, impressions and expectations concerning the proposed project.




Plate 4.17: Highlights of the Scoping Workshop Exercise

Future Consultations

The proponent shall continue to consult with the Regulatory Agencies, the host communities, all stakeholders concerned with or likely to be affected by the project at all stages of project development. The consultations will be sustained throughout the lifespan of the proposed project. Plates 4.18 – Plates 4.20 show sessions during the consultation exercise for proposed project.

Plates 4.18: Community consultation at Omuordu and Omueka Village, Ubima

Plates 4.19: Community Engagement at Mgbuogba Village

Plates 4.20: Community Engagement at Omuowhor Village

4.5.1: Socio-Economic Survey

The entire area belongs to and is inhabited by the upland community of Ikwerre speaking people of Rivers State. The main community is Ubima a town in Ikwerre Local Government Area of Rivers State. It is about two kilometers away from the Port Harcourt-Owerri road. The Ubima community is home to some prominent sons of Rivers State such as His Excellency, Rt. Hon. Rotimi C. Amaechi (Hon. Minister, Federal Ministry of Transportation). Sir Celestine Omehia former Governor of Rivers State.

The community plays host to the Nigerian Navy Intelligence Headquarters. It is the home of Risonpalm. Risonpalm is a Rivers State Government oil palm industry which has become moribund.

The socio-economic survey for the proposed project centered on four (4) communities in Ubima in Ikwere Local Government Areas LGA of Rivers State. Table 4.15 presents a list of consulted.

Table 4.15: Sampled Communities and LGAs

S/N	Community	LGA
1	Omueka	Ikwere
2	Omuowhor	Ikwere
3	Omuordu	Ikwere
4	Mgbuogba	Ikwere

4.5.2: Study Approach / Design

A combination of several data collection techniques was adopted in the socio-economic survey in order to achieve the objectives of the study. The methods below were combined and adopted at varying degrees for the different communities:

- Questionnaire interview
- Focus Group Discussion (FGD)
- Consultations/Key informants information (KI)
- Participant observation and estimation.

Data was collected on various socio-economic parameters and were analyzed using different appropriate tools. Some of these analytical techniques for demographics are presented below:

Two population projection models were used, (linear and exponential) to project - from available base year statistics the population of the communities.

a) *Linear Extrapolation Model*

$$P_n = P_0 + P_0na \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where:

P_0 = the base year population,

a = some fixed percentage of the base

Population (growth rate), and

n = time elapsed in years.

b) *Exponential Growth Model*

$$P_n = P_0 (1 + r)^n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Source: Palmore and Gardner, 1983

Where:

P_0 = base year population;

r = rate of growth (-annual growth rate)

and n = time period in years.

(c) Age Dependency Ratio:

The age-dependency ratio is the ratio of persons in the "dependent" ages (generally under age 15 and over age 64) to 100 persons in the "economically productive" ages (15-64 years) in a population.

The *Dependency Ratio* is given by the formula:

(d) Gender Ratio:

$$\frac{\text{-Number. of Persons Under 18 or Over 64}}{\text{-Number. of Persons 18-64 yrs old}} \times 100$$

The sex ratio is the ratio of males to females in a given population, usually expressed as the number of males for every 100 females.

The *Sex Ratio* is expressed as:

$$\frac{\text{-Number. of Males}}{\text{-Number. of Females}} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Source: Haupt and Kane, 2004

The survey involved sampling households within the community using a set of questionnaire. Table 4.16 presents the communities sampled and the total number of questionnaires filled. The sample size and the number of questionnaires administered was proportionate to the estimated size of household population of the communities.

Table 4.16: Communities Sampled and Total Number of Questionnaires filled

S/N	Villages in Ubima	Local Government Area	No of filled Questionnaires			
			Informants	Households	Social Groups	Total
1.	Omueka	Ikwere	35	5	4	44
2.	Omuowhor	Ikwere	33	4	6	43
3.	Omuordu	Ikwere	35	3	2	40
4.	Mgbuogba	Ikwere	45	3	5	53
Total						180

4.6 Socio-Cultural Resources

4.6.1 Socio-political System

The project community is Ubima and is located within the administrative jurisdiction of the Ikwerre Local Government Area with headquarters at Isiokpo. They belong to the Ikwerre ethnic group and speak the Ikwerre dialect or language.

The Ikwerre ethnic group is spread among the Ikwerre, Emohua, Obio/Akpor and Port Harcourt local government council areas (LGAs) in Rivers State. A recent cultural survey of Rivers State revealed that ''the Ikwerre people have their roots from the Benin Kingdom at about 1700 AD'' and the first settled place was Isiokpo. From Isiokpo, all that today make up the Ikwerre land, including 'Obio', 'Akpor', etc., came out. Isiokpo is thus the traditional headquarters of Ikwerre.

Another version of the peoples' historical origin though agreed on source of origin differed on when and where was first settled. According to his royal majesty (HRM), Amb.

King, Dr. Frank Eke, *Eze Gbakagbaka of Ikwerreland, Eze-Oha Evo*, paramount ruler of Woji Community (per comm.), *'the Ikwerre are 'Iworowha' people who migrated from Benin kingdom roughly in the 13th Century''. ''They came along the Niger Delta at the same time with the Ekpeye people''*. Iworowha, came and settled in Woji (area of Obio), he was married but barren and then had an encounter with a native doctor who was from Awka. The native doctor promised of delivering him from his travails with his ''magical powers but 'Iworowha was not convinced until he was shown two magical prowess and with concoctions prepared for him, his wife was able to give birth to a child and the ensuing question, have you believed now, translated *''Ikwerrelor ikwerre ugo''* is the root of the ethnic group now known as ''Ikwerre''. Iworowha was to have ''Obio'', literally meaning ''stranger'' as ''first son'', and ''Obio'' in turn begot two sons, ''Evo'' and ''Apara' and a daughter in that order. Other migrants later joined the earlier settlements and together make up the area known today as ''Ikwerre''. Further analysis of the ''Ikwerre'' genealogy by the *''Eze Gbakagbaka''* revealed that ''Evo', a progeny of Obio had three (3) sons, namely ''Evo'' (named after Evo Senior as we have them today), ''Opotoma'' and ''Esara''. ''Evo', son of ''Evo'' begot ''Oro-Evo'', ''Opotoma'' begot ''Oropotoma'' and ''Esara'' begot ''Oro-Esara'' respectively. And from the house of the first son (house), ''Woji'; emanated as first son out of seven (7) other children. Historically, the ***Ubima*** community and its' constituent villages have settled on their lands more than 3 centuries now and were influenced more in their settlement by the search for agricultural lands than anything else. They also have very strong affinity with the Isiokpo people.

Ubima Community also has a central community development committee (CDC). The Community Development Committee (CDC) is a government-influenced group which is made up of elected officials with tenure of three (3) years in office. The CDC reports to the Council of Chiefs/Elders, and as the most influential of the social organisations, it is the responsibility of the CDC to mobilise the different sections and interest group in the community for development purposes. They also liaise between the community's external agencies and the government particularly in matters bordering on community development. However, the roles and duties of the organ, as the central body of the community are complementary and supportive of the Council of Chiefs/Elders.

Until very recently, a youth body originally charged with community cleanliness (they carry out sanitation exercises to rid the community of filth), and also the police of the community (enforcement of law and order are in their hands) was another organ of the community's traditional governance. But an embargo has been placed on the youth group from the Ikwerre LGA Council Secretariat ''because of the wave of kidnappings and cultist activities'' that have swept through the State. The CDC chairman and EXCO, the youth chairman and their EXCO bodies originally work hand in hand for the betterment of the community. As it is widely known in this part of the world, the role of the women folks is rather silent, but they perform crucial roles of community welfare, and partake in other activities, such as ceremonial functions in burials, marriages, as well as in festivals that require their inputs. The group is rather not neglected in decision making, particularly on major issues concerning the entire community especially in these days of women empowerment. They were therefore, described as ''being effectively on ground''.

Traditional marriage in Ubima, as it is with every other ethnic nationality in Nigeria, is a sacred process that is highly revered. Accordingly, the man would go for a formal introduction, often referred to as the "Door knocking" the moment he identifies the woman he wants to marry. He does this by taking few elders of his family to the girl's family for the "Introduction". He goes there with a keg of palm win and dry gin (okanme). While this process lasted, the girl is not defiled. Both are kept away from having sex before the marriage. On the day of the marriage, what the man wears is of a great essence. He spots a loose end wrapper atop of etibo (flowing shirt) with a hat to match. He may decide to wear sandals or hard shoes.

The girl may go in wrapper with some traditional tops. She spots traditionally made beads round her waist and some more round her wrists. The details of the conjugal process may not be necessary at this point, but what is most interesting is the fact that the atmosphere at the marriage venue is always electric, as it is spiced up with some traditional displays by the youths of the community. Consequently, the marital status of the project community were observed as followed 68% (married), 16% (single) and 5.3% were married but are either separated or formally divorced while 10.7% were widows.

Political Administration

Ubima community has a well organized political structure. The Traditional Leader (Nyeweali) is the paramount ruler in the community. The Nyeweali, and his council of chiefs (Ndioha Owhor holders) oversee the settlement of disputes, protection of cultural and traditional norms and values. The nyeweali and his cabinet run the affairs of the community. They also maintain cordial relationship with neighbours and the government in addition to carrying out other rites attached to such an exulted office. From consultations and visits to the area it was observed that the people are peace loving and hardworking. There are elected Community Development Council executives whose tenure last two years. The council sees to the welfare and development of the community. There are several groups in the area.

The women have their group known in local parlance as otu umuwanyi. This group have formed themselves into cooperative groups, with the aim of raising funds and granting loans to members. They contribute immensely to the smooth running of the community. The youths constitute themselves into very militant groups that serve as vanguards to maintain law and order. They sometimes act as parallel government, especially when issues of revenue generation from oil exploration and production (E & P) operations are concerned. The responsibilities of the youth organization include enforcement of laws and acting as watchdogs in the community.

Hierarchical presentation of the political administration in Ubima community is presented in Figure 4.21

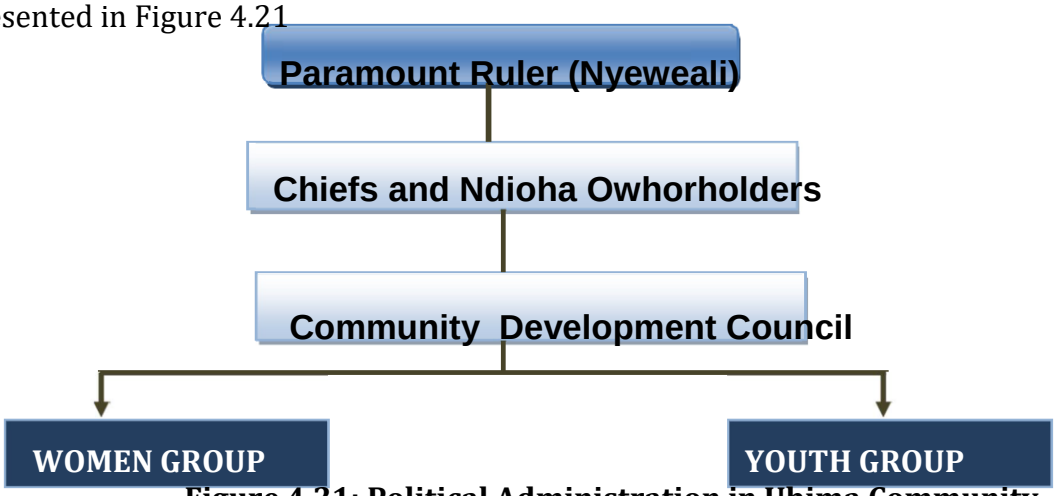

Figure 4.21: Political Administration in Ubima Community

4.6.2 Life Style and Social Indulgent Practices

The community identifies the prevalence of some social vices among their residents. Some of these vices include abuse of alcohol, cigarette smoking, prostitution and teenage

pregnancy. The use of spirits and alcoholic beverages is very common among male and female adults. One major reason adduced for this is the sales of family lands and sharing of money among young family members. Many adult residents of both genders started drinking at the time they were teenagers. Smoking of cigarettes is a habit many started in their youth and formative years. It is less rampant than drinking and it is more noticeable among males in the community.

4.6.3 Belief Systems and Practices

About 91% of residents of the community indicated that they are Christians. They are members of various Christian denominations with their worship places built across the community. The Lutheran church is the major Christian denomination where most indigenes traditionally worshiped. Over the years, however, many residents have embraced other Christian denominations. Worship places of various denominations including the Redeemed Christian Church of God, Church of God Mission and Deeper Life Bible Church are in the community. Others are the Anglican Church, United Evangelical Church, Seventh Day Adventist, and Newlife Believers Assembly, among others. The main Christian festivals of Christmas and Easter are celebrated by households across the community. There are some non-Christians in the population. Some of these are adherents to traditional religion and a few are Muslims. They also have their worship places and observe the major Muslim festivals of Eid el-Malud, Ed el-Fitre and Eid el-Kabir.

Deities such as minikwu, mininta, ikpolu, abaro mini, obanikwu, omogbele, ewe eke have their shrines located around within the community. These deities are considered to be guardians of various families in the community.

Community Taboos

They also mentioned some taboos such as:

- A stranger cannot be a priest to any of Ubima community deities. The people believe that if a stranger serves as a priest to any of the deities, the gods may not accept any sacrifice offered by such a stranger.
- No sexual intercourse on the floor or in the bush. According to the residents, this is a taboo against ali the goddess of the land who is in charge of fertility.

An offence against ali spells doom as she withdraws fertility and this offence could also lead to famine in the land until she is appeased.

- Strangers should not wear red caps in the community. No shedding of blood of a free born of Ubima community.
- No sexual relationship with a married woman in the community.

4.6.4 Conflict Management and Security

Conflicts situations arise daily at various levels from the household to the community. They do not necessarily have violent outcomes. However, traditional conflict management and resolution mechanisms are evident at various levels in the community. Family elders are traditionally charged with resolving conflicts among individuals and among households within their extended families. Leaders of community based organizations and social groups like the Youth group are similarly active in resolving conflict situations that arise among their members. Communal conflicts are resolved by community elders and leaders. A common practice in the conflict management and resolution process in the community is the fact that individuals and parties in dispute are usually offered opportunities to present their case. Decisions are not taken and imposed on parties without their representation before the arbitration body. Decisions of these traditional processes are usually binding on the disputing parties.

Today, despite the unrestrained insecurity in some parts of the country, none of this crisis has been recorded among Fulani cattlemen and local farmers in the study area (**Plate 1.3**). This is basically as a result of the kind of relationship that exist among the Fulani and people of the study area and the wisdom in preserving the environment.

4.6.5 Land ownership/acquisition

Three levels of land ownership exist in the sampled communities viz: community, family and individual ownerships. All the communities sampled had the three options as presented in Table 4.17. Land belonged to either families or communities. Communally owned lands are allocated to individuals and to families for use.

Table 4.17: Distribution of - Land Ownership by sampled communities

S/NO	Ubima Villages	Land ownership pattern
1.	Omueka	Individual, Family, Communal
2.	Omuowhor	Individual, Family, Communal
3.	Omuordu	Individual, Family, Communal
4.	Mgbuogba	Individual, Family, Communal

4.6.6 Settlement Pattern

A settlement pattern refers to the shape of the settlement as seen from above. The shapes of early settlements were influenced by the surrounding landscape. They were also shaped by other factors such as who owned the land and whether the land was good for building on or not. Houses built were close to one another (nucleated) and accommodated households with hardly any spaces between compounds. Some of the communities were more densely populated than others.

4.7 Demographic Characteristics

4.7.1 Population Size and Growth

The National Population Commission (NPC) published a provisional population of 190,194 for Ikwere LGA, following the 2006 national census. Population of the LGA has grown since 2006, following the concept of fertility, mortality and migration. The NPC, in consideration of the inter play of these factors estimated that the population of Nigeria grows annually at 3.2% (NDHS, 2008). Following this annual growth rate and exponential growth model, the population is projected to be as follows: 2014 is 244,780 and it is expected to increase to 252,578 by 2015; 260,934 by 2016 and 293,981 by 2020. Detail is presented in Table 4.18. This projection suggests the expected population trend in the area especially when the proposed project will be implemented.

Table 4.18: Projected Population of Ikwere LGA, 2006-2020

Year	Projected Population (at 3.2% annual growth)
2006	190,194
2014	244,780

2015	252,578
2016	260,934
2017	268,934
2018	277,283
2019	285,632
2020	293,981

Source: NPC Priority Table Vol. IV

4.7.2 Household Composition, Structure and Size

The traditional household unit in the project community has a male at its head while its members include a mother, who is wife of the head, and children. In some other instance, especially where the husband is death the wife or the fist son plays the role of head of household. The children would include biological offspring of the couple, acquaintances and relations living with them. Some may include members who are helps ("house-helps"). These live with the family while providing domestic services in the household. Household members are fed and generally catered for from the resources of the household. The NPC estimated a mean household size of 5.4 in the project community and 5.3 in Rivers State.

4.7.3 Population Structure

The population structure analyses the content of the population in terms of sex and age groups. The population of the sampled local government areas was based on 2006 census by the National Population Commission. The community figures were not available yet, at the time of the study. The analysis of sex ratios of the sampled local government areas is presented in Table 4.19

The age-sex distribution of the sampled communities shows that there were more people in the lower age brackets and less in the older age brackets see Table 4.15. There was also a good proportion of the working age group in the population. When this happens, the dependency ratio is low as many working age adults work to take care of the dependents who are either in the lower ages (0-18years) and the older population that can no longer work (65 years and above). The distribution of the age groups by sex gives a pyramid structure presented in Table 4.20 and Figure 4.22. This indicates that the younger age classes were more in number than the older age classes giving a pyramidal shape.

Table 4.20 presents the age distribution in the area

Age Group	Population	
	Male	Female
0 - 4	850	830
5 - 9	720	730
10 – 14	680	715
15 – 19	450	450
20 – 24	430	410
25 – 29	400	410
30 – 34	360	370
35 – 39	300	308
40 – 44	230	225
45 – 49	218	210
50 – 54	115	118
55 – 59	80	86
60 – 64	40	50
65+	20	40

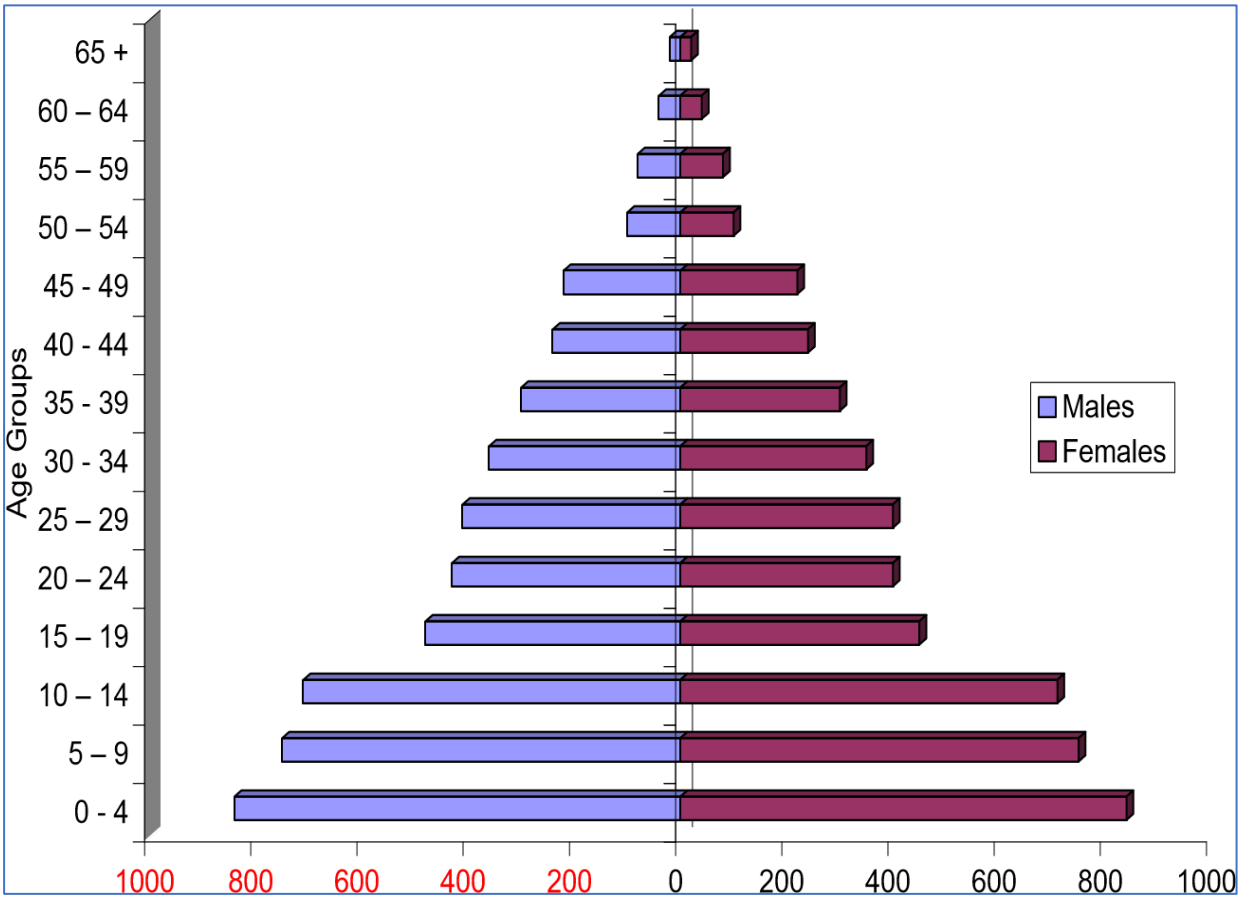

Figure 4.22: Distribution of Age groups and Sex in the study area

4.7.4 Fertility, Mortality and Life Expectancy

Two measures of fertility that are most commonly in use in Nigeria are the Total Fertility Rate (TFR) and the Crude Birth Rate (CBR). Total Fertility Rate (TFR) is the preferred measure and this is because it provides an indication of the total number of children a woman will have in her reproductive life time. There are no TFR values for either the project community or Ikwere LGA , however the NBS estimates that the value for the South-South geo-political region is 4.6 while the national average is 5.9 (ABS, 2010). The implication of this is that the rate of fertility in the South-South states is lower than the national average. The Crude Birth Rate (CBR) describes the relationship between the number of life births per 1000 of the population and the midyear population of community. NBS in its ABS, 2010 estimates the CBR for Rivers State as 15 per 1000.The World Health Organization (WHO) in its Nigeria Country Profile has

estimated Life Expectancy at birth in Nigeria at 53 years for males and 55 years for females (WHO, 2012).

4.7.5 Adult Literacy Level and Public Education Services in the Study Area

Adult literacy rate, determined by the proportion of population between the ages of 15 years and above that has completed a normal course of primary education and can read and write in the English language, is 75.2% in Rivers State (NBS, National Literacy Survey, 2010). This is slightly higher than the regional average of 74% for the South-South and much higher than the national average of 57.9%.

The level of school attainment, for those between the ages of six years and above in Ikwere LGA, is presented in Table 4.21. About 10% of the population has not attended any form of formal schooling. Comparatively, there are more females than males (53%:47%) that have not had any formal education.

Table4.21: School Attainment in the Ubima Community

Level of School Attained	Males	Females	Total	
			(No.)	%
Nursery	7,289	8,204	15,493	9.5
Primary	12,228	11,163	23,391	14.3
Secondary (JSS/SSS)	10,875	10,645	21,520	13.2
Tertiary (BSc/HND/OND/NCE)	31,524	32,186	63,710	39.1
Post Graduate	19,448	15,300	34,748	21.3
Technical schools	2,641	1,245	3,886	2.4
Others	221	133	354	0.2
Total	84,226	78,876	163,102	100.0

Source: Field Work, 2020

Pupil's enrolment in public primary schools in project community is presented in Table 4.21 while similar information for the public secondary school is presented in Table 4.22. The number of teachers in these schools and the average student teacher ratio in each school is presented in Table 4.21. State Primary School has 360 students enrolled in primary 1-6 and about 59.2% of these are females. It is one of the model primary schools

built by the Rivers State Government. The number of arms per class is fixed at 30. Average student teacher ratio is 30:1 in the school. Model Primary school has a total student enrolment of 450 in primary 1-6. The secondary school has 1,340 students in junior school and 805 in senior school. There are more female than male students in both schools; to the ratio of 59%:41% in junior school and 55.5%:44.5% in senior school. Average student teacher ratio in junior school is 23.1:1 and 17.5:1 in senior school.

Table 4.21: Student Enrolment in State Primary School in Ubima

Class	**State Primary School,** Ubima			
	Males	**Females**	**Total**	
			(No.)	**(%)**
Primary 1	23	19	42	9.3
Primary 2	33	37	70	15.6
Primary 3	45	43	88	19.6
Primary 4	59	36	95	21.1
Primary 5	45	45	90	20.0
Primary 6	30	35	65	14.4
Total	235	215	450	100.0

Source: FMoT Field work, 2020

Table 4.22: Student Enrolment in Secondary School in Ubima

Class	Junior School (UBE)				Senior School			
	Males	Females	Total		Males	Females	Total	
			(No.)	(%)			(No.)	(%)
JSS 1	213	307	520	38.8	-	-	-	-
JSS 2	193	277	470	35.1	-	-	-	-
JSS 3	144	206	350	26.1	-	-	-	-
SSS 1	-	-	-	-	150	200	350	43.5
SSS 2	-	-	-	-	145	192	337	41.9
SSS 3	-	-	-	-	63	55	118	14.6
Total	550	790	1,340	100.0	358	447	805	100.0

Source: FMoT Field Work 2020

Table 4.23: Number of Teachers in State and Model Primary Schools and CSS, by Sex; and Average Student/Teacher Ratios

Schools	Teachers			Total Number of Students	Average Student/Teacher Ratio
	Males	Females	Total		
State Primary School	3	9	12	360	30:1
CSS (Junior School)	25	33	58	1,340	23.1:1
CSS (Senior School)	18	28	46	805	17.5:1

Source: FMoT Field Work 2020

The proportion of children out of school and rate of school dropout in the community is very low. Teachers in the schools estimate occurrence of both phenomena at less than 1%, and attribute school dropout in primary schools mainly to the transfer of parents and guardians of the children from the community. More dropout and truancy is expected in the secondary school but the principal also disclosed that these cases are also less than 1%. Some of the reasons adduced for this include the transfer of parents and guardians, and the decision of some students to quit school and pick up any available casual labour or begin some hawking or apprenticeship project on their own.

4.8 Quality Of Life

4.8.1 Housing Conditions

Houses are not built according to any authorized plan and their spacing is neither uniform nor definite. Most of those observed during visits to the community are between three and five meters apart. Every part of the settlement is accessed by a tarred or graded earth road.

The houses are predominantly family bungalows (about 68%), followed by tenement houses (about 28%), Table 4.24 Storey buildings and flats are very few in the community. A number of the family bungalows have rooms that have been let out and are, therefore, residence to more than one household.

Table 4.24: Some Housing Attributes

Attributes	Frequency	
	(No.)	(%)
Type of House		
Family bungalow	49	66.2
Tenement house	21	28.4
Storey building	1	1.4
Flats	3	4.0
	74	100.0
House Construction Materials (Roof)		
Corrugated iron sheets	64	91.4
Aluminum	5	7.2
Asbestos	1	1.4
	70	100.0
Energy for Household Cooking		
Firewood	38	53.5
Kerosene	27	38.0
Cooking gas	6	8.5
	71	100.0
Energy for Household Lighting		
Kerosene	23	20.9
Public electricity	72	65.5
Private electricity generator	15	13.6
	110	100.0

Source: FMoT Field work, 2020

4.8.2 House Construction Materials

The basic construction material for walls of houses is cement block. The community no longer has living houses that are built with wattle and daub (mud). Similarly, the common roofing material is corrugated iron sheet. This material accounts for the roof of about 90% of houses in the community, while use of aluminum and asbestos is not significant, there are no living houses roofed with thatch in the community.

Walling material for 44.6% of houses in Nigeria and 69.0% in Rivers State is cement while mud accounts for the walls of 35.5% and 15.9% in Nigeria and Rivers State, respectively. The most durable walling materials used across the country are cement/block/brick and stone. About 66.1% of houses in Rivers State and 47.3% in Nigeria are roofed with corrugated iron sheets**.** Other roofing materials used across Nigeria include thatch, asbestos, cement, mud and wood/bamboo (ABS, 2010). Comparing use of materials, the higher proportion of houses built with cement blocks and roofed with corrugated iron sheets in the project community suggests more durable housing than both the national and state averages (see Table 1.9).

4.8.3 Available Household Utilities

Water for Household Use

There are functional public water supplies (*molopump*) in project community. Although, most households fetch water for use from water boreholes. These are also private and commercial water boreholes. About 45% of houses have their own installed water borehole facilities. The majority of households depend on commercial boreholes for water. A 20 litre jerry can of water from the commercial boreholes costs between ₦10 and ₦15. Water from these boreholes cannot be described as clean because regular scientific analyses are not conducted and the water is not treated. Similarly, most settlements in Nigeria do not have access to treated pipe borne water**.** The predominant sources of water nationally are bore hole (28.4%) and (42.4%) in Rivers State, and protected and unprotected wells 31.5% nationally and 35.1% in Rivers State. Only 7.7% of households in Nigeria and 10.7% in Rivers State have access to treated pipe borne water (ABS, 2010). Apart from treated pipe borne water the other sources cannot be considered potable water, and they are not necessarily safe for consumption.

4.8.4 Domestic Waste and Sewage Management Practices in Households

There are designated public waste collection centres established at some street corners in the community. Households deposit their waste at these centres and they are carried away by contractors appointed by the Rivers State Government Waste Management Agency. Households drop their waste after 6pm and they are carried away by the contractors between 6pm and 6am, daily. The operations (dropping and carrying away of waste) is supervised by monitors who have managed to ensure that dropping is not

indiscriminate and removal is complete. There is no sorting of waste. The community is generally clean; it is not commonly littered with household refuse. Community residents are satisfied with the existing arrangement but have expressed concerns about industrial wastes which contractors, engaged by companies in the community, dump in borrow pits located within the community.

There are no longer houses with pit toilets in the community. National data (ABS, 2010) indicates that the most common toilet facilities in houses in Nigeria are pit toilets, some are covered and others are not. In Rivers State, in descending order, pier, water closet and covered pit toilets are most common. Comparing the safe methods (water closet, covered pit and VIP), 54.2% of houses use acceptable sewage disposal methods nationally while 53.0% do so in Rivers State.

4.9 The Economy

4.9.1 Natural Resources and Conservation Practices

A major traditional natural resource conservation practice in the community is shifting cultivation and its attendant bush fallow system. The practice requires that farmlands are cultivated for a period and left fallow for a number of years. The period of lying fallow allows for the farmland to regenerate naturally. During the fallow period also, farmers cultivate alternative farmlands which had been left fallow in the previous period. This is a traditional practice that has served to protect and conserve the community's very valuable natural resource from extensive exploitation by allowing for the occurrence of natural regeneration processes. The bush fallow period is largely determined by demand for farmlands and this varies among households in the community. However, a fallow period of between three and five years is common.

4.9.2 Land Ownership and Tenure

Land in the project community is a major traditional family asset and factor of production. Land is an asset every family happily hands over to succeeding generations. It is the significant inheritance within each extended family. Such family lands are used for housing development and as farmlands. Traditionally family farmlands are allocated to individual family members to cultivate during the yearly farming season. Widows do not retain family farmlands in their husbands' names and are not involved in managing the

land. Individuals retain ownership rights over lands allocated to them for housing development, and their descendants can inherit such rights. Any intentions to obtain land for corporate or industrial use should be initiated through the community leadership, which is able to offer proper guidance concerning ownership.

4.9.3 Employment Situation in Households

The employment situation in project community has been determined by considering the number of household members, aged 25-64 years, who are working and those who desire to work and have been looking for work in the last six months preceding the study, but have not been able to secure an employment. While the former were considered employed, the latter were considered unemployed. Household members within this age bracket who are still in school were not included in this analysis. The employment situation in households is presented in Table 4.25 among the employed, there are some who are working on short term contracts. These contracts mostly range from one week to six months. They are mostly obtainable in construction industries and they are usually casual. This group on short term contracts has been identified as being on temporary employment. About 30% of household members were indicated as unemployed and 34% as temporarily employed. The proportion of household members who are either unemployed or temporarily employed is quite high. The higher rate of employment among females is due to the fact that many of them engaged in simple, low capital and low income trades like petty trading and small subsistence farming.

Table 4.25: Employment Status of Household Members in Ubima

Category	Frequency			
	Male	Female	Total	
			(No.)	(%)
Employed	8	10	18	33.96
Employed (Temporary/Casual)	19	2	21	39.62
Unemployed	9	5	14	26.42
Total	36	17	53	100.0

Source: field work, 2020

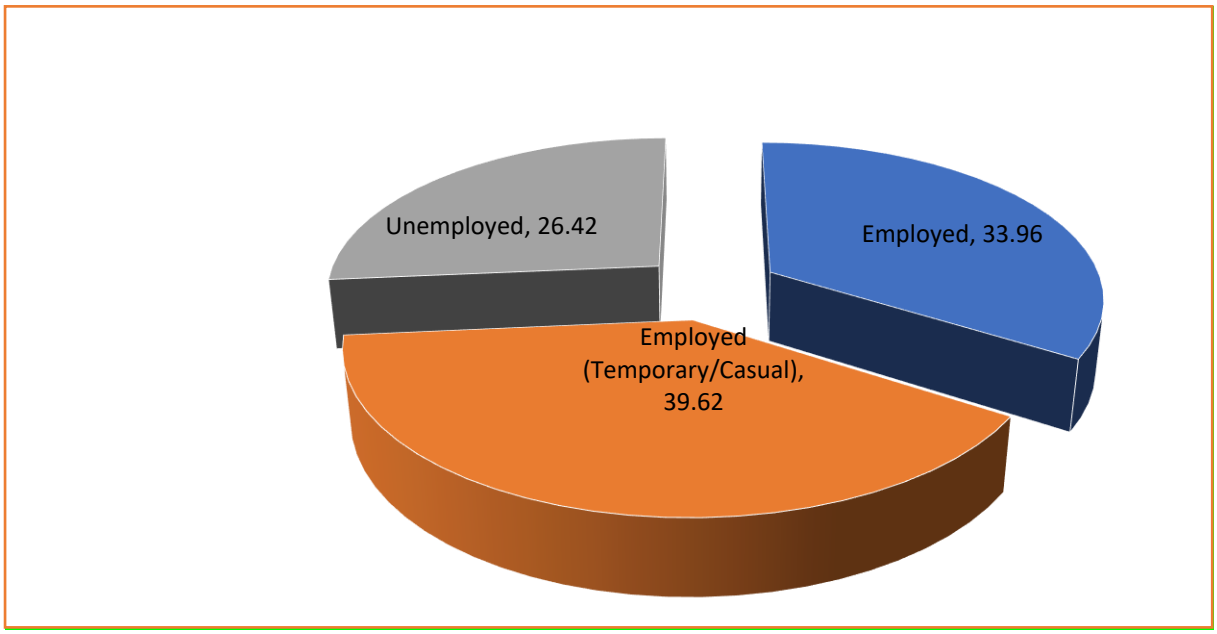

Figure 4.23: Employment Status of Ubima

NBS (2011) estimates of the level of unemployment among different groups in Nigeria, a distinction is made between rural and urban dwellers. However, the project community is considered a growing urban community. The NBS (NBS, 2011) estimates that across Nigeria, the rate of unemployment among uneducated urban residents is 19.0%; among those with primary school education it is 15.5%. Among JSS graduates it is 16.6% and 13.9% among SSS graduates.

By the same publication, the age distribution shows that among 15-24 year olds in urban communities, the rate of unemployment is 33.5% and among 25-44 year olds it is 16.3%. For those aged 45-59 years and 60-64 years the rates are 12.5% and 18.0%, respectively. The sex distribution of unemployment in urban areas is 16.9% among males and 17.2% among females.

The rate of unemployment is highest among females aged between 15 and 24 years who are uneducated. Residents in this category most times do not have any skills that can enhance employment. It is envisaged that the proposed project will provide some employment to residents of project community. This could help reduce the level of unemployment in the community.

4.9.4 Livelihood Activities

It is traditional for most households to combine their farming with other activities as presented in **Table 4.24**. The percentage household involved in farming is over 60%. Although this percentage has decline partly due to loss of land to industrial activities and seeking alternative employment in public service. The non-primary livelihood activities in the community include trading, artisanship practices, employment in the civil and public services, employment in companies and contracting. These account for about 35% of household livelihood activities. Some indigenous households still combine their farming activities with one or more of these non-primary livelihood activities.

Plate 4.21: Some Palm Fruit Harvested

Plate 4.21: Palm Fruit Harvesting

Household farming has basically remained a subsistence activity, consisting mainly of crop farming. Crops are grown on family farmlands which are small patches of land, given that significant portions of traditional farmlands have been converted to industrial, institutional and other uses. The usual crops are maize, cassava, yams, vegetables, plantains and fruit trees like mango and palm trees which are grown for both their commercial value and for food in the household. Similarly, livestock are kept in the homestead and they consist mainly of a few heads of goat and some birds (especially chicken). Farming implements are rudimentary, consisting mostly of hoes and machetes. Generally, the crop planting season is between February and April and harvest between June and October, but this is dependent on the crops grown.

Oil palms cultivation is another farming activity that is visible in the study area. Oil palm generally begins to produce fruits 30 months after being planted in the fields with commercial harvest commencing six months later. However, the yield of an oil palm is relatively low at this stage. As the oil palm continues to mature, its yield increases and it reaches peak production in years seven to 18. Yield starts to gradually decrease after 18 years. Many palm tree plantations were sighted in the course of this study and was gathered that major of those involved in the cultivation of palms are farmer from neighboring communities. They work and pay royalties to their farm owners.

Trading is a significant and growing livelihood activity in the project community. It involves indigenous and non-indigenous households and products that ranged from fresh farm crops and primary products like vegetables, fruits and fresh fish to preserved ones like smoked fish. There are also various types of manufactured and household products that are traded, like provisions, electrical and electronic products, and clothing, among others. This type of selling is conducted from a variety of places including table tops usually located in the front of houses and shops. Goods sold ranged from a few items like confectioneries, bread, fruits, etc to items like clothing, shoes and bags, electrical fittings, alcoholic and non-alcoholic beverages and stationery, among others.

Artisanship practices provide a major form of small and medium scale livelihood activities. A lot of them also represent local entrepreneurial effort. Some of the artisanship practices identified in the study area include tailoring, printing, welding, carpentry and masonry, electrical and electronic fittings and repairs. Others are activities in the auto industry including mechanics, electrical, vulcanizing and panel beating, furniture and cabinet making. Artisans' operations are limited by low levels of investment in their businesses, and this has been as a result of difficulties accessing funds. Their incomes are mainly a function of the size of their investment, but for most, monthly income averages between N25, 000 and N35, 000.

Some residents practice more than one livelihood activity. Engaging in multiple livelihood activities provides household members complementary sources of income. In many cases it is an indication that each of these activities only provides subsistence income. Generally, Ubima community is growing into an urban settlement and livelihood activities are shifting from primary production to secondary activities like commerce and the provision of services.

Table 4.26: Livelihood Activities in Ubima

Livelihood Activities	Ubima			
	Male	Female	Total	
			No.	%
Farming	4	5	9	20.5
Trading	3	5	8	18.2
Civil/Public Service	3	2	5	11.4
Company Employment	7	1	8	18.2
Artisanship	5	2	7	15.9
Contracting/Professional Services	2	2	4	9.0
Others	1	-	1	2.3
Total	27	17	44	100

Source: Field work, 2020

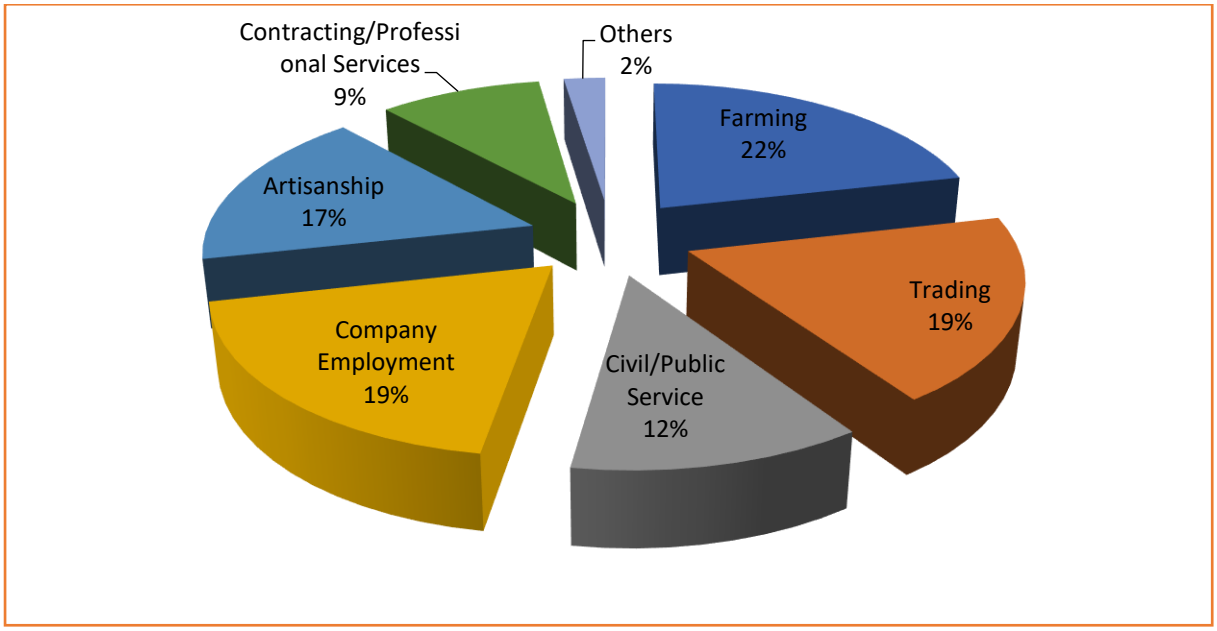

Figure 2.24: Household Income Levels and Expenditure Patterns

Income levels in households in the community were examined in four broad groups, first group were those households that earn less than ₦20,000 monthly, then those that earn between ₦20,000 and ₦50,000; those that earn between ₦51,000 and ₦100,000 and those that earn above ₦100,000 monthly. Household income analysis in the project is

presented in **Table 4.25**. Income mid-point is the midpoint of each income range. Cumulative income is the product of frequency and income midpoint. Mean household monthly income, calculated as the arithmetic mean of total cumulative income and the number of households that responded to the household questionnaire is about ₦49, 288. Modal income bracket is ₦20, 000-₦50, 000 with a midpoint of ₦35, 000.

Given that the mean income value for the estimated household size is 5.4 and assuming a naira to United States of America (USA) dollar conversion rate of ₦160:1USD (United States Dollar) and 30 days in a month, an individual member of the average household will earn about ₦304 or 1.9USD, daily. Repeating the same analysis using the midpoint of the modal income range, the average household member will earn about ₦216 or 1.4USD daily. By these analyses, the average household member in project community earns more than 1USD per day, which is above poverty line.

Table 4.25: Household Income Levels in Ubima

Income Levels (₦)	**Income Midpoint (₦)**	**Ubima**			
		(No.)	**(%)**	**Total**	
				(₦'000)	**(%)**
Less than 20,000	9,500	19	26.0	180.5	5.0
20,000-50,000	35,000	31	42.5	1085.0	30.1
51,000-100,000	75,500	15	20.5	1132.5	31.5
More than 100,000	150,000	8	11.0	1200.0	33.4
Total	-	73	100.0	3598.0	100.0

Source: Field work 2020

The major items of expenditure in the households are food and water, health care, education, accommodation, transportation and clothing. Results of interviews and discussions indicate that between 75% and 80% of the average household's income is spent on these items. Most of the household's income (about 30%) is spent to procure foodstuff, household provisions, fruits and water. In other to provide their children and wards with good education, parents and guardians pay various sums estimated at about 20% of their income, at private schools. Those who have children in the public schools also pay to provide some school items. Expenditure on health care derives from drug

purchases from drug stores ('chemists') and preference for medical services provided at private clinics over the public facilities. Non indigenous residents pay for accommodation and this constitutes a significant part of their expenses. Residents use commercial motor cycles and vehicles to get to their places of work, school, market, church and other places of interest. Household utilities, represented by payments for electricity, petrol, kerosene and others, and provisions for clothing account for about 10% of the average household's expenditure. A few household members are also able to spend on leisure, including social and night club activities. This constitutes about 3% of the total household expenditure.

Table 4.28: Expenditure Pattern of Households in Ubima

Expenditure Items	**Frequency (%)**
Food and Water	30.0
Education	20.0
Health	15.0
Accommodation	14.0
Transportation	8.0
Clothing	5.0
Household Utilities	5.0
Others	3.0
Total	100.0

Source: Field work 2020

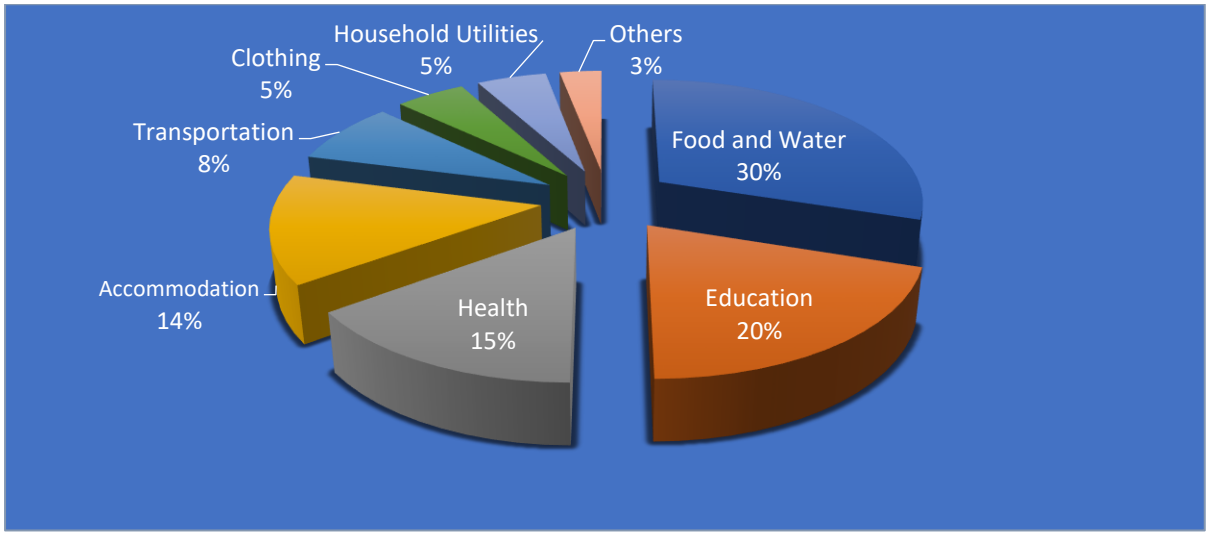

Figure 4.25: Expenditure Pattern of Households in the Community

4.10 Infrastructural Base and Development

4.10.1 Available Infrastructure and Their Functional Status

The physical amenities consist basically of roads, a mobile communication network and port facilities, while the social consist mainly of education, health, electrification, commercial and security facilities. The functional status of available amenities presented in **Table 4.26**. Public telecommunication services are functional in the community. These are provided by GSM service providers including MTN, Glo, Airtel and Etisalat.

Table 4.26: Infrastructural Framework in Ubima

Infrastructural Facilities	Functional Status
Roads	The roads were accessible and motorable.
Telecommunication Services	Mobile telecommunication services are provided by the main GSM service providers in Nigeria which include MTN, Globacom, Airtel and Etisalat.
Public Electricity	Public electricity is provided by PHED from the national grid. This is functional but residents experience regular daily electricity outages this is the reason why a number of residents (about 13.6%) use private electricity generators.
Water Supply	There were functional molo-pomp sighted within the community. Households depend mainly on water from private and commercial water boreholes for their daily water needs.
Education	One community secondary school and one State primary school and other privates. The public primary and secondary schools are all functional.
Health	Only one primary healthcare centre was sighted at Ubima and it was functional, the major cases were referred to UPTH which is over 20 minutes' drive from the project community.
Market	All the markets are functional.
Hospitality	This consists mainly of small hotels, brothels and local bars.

Plate 4.22: Government Secondary School Ubima


Plate 4.23: States Primary Schools 1 and 2

Plate 4.24: Ubima Community Secondary School

Social amenities include public electricity provided from the national grid by the Port Harcourt Electricity Distribution Company (PHED.) Public electricity supply in the community is characterized by frequent electricity outages. This is why a number of residents (about 13.6%) use private electricity generators**.** Residents receive between six and eight hours of electricity daily. There is no functional public water supply scheme in Ubima. Households depend mainly on water from private and commercial water boreholes for their daily water needs. Some of the public places like the schools that have private boreholes are not able to use them because of non-availability of electricity.

4: 11 Vulnerable Groups

Considering the potential socio-economic sensitivities, some groups in the study area have been identified as very vulnerable to the potential impacts of the proposed project. These include the indigenous community youth, the elderly, widows and families that own and farm the land where the proposed project will be sited. It is envisaged that some

of the youth may not be able to cope with changes in the socio-economic environment as a result of activities associated with the proposed project. Some of these would be an expected increase in non-indigenous workers and camp followers and the corresponding changes in the ethnic composition of Ubima community, morals and social vices. There is also the potential impact of anticipated economic changes due to the proposed project.

The youth may be exposed to life styles and social vices as they mingle with workers from different backgrounds. Many of them may also not be in a position to benefit from employment opportunities that may be created by the project because they do not have the requisite skill and training. Among the youth, especially the adolescent male, are those who may readily drop out of school to work as casual labour during the project construction phase. The adolescent female on the other hand would be faced with managing her sexuality in an environment where there would be considerable exposure to sexual excesses, activities of commercial sex workers and the continuous advances by older and more experienced working class males whose income would be an effective instrument to lure the girls. Again with this group there would be the likelihood of school dropout and teenage pregnancy. School dropout due to any of these reasons may have a long lasting impact because those affected may never be able to continue with their education.

4.12: Peoples' Perceptions, Fears and Expectations of the Project

Perceptions

The people's perception of the proposed project was discussed in each of the FGDs and the perceptions were quite similar to those recorded for such projects in the past. There were several complains, requests and views expressed by the communities concerning the operations of the Port Harcourt Industrial Park in the area.

On the other hand, concerning the project being proposed, the surveyed communities - pledged to cooperate with Government Ministry to ensure the project goes on successfully. All the sampled opinion confirmed that the proposed project will expand their socio-economic space.

Fears

The fears of the people in the communities visited were based on their experiences of previous developments. Amongst other fears, some community members expressed some doubts about the sincerity of Government as regards the proposed project. The fears expressed were listed from community to community and summarized follows:

- destruction of farm land;
- inadequate compensation for land take;
- deleterious effect of noise on humans (children and babies in particular) and wild life
- disruption of traffic on roads during movement of equipment and personnel;

Expectations and Needs of Communities

The needs of the people were listed in order of priority for each of the communities. - Some communities lacked good drinking water while others had no schools and/or health centre.

A summary of the needs of the people in the sampled communities is presented in Table 4.29.

Table 4.29: Summary of Community Needs

S/N	Community Needs
1	Repair of Community Roads
2	Water drainage repairs
3	Provision of Employment
4	Equipping the Health Centers
5	Provision of Portable water
6	Granting of Scholarships
7	Provision of Electricity
8	Provide/equip Schools
9	Provision of moderrn Market
10	Provision of Town hall

4.13 Health Profile

A wide range of economic factors determines health and well-being of individuals and communities. They include social and environmental conditions as well as factors like family history and access to health services (Taylor and Plaair-Stephen, 2002).

According to Dorland's Medical Dictionary 2007, and Park, 2005, health is defined as a state of optimal physical, mental, and social well-being and not merely the absence of disease. Countries under the umbrella of the World Health Organization are working towards prevention of diseases, promotion of health and improvement of the quality of life of individuals and groups or communities. These parameters were adequately studied and its specific findings are presented in the subsections below.

Knowledge, Attitudes, Practices and Behaviour on Sexually Transmissible Infections

The knowledge of respondents, their attitudes, practices and behavior on sexually transmissible infections is quite high and reflects a good understanding of the health education and messages that are regularly carried out on the media and through person to person campaign.

Sexual Behaviour and Knowledge of HIV/AIDS and COVID -19

The sexual behaviour of members of Ubima communities can encourage the transmission of sexually transmitted infections, including HIV/AIDS and COVID-19. Although polygamy is commonly practiced especially among the communities, most adult males and single girls had multiple sexual partners, as a man is culturally permitted to engage in extra-marital affairs. This sexual behavior, according to the discussants at the various focus group discussions held in the communities studied revealed that over 97 % of the households are aware of the repercussion of bad sexual behavior and HIV/AIDS and COVID 19 contraction. Though, the number of persons using noise and face mask were low.

Respondents in Ubima expressed some basic knowledge of STIs, and the most popular was gonorrhea. There was also a high level of awareness about HIV/AIDS among the

communities in the proposed project area with as much as 97.2% of respondents that have heard about HIV/AIDS (Figure 4.20).

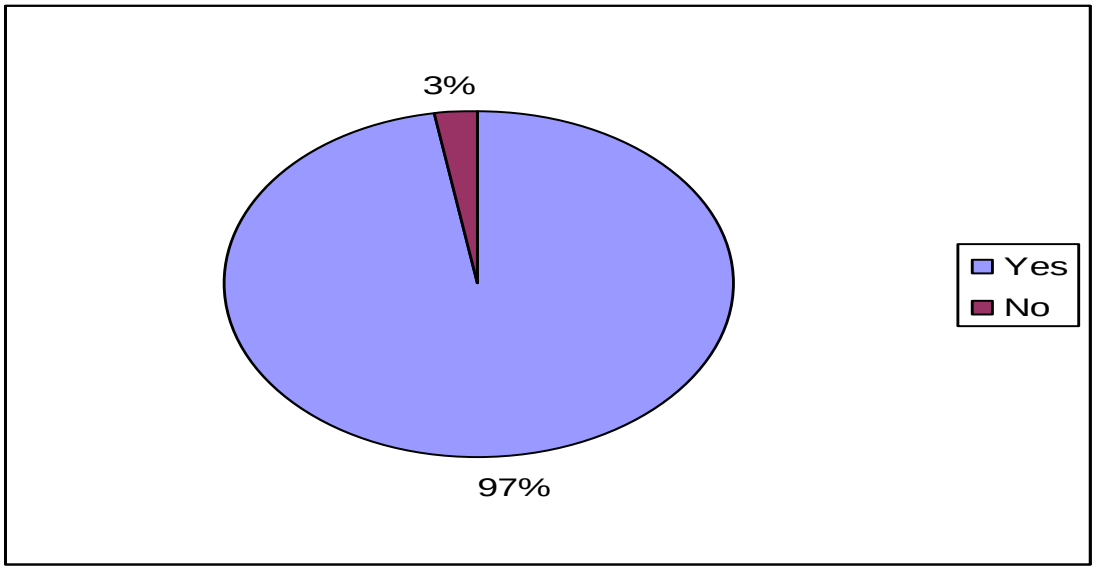

Figure 4.26: Proportion of Residents who has HIV/AIDS and Bad Sexual Behaviour

However, only 49.7% of those who had heard of HIV/AIDS could say whether the disease posed a threat to their communities. This could be a function of the level of available data of HIV/AIDS statistics in the communities and did not detract from the fact that members of the community were aware of the existence of the condition. The commonest sources of information on HIV/AIDS were the media, health workers and friends.

Generally, HIV in adult Nigerians is however mainly transmitted through the heterosexual route; this explains why the ABC method forms the basis for HIV control in Nigeria. The ABC method is an acronym that stands for; **a**bstinence from sex, **b**eing faithful in monogamous relationship between HIV-negative partners, and **c**ondom use for people not practicing abstinence.

Most discussants in the focus group discussions conducted in the communities have heard of HIV/AIDS and demonstrated good knowledge of the ABC methods of HIV prevention. The study noted that over 97 % of the households are aware of HIV/AIDS as a pandemic disease.

Presence of Risk Factors (Use of Alcohol and Cigarette)

Alcohol and cigarette were commonly used in the study area as observed during the fieldwork, like most riverine communities in Rivers State. Alcoholic beverages, including palm wine and the locally distilled gin called *kai*-kai or *ogogoro,* were freely available (though not for free) in the communities studied. Alcoholic beverages were used during social functions and even in ancestral worship; alcohol is also a ubiquitous solvent in several traditional medicine, ranging from pain relief to aphrodisiac. Binge drinking was however said to be high in the communities studied, especially during festive periods and burial ceremonies, when indigenous people converge from all works of life. However cases of alcoholism were said to be low, in spite of the large number of persons that take alcohol in the communities.

Smoking was not too common in the communities studied; about a fifth of the young adult males in the communities were said to smoke cigarette, but an average smoker took at most three sticks of cigarette a day. Women in most of the communities studied rarely smoke cigarette.

The commonest form of alcohol used in households was beer with 31% of households having at least a consumer and this was followed by hot drinks/spirits (29%). In general, it would appear that at least one out of every four households in the project area has alcohol consumers (**Figure 4.27).**

It was noted that alcohol use has been associated with less care in sexual relationships and may therefore facilitate unprotected sexual intercourse and transmission of STDs.

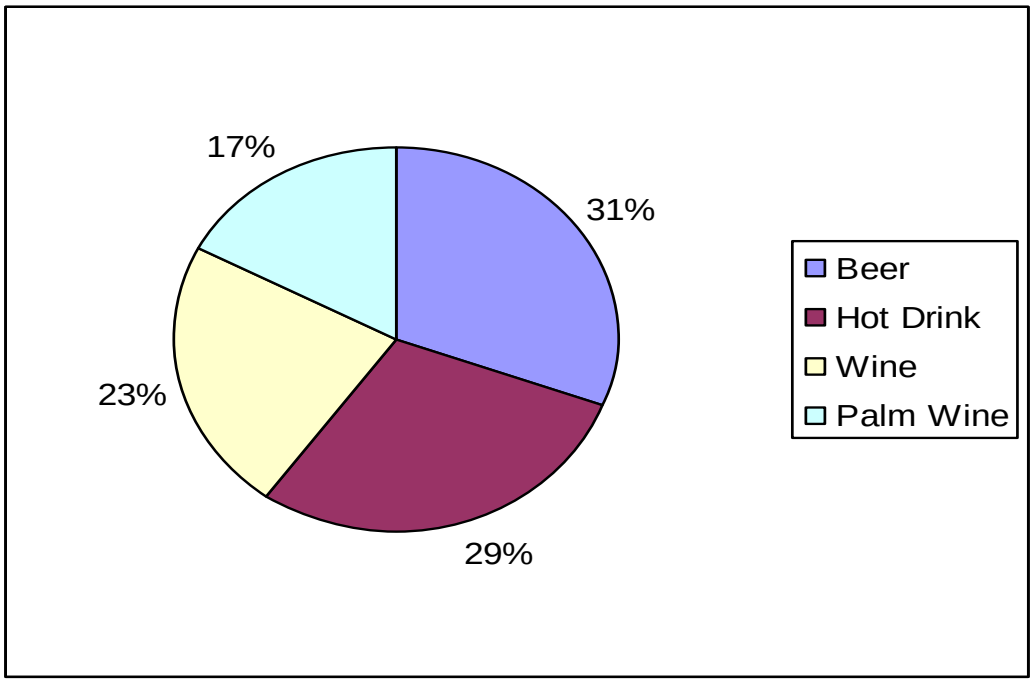

Figure 4.27: Proportion of Households in which different types of Alcohol were consumed

Tobacco chewing/snuffing is practiced in 34% of the households while in 31% there was at least one member who smoked marijuana (Figure 4.28). Tobacco use has been associated with diseases such as Lung Cancer, Ischemic Heart Disease, Hypertension and bronchitis among others. The use of marijuana has been associated with withdrawal symptoms and increased criminality. The cost of maintaining the habit may also have significant impact on household expenditure and compromise the purchase of essential items like foodstuff and appropriate clothing.

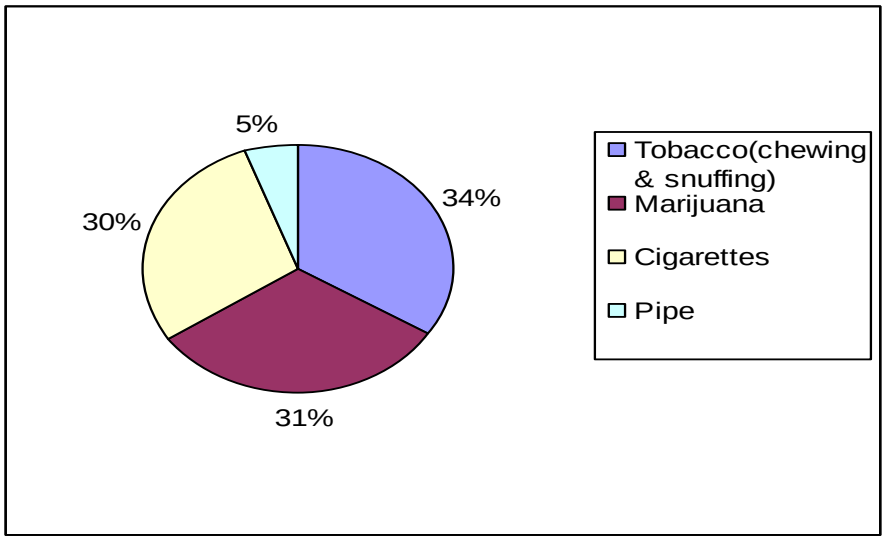

Figure 4.28: Proportion of Respondents using Tobacco or similar substances.

Household Food Security and the Nutritional Status of Under-five Children

Most members of the communities regularly eat the local staples of cassava and yam. These are starchy staples. They are however complemented with fish and vegetable, which are the major agricultural produce of the people. Household food security in the communities was said to be good. The prevalence of under-weight under-five children is one of the indicators for goal one of the Millennium Development Goals. The nutritional status of members of the communities was assessed during the field survey, through the anthropometric measurement of under-five children in the communities. The result of the anthropometric measurements of the under-five children is presented in Figure 4.29.

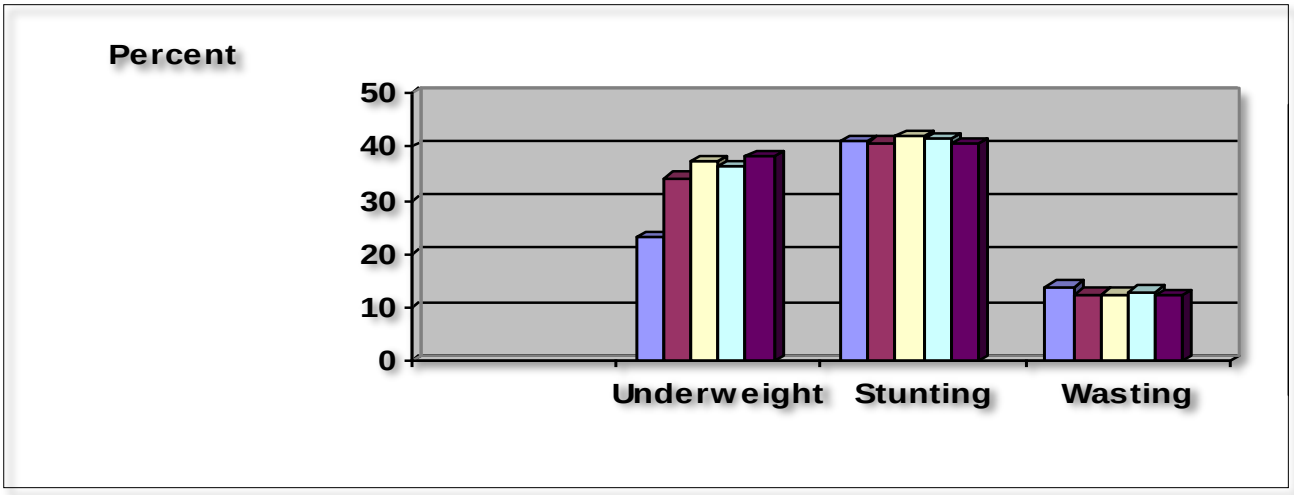

Figure 4.29: Nutritional Status of Under-Fives in the Study Area

The level of malnutrition in the study area was high, which was traced to the poor living condition and unbalanced diet as was observed during field work. This observation also corroborates with the findings of Ruel and Menon, (2003*)* which says that malnutrition is not only a reflection of the diet and socio-economic status of the people, but also points to the environmental conditions in the communities.

4.13.2 Morbidity Pattern (Under-five Children)

Rivers State's infant and maternal mortality rate has reduced by about 40 per cent in the last four years, from about 1000 deaths per 100,000 births to 600 deaths per 100,000 births. The reduction in the IMR/MMR came from the free health care programme for the infant (0-5years), ante natal and the aged (above 60 years) in the state (NDHS, 2008). In spite of this effort by the state Government, most of the pregnant women in the study area still patronized quacks and untrained traditional birth attendants. That notwithstanding, the average number of under-five deaths in the communities studied, in a year, was put at one. The morbidity rates (0-5years) in the study area were similar to those of other riverine communities of the State.

Table 4.30: Morbidity Pattern (Under five years)

Communities	MALES No.				FEMALES No.			
	Kwashiokor	Anaemia	Rickets	Goitre	Kwashiokor	Anaemia	Rickets	Goitre
Omueka	0	7	3	0	0	5	1	0
omuowhor	0	11	2	0	0	13	2	0
Omuordu	3	6	3	0	2	2	1	0
mgbuogba	0	3	1	0	0	6	1	0

Diseases Prevalence

The diseases identified were malaria, typhoid, cholera, pneumonia, tetanus and measles among others. Various eye ailments have also been reported, arising from the exposure of unprotected eyes to fish processing (especially smoking) activities. From the finding, malaria and typhoid accounted for over 87% followed by cholera. Essentially, visits to health centres and hospitals for treatment is always the last resort of majority of persons who claim to be discouraged by the cost of treatment and long queues in general hospitals

at University of Port Harcourt and by the official documentary procedures and processes that have to be observed in health centres, in order to access Medicare.

Patent medicine stores/itinerant drug vendors are therefore very popular Medicare avenues and thus enjoy a lot of patronage, even though the quality of dispensed drugs cannot be fully ascertained.

Malaria and Cholera

Like in tropical areas, Malaria seemed highly prevalent in the studied area, as gathered from both quantitative and qualitative data acquired during the survey. This is so because of the prevalence of mosquitoes in the area. And no distinct programs seem to exist yet in the communities to combat this disease. In all the communities visited with the exception of a few homes in Ubima, most other respondents did not use treated/untreated mosquito nets or mosquito repellents. Respondents in all the communities visited claimed to have had suspected case fatalities of malaria and cholera.

Hypertension

High Blood Pressure (BP) is a disease condition that compels the heart to pump with more force and the arteries to carry blood moving under greater pressure than is normal. Persistence of this condition leads to heart and artery malfunctions, with consequential effects on other body organs thus creating an increased risk of heart failure, stroke, kidney failure and heart attack. Respondents were interviewed to determine whether any member of their households had been previously diagnosed as hypertensive and 45% of the households had one or more persons who had been previously diagnosed. Although, they were age related cases.

Public Health

Available Health Facilities

There is a health center and a general hospital in the study area. There is only one doctor attached to the general hospital. While the community health centre (Plate 4.25) enjoys relatively large patronage from the aged, expectant/nursing mothers and youths,

Plate 4.25: Ubima Primary Health Centre

In addition, the free medical health care of the community health centre may have also encouraged the relatively high patronage. It is also important to note that the health centre rarely has referral cases, but when they occur, patients are referred to Port Harcourt. Common health conditions reported to the health centre include: malaria, hypertension, diabetes, typhoid fever etc. Some residents still avail themselves of traditional means of treatment of minor ailments with the use of herbs such as paw-paw leaves, bitter leaf boiled and extract mixed with local gin. Serious/complicated health cases are referred to Braithwaite Memorial or Calsly Harrison Specialist Hospitals in Port Harcourt. There are however, drugstores in the community. Records showing the health status of the natives are very scanty.

Plate 4.26: General Hospital at Ubima Community

Indoor and Outdoor Air quality

Firewood was the commonest source of fuel for domestic use in the twenty-two communities studied. The level of use of firewood in the communities is however consistent with the findings of other related study in the area where an average of 73% of the households were noted to use firewood as their primary energy source (NDDC, 2008). The use of firewood and other bio-mass as domestic fuel is a major cause of indoor air pollution, with wide-ranging health implications (WHO, 2003). Although the results of air quality measurement carried out during the field work showed that all the pollutants of interest were within regulatory limits, and therefore do not pose any serious health risks.

Access to Sanitation Facility

Sanitation facility was defined during the community survey as a private excreta disposal facility (that is either a toilet or a latrine, but not an overhung toilet, or a flush toilet without septic tanks that channels it effluents directly into the river). A household access was defined as a household having a private sanitation facility, or sharing a facility with not more than five other households in the building or compound.

A few of the toilet facilities were observed to be poorly maintained, mainly due to lack of adequate water supply for the effective operation of the water closet. The septic tanks that serve these toilets were also noted to be located very close to the water borehole, and therefore likely to contaminate groundwater.

CHAPTER FIVE

ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS

5.1 Overview

In this chapter of the report, an overview of the methodology adopted for assessment of project impacts as well as a summary of the associated and potential impacts of the proposed project on the environmental and socio-economic conditions of the project area is presented. The assessment of impacts is as comprehensive as possible, within the limits of available information.

These impacts were identified by examining the ways in which the activities associated with the different phases interact with the environment and its different components. The two key aspects of the proposed project (construction and operations) have several sub-components that can either directly or indirectly interact with different components of the environment leading to environmental issues. The assessment of the identified impacts was based largely on field observations, baseline data and existing literature. In practice, many elements of the environment are inter-related and cannot be considered in isolation. However, for convenience, some of these elements discussed here are under separate headings.

5.2 Impact Assessment Methodology

The potential for an environmental and social impact exists where an environmental aspect has been identified i.e. where a project activity has been determined to have the potential to interact with the biophysical and socio-cultural environment. The significance of each impact is then determined.

The methodology used for assessing the potential and associated impacts of the proposed Port Harcourt Industrial Park Project consists of five (5) major steps:

Step 1: Identification and description of project activities and their interaction (directly and indirectly) with the identified environmental and social receptors/resources within the Project site and its area of influence;

Step 2: Comprehensive preliminary identification of potential impacts as a result of cause and effect relationship;

Step 3: Comparative assessment of impact importance, identification of impacts that are likely to be significant through application of a basic set of impact significance criteria to the preliminary information available about each impact;

Step 4: Detailed assessment of the identified focus area impacts characterization techniques, quantification of impacts to the extent possible and rigorous qualitative characterization of impacts that cannot be quantified; and

Step 5: Final assessment of the severity levels of impacts through application of the results of the quantitative and qualitative characterization of impacts developed in Step 4 to a set of objective impact severity criteria; identification of impacts warranting mitigation and determination of residual impacts. The impact assessment process adopted for this ESIA study is illustrated Figure 5.1

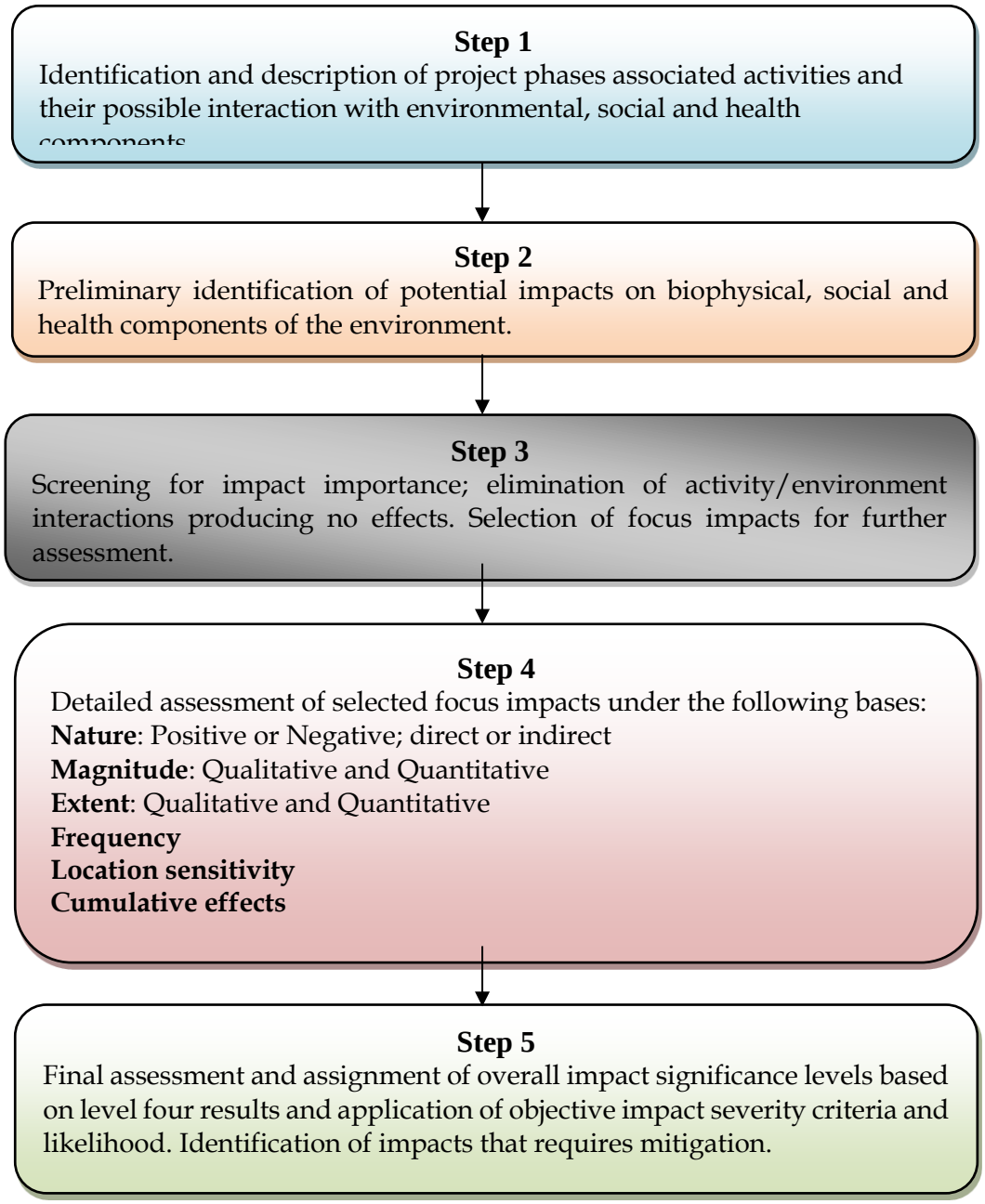

Figure 5.1: Overview of the Impact Assessment Process

The primary objectives of the impact assessment process are to:

- Establish the significance of identified potential impacts that may occur as a result of proposed Project activities.
- Differentiate between those impacts that are insignificant (i.e. can be sustained by natural systems) and those that are significant (i.e. cannot be sustained by natural systems).
- Apply mitigation measures for the identified significant impacts and assess residual impacts

In determining the significance of impacts, the factors considered include: magnitude of impacts (which is a function of the combination of the following impact characteristics: **extent**, **duration**, **scale**, and **frequency**); and value/sensitivity/fragility and importance of relevant environmental and social receptors within the Project site and its area of influence. Relevant legal/regulatory requirements and public perceptions (based on stakeholder' consultations) are also considered.

The assessment of impact significance is both in qualitative and quantitative terms. Qualitatively, the impact significance is ranked on four (4) widely accepted levels: **Major**, **Moderate**, **Minor** and **Negligible.** These rankings are used for both biophysical and socio-cultural impacts.

The impact assessment covers the entire life cycle of the Project i.e.: pre-construction; construction; commissioning; operation; and decommissioning. Potential cumulative impacts as a result of the proposed Port Harcourt Industrial Park Project are also assessed.

5.3 Impact Prediction Methodology

Various impact prediction guidelines and methodologies have been developed and applied in various EIA activities. Internationally acceptable methods of impact prediction and evaluation include the following:

- Checklist (Canter, 1977)
- Interaction Matrix (Leopold *et al*., 1971)
- Overlays Mapping (McHarg, 1968)
- Networks
- Battelle Environmental Evaluation System (Dee *et al.*, 1972).

The Leopold Interaction Matrix method, when compared to the other impact prediction techniques is simple, provides the same level of details, requires comparable knowledge of the environment and relies on limited data unlike the other methods that rely on availability of

large historical data bank. A modified Leopold Interaction Matrix was thus adopted for the purpose of impact screening for this ESIA.

5.4 Identification of Environmental and Socio-economic Aspects and Impacts

5.4.1 Definition of Environmental and Social-economic Aspects

The International Organization for Standardization's Environmental Management Systems (EMS), ISO 14001, defines an environmental aspect as: *"An element of an organization's activities, products or services that can interact with the environment."*

To identify environmental and social aspects of the Project, the planned project activities were considered in terms of their direct or indirect potential to:

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

5.4.2 Definition of Impacts

ISO 14001 defines an environmental impact as: *"Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services."* An environmental or socio-economic impact may result from any of the identified environmental aspects.

5.4.3 Potential Impact Characteristics

The criteria applied to the screening of various activities were:

i. Negative: An impact that is considered to represent an adverse change from the baseline or to introduce a new undesirable factor.
ii. Positive: An impact that is considered to represent an improvement to the baseline or to introduce a new desirable factor.
iii. Direct: Impacts that result from the direct interaction between a planned project activity and the receiving environment.
iv. Indirect: Impacts that result from other activities that are encouraged to happen as a consequence of the Project.

v. Temporary: Temporary impacts are predicted to be of short duration, reversible and intermittent/occasional in nature.

vi. Short-term: Short term impacts are predicted to last only for a limited period but will cease on completion of the activity, or as a result of mitigation measures and natural recovery.

vii. Long-term: Impacts that will continue for the life of the Project, but cease when the Project stops operating.

viii. Permanent: Potential impacts that may occur during the development of the Project and cause a permanent change in the affected receptor or resource that endures substantially beyond the Project lifetime.

ix. On-site: Impact that is limited to the Project site.

x. Reversible: An impact that the environment can return to its natural state.

xi. Irreversible: An impact that the environment cannot return to its original state, e.g. the extinction of an animal or plant species.

xii. Cumulative: Potential impacts that may result from incremental changes caused by other past, present or reasonably foreseeable actions together with the Project.

xiii. Residual: Both environmental and social impacts that will remain after the application of mitigation measures to Project impacts during each of the Project phases (pre-construction, construction, commissioning, operation, decommissioning).

5.4.4 Screening and Scoping for Potential Impacts

In assessing the impacts of the proposed Port Harcourt Industrial Park project, the following information was used:

a. Knowledge of the proposed park activities, equipment types, procedures, and abandonment programme,
b. The results of the environmental baseline studies (biophysical, socio-economic and health)
c. Findings of other ESIA studies on similar areas and projects and other literature findings on the primary project activities,
d. Comparison with FMEnv/ UNEP/WHO/World Bank guidelines and standards,
e. Environmental audit reports (secondary data) on similar existing projects,
f. Series of resource persons (ESIA Preparers) discussions,
g. Past experience on other ESIA projects by the ESIA preparers.

The various components of the proposed Industrial park that could have impacts on the biophysical, socio-economic and health environment of the project area were determined through an evaluation of the proposed project activities, the baseline of the project area that was reviewed, and the national/international legislative requirements. The activities of the proposed project with potential to have impacts on the environment include the following;

The project phases and its associated works essentially consist of:

Table 5.1: Summary of Project phases and associated activities

Phases	**Activities**
Pre-Operation	• Pre-mobilisation/Project design • Clearing of vegetation and other debris • Construction of workers' camp and upgrade of existing access road • Mobilisation of equipment and men to site • Transportation of materials
Construction	• Civil work activities include construction of factory buildings, workshop, warehouse • Construction of access roads and public utilities (sewage, power, water system) • On site fabrication of materials • Installation of equipment and machinery, • installation of ancillary facilities • Waste generation and disposal
Operation	• Operation of the industrial park • Operation and maintenance of infrastructure and other facilities • Waste generation and management.
Decommissioning	• Removal of equipment and dismantling of structures • Site remediation and rehabilitation • Waste generation and disposal • Abandonment

The associated impacts indicators were identified and are listed in Table 5.2 below.

Table 5.2: Impactable Components and Associated Impact Indicators

Environmental Receptor	Comment	Impact Indicators
Physical		
Air Quality	Ambient air quality within the Project site and its area of influence	Increased concentration of gaseous and particulate pollutants (such as NOx, SOx, CO, VOC, PM10, PM2.5 , CO2)
Noise and Vibration	Ambient noise and vibration level within Project site and its area of influence	Increased ambient noise and vibration level, night and day-time disturbance, hearing loss, communication impairment etc.
Soil	Soil environment within the Project site and its area of influence	Changes in physical, chemical and biological properties, loss of soil ecology and fertility, compaction, erosion etc.
Underground water/aquifers	Underground water resources within the Project site and its area of influence	Decrease in underground water/aquifer reservoir level, groundwater contamination, and availability of potable water.
Landscape/topography	The geomorphological land forms and terrain of the Project site and its area of influence	Alteration in drainage pattern, changes in landscape.
Biological		
Terrestrial Flora and habitats	Plant species within the Project site and its area of influence	Loss of terrestrial flora, introduction of new species.
Terrestrial Fauna including avifauna	Terrestrial fauna and avifauna within the Project's area of influence	Loss of terrestrial fauna; involuntary migration.
Aquatic organisms	Aquatic organisms (e.g. phytoplankton, zooplankton, benthos, and fishes)	Loss of aquatic organisms; involuntary migration.
Socio-economic Environment		
Land use	Existing land use within the Project site and its area of influence	Loss of existing land value for farming activities
Visual prominence	The aesthetic quality of the project on the surrounding visual catchment.	The compatibility of the expansion Project with the character of the locality.
Demography	Demography of communities in the Project's area of influence	Changes in total population, gender ratio, age distribution, socio-economic structure etc.

Utilities	The existing utilities (e.g. power supply, water, sewerage services) in the Project's area of influence	Changes in existing utilities, damage to public utilities e.g. pipes, cables.
Infrastructure	The existing infrastructure such as road, rail tracks, waste handling facilities within the Project's area of influence	Damage to road infrastructure including rail, road traffic; access to health facilities, communication facilities, or waste management facilities
Cultural values	Cultural sites within the Project's area of influence	Damage to cultural sites within the Project's area
Employment/income	The employment situation in the Project's area of influence	Opportunities for local and national employment; changes in income level
Other (Health and Safety)		
Construction workers	Workers' health and safety	Accidents, injury, fatality, exposure to nuisance (dust, noise), fire etc.
Workplace health and safety	The health and safety of employees involved with the plant operation.	Accidents, injury, exposure to nuisance (dust, noise), fire, explosion.
General public	Community health and safety	Exposure to road accident, fire, explosion, etc.

Likewise, the sources of probable impacts from the various stages of the proposed deep sea port are also outlined in Table 5.3.below.

Table 5.3: Phases of Project Development Activities and Sources of Impact

S/No	Project Phase	Activities/Sources of Impact
1.	Mobilization of personnel and equipment to proposed project Site.	• Increased ambient noise level due personnel and vehicular movement. • Increased pressure on existing infrastructures. • Increased social vices.

2.	Clearing of the vegetation	• Injuries/incidents from wildlife attacks and equipment use. • Migration of wildlife. • Exposure of soil surface to the elements. • Increased potential for soil erosion. • Attacks by snakes, insects and other wild animals.
3.	Construction works	• Injuries/incidents from equipment use. • Air and noise pollution. • Employment generation. • Waste generation.
4.	Project operation	• Pressure on existing infrastructures. • Increased social vices. • Socio-economic increase.
5.	Decommissioning and closure including demobilization of personnel and removal of equipment and structures from the project site after project lifespan	• Loss of revenue for both state and federal government. • Loss of jobs. • Increased social vices.

5.3.2 Scoping

Scoping identifies the various aspects (activities) of the proposed project that could have significant impact on the environment. Scoping also enables proffering solutions to issues such as;

- What are the potential impacts from the execution of the project? ;
- What will be the magnitude, extent, and duration of the impacts? ;
- Of what relevance are the impacts on the environment within local, national, and international contexts?; and
- What mitigation or ameliorative measures can be put in place to reduce or avoid the adverse impacts or to enhance and maximize positive impacts?

Consequently scoping of the proposed Port Harcourt Industrial Park was used to identify the components of the environment that will be significantly impacted to include air quality/climatic conditions, soil/Agriculture, vegetation/wildlife (biodiversity, surface/ground water, noise level, health and safety, socio-economic activities.

5.3.3 Scope of the Study (Spatial/Temporal)

Based on the identified activities likely to cause adverse significant impacts, the various indicator environmental parameters (Table 5.2) status was evaluated from the generated baseline to assess the impacts on them.

Air Quality/Climate

The air quality and climatic parameters of the proposed project area that were evaluated include particulates, SOx, NOx, CO, H_2S, and SPM.

Soils/Agriculture/Topography

The soil physico-chemical and microbial properties of the proposed project area were evaluated. These included pH, textural classification, Metals/Heavy metals, Conductivity, soil micro fauna.

Ground water

Ground water from boreholes were sampled/analyzed and the following parameters evaluated: Dissolved/suspended solids, Dissolved Oxygen, nutrients, Heavy metals, salinity, pH, Conductivity.

Vegetation/Wildlife (Biodiversity)

The various vegetation types, their structure, and economic uses in the proposed project area were evaluated. Also the various species of wildlife in the area were studied and evaluated.

Ambient Noise

The ambient noise level of the proposed projected area was evaluated. Noise is of importance in the assessment because of its immediate effects on wildlife as well as the nuisance, impaired hearing and discomfort it causes to humans.

Socio-economics and Health Conditions

The socio-economic and health conditions of the proposed project area host/beneficial community was evaluated. Particularly the perceptions of the various groups in the community towards the proposed project were also noted and evaluated. The consultation and discussions held with the various stakeholders were noted with the backdrop of gauging the perception and importance attached to the proposed deep sea port project.

Waste

The various waste types, handling and disposal methods in the proposed project area was evaluated.

5.4 Impacts Identification

The anticipated associated and potential impacts of the proposed project activities on the biophysical, social and human health environment were identified based on the interaction between project activities and environmental sensitivities identified in the baseline (Table 5.4). The interactions among the environmental sensitivities were also considered for impact evaluation and categorization.

Identified Project activities and environmental and socio-economic receptors were integrated into a matrix with the Project activities on the y- axis and environmental receptors on the x-axis, and the matrix was completed for each of the project elements. The Leopold's Interaction matrix was subsequently assessed to identify every possible case of activity-receptor interaction Table 5.4. Using the above documentation, the checklist of potential/associated impacts for the project phases/activities of the project is presented in Table 5.5 below.

Table 5.4: Screening Matrix for Potential Biophysical and Social Impacts

PROJECT PHASES AND ACTIVITIES	Biophysical Impact Indicators											Social Impact Indicators							
	Geology/Topogr	Soil	Surface Water	Hydrobiology and Fisheries	Vegetation	Wildlife	Air quality	Vibration and	Aesthetics	Groundwater	Sediments	Population	Infrastructure	Macro and micro	Social and	Physical and Economic	Cultural and Archaeological	Transportation	Education
Site Preparation Activities and Construction –																			
Physical Presence of Workers, Equipment and Materials on Site	1	1	-	-	1	1	1	1	1	1	-	1	1	1	1	1+	1	-	-
Transportation of Workers and Materials	-	-	-	-	-	-	1	1	-	-	-	-	-	1+	-	1+	-	1+	-
Physical Site Clearing	1	1	-	-	2	2	1	1	-	-	-	-	-	1+	1	1	1	1	1
Construction Works	-	-	-	-	1	-	1	1	-	1	-	-	-	1+	1	1	1	1	1
Wastes and Emissions Handling and Disposal	-	1	-	-	-	1	1	-	1	1	-	-	1	1+	-	-	-	-	-
Installation, Commissioning and Operations																			
Wastes and Emissions Handling and Disposal	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
Industrial Park Operations	-	-	-	-	-	-	2	2	2	1	-	-	+	+	-	+	-	-	+
Wastes and Emissions Handling and Disposal	-	-	-	-	-	-	2	2	-	-	-	-	1	+	-	-	-	-	-
Decommissioning																			
Removal of Installed Facilities	1	1	-	-	1	1	1	1	2	1	1	-	-	1+	-	1+	-	1+	-
Wastes and Emissions Handling and Disposal	-	1	-	-	1+	-	1	1	-	1	1	-	-	1+	-	1+	-	1+	-

Table 5.5: Associated and potential impacts of the proposed project

Project Phase	Project Activities	Environmental/Socio-economics Aspect	Potential/Associated Impacts
PRE-CONSTRUCTION	Consultation with stakeholders	Socio-Economics	• Community agitation over compensations, land disputes, wrong stakeholder identification, leadership tussles etc • Lobbying, agitations/feuds for contractual agreements/ jobs by local workers. • Compensation for farm/tree crops. • Increased income generation. • Improvement in quality of life for adequately compensated individuals • Exclusion of vulnerable groups from consultations which may lead to strife
	Employment of skilled and unskilled labour	Socio-economics	• Creation of employment for skilled and unskilled workforce. • Skill acquisition and enhancements to local indigenes and workforce. • Business opportunities for local contractors through sub-contracting activities • Conflicts/community agitations over employment issues(quota and methods)
	Construction of workers camp, access roads and mobilization of equipment & personnel to site	Air Quality/Noise	• Increase of dust particles and vehicular emissions Nuisance (noise and vibrations) due to movement from heavy duty equipment and vehicles affecting site workers • increased pressure on existing social infrastructure

			• Increase of communicable diseases due to influx of people • Increase in social vices(like theft, prostitution etc) resulting from increased number of people • Increased traffic during mobilization on road with risk of accidents leading to injury/death and loss of asset • Risk of terrorist attack and hostage taking leading to injury/death of personnel
		Waste/Environmental Aesthetics	• Reduction in environmental aesthetics value due to indiscriminate deposition of base camp-associated wastes.
	Clearing of vegetation and other debris	Vegetation	• Loss of vegetation in the project site area. • Loss of habitat for wildlife
		Soils	• Exposure of soil surface to the elements that can trigger erosion. • Soil degradation e.g. compaction of soil as a result of the movement of earth moving equipment • Exposure of soil surface to wind and sheet erosion.
		Human Health	• Injuries from wildlife attacks (snakes bites and insects stings). • Injuries from machete and other equipment during vegetation clearing. • Waste generation.
		Flora and Fauna	• Flora/habitat loss and disturbance through vegetation clearing and earthworks within project site and access roads.

			• Loss of individual or localized population of fauna • Loss of wildlife habitat and emigration of wildlife.
CONSTRUCTION	Civil works activities such as construction of buildings, factories Installation of ancillary facilities, Installation of electricity power infrastructure, Painting and coating, transportation and logistics etc.	Socio-Economics	• Employment of local labor and skills acquisition for workers taking advantage on new opportunities. • Increased business and economic activities as well as diversification of income sources due to supply contracting and sub-contracting • Increase in revenue opportunities for local population due to presence of non-resident workers and travelers
		Human Health	• Workplace accidents from burns, cuts, bruises, trips and falls, object at height leading to injury of fatalities. • Risks injury/death and loss of assets resulting from accidents associated with road transportation to and fro construction sites • Risks injury/death and loss of assets resulting from accidents associated with road transportation to and fro construction sites • Inhalation by onsite workers of cement dust and toxic fumes during foundation works and welding of material components • Traffic congestion during transportation of demobilized equipment and personnel • Potential collapse of buildings/structures on land as a result of unstable geotechnical conditions • restriction of access roads to prevent unauthorized uses

			• Loss of employment and business opportunities due to completion of construction phase
		Flora and Fauna	• Reduction in wildlife population as a result of poaching due to easier access created by project site clearing. • Noise nuisance (including impulsive noise) from construction activities, resulting to temporal migration of sensitive mammals and rodents
		Groundwater	• Groundwater contamination resulting from accidental leakages and spill of hazardous substances (diesel, lubricants ,hydraulic oil etc)
		Air quality/Noise	• Generation of dust and automobile/heavy duty equipment emissions. • Decrease in air quality as a result of emissions from vehicles and equipment. • Increased ambient noise level from heavy equipment and machinery, vehicular movement, and civil work activities.
		Waste/Environmental Aesthetics	• Reduction in environmental aesthetics value due to indiscriminate disposal of wastes. • Visual intrusion as a result of alterations from accidental ignition of onsite diesel storage tanks
		Soil	• Soil degradation and possibly accelerated erosion • Reduction in structural stability and percolative ability of the soil. • loss of soil dwelling organisms

OPERATION	Operation and maintenance of the industrial park	Human Health	• Injuries/fatalities of personnel due to road accidents during facility inspection and checks • Explosion and fire hazards at the facilities.
		Air quality/Noise	• Emission from equipment and machines in the park • Increase in noise level during operation hours.
		Socio-Economics	• Increased business opportunities and quality of life (small, medium and large scale) • Unchecked encroachment on the project site, leading to land-use conflicts and accident • Enhanced aesthetic appeal due to presence and eventual operation of many facilities in the project site
		Flora and Fauna	• Injury/ mortality of birds due to collision with wires around the project area. • Fauna disturbance and displacement as a result of migration away from demolition activity area(this include impacts on birds)
Decommissioning and Abandonment	Demolition of buildings, Site remediation and rehabilitation	Socio-Economic	• Loss of employment • Availability of land for alternative uses
		Air quality/noise	• Increased noise level • Generation of dust and automobile/heavy duty equipment emissions
		Human and Health	• Risk of accident and injury to workers during demolition of structures • Traffic obstruction from transportation of decommissioned structures and equipment

5.5 Impacts Quantification, Determination and Ranking

The identified potential and associated impacts of the proposed project were quantified using the Risk Assessment Matrix (RAM) and the International Standard Organization (ISO) 14001 criteria for identifying and quantifying environmental aspects /impacts.

The following are the ISO 14001 based criteria and ratings for identifying significant environmental impacts of the proposed project.

LEGAL/Regulatory Requirements (L)

Is there legal/regulatory requirements, or permit requirement?

0 = There is no legal/regulatory requirement

3 = There is legal/regulatory requirement

5 = There is a permit required

RISK (R)

What are the Risk/ Hazard rating based on Risk Assessment Matrix?

1 = Low Risk

3 = Medium/Intermediate Risk

5 = High Risk

Environmental Impact Frequency (F)

What is frequency rating of impact based on RAM?

1 = Low Frequency

3 = Medium/Intermediate Frequency

5 = High Frequency

Importance of Affected Environmental Component and Impact (I)

What is rating of importance based on consensus of opinion?

1 = Low Importance

3 = Medium/Intermediate

5 = High Importance

Public Perception (P)

What is the rating of public perception and interest in proposed project and impacts based on consultation with stakeholders?

1 = Low Perception and Interest

3 = Medium/Intermediate perception and interest

5 = High Perception and interest

The significant potential impacts of the project activities were identified as those impacts outlined in Table 5.4.

Impacts Weighting:

The total weighting of L+R+F+I+P is 25

The benchmark for impact quantification for this study is as follows;

If the sum of **L+R+F+I+P = <10,** then the impact is rated **LOW**

If the sum of **L+R+F+I+P is between 10-17,** then the impact rating is **MEDIUM**

If the sum of **L+R+F+I+P is >17,** then the impact rating is **HIGH**

Table 5.6: The Risk Assessment Matrix (RAM)

		Severity				
Likelihood		Minor injuries/ not detectable	First Aid Injury / short term	3 day injury temporary disability/ prolonged but recoverable impact	Major injury/Long term absence/ Prolong impacts	Fatality/ catastrophic
PROBABILITY	Remote possibility /rare	1	2	3	4	5
	Might happen/ unlikely	2	4	6	8	10
	Feasible/ moderate	3	6	9	12	15
	Highly probable/ likely	4	8	12	16	20
	Invariably happen/most certain	5	10	15	20	25
	Scale					
	+	0	Low	Moderate	High	
	Decisions and nature of actions					
	Rating		**Definition**			

		Severity	
	11-25	H	Unacceptable risk, action required, Risk reduction required – High priority, High Impact – Senior management involvement and planning needed.
	6-10	M	Medium risk – action required so far as is reasonably practical, moderate impact – management responsibility should be specified
	1-5	L	Low risk – no further action required, Low impact – managed by routine procedure
	0	0	No impact – Neutral
	+	+	Positive Impact

Table 5.7: Further Definitions of Consequences on the Risk Assessment Matrix

Severity	Potential Impact	Definition
0	Zero Effect	No environmental damage. No change in the environment. No financial consequences.
1	Slight Effect	Local environmental damage within the fence and within systems. Negligible financial consequences
2	Minor Effect	Contamination, damage sufficiently large to affect the environment, single outdo of statutory or prescribed criteria, single complaint.
3	Localized Effect	Limited discharges of known toxicity. Repeated outdo of statutory or prescribed limit. Affecting neighbourhood.
4	Major Effect	Severe environmental damage. The company is required to take extensive measures to restore the contaminated environment to its original state. Extended outdo of statutory or prescribed limits.
5	Massive Effect	Persistent severe environmental damage or severe nuisance extending over a large area. In terms of commercial or recreational use or nature conservancy, a major economic loss for the company. Constant high outdo of statutory or prescribed limits.

The identified associated and potential impacts from the various activities of the proposed project as outlined in Table 5.4 are determined, quantified, and ranked as outlined in Table 5.6 below.

Table 5.8: Impacts quantification and Ratings of the proposed project

Project Phase	Project Activities	Potential/Associated Impacts	Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium /Low)
Pre-construction	Consultation with stakeholders	• Lobbying, agitations for jobs, employment and contractual agreement by local workers. • Community agitation over compensations, land disputes, wrong stakeholder identification, and leadership tussles. ▪ Exclusion of vulnerable groups from consultations which may lead to strife. ▪ Compensation for farm/tree crops loss.	-	ST		R	0	1	1	5	5	12	MEDIUM
		▪ Increased income generation. ▪ Improvement in quality of life for adequately compensated individuals	+		LT	R	0	1	3	5	5	14	MEDIUM

Project Phase	Project Activities	Potential/Associated Impacts	Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium /Low)
	Employment of skilled and unskilled labour	▪ Creation of employment of skilled and unskilled work force ▪ Creation of employment for skilled and unskilled workforce. ▪ Skill acquisition and enhancements to local indigenes and workforce. ▪ Business opportunities for local contractors through sub-contracting activities	+		LT	R	0	1	3	5	5	14	MEDIUM
		• Conflicts/community agitations over employment issues (quota and methods)	-	ST		R	0	3	1	5	5	14	MEDIUM
	Mobilization of equipment and personnel to site	▪ Increase of dust particles and vehicular emissions Nuisance (noise and vibrations) due to movement from heavy duty equipment and vehicles affecting site workers	-	ST		R	3	1	1	3	3	13	MEDIUM
		▪ Increased Income and local economy.	+		LT	R	0	1	3	5	3	12	MEDIUM
		▪ Increased pressure on existing social infrastructure	_	ST		R	0	3	1	3	3	10	LOW
		• Increased social vices. • Increase of communicable diseases due to influx of people	-	ST		R	0	5	3	5	5	18	HIGH

Project Phase	Project Activities	Potential/Associated Impacts	Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium /Low)
		• Increased traffic during mobilization on road with risk of accidents leading to injury/death and loss of asset • Risk of terrorist attack and hostage taking leading to injury/death of personnel	_	ST		R	0	3	1	3	3	10	LOW
		▪ Reduction in aesthetics of environment due to indiscriminate waste disposal.	-	ST		R	3	3	1	3	3	13	MEDIUM
	Clearing of vegetation and other debris	▪ Loss of vegetation in the project area.	-		LT	I	3	3	3	5	5	19	HIGH
		▪ Loss of wildlife, their habitat and migration of wildlife.	-		LT	I	3	3	3	5	5	19	HIGH
		• Exposure of soil surface to the elements and triggering of erosion. • Soil degradation e.g. compaction of soil as a result of the movement of earth moving equipment	-	ST		R	3	3	1	3	3	13	MEDIUM
		▪ Injuries from wildlife attacks (snakes bites and insects stings). ▪ Injury from equipment usage during vegetation clearing.	-	ST		I	0	3	3	3	3	12	MEDIUM
		▪ Domestic and Sanitary Waste Generation	-	ST		R	3	3	3	3	3	15	MEDIUM

Project Phase	Project Activities	Potential/Associated Impacts	Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium /Low)
Construction	Civil works activities such as construction of factories buildings, Installation of public utilities, Installation of electricity power infrastructure, transportation and logistics etc.	▪ Increased ambient noise level from heavy equipment and machinery, vehicular movement, and civil work activities.	-	ST		R	3	3	1	1	3	11	MEDIUM
		▪ Generation of dust and automobile/heavy duty equipment emissions. ▪ Decrease in air quality as a result of emissions from vehicles and equipment.	-	ST		R	3	3	1	1	3	9	MEDIUM
		▪ Loss of flora and fauna ▪ Noise nuisance (including impulsive noise) from construction activities, resulting to temporal migration of sensitive mammals and rodents	-		LT	I	3	3	1	3	3	13	MEDIUM
		▪ Groundwater contamination resulting from accidental leakages and spill of hazardous substances (diesel, lubricants ,hydraulic oil etc)	-	ST		I	3	5	1	3	3	15	MEDIUM
		▪ Workplace accidents from burns, cuts, bruises, trips and falls, object at height leading to injury of fatalities.	-	ST		I	5	5	3	3	3	19	HIGH
		▪ Risks injury/death and loss of assets resulting from accidents associated with road transportation to and fro construction sites	-	ST		I	0	5	3	3	3	14	MEDIUM

Project Phase	Project Activities	Potential/Associated Impacts	Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium /Low)
		▪ Reduction in environmental aesthetics value due to indiscriminate disposal of wastes.	-	ST		I	3	3	1	3	3	13	MEDIUM
		▪ Inhalation by onsite workers of cement dust and toxic fumes during foundation works and welding of material components	-	ST		R	3	5	1	3	3	15	MEDIUM
		▪ Soil degradation and possibly accelerated erosion ▪ Reduction in structural stability and percolative ability of the soil.	-	ST		I	3	3	1	3	3	13	MEDIUM
		▪ Traffic congestion during transportation of demobilized equipment and personnel	-	ST		R	0	1	1	3	3	8	LOW
		▪ Potential collapse of buildings/structures on land as a result of unstable geotechnical conditions	-	ST		I	3	5	1	5	5	19	HIGH
		▪ Restriction of access roads to prevent unauthorized uses	-	ST		R	0		1	3	3	8	LOW
		▪ Loss of employment and business opportunities due to completion of construction phase	-		LT	R	0	3	3	3	3	12	MEDIUM

Project Phase	Project Activities	Potential/Associated Impacts	Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium /Low)
		▪ Advantage on new opportunities. ▪ Increased business and economic activities as well as diversification of income sources due to supply contracting and sub-contracting ▪ Increase in revenue opportunities for local population due to presence of non-resident workers and travelers	+		LT	R	0	1	3	3	3	7	LOW
		▪ Employment of local labor and skills acquisition for workers taking	+		LT	I	0	1	3	3	3	7	LOW
		▪ Injury and death due to work place incidents.	-	ST		I	0	5	1	3	3	12	MEDIUM
		▪ Community conflicts arising from disagreement over contracts and recruitment.	-	ST		R	0	3	1	5	5	13	MEDIUM
		▪ Increase in social vices and kidnapping	-		LT	R	0	5	3	5	5	18	HIGH
Operation	Operation of the industrial park and maintenance of the infrastructure facilities	▪ Increased economic activities. ▪ Revenue generation for both state and federal governments. ▪ Employment for both skilled and unskilled labour.	+		LT	R	0	1	1	3	3	8	LOW
		▪ Injuries/fatalities of personnel due to road accidents during facility inspection and checks ▪ Explosion and fire hazards at the facilities.	-	ST		I	5	5	1	3	3	17	HIGH

Project Phase	Project Activities	Potential/Associated Impacts	Beneficial /Adverse	Short Term	Long Term	Reversible/ irreversible	L	R	F	I	P	L+R+F+I+P	Ranking (High/Medium /Low)
		▪ Pressure on existing infrastructure.	-		LT	R	0	3	3	3	1	10	LOW
		▪ Increased social vices.	-		LT	R	0	3	3	3	3	12	MEDIUM
Decommissioning and closure	Demobilization of equipment and personnel from site after project lifespan.	▪ Emission of exhaust fumes/noxious gases from vehicles, and increased ambient noise level.	-	ST		R	3	1	1	3	1	10	MEDIUM
		▪ Increased turbidity of surface water and shoreline erosion.	-	ST		R	3	3	3	3	1	13	MEDIUM
		▪ Loss of Jobs. ▪ Loss of revenue earner for state and federal government. ▪ Reduced pressure on infrastructure.	-		LT	R	3	5	5	5	5	23	HIGH

KEY: * - (Adverse), + (Beneficial); Short Term (< 3 months), Long Term (>3 Months); R = Reversible, I = Irreversible.

5.6 Description of Impacts

5.6.1 Pre-construction

- **Impacts of Site Clearing/Preparation Activities**
  Cleared top soil will be stockpiled and reused for landscaping. Excess topsoil, if any, will be moved to a stockpile to be used at other locations or used to reclaim existing swamps in the study area. Useful materials cleared from the sites will first be offered to local inhabitants. Vegetation and other material which have no re-use value will be burnt on site. Associated and potential impacts related to site clearing activities are related to the physical clearing process, the alteration of the landscape and conversion of lands (land takes). The overall impact significance is therefore moderate.
- **Impact on Human Movement**
  During the mobilization activities, portions of the sites will be block to restrict public access for safety and security purposes. Although most of the project sites will be acquired by the contractors, any regular transport and traffic routes (foot paths and road tracks) that cross the sites could be cut off, requiring diversions or the use of alternative routes. These disruptions will negatively impact human movement and could affect social, economic and livelihood networks in the study area. Overall impact significance is low.
- **Physical and Economic Displacement**
  Land-take and site clearing will not lead to the physical displacement of communities that live within and in close proximity to the project site. Some land users will be economically displaced because farming and foraging are key sources of livelihood in the study area and some farmers will no longer have access to sections of this zone which they currently rely on. The overall impact significance is moderate.
- **Cultural and Archaeological Resources**
  Over 80% of residents in the communities of the study area are Christians, 10% are Muslims and the others traditional worshippers. Non-natives living or working in the study area may not be conversant with traditional religious practices and rules on shrines and so may inadvertently break traditional religious rules by engaging in culturally unacceptable behaviour. No shrine was observed within the perimeter of the proposed project area. The overall impact is therefore of low significance.
- **Social and Cultural Structure**
  A temporary site office will be established to serve as the project planning point and support facilities during the construction period of the project. The temporary project office activities could lead to a slight increase (about 5%) in the population of communities of the project area. Since most of the workers and the majority of economic migrants are likely to be male, this influx will lead to a significant change in the ratio of males to females. The population increase directly or indirectly related to the project, combined with increased income could trigger a rise in negative social behaviours such as prostitution and crime. Overall impact significance is therefore high.

- **Impact on Groundwater Quality**
  The use of heavy machinery and workers within and around work areas during the project site clearing, preparation and construction phase could potentially result in impacts to groundwater. The soil study indicates high permeability and a relatively shallow groundwater table in some areas (less than 2m). Uncontrolled wash down of oil and grease from equipment or accidental release of any other chemicals stored or used on site could directly impact shallow drinking water wells. The overall impact significance is therefore moderate.
- **Impacts Associated With Transportation of Workers and Materials**
  During the project implementation, there will be transportation of workers and materials to and from the active work areas. Traffic in and out of Project areas will increase. Currently there is an improved road into the area, which helps the make travel in and out of the areas fairly smooth. The project could result in additional pressure on the traffic situation in the study area during the pre-operations phase of the project. Increased water traffic is also anticipated. The overall impact significance is therefore low.
- **Impact on Transportation**
  Transportation of workers and materials during the site clearing, preparation and onsite construction activities of the project will lead to increased traffic activity along the main road into Project areas. Increased vehicular traffic in the study area could lead to longer commuting time for existing road users. The increased traffic could also lead to additional road accidents. The overall impact significance is therefore low.
- **Impacts on Vegetation and Wildlife**
  Trees, shrubs, and climbers as well as associated fauna, will be lost when the project site are cleared. Land use and land cover data from the environmental baseline study indicates that over 80% of the area to be cleared is lowland forest, some portions of which are fallow and farmlands. Overall impact significance is therefore moderate
- **Impact on Soil and Ecology**
  Site clearing activities will involve the removal of vegetation and top soil as well as the clearing of flora across various habitat types in the project area. The areas to be cleared will be mostly dry lowland rainforest, which currently covers most of the project area. Some flora and fauna within these habitats are economically, medicinally and ecologically important. Clearing will result in a loss of habitat for the fauna including wildlife. The clearing activity will also result in further degradation of soil fertility. Overall impact significance is therefore moderate
- **Impact on Micro and Macro Economy**
  The physical presence of workers in the project areas during the site preparation of the access roads, excavation and construction together with employment-seeking migrants will result in increased commercial activities around the project office and nearby communities and those near active work areas. Some labour will be hired locally. There is a high

likelihood of an increase in the price of food, medicine, transportation and general goods and services in the project areas as a result of the influx. Overall impact significance is moderate.

- **Vibration and Noise**
  Site clearing activities will involve the use of chain saws, bull dozers, and other motorized equipment. Noise and vibration levels around work areas during site clearing will therefore increase, but only during the day as no work will be performed at night. Noise and vibrations would also cause birds, and other mobile fauna to move away from the source, while nearby communities could experience unusual noise and vibration impacts; noise effects on humans are covered under health impacts. Overall impact significance is therefore low.
- **Wastes generation**
  Different wastes will be generated during the project pre-construction activities. The wastes will comprise felled trees and cleared vegetation, top soil, spent oils and domestic waste from the project yard. Some wastes generated from site clearing that are not taken away for use by the local people will be burned on site. Contractor's project yard will be equipped with sanitary waste systems and garbage collection systems. The project contractor will also implement a waste management plan for all activities leading up to the commencement of the project operations. Overall impact significance is therefore low.
- **Air Emissions**
  Ambient air quality monitoring indicates that only low levels of pollutants of concern currently exist in the project area. The pre-construction activities associated with the project will result in emissions of air pollutants during the operation of combustion engines, burning of organic material from site clearing, and dust during site clearing and grading. The emissions could cause an increase in concentrations of sulphur oxides, nitrogen oxides, carbon monoxide, Volatile Organic Compounds (VOC) and particulates within the immediate vicinity of emission sources. Dust created from general construction activities would also lead to an increase in air pollutants around the project area. Overall impact significance is therefore moderate.

5.6.2 Construction phase

- **Air Pollution**
  Construction works involving excavations, site preparation and construction traffic will generate substantial dust. Other possible sources of air pollution will arise from exhaust and engine emissions, construction machinery, aggregate crushers and asphalt plants. Air emissions including dust, is regarded as a nuisance when it reduces visibility, soils private property, is aesthetically displeasing or affects palatability of pastures and is also a health hazard. Overall impact significance is therefore moderate.

- **Noise Pollution**
  Road constructions generally require the use of heavy machinery, and although these activities may be intermittent and localized, they nevertheless contribute tremendous amounts of sustained noise during equipment operation. These can degrade the human welfare, health and disrupt activities within noise sensitive areas like schools and hospitals. The elevated noise and vibration levels within the site can variously affect the project workers and the residents, passers-by, wildlife and domestic animals, within the vicinity. All these disturb the natural surroundings; on the other hand, significant vibrations may also affect the nearby structures such as roads. Overall impact significance is therefore moderate.
- **soil erosion**
  Construction works usually expose soils to agents of erosion. Use of heavy machinery and equipment also compact soil hence inability to support plant growth leaving the soils bare and exposing them to erosion agents. Side drains, especially outfalls/mitre drains may increase soil erosion on cultivated fields. Land clearance needed will uproot trees and crops as well as displace topsoil. The clearing of natural vegetation cover could lead to increased soil erosion. This impact is rated significant.
- **Risks of Accidents and Injuries to Workers**
  During construction activities including metal grinding and cutting, concrete work, steel erection and welding among others, construction workers will be exposed to risks of accidents and injuries. Such injuries can result to trip and falls, injuries from hand tools and equipment cuts from sharp edges of metal sheets among others. This impact is rated moderate.
- **Drainage**
  Drainage structures to be designed shall include pipe culverts, box culverts and drains/ditches. Lack of drainages may increase the chances of soil erosion as with the current status of the project area. However, the proposed project shall provide drainages that will address drainage issues in the study area. This impact is beneficial to the project affected communities.
- **Reduced water supply to local community**
  Water sources will be sufficient for the construction works and domestic use. The concern is the water quality due to abstraction by the project works and its associated waste water management. This impact is rated as significant.
- **Groundwater contamination**
  Construction equipment generates large amounts of waste oil and its proper handling is critical. Haphazard storage and leakage can result in the contamination of soils and ground waters. Oil products can also lead to contamination of surface and groundwater if there is a lack of fuelling, maintenance and servicing protocol for construction machinery at the project site. Pollution of water resources by oil-based pollutants from trucks and

construction machinery during construction works could cause health problems for the population downstream. This impact is major.

- **Solid Waste**
  Construction will result in the creation of various solid wastes, principally surplus earth (spoil) and rock (soil debris), metal scraps, plastics (wrappings and containers), cardboard, paper, wood, office wastes including e.g. used toner cartridges, kitchen (canteen) wastes, workshop wastes including e.g. used oil filters, and waste concrete. This can be a nuisance and the site should therefore be kept clean, neat and tidy at all times. No burying or dumping of any waste materials, vegetation, litter or refuse shall be permitted. The Contractor shall implement measures to minimize waste. Overall impact significance is therefore moderate.
- **Wastewater and contaminated water management**
  During the construction phase, various liquid wastes including grey and black water (respectively washing water and sewage), concrete washings, runoff from project yard and workshop areas, and various liquid waste streams from washing construction equipment washing will be generated. These wastes pose real toxicity and quality threats to the soil and ground water, as well as existing wetlands within the area. Overall impact significance is therefore moderate.
- **Discrimination on Employment Opportunities**
  Most of the skilled labourers will have to be brought in from outside the project area, and this may cause some resentment among the local people. Generation of employment opportunities by the project could result into conflict between local residents and new comers or outsiders, if not appropriately managed. A concern expressed during consultations was that unskilled labour may be available to men more than women leading to gender discrimination. Overall impact significance is therefore moderate.
- **Occupational Health and Safety**
  Construction phase may involve employment of hundreds of workers in site, increasing chances of workplace accidents, injuries and illnesses. It will thus be paramount that the contractor adheres to best practices in occupational health and safety. Overall impact significance is therefore moderate.
- **Social Disruption**
  Construction activities will cause some degree of disruption to social order within the project area, and specifically around the Contractors project yard. Managing the welfare of a significant number of workers is inevitably a major challenge, and the co-existence of multiple contractor crews of workers from diverse cultural and geographic backgrounds can be a challenge. During construction, the contractor will be required to implement measures to protect the welfare of the community. This should be achieved via application of a grievance mechanism, which must be developed prior to the construction programme. Overall impact significance is therefore moderate.

- **Impact on Infrastructure**
  The influx of engaged workers and job seekers will lead to increased demand for goods and services and will cause some pressure on existing infrastructure such as housing, educational facilities, roads, hospitals and others in the study area. As has been observed on other similar projects in Nigeria, local residents may lease their houses to migrants and there will be an increase in road traffic, which will further put some pressure on the existing roads. Overall impact significance is therefore moderate.
- **Employment Opportunities**
  Creation of employment opportunities has both economic and social benefits. During the construction period, new jobs will be created in the form of skilled and unskilled labour. A majority of unskilled labour will be sourced from the local residents. Indirect employment will be in the form of suppliers and other forms of sub-contracted works that will be required for construction. Support businesses such as food kiosks may also grow near the project office and along the road corridor. This is a major positive impact.
- **Skills Transfer and Training**
  Through labour recruitment locally the workers will have an opportunity to learn an array of skills that relate to road construction and ancillary works. Improved transport will improve interaction with other communities that will also provide an opportunity for further learning and cultural exchange. This is a major positive impact.
- **Gains in the Local and National Economy**
  There will be gains in the local and national economy as a result of the construction of this proposed Project, through consumption of locally available materials including: timber, metals and cement. The consumption of these materials in addition to fuel oil for the machines to be used at the site and others will attract taxes including Value Added Tax (VAT) and Income Tax which will be payable to the government. The cost of the materials will be payable directly to the suppliers. This is a major positive impact.
- **Provision of Market for Supply of Construction Materials**
  The proposed project shall require supply of large quantity of materials most, of which will be sourced locally in and surrounding areas. This provides market for material suppliers such as quarry companies, sand, wood, cement, paints and roofing material dealer as well as other dealers of building materials and local food sellers. The impact is rated significant and positive. This is positive significant impact.

5.6.3 Operation

- **Employment Opportunities**
  Some people will be employed by the project as management and enforcement agents, caretakers, cleaners, security personnel and technicians for street lights, drainages and plumbers. This is a positive significant impact.

- **Water and Sanitation**
  The project will improve delivery of portable water, effective and accessible sanitation services through the provision of drainages, sewerage and portable water distribution network. This is a significant positive impact.
- **Potential to Improve Drainage**
  Overall, the hydrology and drainage of the study area will be improved due to the provision of drainage structures such as culverts and other cross -drainage facilities like side drains**.** The current drainage structures are mainly inadequate. This is a major positive impact.
- **Infrastructure**
  This project has the tendency of improving the infrastructure existing in the study area. The proposed development will augment existing social amenities and stimulate growth in other sectors such as housing and ultimately add to development in the area. This is a major positive impact.
- **Air Emissions**
  Air emissions during operations will include nitrogen oxides, sulphur oxides, carbon monoxide, volatile organic carbons (VOC) and some particulates. The modelling considered emissions from the project which are identified as the main sources of criteria air pollutants in the proposed project. Criteria pollutants modelled for the ground level concentrations include: carbon monoxide (CO), nitrogen oxides (NO_X), hydrocarbons (HC) and total suspended particulate (PM) due to the characteristics of the fuel to be used during operation. The overall impact significance is therefore low.
- **Sanitary and Solid Waste Health Effects**
  While the project will implement a program to manage solid and liquid wastes, increased population in some settlements as a result of in-migration will cause an increase in sanitary waste discharges and effluents. Untreated sanitary waste and other effluents as well as solid waste can increase the existing prevalence of water and vector borne diseases (e.g., typhoid and diarrhea) and other disease vectors in the project area.
  The magnitude of the potential impact is low the since anticipated population increase in affected communities during the site clearing and construction phases of the project would be generally low for most communities. Overall impact significance is therefore moderate.
- **Noise and Vibration Impacts**
  There will be an increase in noise and vibration during the implementation of various activities associated with the project. Increased noise and vibration will be associated with vehicular movement and horning, workshops, and other installed components.
  Overall impact significance is therefore moderate.
- **Accidents**
  Accidents including spills (fuel and other hazardous chemicals), fires, vehicular accidents, and work area mishaps affecting the general public are possible hazards during the

operational phases of the Project. Population influx during operations will increase the risk of such accidents, including domestic fires. Overall impact significance is therefore high.

5.7 Cumulative Impacts

Cumulative impacts are changes to the environment that are caused by certain activity in combination with other past, present, and future human activities.

The concept of cumulative effects is an important one. It holds that while impacts may be small individually, the overall impact of all environmental changes affecting the receptors taken together can be significant. When a resource is nearing its tolerance threshold, a small change can push it over. The objective of the cumulative impact assessment is to identify the environmental and/or socio-economic aspects that may not on their own constitute a significant impact but when combined with impacts from past, present, or reasonably foreseeable future activities associated with this and/or other projects result in larger and more significant impacts.

Cumulative impacts arising from this proposed industrial park project shall be minimal because the project shall be executed with the latest more environmentally safe available technology which shall reduce greenhouse house effect and climate change. However, there could be cumulative impact such as loss of biodiversity, decrease in air quality etc. especially when there are other operators in the industrial park.

CHAPTER SIX

MITIGATION MEASURES FOR ASSOCIATED AND POTENTIAL IMPACTS

6.0 Introduction

This Chapter is designed to ensure that suitable procedures or mitigation measures are provided to corresponding manage/reduce the identified associated and potential impacts of the proposed project to a level as low as reasonably practicable throughout the life cycle of the project. The identified potential and associated impacts of the proposed Pot Harcourt Industrial Park Project construction have been identified and evaluated while the impacts significance (adverse and beneficial) have also been discussed in chapter five. Consequently, the mitigation and enhancement measures for the adverse and beneficial impacts of the proposed project are presented in this chapter. This chapter therefore presents the mitigation, enhancement and/or alternative measures for the adverse and beneficial impacts of the proposed Port Harcourt Industrial Park.

6.1 Mitigation Hierarchy

Mitigation Measures come with a variety of levels, and these are commonly called "mitigation hierarchy. "The mitigation hierarchy consists of steps aimed at preventing, eliminating or minimizing the environmental and social impacts of a proposed project to levels that are considered as low as reasonably practicable (ALARP). In proffering mitigation measures, the primary objectives are summarized in Table 6.1 below:

Table 6.1: The Mitigation Hierarchy

Step	Focus
Avoidance	Methods aimed at impeding the occurrence of negative impacts, and/or preventing such occurrence from having harmful environmental/ social outcomes.
Minimize	Impact cannot be completely side-stepped; so take steps to ensure minimal damage is done to the environment.
Rectify	Implies that the impact has already happened so do damage control

Reduce	Reduce the extent of the impact through management practices and/or change
Environmental Offset	Actions taken outside of the development site to compensate for the impacts in the development site. In effect, this means that the development undertaker carry out environment conservation activities to compensate for what they do in order to achieve "no net environment loss", or more specifically "no net biodiversity loss".

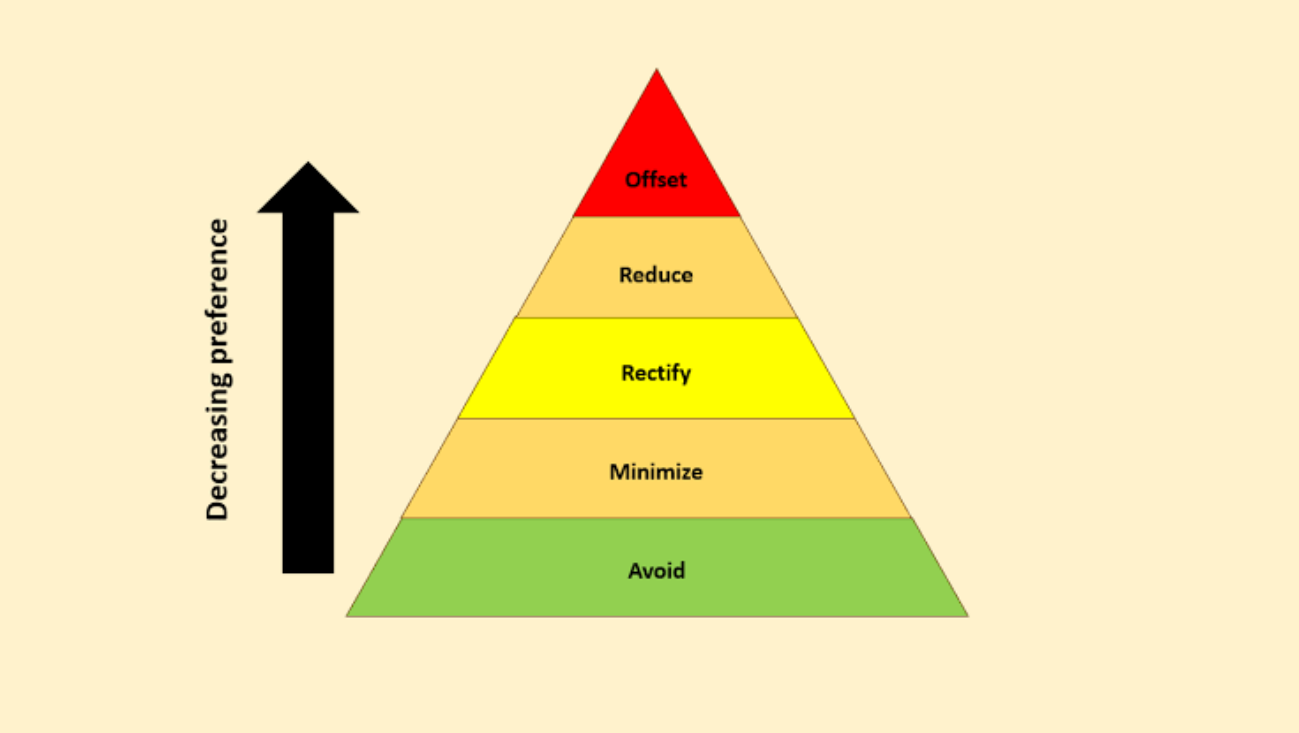

Figure 6.1: The Elements of Mitigation

The framework for determining the form of mitigation measures to be applied for the significant impacts identified for the project is shown in Figure 6.1 below. The frequency, severity, sensitivity, scale, magnitude and nature of the impacts were taken into consideration in the assessment.

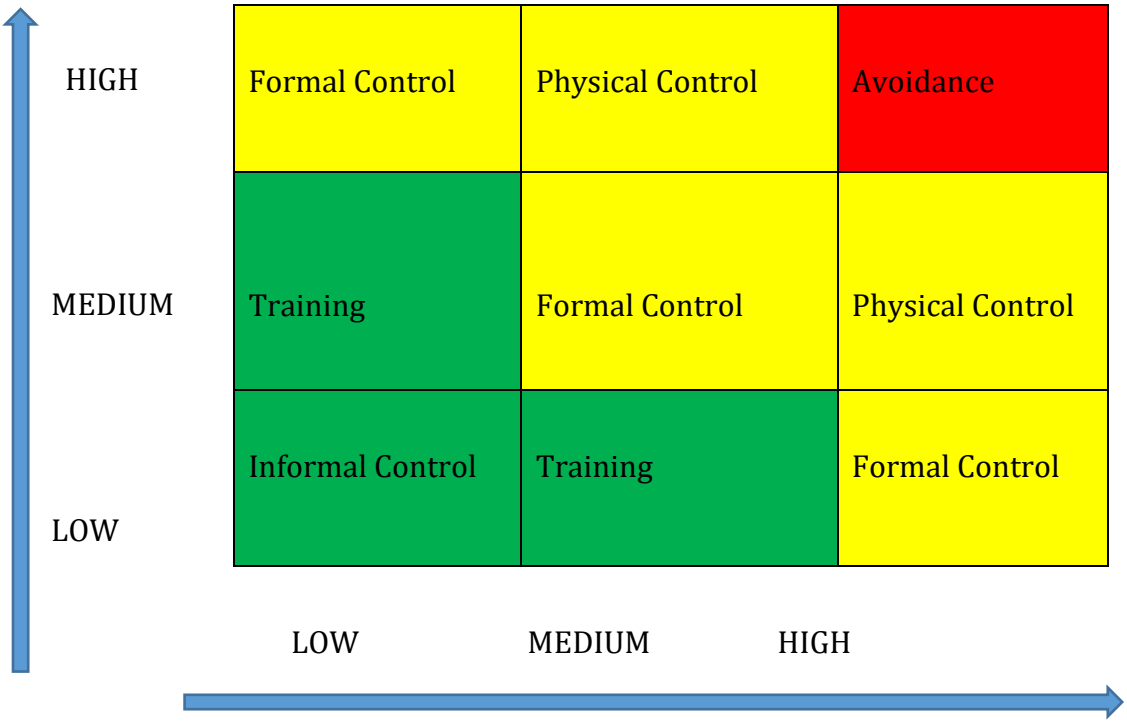

Figure 6.2: Mitigation Definition Criteria

Informal Control

This involves the application of sound judgment and best practice in mitigating the impacts of the of the project activities.

Formal Control

This involves the application of documented policy, process or procedure in mitigating the impacts of the project activities. It ensures that residual associated impacts are reduced to an acceptable level.

Physical Control

This involves the application of physical processes, barriers or instruments (pegs, fence, gates, sign post etc.), not necessarily requiring any special technology in order to mitigate the impacts of the project.

6.2 Proffered Mitigation Measures

Accordingly, this section presents the mitigation measures proffered for the identified impacts of the proposed Industrial Park project. The measures also considered the environmental laws in Nigeria, and internationally and the principles of sustainable development and best available technology. Most of the likely impacts due to the proposed project have been considered in the

design and selection of equipment. The mitigation measures recommended in this section may not be exhaustive. However, they are considered adequate to effectively ameliorate or in some cases, eliminate the negative impacts that may arise in this project. From the assessment undertaken, if the measures are applied, all minor and moderate negative impacts will be reduced significantly and will leave, in most cases, negligible and minor residual impacts. However, for accidental occurrences such as fire outbreak and electrocution, the residual impact would still remain major, given the costly and sometimes irreversible effect of its occurrence. In order to verify these assertions, and to ensure that the measures are effective, it is necessary to have in place a sound and cost-effective Environmental and Social Management Plan (EMP), presented in Chapter Seven of this report. The proffered mitigation measures for the identified potential and associated impacts are presented in Table 6.1 below.

Table 6.1: Proffered Mitigation Measures for the Proposed Port Harcourt Industrial Park

Project Phase	Project Activities	Potential/Associated Impacts	Rating before mitigation measures	MITIGATION MEASURES	Rating after mitigation measures
PRE-CONSTRUCTION	Consultation with stakeholders	• Community agitation over compensations, land disputes, wrong stakeholder identification, leadership tussles etc • Lobbying, agitations/feuds for contractual agreements/ jobs by local workers. • Compensation for farm/tree crops. • Increased income generation. • Improvement in quality of life for adequately compensated individuals • Exclusion of vulnerable groups from consultations which may lead to strife	Medium	Federal Ministry of Transportation shall: • Ensure that all relevant stakeholders are identified • Ensure that early stakeholders' engagement sessions are held, and all agreed issues properly documented and signed • Ensure that project will develop a community relations and engagement plan that identifies fair strategies of engagement for all communities • Ensure that project will also develop and implement a Resettlement Action Plan to ensure equitable settlement of all project affected persons • Ensure that early stakeholders' engagement sessions are held, and all agreed issues properly documented and signed. • Establish and publicize grievance procedure. • Ensure that stakeholders (communities, Govt., land owners, etc.) are adequately consulted and relevant issues addressed • Ensure that agreed fair compensation for land are paid to identified owners promptly as per set standards. • Maintain good cooperative relation with the local community.	Low
	Employment of skilled and unskilled labour	• Creation of employment for skilled and unskilled workforce. • Skill acquisition and enhancements to local indigenes and workforce.	Medium	Federal Ministry of Transportation shall: • Provide employment for qualified locals whether unskilled or skilled • Plan capacity building program and Ensure skills acquisition and development	Low

		• Business opportunities for local contractors through sub-contracting activities			
		• Conflicts/community agitations over employment issues(quota and methods)	Medium	• Ensure that as far as possible employ persons from the surrounding communities during the construction phase of the development to reduce the numbers of persons that will immigrate into the area seeking employment.	Low
	Construction of workers camp, access roads and mobilization of equipment & personnel to site	• Increase of dust particles and vehicular emissions Nuisance (noise and vibrations) due to movement from heavy duty equipment and vehicles affecting site workers.	Medium	Federal Ministry of Transportation shall: • Ensure that contractor should develop an acceptable Construction Management Plan (CMP) which includes all sustainability issues and safety issues • Ensure that camp siting should be away from community resources, schools, etc • Ensure that operational areas shall be sited away from human settlements. • Ensure that equipment yard and personnel camps should be in exact size needed • Sites and camps should be well delineated • Ensure contracting documents with contractors include specifications relating to type, weight and operation of heavy machinery • Raise public awareness of unusual activity • Plan activities such that Regulatory limits are not exceeded • Ensure that noise attenuation measures such as installation of acoustic mufflers on large engines • Use fuel efficient and well maintained haulage trucks with proper exhaust system.	Low

				• Ensure that park vehicles on the site with engines turned off; • Service vehicles as at when due and stick to manufacturers‟ specifications in use • Develop and follow a controlled fuelling, maintenance and servicing protocol • Ensure that covering of vehicles carrying fine grade materials • Ensure releases are in compliance with National and International Regulation • Train and brief workers on safety precaution, their responsibility for their safety and the safety of others; • Provide adequate instructional and warning HSE signs; • Ensure compliance with contract General Health, Safety, and Environment code of contract code and relevant regulations. • Develop a traffic management and provide adequate safety and caution signs e.g. speed control, warning signs, etc.	
		• increased pressure on existing social infrastructure	Low	Federal Ministry of Transportation shall: • Encourage hiring, as practicable, of appropriately qualified workers from areas in the vicinity of the project • Work with contractors to ensure that specialized skill workers from outside areas have access to proper accommodations and other basic infrastructure. • Educate all workers to enhance their Health, Safety, Security, and Environment awareness, and performance on the job	Low

		• Increase of communicable diseases due to influx of people • Increase in social vices(like theft, prostitution etc) resulting from increased number of people	High	Federal Ministry of Transportation shall: • Project will develop a health plan to address potential health issues • Carry out health awareness program (malaria, corporate stop AIDS program, etc.) • Provision of site medical personnel to attend to emergency situations • Restriction of access roads to prevent unauthorized uses • Engage the services of retainer clinics to manage health issues • Educate workforce on the prevention of malaria as well as encourage the use of mosquito nets in construction camp • Ensure its personnel and contractors undergo pre-employment background screening as required Periodically discuss health and social education issues during toolbox/SHE meetings • Promptly deal with reported cases of misconduct to check recurrences	Medium
		• Increased traffic during mobilization on road with risk of accidents leading to injury/death and loss of asset • Risk of terrorist attack and hostage taking leading to injury/death of personnel • Reduction in environmental aesthetics value due to indiscriminate deposition of base camp-associated wastes.	Medium	Federal Ministry of Transportation shall • Ensure activities causing blockages at road crossings are carried out within shortest time practicable • Consult with affected communities prior to demobilization to provide warnings and alternatives • Ensure implementation of project security plan during decommissioning • Maintain ongoing cordial relationships with the stakeholder communities. • Certify government approved security guards are used on demobilization vehicles when warranted • When necessary HIL shall activate its emergency response procedure • Implement effective journey management plan.	Low

	Clearing of vegetation and other debris	• Loss of vegetation in the project site area.	High	Federal Ministry of Transportation shall: • Ensure that at demobilization, all cleared site should be revegetated and returned to its original site • Ensure that removed vegetation and earth should be piled up for later return during demobilization • Avoid damage to flora and fauna by machinery and workers. • Clear vegetation systematically in areas where work is to be done • Ensure prompt landscaping/Planting of vegetation	Medium
		• Exposure of soil surface to environmental elements that can trigger erosion. • Soil degradation e.g. compaction of soil as a result of the movement of earth moving equipment • Exposure of soil surface to wind and sheet erosion.	Medium	Federal Ministry of Transportation shall: • Maintain earth work and open cuts wet by water spraying • Provide adequate surface water drainage from site. • Implement where appropriate sediment run-off controls and visually inspect after rainfall events • Construction on steep slopes and in soft or erodible material will require erosion control measures and correct grassing methods. • Reclaim as practicable topography of excavated or compacted upland areas upon completion of activities.	Low
		• Injuries from wildlife attacks (snakes bites and insects stings). • Injuries from machete and other equipment during vegetation clearing.	Medium	Federal Ministry of Transportation shall: • Ensure that all personnel are qualified and certified for their relevant works • Ensure that approved safe work procedures are provided and complied with at all times • Ensure that the use of appropriate personal protective equipment (PPE) e.g. rubber hand gloves, hard hats, safety boots, etc. by all personnel at the project site • Limit work activities to daytime only.	Low

		Waste generation.	Medium	Federal Ministry of Transportation shall: • Develop project specific waste management plan and ensure proper implementation • Provide adequate containers for waste collection • Periodically assess contractor activities to check the level of compliance to regulatory waste management requirements. • Ensure that safe operating practices are enforced during construction • Ensure the Use of only government approved waste management contractors	Low
		• Flora/habitat loss and disturbance through vegetation clearing and earthworks within project site and access roads. • Loss of individual or localized population of fauna • Loss of wildlife habitat and migration of wildlife.	High	Federal Ministry of Transportation shall: • Ensure inclusion of threatened and endangered species management strategies in the site specific Environmental Management Plan to be developed by EPC contractors to ensure appropriate flora and fauna management. • Ensure that vegetation clearing will be limited to minimum area required for work • Utilization of existing accessible tracks as much as possible	Medium
CONSTRUCTION	Civil works activities such as construction of factories buildings, factories Installation of public utilities,	• Increased business and economic activities as well as diversification of income sources due to supply contracting and sub-contracting • Increase in revenue opportunities for local population due to presence of non-resident workers and travelers	Low	Federal Ministry of Transportation shall: • Encouraging indigenous contractors and suppliers providing them opportunities to supply materials of acceptable standards • Encourage contractors to hire and to develop local labour • Workers are paid promptly as at when due	Low

	transportation and logistics etc.	• Workplace accidents from burns, cuts, bruises, trips and falls, object at height leading to injury of fatalities.	Medium	Federal Ministry of Transportation shall: • Employing an OSH plan that will outline all OSH risks and provide a strategy for their management. • Ensuring all potential hazards such as movable machine parts arelabeled. • Raising awareness and educating workers on risks from equipment and ensuring they receive adequate training on the use of the equipment. • ProvidingtheworkerswithadequatePPEsandmonitoringregularlytoensuretheyarereplacedontimewhentheywear out. • Placing visible and readable signs around where there are risks.	Low
		• Risks injury/death and loss of assets resulting from accidents associated with road transportation to and fro construction sites • Risks injury/death and loss of assets Inhalation by onsite workers of cement dust and toxic fumes during foundation works and welding of material components	High	Federal Ministry of Transportation shall: • Ensuring there is security in and around the site to control the movement of people. • Providing safe and secure storage for equipment and materials in the site and maintaining MSDSs. • Placing visible and readable signs to control the movement of vehicles and notify motorists and pedestrians around the, and workers in the site. • Providing fire-fighting equipment and in easily accessible areas as well as ensuring site personnel are well trained to use them as well as maintaining them regularly. • Labeling chemicals and material according to the risks they possess. • Creating safe and adequate fire and emergency assembly points and making sure they are well labeled. • Establishing emergency procedures against hazards and ensuring the workers stay aware/educated on following them and commensurate to the magnitude and type of emergency, by conducting regular drills and involving the neighbours.	Medium

		• Traffic congestion during transportation of demobilized equipment and personnel	Low	Federal Ministry of Transportation shall: • Ensuring there is security in and around the site to control the movement of people. • Providing safe and secure storage for equipment and materials in the site and maintaining MSDSs. • Placing visible and readable signs to control the movement of vehicles and notify motorists and pedestrians around the, and workers in the site.	Low
		• Potential collapse of buildings/structures on land as a result of unstable geotechnical conditions	High	Federal Ministry of Transportation shall: • Carry out side by side geotechnical investigations during construction to determine suitability of soil to carry Building/Other Structures • Recommendations from geotechnical appraisals shall be appropriately implemented • Construction of Building/Other Structures foundations shall follow good industry engineering practices.	Low
		• Loss of employment and business opportunities due to completion of construction phase		Federal Ministry of Transportation shall: • Ensure skills acquisition and enhancement programs to further empower the workforce for meaningful employment opportunities. • Establish and publicize grievance procedure • Pay due wages for worked period and settle all financial commitments to workforce.	
		• Loss of flora and fauna • Noise nuisance (including impulsive noise) from construction activities, resulting to temporal migration of sensitive mammals and rodents	High	Federal Ministry of Transportation shall: • Maintaining of landscaped gardens, terraces, conservation and management of the vegetation and gardens. Clearing vegetation only in construction areas and demarcating areas where no clearing will happen. • Landscaping with indigenous species on completion of construction.	Medium

				• Using equipment with noise suppressing technologies. Providing workers with PPEs against noise e.g. earplugs. • Placing signs around the site to notify people about the noisy conditions. • Regular maintenance of equipment to ensure they remain efficient and effective. Complying with the FMEnv. Noise Regulations. • Construction works should be carried out only during the specified time which is usually as from 0800hrs to1700hrs. There should not be unnecessary horning of the involved machinery. • Provision of bill boards at the construction site gates notifying of the construction activity and timings	
		• Groundwater contamination resulting from accidental leakages and spill of hazardous substances (diesel, lubricants, hydraulic oil etc.)	Medium	Federal Ministry of Transportation shall: • Plan and set on-site sanitary facilities for the disposal of wastewater. • Maintain vehicles, machinery and equipment in good condition in order to avoid leaks and spill of hazardous materials (lube oils, chemicals, etc.) • Ensure safe management of hazardous materials (chemicals, etc.) • Ensure handling of fuels such as fuelling of vehicles and machinery, and fuels transfers, take place in contained areas, where sufficient measures are in place to ensure containment of spills. • Plan emergency response measures and equipment are available, and personnel are capable of effectively using it for cases of accidental spill.	Low
		• Generation of dust and automobile/heavy duty equipment emissions.	Medium	Federal Ministry of Transportation shall: • Sprinkling water on soil before excavation and periodically when operations are under way to	Low

		• Decrease in air quality as a result of emissions from vehicles and equipment. • Increased ambient noise level from heavy equipment and machinery, vehicular movement, and civil work activities.		prevent raising of dusts. Increase frequency of sprinkling during windy days. Enclosing the structures under construction with dust proof nets. • Minimize vehicular movement with a planned scheduling to reduce the emission of pollutants. • Ensure the use efficient machines with low emission technologies for the ones that burn fossil fuels. Controlling the speed and operation of construction vehicles. • Ensure the reuse of excavated material within the boundary of project site while limiting the movement of cut and fill material. • Ensure that all the vehicles carrying raw materials will be covered with tarpaulin/plastic sheet; unloading and loading activity will be stopped during windy period. • Ensure the regular maintenance and services of machines and engines. • Ensure the use of clean fuels e.g. unleaded and de-sulphurized fuels. • Educate and raise awareness of construction workers one mission reduction techniques. • Ensure sprinkling water on the soil to prevent dust from rising. Creating specific paths for the truck	
		• Reduction in environmental aesthetics value due to indiscriminate disposal of wastes.	Medium	Federal Ministry of Transportation shall: • Employ a waste management plan. Using waste minimization techniques such as buying in bulk. • Allocate responsibilities for waste management and identifying all sources of wastes, and ensuring wastes are handled by personnel licensed to do so. • Make available suitable facilities for the collection, segregation and safe disposal of the wastes. • Create waste collection point are as with clearly	Low

				marked facilities such as colour coded bin sand providing equipment for handling the wastes. The bins should be coded for plastics, rubber, organics, glass, timber, metals etc. • Ensure that all wastes are dumped in their designated areas and through legally acceptable methods and that the bins are regularly cleaned and disinfected. • Access and create opportunities for Regulation, Reducing, Reusing, Recycling, Recovering, Rethinking and Renovation. • Create adequate facilities for the storage of building materials and chemicals and controlling access to these facilities. Ensuring bins are protected from rain and animals.	
		• Soil degradation and possibly accelerated erosion • Reduction in structural stability and percolative ability of the soil.	Medium	Federal Ministry of Transportation shall: • Ensure there is enough space for normal percolation of water • Control the earth works and ensuring the management of excavation activities. Compacting areas with loose soil • Prevent pollution from construction wastes by installation and configuration of drainage structures to ensure their efficiency • Install cascades to break the impact of water flowing into the drains • Adequate landscaping in the project site. • Provide soil erosion control structures on the steeper areas of the site & controlling activities during the rainy season.	Low
OPERATION	Operation and maintenance of the industrial park	• Injuries/fatalities of personnel due to road accidents during facility inspection and checks • Explosion and fire hazards at the facilities.	High	Federal Ministry of Transportation shall: • Ensure SHE briefings prior to commencement of work activities • Develop standard work procedures where work hazards are identified and addressed • Ensure personnel use appropriate PPE	Medium

				• Design work area to internationally acceptable standards • Ensure availability of first aid facilities onsite • Ensure retainer clinics are engaged and site medical personnel are available in case of accidents • Maintain medical emergency response plan so that injured or ill personnel can promptly access appropriate care.	
		• Increased business opportunities and quality of life (small, medium and large scale) • Enhanced aesthetic appeal due to presence and eventual operation of many facilities in the project site	Low	Federal Ministry of Transportation shall: • Encouraging indigenous contractors and suppliers providing them opportunities to supply materials of acceptable standards • Encourage contractors to hire and to develop local labour	Low
		• Unchecked encroachment on the project site, leading to land-use conflicts and accident	Low	Federal Ministry of Transportation shall • Provide warning signs at access roads created to warn against dangers associated with Industrial Parks. • Through consultations, sensitize stakeholders and members of the communities on need to stay clear of the Industrial Park. • As much as practicable provide restrictions (e.g. anti- climbers) to unauthorized access to Industrial Parks and provision of security guard.	Low
		• Fauna disturbance and displacement as a result of migration away from demolition activity area(this include impacts on birds)	Medium	Federal Ministry of Transportation shall: • Ensure inclusion of threatened and endangered species management strategies in the site specific Environmental Management Plan to be developed by EPC contractors to ensure appropriate flora management. • Plan and execute construction works to minimize interference on wildlife • Maintain construction equipment to optimal function conditions	Low

				• Monitor presence of wildlife species during construction activities	
Decommissioning and Abandonment	Demolition of buildings, Site remediation and rehabilitation	• Loss of employment	High	Federal Ministry of Transportation shall: • Ensure skills acquisition and enhancement programs to further empower the workforce for meaningful employment opportunities after the project • Establish and publicize grievance procedure • Pay due wages for worked period and settle all financial commitments to workforce before demobilization	Medium
		• Availability of land for alternative uses	Low	• This is a beneficial impact and FMoT, relevant government agencies together with stakeholders shall work out processes for land relinquishment or alternative uses as at the time of decommissioning.	Low
		• Increased noise level • Generation of dust and automobile/heavy duty equipment emissions	Medium	Federal Ministry of Transportation shall: • Ensure that all vehicles involved in the transport of material and machinery involved are properly maintained and serviced. • Ensure that all demolished material are regularly sprayed to reduce the effects of wind whipping. • All staff employed must be provided with dust masks and be asked to use them. • Plan journey to reduce travel times • Vehicles carrying earth materials should be covered	Low
		• Risk of accident and injury to workers during demolition of structures	High	F:ederal Ministry of Transportation shall • Develop standard work procedures where work hazards are identified and addressed • Ensure personnel use appropriate PPE • Design work area to internationally acceptable standards • Ensure availability of first aid facilities onsite	Medium

				• Ensure retainer clinics are engaged and site medical personnel are available in case of accidents • Maintain medical emergency response plan so that injured or ill personnel can promptly access appropriate care.	
		• Traffic obstruction from transportation of decommissioned structures and equipment	Medium	Federal Ministry of Transportation shall: • Coordinate Building/Other Structures construction and stringing activities to avoid heavy traffic periods • Use warning signs and traffic wardens/directors • Ensure activities causing blockages at road crossings are carried out within shortest time practicable • In the case of longer road blockages, divert traffic to approved alternate routes in liaison with appropriate authorities • Consult with affected communities prior to closures to provide warnings and alternatives.	Low

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.3 SUMMARY

In summary, the mitigation measures recommended in this section are deemed adequate to effectively ameliorate the negative impacts that may attend this project. From the assessment undertaken, when the measures are applied, all high and medium negative impacts will be reduced significantly and will leave, in all case, only negligible residual impacts. In order to ensure sustainability and effectiveness of these measures, it is necessary to have in place a sound cost-effective and fit-for-purpose Environmental Management Plan (EMP). This is presented in the next section of this report.

CHAPTER SEVEN

7.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Introduction

In this Chapter, the Environmental and Social Management Plan (ESMP) which includes the set of mitigation, monitoring and institutionalized measures to be carried in the course of the proposed project implementation are presented. It is worthy to understand that mitigation measures aim to offset any negative impacts that may result from the project, and monitoring is the process of measuring the success of mitigation measures in order to assess their effectiveness. Reporting is the process of measuring actual performance or how well the mitigation measures have been implemented, including the format, timing and responsibility for reporting of the monitoring results.

An Environmental and Social Management Plan (ESMP) has been developed to assist the proponent in mitigating and managing environmental impacts associated with the life cycle of this project. The ESMP has been developed to provide a basis for an Environmental Management System (EMS; ISO 14001 principles) for the project. An ESMP is the essential standalone component of an ESIA 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. ESMP is developed to ensure that the mitigation measures stated in chapter six of this report shall actually be carried out in subsequent stages of the project. The effectiveness of environmental management plan of any organization however rests on the composition, efficiency and management commitment to the following three other ISO standards namely:

- Environmental Management System (ISO 14001)

  This is a structured control method employed by organizations to attend to the environmental effects of their actions and also improve their environmental performance.
- Environmental Auditing (EA)

  According to ISO, there are three environmental auditing guidelines namely: ISO 14010, ISO 14011 and ISO 14012. These guidelines work along with Life Cycle

Assessment (LSA) standards ISO 14040, ISO 14041, ISO 14042 and ISO 14043 to ensure effective implementation of any environmental management system.

- Environmental Performance Evaluation (EPE)
  Environmental Performance Evaluation otherwise code named ISO 14031 provides a management framework for monitoring and measuring performance against set targets.

7.2 Objectives of the ESMP

The objectives of the ESMP contained in this Section are as follows:
Enhancement and demonstration of excellent environmental and social performance built around the principle of continuous improvement;

- Integration of environmental and social issues fully into the various activities, facilities and industrial processes;
- Rationalization and streamlining of environmental and social activities so as to add value in resources efficiency and effectiveness;
- Enabling management to establish environmental and social priorities for the project and all relevant activities;
- Assurance of lost prevention and appropriate recovery preparedness in the event that control is lost during the implementation and operation of the project
- Provision of the benchmarks to be used in the overall planning, monitoring, auditing and reviewing of socio-economic and environmental performance throughout the project life cycle;
- Assignment of roles and responsibilities to appropriate personnel to ensure effective ESMP implementation.

7.3. ENVIRONMENTAL AND SOCIAL MANAGEMENT ORGANIZATION

Federal Ministry of Transportation is committed to providing resources essential to the implementation and control of the ESMP. They shall demonstrate visible commitment to HSE management to enhance the credibility of the HSE policies and objectives. This commitment means providing resources to develop, operate and maintain the HSE-MS and to adhere to the policy and achieve objectives. These include appropriate human resources and

specialized skills, training, programs and capacity building, communication procedures, documentation control and a procedure for the management.

7.3.1 Management Organization

The proponent shall establish a schedule for responsibility and training on matters relating to environmental issues shall be a line responsibility for which all levels of personnel are accountable. Top management shall ensure that all environmental considerations are integrated into project execution. The Environment Department shall offer expert advice on protection measures and shall assist to monitor performance. The head of the HSE unit shall oversee the environmental and social (including health and safety) aspects of the Proposed Port Harcourt Industrial Park Project. The HSE Manager shall ensure that the Project and subcontractors operate in accordance with the applicable regulatory HSE requirements and plans and also monitor implementation of environmental and social protection measures. The HSE unit shall liaise at a predetermined interval with contractors, engineers, quality assurance officers, supervisors and relevant departments on all environmental matters. The Safety and Security Team Leader within the project, assisted by the HSE unit shall be the focal point for all environmental matters relating to detailed design and monitoring of construction of the Industrial Park, completion of other components of the project and all associated networks, operation of the Industrial Parks and decommissioning, restoration of sites and abandonment. The EM Team shall verify the effectiveness of the ESMP implementation in liaison with Regulators (FMEnv & RSMEnv) and other stakeholders as appropriate.

7.3.2 Use and Maintenance of the ESMP

The ESMP shall remain a dynamic working tool and will be owned by the Project team. The Safety Manager is, however, the custodian of the document and may exercise auditing role to verify compliance by the project contractor. The ESMP shall be updated and revised periodically, throughout the project's life span to incorporate improved technologies, better environmental regulations, management systems, guidelines and policies. Constructive suggestions by users (contractors, management, line and operating personnel) shall be assessed by the EM Team and integrated into the ESMP.

7.3.3 Monitoring

The environmental Monitoring plan shall serve as an integral part of the construction and operational activities and is expected to generate the requisite information dissemination. The plan shall play a pivot role in ensuring that the trends for specific parameters are traced and also shall provide information on compliance with legislation norms, set guidelines or desirable operational limits; and form basis for corrective action and modification of activities if necessary. Monitoring will require sampling and analysis of environmental components like soils, water and air emissions. In addition to assessing operational aspects and monitoring, assessments shall also consider compliance with agreed objectives and targets, and the effectiveness of the ESMP and its implementation. The ESMP 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 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 ESIA approval.

7.3.4 Regulatory Compliance

All environment-related regulations as they apply to the Port Harcourt Industrial Park Project have been documented and described in this ESIA. The project management shall ensure compliance with these regulations throughout the project's lifecycle.

7.3.4 Infrastructure and Services

There shall be upgrade of some existing roads and construction of new access roads. Roads used by the project shall be maintained during construction and any damage to roads caused by the project shall be rectified. All roads shall be restored to a condition at least as good as that existing before the project.

7.3.5 Awareness, Training, and Capacity Building

FMoT shall pay deliberate attention to Training, awareness and competence of staff. They shall identify training needs and ensure that all personnel whose work has impact on the environment receive appropriate training on a continual basis knowing that real progress is possible only when everyone is kept informed of the policy and trained to implement required actions. The HSE unit shall further identify, plan, monitor, and record training needs

for personnel whose work may have a significant adverse impact on the environmental or social conditions. The proposed project recognizes that it is important that employees at each relevant function and level are aware of the company's environmental policy; potential impacts of their activities; and roles and responsibilities in achieving conformance with the policy and procedures. This will be achieved through a formal training process. Employee training will include awareness and competency with respect to Environmental and social impacts that could potentially arise from their activities (including dust, noise, soil contamination etc.).

7.3.6 Pollution Control

- **Air Pollution**

In operating equipment, the proponent shall ensure good engine efficiency of equipment and vehicles shall be maintained. Indiscriminate burning of materials resulting from clearance of trees, leaves, bushes and combustible materials for the Industrial Park Project site shall not be permitted.

- **Soil Pollution**

All construction activities shall be performed by methods that will prevent pollution of the soil media by concrete mixtures, debris, and other objectionable pollutants. In the event of a significant soil pollutant from lubricant 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 any lube oil and combustible leaks from engines.

- **Noise Pollution**

Adequate measures shall be taken to reduce the noise involved and keep working hours to a minimum. Also, noise mapping of the construction site 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.

7.3.7 Waste Management Guidelines

The handling, storage and disposal of all wastes that will be generated during the life of the project shall be in accordance with Federal Ministry of Environment guidelines and approved

waste management procedure. A detailed waste management plan shall be developed for the wastes generated during the decommissioning and abandonment of facilities.

- **Waste Handling**

For proper handling and disposal, wastes shall be well defined at source and the definition transmitted along with the waste to the final disposal points. Contractors and HSE personnel shall define and document all wastes generated in the course of work.

- **Waste Minimization**

Waste minimization implies reduction to the greatest extent possible of the volume or toxicity of waste materials. The four principles of waste minimization process; recycle, reduce, reuse 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 facilities and operating equipment. As much as possible, excavated materials shall be used for landscaping or other remedial works on site.

- **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.

- **Waste Disposal**

All waste, shall be cleared regularly from the site and disposed off at Government designated areas and facilities. Wastes in transit must be accompanied and tracked by consignment notes. Only government approved waste management contractors shall be engaged for the waste categories they are licensed to dispose.

7.3.8 Operational Wastes and Disposal Methods

Waste shall be managed in accordance with Federal Ministry of Environment waste management guidelines and procedures. The Contractor will develop a Waste Management Plan to be approved by the project manager and will be responsible for the management of all wastes from cradle to grave using licensed third party waste management contractors and facilities. Detailed inventory of the waste types, sources, and planned management practices during the proposed Industrial Park project is presented in Table 7.1.

Table 7.1: Waste Stream Management Guideline for Proposed Port Harcourt Industrial Park project

Waste / Emission	Category	Hazard	Origin	Disposal Option(s)
CONSTRUCTION PHASE				
Wood scraps, pallets and packaging materials	Non-hazardous (combustible)	Attracts rodents	Wooden crates, paper cartons/sacks, plastic wrappings, Styrofoam, etc.	Wood pallets/paper cartons shall be returned to the supplier and non-reusable one safely contained and evacuated to approved facilities for incineration
Empty drums & aerosol cans (plastic & steel)	Potentially Hazardous (noncombustible)	Dependent of original contents of drum	Packaging of lubricating oil, fuel and corrosion chemicals	Residue from drums shall be purged and cleaned before reuse (subject to quality assurance). Return empty gas cylinders to supplier(s) for refilling. Return drums, barrels, and used containers to vendor or crush at site for recycling
Used and waste lube oil	Hazardous (combustible)	Potential to contaminate soil and water bodies	lube oil flushes and equipment vehicles	Recycle at a permitted treatment facility
Oily rags & sorbents; used protective	Hazardous (combustible)	Potential water &	Maintenance & spill clean-up operations,	Where possible, oily rags and protective clothing shall be washed and

Waste / Emission	Category	Hazard	Origin	Disposal Option(s)
CONSTRUCTION PHASE				
clothing (hand gloves, coveralls, shoes, rainwear, etc.		sediment contamination from hydrocarbons	regular work wear	reused at site. Otherwise, these wastes shall be drained of excess hydrocarbon, packaged separately and contained Safely for incineration in approved facilities.
Paint & paint-related materials	Hazardous (combustible)	Potential to contaminate soil	Paint cans, spent thinner, epoxides, latex, etc.	Safely contained in designated containers and locations prior to evacuation to approved facilities for recycling or incineration.
Batteries: (lead-acid, nickel- cadmium)	Toxic and corrosive	Corrosive adverse environmental, health & safety effects. Lead or heavy metals may cause contamination to surface water /sediment	Warning equipment, portable & emergency electrical tools & electronics, construction & transmission facilities	Lead-acid and Ni Cd batteries shall be safely kept at designated storage locations for evacuation to facilities where they will be recycled, incinerated and safely disposed.

Waste / Emission	Category	Hazard	Origin	Disposal Option(s)
CONSTRUCTION PHASE				
Spent lubricants	Hazardous (combustible)	Potential for water, soil, and sediment contamination by hydrocarbons	Engine and rotating equipment, lubricating system, etc.	Collect in properly labeled metal or plastic drums placed at designated strategic locations and sealed to prevent spill during evacuation. To be recycled or incinerated in approved facilities.
OPERATION PHASE				
Domestic waste (empty food containers, food waste, used cooking oils, office wastes, construction)	Non-hazardous (combustible, biodegradable)	Attracts rodent and arthropods.	Accommodation, office, canteen, worksite	Manually sort plastics and metals for recycling. Appropriate segregate and contain for evacuation to approved incineration facilities
Oil & fuel filter cartridges, waste water filters	Hazardous (combustible)	Potential water and sediment contamination	Internal combustion engines, equipment maintenance and repairs	Collect in properly labelled metal or plastic drums placed at designated strategic locations. Store in sealed, properly labelled metal or plastic

Waste / Emission	Category	Hazard	Origin	Disposal Option(s)
CONSTRUCTION PHASE				
		from hydrocarbons		drums placed in a closed container located within the designated hazardous waste storage area for evacuation to incineration sites.
Scrap metal chippings, scrap cables	Non-hazardous (combustible)	Safety risks	Scrapped equipment / engine parts /miscellaneous refuse metal	Recycled or re-used. Non reusable materials shall be stored in the designated containers for evacuation and disposal at recycling facilities.
Medical waste (soiled dressings, empty drug containers, used needles & syringes, expired drugs, blood & blood products, cultures and stocks)	Hazardous (combustible)	Potential health risk	Clinics / health centers, site first-aid treatment	• All medical waste shall be packaged separately and safely contained in designated containers for incineration at approved facilities. • Empty drug carton/bottles may be re-used at the clinics subject to quality assurance. • Used syringes/needles, containers for storing blood & its products, and culture/ stocks media shall be

Waste / Emission	Category	Hazard	Origin	Disposal Option(s)
CONSTRUCTION PHASE				
				autoclaved (sterilized) and shall be safely contained in designated containers for incineration at approved facilities.
Refrigerants (HCFC)	Non-combustion source-emission	Stratospheric ozone depletion, formation of photochemical smog;	Refrigerants & air Conditioners	Safely contain in designated locations for return to manufacturer, or to approved reuse, and recycling facilities.
Diesel fuel spill/leaks	Hazardous (combustible)	Potential to contamination of soil, water bodies & sediment	Fuel storage/transfer lines, leaking pipes, equipment, etc.	Store in sealed drums for recycling
Sanitary wastewater	Hazardous (non combustible)	Potential to contaminate water column & sediment	Sinks, shower, liquid effluent from toilets etc.	At camps, treated in sewage treatment plant to regulatory limits with certified equipment before discharge if feasible. Otherwise shall be collected and taken offsite to approved sewage treatment

Waste / Emission	Category	Hazard	Origin	Disposal Option(s)
CONSTRUCTION PHASE				
				facilities and treated to meet regulatory requirements before discharge offsite.
Oil sorbents	Hazardous (combustible)	Potential to contamination of soil, water bodies & sediment	Cleanup of small spills	Recycled or disposed of by certified oil recycler
Sewage Sludge	Non-Hazardous	Potential to contaminate water column & sediment	On-site sanitary sewage treatment system	Sent offsite to sewage treatment facility
DEMOBILIZATION				
Contaminated soil affected by spills/leak	Hazardous (combustible)	Potential to contaminate groundwater	Top soil removed from spill/leak site	safely contained in sealed designated containers for evacuation to incineration facilities

7.3.9 Noise Minimization Guidelines

Noise and vibration generated by facilities and equipment shall meet the requirements of other National and International Standards, Codes of Practice and Statutory Regulations. Where noise level exceeds the stipulated limits, it shall be treated as nuisance and the contractor concerned shall put in place adequate mitigation measures to ensure that the situation is properly addressed. All personnel working for a long period in high noise area shall be required to use earmuffs at all times. Permanent warning signs shall be posted at the boundaries of these restricted areas. The following noise limits shall be used in the design.

Areas in workshops and machinery buildings where communication is required

Workshops for light maintenance	70 dB (A)
Workshop offices, plant offices and computer rooms	60 dB (A)
Open plan offices and control rooms	50 dB (A)
Social rooms, changing rooms, wash places and toilets	50 dB (A)
Offices and conference rooms	45 dB (A)
Sleeping areas	40 dB (A)

7.3.10 Audit Programme

Environmental audit shall be conducted at the project site before mobilization and during operation. Mobilization is to commence only after the Industrial Park Project Manager on the advice of the SAFETY and Security Team Leader has provided authorization. Construction activities will be subject to regular audits after mobilization. The audit process shall be used to assure that the equipment used for construction and the operations of the Industrial Park and its associated facilities meet the requirements and specification outlined in the ESIA and also to assess its environmental performance during these phases of the project. This will ensure that environmental protection and management procedures are being enforced.

7.3.11 Accidents and Contingency Plan

The Project Manager shall be responsible for all emergencies and contingency response. All emergencies shall be addressed to him or, in his absence, to the HSE Officer. The Project Manager shall telephone the nearest State Emergency Response Agency, the Fire Service, the Police Command, FMEnv, and the National Environmental Standards and Regulations Enforcement Agency (NESREA) as the case at hand may require.

7.3.12 Managing Stakeholder Perceptions

Public interest in this project is expected to be high. The issue of industrial park development appears to be a sensitive one. 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. In executing the Industrial Park project, FMoT shall manage these perceptions by employing and sustaining dialogue as well as involvement of the communities and other stakeholders in all phases of the project. In particular, FMoT

- 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 good corporate neighborliness.

7.3.13 ESMP and Community Development

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

7.3.14 Responsibilities for ESMP Implementation and Monitoring

Part of the conditions of the approval of the ESIA by the Federal Ministry of Environment (FMEnv) is that there will be regulatory monitoring of the approved project impacts mitigations and monitoring measures. The timing and frequency of the monitoring is determined by the FMEnv. FMEnv works closely with the state Ministry of Environment in monitoring the implementation of the ESIA approval terms and conditions. Current practice is that FMEnv issues an approval letter which includes the cost of IMM and other conditions that has to be fulfilled prior to the issuance of the approval. Meeting the conditions, along with payment of the funds have therefore become prerequisites to the issuance of the ESIA approval. Payment prior to approval also ensures that the funding for monitoring is secured and the activity effected as at when due. The current cost shall be determined by the FMEnv.

7.3.15 Decommissioning, Restoration and Abandonment

The need may arise to decommission the Industrial Park. Standard procedures for decommissioning Industrial Parks shall be invoked. The activities planned for this phase of the project include:

- Dismantling of building including excavation
- Dismantling of all surface equipment including power and telecommunication installations.
- Removal and disposal of concrete works
- Removal and disposal of all platforms mounted in the Kainji Lake, including floating fisheries, polo club facilities and golf course facilities, floating farm, floating jetties, etc.

For abandonment, strict adherence to facilities abandonment policy and guidelines of the FMEnv, which includes restoring the project environment to its original status as much as possible, shall be encouraged. The procedure shall be in accordance with approved FMEnv and international industry standards.

7.3.16 Environmental Monitoring Plan

The adverse environmental and social impacts and their mitigation measures had been identified in these Environmental and Social Impact Assessment document. These

safeguard and environmental management measures shall be implemented during the construction and operation phases of the proposed project. Consequently, these impact mitigation measures shall be incorporated into the contractual arrangements that shall be signed by the Project Contractor/Operator. This section presents the details of the project impacts and their respective mitigation measures, the ESMP implementation approach and responsibilities of stakeholders for their implementation. The project impacts, their respective mitigation measures and other pertinent implementation details are as shown in Table 7.2 below:

Table 7.2 Details of Environmental Monitoring Plan

MONITORING SCOPE	PARAMETER	LOCATION	FREQUENCY		RESPONSIBILITY
			CONSTRUCTION	OPERATION	
Air	TSP, NO2, SO2, CO	Project area	Bi weekly	Bi weekly	FMoT, HSE Unit, FMEnv, RSMEnv
Wastewater and groundwater	TSS, COD, BOD, EC, TDS, Cd, Pb, etc.	Effluent outlet and boreholes	Monthly	quarterly	FMoT, HSE Unit, FMEnv, RSMEnv
Noise	Sound level	Project site	Monthly	Monthly	FMoT, HSE Unit, FMEnv, RSMEnv
Solid waste	Ignitability, corrosivity, reactivity etc.	Waste Generation and disposal sites	Quarterly	Bi annual	FMoT, HSE Unit, FMEnv, RSMEnv
Spoils	Visual inspection	Project site	Bi weekly		FMoT, HSE Unit, FMEnv, RSMEnv
Soil	Visual inspection	Project site	Bi weekly	Monthly	FMoT, HSE Unit, FMEnv, RSMEnv
Public safety, OHS	Signs, culverts, incident, accident records	Project site	Monthly	Annually	FMoT, HSE Unit, FMEnv, RSMEnv

Land acquisition	Compensation, income, housing, employment and social adaptation	Host communities	Middle and end of land acquisition	Annually	FMoT, HSE Unit, FMEnv, RSMEnv, Environmental Consultant
Socio economic benefit	Increased number of tourists, local revenue and increase income of locals	Entire project area	End of land acquisition		FMoT, HSE Unit
Community participation	Number of participant	Project communities	Bi annual	Second year	FMoT, HSE Unit, FMEnv, RSMEnv
Increased pressure on available utilities and infrastructure	Boreholes, wells, roads etc	Project communities	Monthly	Yearly	FMoT, HSE Unit
Increased heavy traffic	Visual inspection	Project area	Weekly	Monthly	FMoT, HSE Unit

HSE Unit- Health, Safety and Environment Unit

FMEnv-Federal Ministry of Environment

FMoT-Federal Ministry of Transportation

7.12 Environmental Auditing

In line with the FMEnv requirements, the project shall be audited every three years, this is to check the prediction of the environmental assessment and assess the general performance of the project to ensure that environmental standards are maintained and environmental management and monitoring plan are followed. Environmental audit acts as an internal control process that ensures that environmental protection and management procedures are enforced. The audit objectives are to examine the line management system and procedures, facility operations and monitoring practices. It shall cover the following: Verification of prediction in the ESIA.

- Verification of implementation of mitigating recommendations
- Review incident reporting and remedy schemes
- Identification of current and potential environmental problems
- Recommend necessary improvements to management operation practices
- Thorough documentation, feedback and implementation procedures

CHAPTER EIGHT

8.0 DECOMMISSIONING AND CLOSURE

8.1 Introduction

Decommissioning of the project will be given utmost priority as the project proponent believes in leaving the environment in this project site 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, removal of all structures will 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 authorities must commence early and be concluded before of the execution of the decommissioning plan. The Federal Ministry of Environment, NESREA and other regulatory bodies shall be informed about the plan. Furthermore, guideline for site restoration and remediation prevailing at time shall be used.

Before decommissioning, the following plans will be developed:

- The choice of environmentally sound methods for removal, re-use, recycling or disposal of special wastes that may arise from the decommissioning process
- Time frame/schedule for the decommissioning and post-decommissioning process.
- Identification of components of the project that will be removed;
- Proper rehabilitation and 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.

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 as well as the regulatory authorities.

8.3 Decommissioning of Project and Ancillary Facilities/ Equipment Re-Use

At the end of this project lifespan, the project and all ancillary facilities will be decommissioned. All installed facilities on project site will be adequately dismantled and removed to allow for proper remediation of the project site. A Health, Safety and Environmental Management Systems will be implemented to assure safety of personnel and the public during decommissioning as well as minimize negative environmental impacts.

All the components that can be used or recycled 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 the proponent. Disturbed areas on the Industrial Park 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 Industrial Park is not foreseen, however, decommissioning of related facilities especially project site offices and workshops are 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 Environmental Protection and Rehabilitation Plan (EPRP) 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 EPRP 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 AEPB/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 Abuja Industrial Park 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 Site Remediation and Restoration

Following decommissioning and abandonment, FMoT Shall carry out site remediation and restoration work as part of the project's Environmental Management programmes. This will entail:

1) A survey of the decommissioned site for contamination as part of a conceptual site model and a strategy plan.
2) Evaluation of the site hydrology and geology.
3) Preparation of a site assessment report to be approved by FMEnv.
4) Interim action or remediation is designed to confirm the applicability and feasibility of one or more potential remedial options.

Finally, the site shall be monitored for compliance and performance to confirm the effectiveness of the remedial measures. At the end of the site abandonment, the following useful documentation shall be reviewed:

1) The initial Decommissioning and Restoration Plan.
2) The abandonment operations conducted in the field, along with changes to plan necessitated by field conditions.
3) Soil test reports.

CHAPTER NINE

9.0 CONCLUSION

The Environmental and Social Impact Assessment (ESIA) of the proposed project has been carried out in line with statutory requirements for environmental management in Nigeria and as such ensures that potential environmental, social and health impacts of the project are fully appraised. This ESIA report has documented the existing environment of the area, potential and associated impacts of the proposed project, proffered cost effective mitigation/ ameliorative measures for impacts and enhancement measures for the beneficial impacts. A management plan that would be effective throughout the projects life cycle has also been put in place to assure environmental sustainability of the project.

This ESIA shall serve as a reference platform against which future changes in the environment vis-à-vis the project in view can be monitored. The document shall also provide the necessary information required for the issuance of Approval and Environmental Impact Statement for the proposed project by the FMEnv and other interest groups. The environmental baseline condition of the project area showed that the physical, chemical and biological characteristics as well as meteorological, climatic and hydrological characteristics were generally consistent with previous studies carried out within the environment with some few exceptions. Also documented were unique assemblages of wild flora and fauna species with abundances that relate to the nutrients and chemical composition of the ecosystems.

Multidisciplinary approach was employed in the assessment of the natural environmental status and sensitivities of the various ecological components of the project area with the use of extensive literature survey, field sampling, measurement/testing, analysis and methodologies compatible with national and international standards.

The sensitivity of the environment to element of the proposed project activities were identified and assessed and appropriate mitigation measures were

developed to reduce their adverse effects to ALARP on one hand and enhance their beneficial contributions on the other hand.

An Environmental and Social Management Plan (ESMP) covering the biophysical and socio-economic aspects of the project was developed in order to ensure that mitigation measures would be established and maintained throughout the life cycle of the project. Mitigation measures were based on best available technology, safety, health and environmental considerations.

Socio economic consultations with the project host communities and other relevant stake holders were also carried out and shall continue throughout the life cycle of the project

It is therefore hoped that all data/evidence contained in this report is sufficient in the development of an environmental impact statement (EIS), and afterward in the acquiring of necessary permits for commencement of project.

In consideration of the above therefore, there is no major environmental issue to impede the development of the proposed project.

REFERENCES

Akobundu, I.O and Agyakwa, C.W (1998). A Handbook of West African weeds. International institute of Tropical Agriculture, Ibadan, Nigeria, 564 pp.

APHA (1998). American Health Association (APHA) 1998: Standards for the Examination of Water and Waste water 20th Edition.

Federal Environmental Protection Agency (1991). Guidelines and Standards for Environmental Pollution Control in Nigeria. FEPA Lagos.

Federal Ministry of Environment (FMENV) National Guidelines and Standards for Water Quality in Nigeria.

FMENV (1994). The Federal Ministry of Environment: Impact Assessment Procedure. Federal Ministry of Environment.Nigeria. 35pp.

Golterman, H.L., Clymo, R.S., and Ohnstadt, M.A.(1978) Methods for physical and chemical Anaylsis of freshwaters. 1BP Handbook No 8, 2nd edition

Hutchinson and Dalziel (1979). Flora of west tropical Africa. Vol 2. London, 51-103.

J.A. and Gardner R.W., 1983: Measuring Mortality, Fertility, and Natural Increase World Health Organisation, 2003.

Keay, A.J., Syme, J. and Barnes, P.M (1967). Cephaloridine in the treatment of prophylaxis of infection in the newborn. *Postgraduate Medical Journal*.43:105-9

Kent and Coker (1992). Vegetation Description and Analysis. A practical Approach.pp 101-

National Bureau of Statistics, 2017: Annual Abstract of Statistics.

National Population Census (NPC), 1991: Population Census of Federal Republic of Nigeria.

National Population Commission (NPC), Annual Abstract, 2012

National Population Commission 2006, Landmass complied from NPC Report, 1991 NPC and ORC Macro, 2013: Growth and Poverty in Sub-Saharan Africa.

Olayinka, A.I. and Olorunfemi, M.O. (1992) Determination of Geoelectric Characteristics in Okene Area and Implications for Borehole Siting. Journal of Mining and Geology, 28, 403411

Richard A. Krueger, Mary Anne Casey, 2009: A Practical Guide to Applied Research. Palmore

SIEP (1995) Social Impact Assessment Guidelines HSE Manual. Shell International Exploration and Production B. V. The Hague

World Bank (1995). Nigeria: Strategic Options for Redressing Industrial Pollution, Vol. 1, Industry and Energy Division, West Central Africa Department.

World Bank (1997). Nigeria: Strategic Options for Redressing Industrial Pollution, Vol. 1, Industry and Energy Division, West Central Africa Department.

World Health Organisation (1999): Guidelines for Community Noise. An Outcome of the WHO Expert taskforce Meeting held in London, United Kingdom.

World Health Organisation (2005): Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen dioxide and Sulphur Dioxide, Global Update, 2005, Summary of Risk Assessment.

World Health Organization (WHO) (2006). WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide: Global Update 2005, Summary of Risk Assessment. Geneva. WHO